

Reviewer Name	Ch	From Page (start)	From Line (start)	To Page (end)	To Line (end)	Comment	Additional Comments	Author Response/Comment
Joseph Tzanopoulos	2	0	0			This is a very well written chapter of high quality. It's very well researched and it manages to accommodate differences in researcher's views on drivers of change on pollinators. It is nicely and clearly structure, written in a language that can be clearly understood by both academics and policy makers. Most importantly, it does recognise and address the complexity of the topic, avoiding oversimplifications. As a result, I have only few minor comments that may improve further the quality of this chapter.		Thank you for this encouraging comment
Leslie Firbank	2	0	0			Lots of good stuff here. The document would help by statements up front about the coverage (it's all about insects, largely those of economic importance, esp bees). More generally, the document is a review rather than assessment. It describes effects, but does not really address their importance in the grand scheme of things		We tried to come closer to an assessment with the SOD
Liette Vasseur	2	0	0			some sentences are difficult to read due to the seleciton of the terms and words such as "lead".		We have tried to improve the text
Liette Vasseur	2	0	0	0	0	Careful to pass from present tense to past tense, etc. in the text. It again makes the text difficult to read.		We have tried to improve the text
Liette Vasseur	2	0	0	0		sometimes we have the word confidence and sometimes evidence with strong, robust, etc. I hope there is a chapter that defines these terms.		Across the Assessment we have tried to use unified terminology
Liette Vasseur	2	0	0	0		I imagine that typos and misuse of words are going to be rechecked by a specialist. The number of such issues in creasing in this section. E.g. line 1488: remove on after impact; line 1494, add a . After Oerke 2006). And remove base after evidence. I should say this sentence needs a lot of work.		Will be thoroughly checked for the FGD
Liette Vasseur	2	0	0	0	0	It may be good at the beginning of this chapter to stress the fact that here we are talking about insect (mainly bee) pollinators (not birds, bats, etc.).		While we have included a bit more on other groups, the framing for food results in the dominance of bees

Richard Corlett	2	0	0	0	0	This is an an excellent first draft, although the language standard is very patchy.		Thank you for this encouraging comment, we are on our way to improve the language
Richard Corlett	2	0	0	0	0	Coverage of natural systems is thin. Is this intentional?		We tried to include more information on natural systems, however food production is the main focus of the chapter
Richard Corlett	2	0	0	0	0	There does seem to be rather too much on Europe and too little on countries like Japan and India with big pollinator literatures.		We hope to have improved in the suggested direction
Richard Corlett	2	0	0	0	0	I think it would be useful to maintain a clearer distinction between preserving pollinator diversity and maintaining pollination services, which are not necessary tightly linked.		We have tried to use the respective terms where appropriate
Teruyoshi Nagamitsu	2	0	0	0	0	This chapter is organized properly and written well. Necessary or enough references are cited.		Thank you for this encouraging comment
Jeff Ollerton	2	0	0	0	0	Standardise use of honey bee/honeybee and bumblebee/bumble bee		Will be done all over the assessment
Timothy Schowalter	2	0	0	0		This chapter needs a lot of editing. Some passages are difficult to understand.		We hope to have improved it in the suggested direction
Timothy Schowalter	2	0	0	0		Note throughout the report that "honey bee" and "bumble bee" should be two words.		Will be standardised all over the assessment in a last step
Timothy Schowalter	2	0	0	0		Overall, this chapter appears to cover the range of threats to pollination services.		Thank you for this encouraging comment
Scott Black	2	0	0	0		all managed bumble bee and bumble bee disease sections - It seems that Bombus (and generally bee) diseases are covered in at least 4 different sections (maybe 5) over the sections of the chapters 2 and 3. The message is (sometimes slightly, sometimes greatly) different in each section. This even made reviewing the document difficult as I couldn't tell if certain parts were left out intentionally to have covered elsewhere, or if it was just evidence of different authors telling different stories. Seems to me that they should consolidate, or at least collaborate to make a more consistent story. Otherwise I think I would be very confused as a reader.		We have now reorganised the chapter along these suggestions

Serena Heckler	2	0	0	0	0	There seems to be a general assumption throughout this chapter that there is a dichotomy between "wild" or "natural" landscape and intensively managed, large-scale agriculture with nothing in between. Traditional agriculture, small-scale agriculture is almost entirely absent and the concerns and constraints faced by small-scale subsistence farmers, hunter-gatherers and pastoralists are virtually invisible. In considering drivers (and the implied responses to them), there is a third way between large-scale agriculture and "fortress-style" conservation. Models based on traditional agriculture, small-scale agriculture are growing increasingly common as a response to the drivers detailed here. This chapter should take into account that these models already exist all over the world. See, for instance, the UNCTAD report "Trade and Environment Review 2013: Wake up before it is too late: make agriculture truly sustainable now for food security in a changing climate" (2013) ( <a href="http://unctad.org/en/publicationslibrary/ditcted2012d3_en.pdf">http://unctad.org/en/publicationslibrary/ditcted2012d3_en.pdf</a> )		We have tried to include traditional systems into the agricultural management section, plus other forms, e.g. small-scale farming by ILK
Serena Heckler	2	0	0	0	0	In a number of places, there is a strange formulation which doesn't seem very scientifically rigorous. On lines 4, 255, 438 and many other places, the authors write "there is high confidence in the fact...". This use of "fact" is not in accordance with the scientific method. Better to change "fact" to "finding".		We have tried to improve and standardise this
Matthew Heard	2	0	0			Generally this is the best organised and most comprehensive and well written chapter I have read. There is considerable cross-referencing across to other chapters that should be checked for consistency		Thank you for this encouraging comment. Consistency checks are still a challenge, but ongoing
Nadine Azzu	2	0	0	0		<b>I think the Executive Summary reads quite nicely!</b>		Thank you for this encouraging comment. We now have done a <b>thorough update of the ES.</b>
Graciela Rusch	2	0	0	0	0	Check consistency of spelling UK and other English forms.		Supposed to be British English in the end (will be done all over the assessment)

Mario Marcos Espirito	2	0	0	0	0	As a whole, the chapter is very well written and nicely organized. Also, information is illustrated with a good number of figures and tables. It is a bit long and would benefit from a reduction in length.		We hope to have improved in the suggested direction
Mario Marcos Espirito	2	0	0	0	0	There are considerable overlap between chapters 2 and 3, especially because is difficult to separate drivers from trends. Effort should be made to eliminate such overlap, with a clear definition of what is the scope of each chapter. Since chapter 2 is quite long, maybe the overlapping parts should be removed from here		We hope to have improved in the suggested direction
Martha Groom	2	0	0	0	0	Global comment: well constructed and comprehensive draft, but in many areas needs more careful editing for minor grammatical errors or slightly awkward constructions. My interpretation is that this type of editing is not solicited, only content issues, and hence I've not offered those comments unless the meaning was unclear.		Thnaks, perfect
Martha Groom	2	0	0	0	0	Global comment: The consolidation and careful interpretation of the information on pollinator risks is extremely impressive overall. While a few areas can use some further improvement, this provides a powerful overview of our current state of knowledge. However, coming to the end, it seems to me a bit more of the highlights should be brought in to the introductory summary, as this may be all that is taken away by some users of the report. I'd be happy to try to add more if that were wanted, but at least want to flag that some key issues may not be highlighted in that summary. Perhaps asking several external reviewers to contribute to a light revision of the summary section could make it even more robust.		We hope to have improved in the suggested direction

Valerie Peters	2	0	0	0	0	<p>Could create a similar section like 2.8.3 Future options to reduce climate change impacts on biodiversity/pollinators to be placed in sections 2.1 and 2.2 if this is not elsewhere in assessment (maybe this is already in chapter 6?), for instance in section 2.1. there could be a future options to reduce land use impacts on biodiversity/pollinators that includes studies on pollinator restoration via planting species with higher interaction strength in networks, identifying bridging species or planting assemblages of plants with overlapping flowering phenologies, e.g. of citation: Menz et al. 2011. Reconnecting plants and pollinators: challenges in the restoration of pollination mutualisms. Trends in Plant Science 16: 1360-1385. As well there could be a section in 2.2. for Future options to reduce agriculture impacts on biodiversity/pollinators with agri-environment scheme studies such as Holland et al. 2015. Managing habitats on English farmland for insect pollinator conservation. Biological conservation 182: 215-222, etc; plus Prairie strips in agricultural lands work and literature; and intercropping with plant species that benefit pollinators such as Peters 2014. Intercropping with shrub species that display a 'steady-state' flowering phenology as a strategy for biodiversity conservation in tropical agroecosystems. PLoSone 9: e90510 and Carrie et al. 2012. Selection of floral resources to optimise conservation of agriculturally-functional insect groups. Journal of Insect Conservation 16:635-640.</p>		<p>As this is not at the core of our task (according to the scoping documents) we unfortunately had to remove these type of sections - it will be dealt with in chapter 6</p>
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Les Davies	2	0	0	0	0	Title of chapter is somewhat unclear and the English is questionable - 'Drivers of change of pollinators ..'? Could this mean drivers of bee metamorphosis? And changes in what aspect of pollinators? Numbers? Species balance? In Australia (and no doubt elsewhere) a number of bird species are good pollinators. But I don't think this project includes them! Is this project about just insect pollinators or just bee pollinators? Rather than 'Drivers of change ....' what about 'Factors impacting insect pollinators and the services they provide'		A nice new working title would be: Factors driving changes in pollinator populations, pollinator networks and pollination services. But we have to figure out, whether such changes can be made, as we are somewhat bound by the scoping document
Les Davies	2	0	0			<b>Overarching Comments:</b> This chapter is quite well developed and generally well-written. At 93 pages for this one chapter, efforts should be made to keep the writing tight and to the point and un-necessary tables and figures should be considered for <i>culling</i>		Restructuring helped to tighten, and we are taking care about the length
Leo Galetto	2	0	0	general		Many sections of Chapter 3 are overlapped with some of the drivers presented here (or repeated). My suggestion there was to delete the overlapped sections.		Cross-chapter discussion are ongoing and we try to move in this direction (while some overlap might be inevitable in order to guarantee that the text can be understood)
Laura Burkle	2	0	0	0	0	the whole document should be edited with attention to detail, by a native English speaker		Will be done at the final stage; thanks for your patience to read through a sometimes strange kind of English...
Leslie Firbank	2	Fig 2.2.1	0			More needed in caption - what system is this?		Figure was removed
Leslie Firbank	2	Fig 2.2.2	0			Not very helpful, could be dropped		We thought differently (having a broad audience in mind) and kept the figure

Madeleine Chagnon	2	Fig 2.3 3- Routes exposure	0		Redraw infograph :Should include water (Main et al., 2014; Samson Robert et al. 2015) probably other ref also		highlighted as honeybees; water (other than guttation) not shown as a clear potential route of significant exposure in honeybees but hypothesized (levels in water are usually very low when compared with intake levels)
Leslie Firbank	2	fig 2.3.1	0		AN obvious point - is there a way to relate to toxicity ?		No - as the pesticides within a class vary widely in toxicity, e.g. pyrethroid fluvalinate in actually used as a varroacide in beehives any such comparison would be misleading
Madeleine Chagnon	2	Fig 2.3.4	0		graph is 6 years old and should now include Neonics		NNIs have not resulted in incidents of acute mortality from normal use within the timespan (and more recently incidents have only been related only poorly applied seed treatment where HQ is not appropriate)
Leslie Firbank	2	Fig 2.4.1	0		It would be better to contrast Bt and HT traits, rather than different countries?		James (2014) presents this figure as a key one. Furthermore we consider important to show that the trend is similar in industrial and developing countries
Martha Groom	2	Figure 2.1.2	0		Wonderful visualization, but some lay audiences might be confused by bee changing in size on Y axis. Could have cluster of 3-4 different pollinators at bottom of Y axis, then just one of these shown at the top - that conveys a change in diversity clearly, and also numerically a change in total abundance to convey a more accurate take home message		We have slightly adapted the figure.

Martha Groom	2	Figure 2.2.2.	0			A helpful figure, but it needs to clarify that pollinators are leaving after the crop has finished blooming. The image on the bottom left is not so clear and should instead show all the plants in fruit, with no flowers, rather than just a solitary leaf. I think that, and a clearer caption, would make this concept come across well.		We have adjusted the caption
Scott Black	2	Figure 2.3.1	0			Question: does this graph include pesticide amounts used from coated seed?		This is all uses so treated seed is included
Scott Black	2	Figure 2.3.2	0			It seems worth noting that the LD50's are likely for adult bees and therefore the risks of pesticides such as insect growth regulators, which are harmful to juvenile insects, would not be accurately represented. Also, the issue of indirect and sublethal affects is also lost with use of an LD50.		this is a representation of the data provided -there was no info on which pesticides were used
Graciela Rusch	2	figure 2.3.2	0			There should be a comment in the figure caption and the text explaining how to interpret the units of amount. Kg applied does not reflect fully the impact of the agro-chemicals. More powerful insecticides require lower dosis of active substances than 'conventional' chemicals		but more powerful insecticides will also have more toxicity to bees which is shown by the legend (unless they are highly selective)
Scott Black	2	Figure 2.3.3	0			Consider adding in exposure to ground dwelling bees from applications that leave residues in the soil. Soil drench is an obvious example but seed coatings and other methods of application also lead to soil contamination.		highlighted as related to honeybees; thus, other aspects not included here (like ground dwelling bees as you propose, or like water issues as proposed in comment 34)
Scott Black	2	Figure 2.3.4	0			I am curious how/why the time span from 1985 - 2007 was selected.		Based on available incident data - but not affected by more recent incidents since most reflect data from pre 91/414 (EC Directive on pesticide regulation) when the HQ was implemented more widely to exclude incidents from occurring (e.g. OP uses on flowering crops)

Scott Black	2	Figure 2.3.4	0			Recognizing that both the hazard quotient and incident reports are blunt measuring tools for acute mortality, it should be cautioned that such measurements fail to address subtle risks that can dramatically impact pollinator populations.		Sublethal effects are not measurable in such incident data and no claim is made for such in the text - separate section on sublethal effects
Scott Black	2	Figure 2.3.4	0			This figure also doesn't address the magnitude of the incidents. I don't know if the profile of a pesticide's impact would change if the magnitude of the incident was also considered.		No info on magnitude available may be a few bees or several thousand bees in an incident -both are equal in an incident scheme
Martha Groom	2	Figure 2.8.1	0			The maps of Figure 2.8.1 are more difficult with differing color schemes and tiny size, as is the coding of what is depicted under each map, while the descriptions on the left for each row are VERY useful. Removing the text below each map could allow the figures to be enlarged (and made more consistent) and then the information could go into the legend (more clearly than the coding there now). What is very, very nice here is the coupling of two distinct studies and types of pollinator.		Thanks for your very positive take on the figure; after the SOD we will adjust all elements and make completely new graphs based on the original data behind the maps
Jeff Ollerton	2	References	0	0	0	Double check references as some are cited but not in list		We have tried to improve this (still some way to go)
Martha Groom	2	Table 2.1.1	0			Useful summary, but several problems in clarity. 1) Category of "Land Use" is unclear. Moderate increases in Land Use means increases in Habitat Change? This is quite unclear. Homogenization - need to specify how Land Use leads to homogenization? Really, this is about Land Use Change, but this is a huge category and requires more specificity to be usable. Particularly as a leading category, this needs to be more carefully parsed; 2) Category for Patch Size also is unclear, but could be changed to "Decreased Patch Size" and the set of effects mentioned would all make sense; 3) "Connectivity" similarly ambiguous as is - change to "Increased Connectivity"; 4) Change to "Increased Distance to natural habitat" to make it clear. IN all of these, directionality or specificity is necessary or the categories and effects do not align unambiguously.		We have tried to incorporate some of these suggestions

Martha Groom	2	Table 2.1.1	0		Placement may be too early. Really addresses landscape configuration and fragmentation more than land use cover change, which is the topic of this first section.		We have tried to adjust the placement in conjunction with the entire restructuring of the relevant sections
Valerie Peters	2	Table 2.1.1.	0		Table 2.1.1, maybe add a qualifier for each factor, for instance Decreasing Patch Size and Increasing Connectivity		We have incorporated the suggestion
Graciela Rusch	2	table 2.1.2	0		There seems to be an error in the Negative:Positive relationship for bees. Please, explain in the figure caption what the ratios are (calculation).		Thanks, we corrected this
Martha Groom	2	Table 2.1.2	0		Typo in first data line - Ratio Negative:Positive should be 3:1		Thanks, we corrected this
Scott Black	2	Table 2.3.3	0		Recognizing the table is not exhaustive I only recommend a few additions: add Nn.-imidacloprid and Py- deltamethrin For <i>Am</i> brood production Reference: Decourtye, A., J. Devillers, S. Cluzeau, M. Charreton, and M.-H. Pham-Delègue. 2004. Effects of imidacloprid and deltamethrin on associative learning in honeybees under semi-field and laboratory conditions. <i>Ecotoxicology and Environmental Safety</i> 57:410–419.		Apologies missed during FOD review but will be added during review of the SOD
Scott Black	2	Table 2.3.3	0		add Nn.- thiamethoxam for <i>Am</i> homing ability and survival. Henry, M., M. Beguin, F. Requier, O. Rollin, J-F. Odoux, P. Aupinel, J. Aptel, S. Tchamitchian, and A. Decourtye. 2012. A common pesticide decreases foraging success and survival in honey bees. <i>Science</i> 336(6079):348–350.		Apologies missed during FOD review but will be added during review of the SOD
Graciela Rusch	2	table 2.5.1	0		There seems to be an error in the first row under Effects on wild pollinators (all others refer to the degree of confidence).		Thanks for highlighting; we have corrected the table

Martha Groom	2	Table 2.5.1	0			Should shift "NEGATIVE" to legend or to the title of this column (in lower case) to indicate that all impacts recorded are negative (studies are not addressing overall yield in most or all cases). Confusing use of this term just once in the table where other words in bold all caps indicate degree of confidence. If goal is to have this linked in parallel to the case for solitary bees, then this should note that these studies do not discuss effects on crop pollination, and then use exactly the same format as in Table 2.5.2 in reporting impacts. Confusing to have different formats, and not make clear that this address impacts on pollinators, but not necessarily on crop yield.		Thanks for highlighting; we have corrected the table
Martha Groom	2	Table 2.8.1	0			I believe the conversion of Table to pie charts will be effective.		We will do this in the last step of the writing
Diane Castle	2	1	1	1	697	<b>Proposal:</b> Throughout It would be clearer to replace the term "abundance and richness" with "abundance and diversity" <b>Rationale :</b> This is a more precise and translatable term		We have tried to improve the text along these suggestion - but might have missed it here and there

Julia Astegiano	2	1	1	93	4510	<p>Chapter 2 describes the effects of main drivers of change on pollinator diversity, plant-pollinator assemblages and pollination services, such as land use change, invasive species, diseases and other antagonists, GMO, agriculture, pollinator management, and climate change. It also covers the joint effects of multiple threats. I found the selection of main topics as well the structure of the chapter really interesting and complete, allowing readers to get the main message about the particular and joint effects of these main drivers of biodiversity and pollination service change. As a general comment, I would suggest doing a more faire treatment of insights provided by the network approach to study those effects. For instance, the section analysing the effects of species invasiveness made a full coverage about results coming from network studies whereas the section analysing diseases and antagonistic interactions lacks any comment about valuable insight provided by network studies in those topics. Similarly, there are only few mentions of insights coming from modelling studies, which in some cases are the only kind of studies available to understand the effects of drivers at higher spatial and temporal scales. Finally, each section ends with very interesting and clear conclusions but generally future directions are lacking. I suggest that new emerging questions that are specific to each section should be included at the end of it and that general questions should be included at the end of the chapter.</p>		<p>We have tried to improve the text along these suggestions. However, we did not manage the new emerging questions in a satisfactory manner and hope to be able to do this in the next round</p>
Colin Fontaine	2	2	1	2	1	<p>the title includes pollination networks but the chapter does not include much about it. One way to integrate networks is to use them to show that crop pollination is not only dependant on the presence of pollinators but also to the presence of wild plant species, because many crop pollinators depend on other floral resources. I think that this is an important message that would deserve to be highlighted. the figure 1 of Carvalho et al. Eco. Letters 2011 could be a good illustration</p>		<p>We have tried to improve the text along these suggestions</p>

Leslie Firbank	2	5	1	7		The exec summary is basically sound, but needs re-ordering. I'm surprised not see increased levels of N as a driver, as it has generated much less pollinator-friendly vegetation in fields and also more widely		We now have done a thorough update of the ES. Also N is now in our chapter
Jan Axmacher	2	5	1	93	4510	While this chapter in my view comprises a very good collection of highly relevant material, I am very concerned about the apparent taxonomic bias displayed throughout. What I find very problematic is that throughout the entire text in this chapter, a number of important pollinator taxa are apparently not considered at all. While a search for the keyword "bee" yields 1097 results and the keyphrase "butterfl" still appears 76 times, the much more species-rich (in comparison at least to butterflies) "moths" as pollinators only appear 3 times throughout the entire document, with two of the respective results representing references. Beetles only feature as predators/pests for bees, but are not considered at all in their role as pollinators in their own right. While I am unfamiliar with the state of knowledge surrounding drivers in distribution and diversity of pollinating beetles, I am aware of a substantial body of literature available on moths and drivers of moth distribution and diversity in a wide variety of habitats, landscapes and geographic regions. This includes some of my own work, but also e.g. studies by Konrad Fiedler, Jan Beck, Gunnar Brehm and other colleagues working on this topic. Not least given the substantial species richness in pollinating moth taxa (in comparison e.g. to butterflies, but also to many hymenopteran taxa) I would strongly urge the authors of this chapter to take this literature into consideration.		As we agree in principle, we have tried to include a bit more on moths. However, there is not too much available in terms of the pollination role especially in the context of food production, except a few recent papers which we have cited. One of our authors (JS) also was tempted to bring in more moth examples, but then we rather restricted it to a few Lepidoptera examples from the field of butterflies.
Richard Corlett	2	5	1	7	111	The weak executive summary does not agree with text, but I presume this will be corrected.		We now have done a thorough update of the ES.
Madeleine Chagnon	2	5	1	7	111	Are you putting references in the summary? If yes many are missing, if not, remove others		We now have done a thorough update of the ES and removed the references
Lennard Pisa	2	5	1	93	4503	Though it is not necessary for me to comment on spelling and grammar,		You are right

Lennard Pisa	2	5	1	93	4503	there is considerable room for improvement here. Pay attention to plural vs singular verbs		We have tried to improve the text along these suggestions
Lennard Pisa	2	5	1	93	4503	remove unnecessary subordinate clauses and generally shorten sentences.		We have tried to improve the text along these suggestions
May Berenbaum	2	5	1	91	4450	Reviewers were instructed not to copy-edit; that said, there are a very large number of sentence fragments, misspellings, typographical errors, inconsistently formatted references, and odd diction (e.g., using "however" as a coordinating conjunction instead of a conjunctive adverb, using "like" where "such as" belongs, capitalizing ordinal adjectives or common names (e.g., hymenopteran is proper, Hymenopteran is not). I have a hard copy with grammatical edits if that's of any use to you		We have tried to improve the text along these suggestions and unfortunately came back to this comment too late to get hold of the hard copy in time; but we want to use the hard copy for improvements in the last step
Anders Nielsen	2	5	1	7	111	The different pressures should be presented in a more equal extent. As it reads now climate change covers 22 lines, while land-use change covers only 5. No doubt that climate change will impact plant-pollinator interactions, but as for now the effects of land-use changes are the best documented and appears to be the major driver of change		We have tried to improve the text along these suggestions
Andreas Obrecht	2	5	1	5	111	The executive summary should be structured in a way that is easier to grasp. Definitions should be avoided. The Driver-Pressure-State-Impact-Response structure would not be bad		We have tried to improve the text along these suggestions - but did not decide to use the DPSIR scheme, as this is much closer to the task of chapter 6
Colin Fontaine	2	5	1	89	4361	Dear authors, I would like first to thank you for the impressive work of putting together this amount of knowledge on pollination. I have learned a lot while reading. I hope that you will find some of my comments helpful.		Thank you for this encouraging comment



Thomas Brooks	2	5	1	7	111	The subsections of this Executive Summary duplicate the "Conclusions" subsections of each section in the main text below. I assume that this is deliberate?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Laura Burkle	2	5	1	5	111	it would be nice to emphasize also what we don't yet know in the executive summary; for example, the insecticides section of the summary does this		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Jana Vamosi	2	5	1			This chapter is a very thorough analysis and summary of the drivers of pollinator abundance and diversity, as well as the effects on pollination services. While some fine editing is still required throughout, I'll keep my comments to major suggestions. I felt the Executive Summary would read better if I included more synthesis of important findings and future directions as opposed to a section-by-section summary.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Marina Rosales Benites de Franco	Executive summary	5	2	5	3	I suggest to include the following: Land uses is currently the main driver ...leading to lost and .....		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Marina Rosales Benites de Franco	Executive summary	6	2	5	6	Finally, they also ..... of plant production.....		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Maximilian Weigend	2	5	3	3	5	it might be worthwhile mentioning here, that the effect of land use is highly divergent in different regions of the world		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Liette Vasseur	2	5	3			"Land use is the main driver of land cover change...": this seems a little circular. I might be better to state, land cover changes occur due to human activities, the main driver being the use of land for food production.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Natacha Chacoff	2	5	3	5	3	and consequently natural habitat reductions.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Jeff Ollerton	2	5	3	5	43	The grammar in some parts of this needs attention from a native English speaker. Ditto other parts of this while section, especially the Conclusions.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	5	3	5	5	In the first sentence in the summary, change in land use is en large directly and only connected to habitat fragmentation (HF).		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	5	3	5	5	This is in my opinion a bit strange as HF is but one aspect of of change in land use.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	5	3	5	5	The way it is stated now considers HF as the main effect/element of changes in land use, that is not the case.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	5	3	5	5	Reductions in pollinator diversity and density etc. are affected by other things related to change in land use as well.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	5	3	5	5	Please make the text generic and coherent.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Jason Gibbs	2	5	3	5	64	Grammatical issues in parts of the executive summary		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Serena Heckler	2	5	3	7	111	It could be also mentioned that, according to indigenous peoples and local communities, there may be other drivers of change that are related to their worldviews or local realities. For example, the Quechua and Aymara communities of the Lake Titikaka give a major role to the loss of respect between humans, to nature and to their deities, as a main driver of change of the climate. The loss of respect alters the communal and social practices causing the ceasing of rituals or the lack of transmission of knowledge from elderly to youth, for instance. (Source: PRATEC, CAI PACHA. 2012. "Cambio Climático y Saberes de Vida. Los retos del Programa Titikaka (Perú-Bolivia). Lima. PRATEC/CAI PACHA).		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Jochen Freund	2	5	3	13	441	Throughout the chapter, habitat fragmentation is an important concept, but often used in a vague, over-simplifying (over-generalizing) way: it is difficult to define habitat for all pollinators. Fragmentation of natural / semi-natural habitats has indeed been shown to have negative influence on some pollinator groups, but not for all pollinator groups. Further, the evidence for universally negative effects of fragmentation per se appears to be described with too high confidence. Especially when the word landscape fragmentation is used, low fragmentation would mean homogenous landscapes; certain aspects of fragmentation (landscape mosaics, fine-grain landscape) may be beneficial for many pollinators and for delivery of crop pollination. Some of these aspects should be reflected in the summarizing material (executive summaries, figures, tables). On example is p13L438		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Jochen Freund	2	5	3	7	111	The overall structure of the chapter and the executive summary would profit from a revision and reduction of the number of chapters.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Jochen Freund	2	5	3	5	15	Section 2.1 focuses on land cover / landscape effects and should have a different title to be more clearly separated from section 2.2.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Gretchen LeBuhn	2	5	3			Isn't this land use change, not simply land use.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Gretchen LeBuhn	2	5	5			Change to "Reductions in wild land" or some other descriptor of what the reduction refers to.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	5	6	5	7	The last sentence does not add any extra information to the sentence before. Fruit set belongs to survival of plant species/communities		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	5	6	5	7	I would ommit it.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Anne-Laure Jacquemart	2	5	6	5		add seed set		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
David Evans	2	8	8	187	189	Maximise readability of the figures by avoiding mixing too many reds and greens that are easily mixed by colourblind readers		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Mercy Gichora	2	5	9	5	9	At the start of the paragraph, drop the definite article "the".	*additional comments: The subject is clearly complex and will require many more studies to be undertaken to fill the highlighted gaps. There were a number of grammatical errors which at this point did not require specific attention but I nonetheless addressed them. The comments that are highlighted in yellow suggest a few areas for improvement.	The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Mercy Gichora	2	5	9	5	9	use plural form to read "systems"		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Felix Herzog	2	5	9	5	9	REPLACE "intensive tillage system" BY "narrow crop rotations"	unclear what "intensive tillage system" is, the term is not defined	The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Shaju Thomas	E.Su mm ary	5	9	5	9	not only fertilizer but alos, pesticidies and herbicidies	these are very damaging	The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Thomas Steeger	2	5	9	5	10	sentence should read " . . .tillage system dramatically decrease . . ."		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Lennard Pisa	2	5	9	5	43	The division into sections is rather artificial and subjective.		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Lennard Pisa	2	5	9	5	43	In my opinion intensive agricultural management includes use of pesticides and GMO crops, in the text		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Lennard Pisa	2	5	9	5	43	they are stated as seperate things having their own sections.		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Lennard Pisa	2	5	9	5	43	I would change the elucidation structure in main text and summary to group them together conceptually.		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Hollis Woodard	2	5	9	5	10	Remove "the" at start of sentence; change end to "dramatically decrease biodiversity"		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Mercy Gichora	2	5	10	5	10	Interchange the words to read 'dramatically decrease biodiversity'. Drop the definite article 'the'.		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Thomas Steeger	2	5	10	5	11	sentence should read " . . .for pollinators by removing flowering weeds . . ."		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Mercy Gichora	2	5	11	5	11	Drop the word "and" which is before 'available'		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Anne-Laure Jacquemart	2	5	11			"removing weeds" : enlarge ! Not only weeds !		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>

Jan Axmacher	2	5	12	5	13	This statement appears to lack crucial information, e.g. amount in? I would suggest rephrasing of this sentence to clarify its message.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Mercy Gichora	2	5	12	5	13	Use 'Mass-flowering' as a compound word. Rephrase the sentence which begins with the word 'although' for clarity of meaning.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Thomas Steeger	2	5	12	5	13	"However, certain mass flowering . . ."		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Hollis Woodard	2	5	12	5	13	Error in sentence that starts with "Although"		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Peter Campbell	Executive Summary	5	13		15	The statement that a move towards extensive management practises eg Organic farming could be beneficial for pollinators needs to be balanced with a statement about the potential knock-on effect of needing to put more semi-natural land under cultivation in order to maintain yields and feed a growing population. More land under cultivation would not be good for pollinators. See Chapter 6!!! A group of researchers at Stanford University in the United States have reported that without the advances in agricultural technology since 1960 (ie extensive agriculture), we would need more than twice as much land (almost 2 billion ha more land) to grow all the food we produce today ( <a href="http://www.pnas.org/content/107/26/12052">http://www.pnas.org/content/107/26/12052</a> .) or 2 Billion people from todays global population that we would not be able to feed. When discussing options of extensive versus intensive agriculture for pollinators this global food security and land use context needs to be given!		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Ignasi Bartomeus	2	5	13	5	13	I'd change it to "huge amount OF RESOURCES for..."		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Mercy Gichora	2	5	13	5	14	Introducing the concept of extensive management and its benefits in this paragraph breaks flow of logic as the main idea is highlighted earlier is intensive management. It is necessary to <u>highlight extensive management as well.</u>		The executive summary was completely redone after the update of the chapter text based on the <u>reviewer comments</u>
Felix Herzog	2	5	13	5	13	REPLACE "amount for some pollinators, that make" BY "resources for some pollinators, these are ..."	(wording)	The executive summary was completely redone after the update of the chapter text based on the <u>reviewer comments</u>
Natacha Chacoff	2	5	13	5	13	huge amount of floral rewards		The executive summary was completely redone after the update of the chapter text based on the <u>reviewer comments</u>
Timothy Schowalter	2	5	13	5	15	Sentence is unclear		The executive summary was completely redone after the update of the chapter text based on the <u>reviewer comments</u>
Thomas Steeger	2	5	13	5	14	sentence should read "Extensive management practices, e.g., organic farming, have the potential to maintain . . ."		The executive summary was completely redone after the update of the chapter text based on the <u>reviewer comments</u>
Erik Andersson	2	5	13	5	13	Huge amount of food, presumably.		The executive summary was completely redone after the update of the chapter text based on the <u>reviewer comments</u>
Shalene Jha	2	5	13	5	13	perhaps the authors mean to use 'they' instead of 'that' - or else the sentence requires completion		The executive summary was completely redone after the update of the chapter text based on the <u>reviewer comments</u>
Mercy Gichora	2	5	14	5	14	.. have (in plural) the potential to maintain rich pollinator communities', drop the extra words n between. Add the word 'ensure' before efficient pollination..		The executive summary was completely redone after the update of the chapter text based on the <u>reviewer comments</u>
Serena Heckler	2	5	14	5	14	<u>In reference to the first comment above, the words "traditional agriculture" could be added to "organic farming". These two categories intersect, but are not the same. Traditional agriculture is much more prevalent around the world.</u>		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Hollis Woodard	2	5	14	5	14	Comma after "farming"		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Catrin Westphal	Executive Summary	5	15	5	15	after landscape context, I would add "and regional species pool"	Tscharntke, T., et al. (2005). "Landscape perspectives on agricultural intensification and biodiversity - ecosystem service management." Ecology Letters 8(8): 857-874.; Tscharntke, T., et al. (2012). "Landscape moderation of biodiversity patterns and processes - eight hypotheses." Biological Reviews 87(3): 661-685.	The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Mercy Gichora	2	5	15	5	15	Replace 'however,' with 'even though'		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Felix Herzog	2	5	15	5	15	LAST SENTENCE: However, such gains strongly (...) landscape context and often come at the expense of reduced crop yields.	add this specification, it is one of the major points mentioned based on Gabriel et al. 2013	The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Christopher N Connolly	2	5	17	5	18	1. Toxicity is vague when it depends on potency and the importance of the target. 2.An important omission is the exposure duration.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Maximilian Weigend	2	5	17	3	29	overall excellent, spelling out the other important pollinator groups not investigated might be worthwhile		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Scott Black	2	5	18	5	19	Level of exposure is also a factor of residence time in plants and soil.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Hollis Woodard	2	5	18	5	18	Change "ingredient" to "ingredient(s)"		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Thomas Steeger	2	5	20	5	21	sentence should read ". . .can cause direct mortality to pollinators provided exposure is sufficient and the hazard is increased if they are used inappropriately. However, the sublethal effects from exposure . . ."		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Mercy Gichora	2	5	21	5	21	The meaning of 'field-realistic' conditions is not clear as it is not a standard term.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Mercy Gichora	2	5	22	5	22	Use the plural form 'have' been reported		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Peter Campbell	Executive Summary	5	23		23	After "field realistic doses" should add "or field relevant dosing methods" . Eg many studies directly dose individual bees or even place spiked feeding stations directly into colonies.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Peter Campbell	Executive Summary	5	23		24	"limited range of insecticides". This statement may be true for published literature but is not true for honeybees in terms of regulatory studies submitted to regulatory authorities, where all pesticides will have been tested for acute toxicity to honeybees at the very least.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Scott Black	2	5	23	5	23	"Although not always using field realistic does" should be stricken from this summary. The definition of what constitutes field-realistic doses are under debate. See section on pesticide for more detail.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Hollis Woodard	2	5	23	5	23	Change "honeybees" to "honey bees" - here and throughout text!		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Christopher N Connolly	2	5	24		26	There is data on bumblebee colonies (Gill 2012, Whitehorn 2012, Moffat 2015		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Peter Campbell	Exec Summary	5	26		27	"some reviews consider that synergistic and long term effects have been widely underestimated". How reliable are these reviews to which you refer? Were they carried out under field relevant conditions, were they balanced and reviewing all available literature? This is a very strong statement to put into exec summary so the evidence on which it is based must be strong and robust.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Mercy Gichora	2	5	27	5	27	Use compound word 'under-estimated'		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Maximilian Weigend	2	5	32	5	43	excellent, precautionary principle might be spelt out here		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Mercy Gichora	2	5	32	5	33	Interchange the words to begin with the full phrase before the abbreviation and use brackets for the abbreviation.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Jochen Freund	2	5	32	5	43	The section for GMOs (2.4) should be dropped and the relevant points included in 2.2. and 2.3: the chapter does not provide clear evidence for effects of GMO crops on pollinators, except for the indirect effects via weed control. Having this as a separate chapter gives a wrong impression that GMOs would be by themselves one of the main drivers of pollinator loss. Towards the end of the paragraph in the summary, the wording does not make clear enough what actually describes evidence for negative effects on pollinators.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Martha Groom	2	5	32	5	43	Paragraph does not address impacts on Lepidoptera or coleoptera from Bt. Implies issue relates to bees alone, and only to non-lethal impacts. Suggest modify as follows: "Direct effects...show that Bt-toxins are most specific, causing lethal and non-lethal impacts in butterflies and moths, honeybees, and beetles. Impacts on insect pollinators are poorly understood, as few studies have been completed, and primarily with a single species (Lang and Otto 2010)." Helpful to have the level of uncertainty identified, as well as the fact that the impacts DO occur for a wider array of species, and while not as prominent as honey bees, so do serve important roles as pollinators (e.g., Chlosyne lacinia).	Note: Lang and Otto's review is also referenced elsewhere in this chapter. For full citation see p. 51, line 2395-7; If references not included in this summary section, could specify species (monarch butterfly) instead of reference in my suggested sentence.	The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Matthew Heard	2		32			Other plant breeding technologies that produce similar phenotypes to GM should be included. Risk assessment should be on traits not methods		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Andreas Obrecht	2	5	33	5	33	To a non specialist, it is not clear what a "target organism" of GMO is.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Mercy Gichora	2	5	34	5	34	End sentence with the words 'effects of exposure'.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Scott Black	2	5	34	5	35	Bt-toxins are lethal to lep and fly pollinators. Please clarify.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Peter Campbell	Exec Summary	5	35		36	"sub-lethal or behavioural effects on the behaviour and learning in honeybees have been reported" . Most of the literature supporting such a statement come from either laboratory studies or field-unrealistic dosing and has not been demonstrated at Environmetnally relevent doses and field relevant dosing methods		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Peter Campbell	Exec Summary	5	39		40	"HT-Crops resulting in indirect effects leading to decline in Monarch butterfly in USA". Is this really as proven as suggested? The paper quoted is a modelling study and I have provide another pupblished paper based on a census study which challenges this assumption. See my comments on Box 2.4.1.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Peter Campbell	executive summary	5	39	5	40	is this conclusion as robust as suggested eg there is an unreferenced census study (see comment on 2.4.1 above) which hchallenges this modelling based statement?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Thomas Steeger	2	5	39	5	40	the sentence regarding HT crops and the use of herbicides explaining the decline of monarch butterflies in North America should be referenced; otherwise, it appears to be an opinion rather than a fact. Has this been an established fact or are multiple factors associated with the decline in monarchs?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
May Berenbaum	2	5	40	5	40	Stating that "HT crops...explain...the decline of momarch butterflies in North America" is inconsistent with statements in Box 2.4.1, which indicate the data of Pleassants and Oberhauser 2013 are correlational. In fact, that study examines population changes from 1999 to 2010 and doesn't include the variation in monarch populations from 1995 to 1999, which clearly are not correlated with HT crop acreage.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

May Berenbaum	2	5	41	5	41	"proven" should probably be "demonstrated"		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Hollis Woodard	2	5	41	5	41	Change "few evidences" to "little evidence"		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Christopher N Connolly	2	5	42	5	43	Some mention that each GMO should be considered independently to move away from the for/against GMO crops.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Felix Herzog	2	5	43	5	43	ADD SENTENCE: However, agricultural GMOs are probably less threatening for pollinator diversity than the above mentioned factors.	I know that it is difficult to weigh the importance of the different factors. But when reading the GMO section I found less solid evidence for harm than in the other sections. This should be reflected in the Synthesis, either by adding such a sentence or by rephrasing the GMO summary	The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Maximilian Weigend	2	5	45	6	55	mention other managed pollinators at least in passing		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	5	45	5	55	Global, complex and ambivalent driver...of what?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	5	45	5	55	Check grammar and elucidation structure.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Lennard Pisa	2	5	45	5	55	I would leave the "coin metaphore" out. Less is more.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Hollis Woodard	2	5	45	5	48	Sentences needs rewording		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Leo Galetto	2	5	48	5	51	<p>This is a general comment for these particular sentences, although it can be applied for the entire chapter. I think this is a partial view of the history because the arguments are based on the dominant cultural view (economic and ethical) of our Western societies. The economic perspective (and in many cases a neoliberal perspective) predominates and is behind many references within the assessment (e.g., “necessity to pollinate large, intensively managed croplands”, “tip the balance in favour of continuing intense management”; etc.). If we consider the general IPBES conceptual framework recently published (Díaz et al. 2015; <i>“The first public product of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is its Conceptual Framework. This conceptual and analytical tool, presented here in detail, will underpin all IPBES functions and provide structure and comparability to the syntheses that IPBES will produce at different spatial scales, on different themes, and in different regions. Salient innovative aspects of the IPBES Conceptual Framework are its transparent and participatory construction process and its explicit consideration of diverse scientific disciplines, stakeholders, and knowledge systems, including indigenous and local knowledge .”</i>, a wider view is necessary to be considered. We can deconstruct the arguments pointed out in these particular sentences (but also within the Chapter). For example, “necessity to pollinate large, intensively managed croplands” and its justification “tip the balance in favour of continuing intense management” is not a “real problem” because the main problem is “food as commodities” that determines the high speculation of the markets determining high (artificial) prices impacting with distribution of the available (enough) food for more than 1000 million hungry people. This</p>		<p>The executive summary was completely redone after the update of the chapter text based on the reviewer comments</p>
Hollis Woodard	2	5	48	5	48	<p>Change "bumblebees" to "bumble bees"</p>		<p>The executive summary was completely redone after the update of the chapter text based on the reviewer comments</p>

Jan Axmacher	2	5	49	5	51	Would it not be much more appropriate in this case to introduce artificial nesting opportunities for wild bees and other wild pollinator groups, not least to strongly increase the resilience of the pollinator networks towards diseases and associated problems?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Nadine Azzu	2	5	49	5	51	Why, though? And why are we kind of saying to continue intense management as long as we have managed hives (that is how I read this, I may be wrong)..? What about management practices that encourage natural habitat provision (e.g. hedgerows strategically placed in large-scale orchards)? (which can then also contribute to other benefits such as crop diversity and soil fertility)		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Shalene Jha	2	5	50	5	51	tip the balance in favour of continuing intense management...' - I believe this statement is too strongly in favor of managed bee usage and should be toned down		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Arathi Seshadri	2	5	51	5	53	I am a little skeptical about the statement that managed solitary and stingless bees may be safer alternatives to honeybees (HB) and bumblebees (BB). Given that the solitary and stingless bees have not been managed for as long as the HB and BB have been, it may just be a matter of time that we see the same issue pop up. So, intensive management of one or a few species may be the real problem, similar to monocropping, rather than the type of bee and it may be good clarify this.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Serena Heckler	2	5	51	6	55	These sentences imply either little history of stingless bee management ("relatively short time, studies are scarce" etc) or negative outcomes of such techniques ("negative impact had so far on wild species" etc). However, there is in fact a long history of stingless bee management that makes use of traditional ecological knowledge within numerous indigenous communities that has not demonstrated negative impacts on wild species. Suggest changing last sentence to read " <u>Stingless beekeeping that makes use of traditional knowledge has a long history globally</u> , yet we also have to have in mind the negative impact <u>modern</u> bee management practices had so far on wild species to foresee and avoid..."		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Hollis Woodard	2	5	51	5	51	Change to: "In THE case.."		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Scott Black	2	5	52	5	53	The sentence stating that managed solitary bees is not supported. Although there is less evidence of issues related to this but that is because there is less data overall. To state that we have limited data and then say "they seem to be a safer alternative" is problematic. You could change to say they "might be" instead of "seem to be".		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Thomas Steeger	2	5	52	5	53	do "they" represent solitary and stingless bees and with respect to "safer" alternative than honey bees and bumble bees-- safer in terms of what?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Hollis Woodard	2	5	52	5	53	This is contradictory/vague - if we don't have the empirical data to support the idea, then how do they "seem" safer?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Hollis Woodard	2	5	54	5	54	Missing some words in sentence		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Peter Campbell	exe c sum mar y	6	57	6	64	Surely Varroa mite and the diseases they carry needs to be mentioned in the executive summary as a major threat to honeybees. Otherwise the credibility of this section with beekeepers and most balanced honey bee scientists will be questioned.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Shaju Thomas	2	6	57	6	57	predators	real threat	The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	6	57	6	64	So disease and pests can be pointed to as such to be a driver of pollinator decline??		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Lennard Pisa	2	6	57	6	64	I would be more careful with causality and generalization here, it might be that pathogens are NOT causing a decline		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	6	57	6	64	but have no influence on population dynamics. This can be very different for different species.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	6	57	6	64	State what you mean more general.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Jochen Freund	2	6	57	6	64	Diseases and natural enemies of pollinators are in principal a natural component of ecosystems, which is not by itself a driver of pollinator loss. As discussed in this section, increased disease and pest pressure on natural bee populations can result from bee management (or from introduction of exotic species [compare 2.7.2], from climate change or from a combination of these drivers). I would strongly suggest to drop section 2.6 and include the relevant information in section 2.5 on bee management, or where appropriate in other sections. This would also help reduce redundancy and shorten the chapter.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Jason Gibbs	2	6	60	6	60	be more specific about levels of study in these bees. What solitary bees or how many have bee examined? Also mention that a wide diversity of other functional and taxonomic bee groups have not bee studied at al (like non-managed social bees)		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Diane Castle	2	1	62	1	62	<p><b>Proposal:</b> edit text from " For managed social bees they are known to vary in time and space and are <i>often</i> associated with colonies that are not in ideal nutritional state or ..... " to</p> <p style="text-align: right;">" For</p> <p>managed social bees they are known to vary in time and space and <i>can be</i> associated ....."</p> <p><b>Rational:</b> it over states the situation to say disease is "often" associated with the stressors listed as there are other factors that can exacerbated disease such as the Varroa mite .</p> <p><b>Supporting references:</b></p> <p>*Genersch, E (2010), Honey bee pathology: current threats to honey bees and beekeeping. Appl Microbiol Biotechnol 87:87–97.</p> <p>*Martin S J, Highfield A C, Brettell L, Villalobos E M, Budge G E, Powell M, Nikaido S and Schroeder D C (2012), Global Honey Bee Viral Landscape Altered by a Parasitic Mite. Science 336, 1304</p> <p>*Nazzi F, Brown S P, Annoscia D, Del Piccolo F, Di Prisco G, Varricchio P, Della Vedova G, Cattonaro F, Caprio E, and Pennacchio F (2012), Synergistic Parasite-Pathogen Interactions Mediated by Host Immunity Can Drive the Collapse of Honey Bee Colonies. PLoS Pathog 8(6): e1002735. doi:10.1371/journal.ppat.1002735</p>		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Mario Marcos Espirito	2	6	63	6	64	The last sentence is loose.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Nadine Azzu	2	8	63	8	63	Change IN pollinators (not "of")		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Maximilian Weigend	2	6	66	6	73	I think breaking this down into invasive plants/pests/pollinators might make sense here, since the effects may be dramatically different and call for different action		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Natacha Chacoff	2	6	75	6	101	the rest of the drivers uses less space to describe the main findings		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Shalene Jha	2	6	75	6	87	seems like this paragraph needs a bolded heading in the first line, or it could be moved after 'climate change' on line 90		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Penelope Whitehorn	2	6	75	6	101	Section on climate change in Executive summary seems to follow different format and is only paragraph that contains references. Also it's not clear why sentences on L89-90 & L99 are in bold. Suggest cutting down these 3 paragraphs and having just one paragraph for climate change.		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Hollis Woodard	2	6	78	6	78	Reword		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Jan Axmacher	2	6	80	6	82	It might be noteworthy in this context that problems could be particularly severe for migratory species (e.g. many lepidoptera)		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Jochen Freund	2	6	81	6	82	The evidence for widespread disruption of species interactions is very limited, which should be better reflected here.		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Andreas Kruess	2	6	82	6	82	"disrupting life cycle" of a species will lead to the extinction of the species. I think the authors intend to say "altering life cycle"		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Maximilian Weigend	2	6	82	6	82	"altering life cycles" make more objective, since I am not sure that all change need be negative		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>
Andreas Kruess	2	6	84	6	84	It is unusual to cite references in the Executive summary. Delete this		The executive summary was completely redone after the update of the chapter text based on the <a href="#">reviewer comments</a>

Ignasi Bartomeus	2	6	84	6	84	This are the only references of the executive summary. Remove them?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Natacha Chacoff	2	6	84	6	84	please consider to delete the references here as in the rest of the summary there are no other references		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Anders Nielsen	2	6	84	6	84	Remove references from the summary		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Shalene Jha	2	6	84	6	84	seems odd to haea reference here when the rest of the section has no references		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Laura Burkle	2	6	84	6	87	very specific...seems odd in the executive summary. Delete?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Luisa Carvalheiro	2	6	86	6	86	add: (e.g. SEDG, Sustainable European Development Goal)		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	6	89	6	101	The sub sections on migration and extinction related to climate change belong to "climate change", there is no need to give them their		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Lennard Pisa	2	6	89	6	101	own sub section in my opinion, just use 1 section on climate change.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Jochen Freund	2	6	89	6	97	I did not find this to be supported by strong evidence. I would rather think that there is great uncertainty as to whether pollinators can track climate change. What I know about northward expansions of several thermophilous European bee species from outside of mountain regions, the lower vulnerability of lowland species may also be not general or evidenced enough to be included in the summary. Given current evidence, this paragraph might better be shortened and included in the preceding paragraph.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Anne-Laure Jacquemart	2	6	89		101	The same is also true for plant species, not only for pollinators		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Thomas Steeger	2	6	90	6	91	replace "will" exceed with "may" exceed		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Ignasi Bartomeus	2	6	91	6	92	I am not fully comfortable with this sentence, because speed of migration is unknown for most species		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Thomas Steeger	2	6	92	6	93	replace "will" find themselves with "may" find themselves		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Scott Black	2	6	96	6	97	Many species that live in areas near sealevel will also be heavily impacted. Many species of butterflies are threatened with sea level rise impacting habitat.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Anna Traveset	2	6	99	6	101	I think an approximate figure should be given, as a 'large' fraction is too vague. The main pollinator groups (e.g. bees, butterflies, hoverflies) with highest extinction risk could also be given here.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Leo Galetto	2	6	99	7	111	The final paragraph of the Executive Summary, mainly the final conclusion: "This multiplicity and variety of threats to pollinators and pollination have the potential to seriously affect future food security, human health and ecosystem functions", includes statements as "food security" that can be placed only under the predominant ethical view of our Western Societies. Thus, the first general comment stated above can also be applied here.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Laura Burkle	2	6	99	6	101	combine with next paragraph, "multiple pressures"		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Thomas Steeger	2	6	103	6	104	sentence should read "... that individually impact the health . . ."		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Anders Nielsen	2	6	103	6	104	The list of pressures should reflect the list of pressures presented already		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Jochen Freund	2	6	106	6	107	This sounds like there was strong evidence for synergistic effects of multiple drivers, increasing the pressure on pollinators. As discussed in the respective section, there are too few studies on this topic and the few that exist do not uniformly point towards synergistic negative effects		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
May Berenbaum	2	7	108	7	108	What is meant by "biology" if not ecology? Physiology? Genetics?		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Peter Campbell	Executive Summary	7	110		111	"multiplicity and variety of threats combining to seriously affect future food security, human health and ecosystem function". Where is the current evidence of crop failure/declining yields due to insufficient pollination services. This is a very strong and scaremongering statement with little evidence to support except 1 published paper using extrapolated calculations.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments

Marina Rosales Benites de Franco	Executive summary	7	111	1	111	security, human health, ecosystem function and its production.		The executive summary was completely redone after the update of the chapter text based on the reviewer comments
Leslie Firbank	2	8	161			It's worth explaining which pollinators here, does this apply just to those for crops, those for all plants in farmed areas, for all habitats?		Adjusted
Jeff Ollerton	2	8	161			It strikes me as odd to discuss the drivers of change before discussing the changes themselves.		This is a matter of the predefined arrangements of chapters; in the SPM for example we follow the logic proposed by you - first describing the changes and then their drivers
Anders Nielsen	2	8	161	8	161	"pollination networks" should be better explained. Why use this concept, what is it and what are the advantages of using a network approach towards studying plant-pollinator interactions. If the concept comes without any explanation readers outside the field of community ecology will have <del>problems following the argumentation</del>		This should be explained in chapter 1; the term was prescribed through the scoping document
Andreas Obrecht	2	8	163	8	166	It would be sufficient to write "direct drivers to change of pollinators are: x, y, z and indirect drivers are x,y,z". I'm not sure <del>what pollination networks are.</del>		Hope the modified version comes closer to your expectations?
Gretchen LeBuhn	2	8	163			change to" There are a number of potential drivers of changes in..."		Thanks; done

Leo Galetto	2	8	163	8	169	Here is presented a summary of the drivers (indirect, as trade and policies, and direct) for the change of pollinators, pollination networks and pollination services. The focus is on direct drivers. I agree with the selection of these drivers and also I can understand that the scientific evidence is focused on these ones. Nevertheless, in the IPBES conceptual framework (Díaz et al. 2015) presented additional indirect drivers (e.g., economic and demographic growth, lifestyle choices) that will “influence the amount of land that is converted and allocated to food crops, energy crops or plantations; accelerated carbon-based industrial growth over the past two centuries has led to anthropogenic climate change at the global scale; synthetic fertilizer subsidy policies have greatly contributed to the detrimental nutrient loading of freshwater and coastal ecosystems. All of these have strong effects on biodiversity, ecosystem functioning and their derived benefits and, in turn, influence different social arrangements intended to deal with these problems”. Thus, indirect drivers are directly linked with the direct drivers presented here. In my opinion, this trend is because all these drivers are analysed under the predominant epistemological-ethical view (i.e. anthropocentrism-utilitarianism) of our Western Society. Díaz et al. (2015) highlighted that other different knowledge systems can work in complementary and mutually enriching ways and mentioned: “The stated goal of IPBES explicitly mentions the interface between science and policy, it is understood that the term ‘science’ in this denotes a broader concept that includes contributions not only from natural, social and engineering disciplines within western science, but also from knowledge of indigenous and local community stakeholders and practitioners”. If we can consider other epistemological-ethical		Thanks for this comment. We have tried to further highlight some of the elements mentioned by you, together with some pointers to the respective sections in our chapter. We also have added the separate section 2.8 to deal with some of these points.
Liette Vasseur	2	8	164	8	169	I would split the sentence as it is very long. It will work better with one sentence on indirect drivers and a second one on direct drivers.		We have modified the introduction accordingly
Lennard Pisa	2	8	164	8	164	Get the semantical causality right!		We have modified the introduction accordingly
Lennard Pisa	2	8	164	8	164	"In the present chapter, these drivers are assesed, especially those of importance for food production"		We have modified the introduction accordingly

Lennard Pisa	2	8	164	8	164	So are you assessing the drivers behind dynamics of pollinators or the drivers of importance for food production?		We have modified the introduction accordingly
Lennard Pisa	2	8	164	8	164	I think you want to assess the drivers behind population dynamics of pollinators important to food production...		Yes; modified accordingly
Lennard Pisa	2	8	164	8	164	Be precise in your writing.		Yes; modified accordingly
Penelope Whitehorn	2	8	164	8	165	Sentence states that this chapter includes an assessment of indirect drivers of change - it is not clear where this is to be found.		We have modified the introduction accordingly
Christopher N Connolly	2	6	167	6	168	I don't think examples should be stated as this implies they are of greatest risk.		We have modified the introduction accordingly
Peter Campbell	2	8	167		168	Why single out neonicotinoids?		Because this introduction mirrors the scoping notes provided by IPBES, where neonics have been singled out
Thomas Steeger	2	8	167	8	168	by "chemicals" do you mean pesticides? If so, then say pesticides. Recommend deleting " ,including fungicides and insecticides such as neonicotinoids"		Because this introduction mirrors the scoping notes provided by IPBES, this wording has been chosen
Keng Hong	2	8	167	8	168	iii) the use of toxic (including fungicides, herbicides, and insecticides such as neonicotinoids) and non-toxic (including fertilisers) can induce drastic chemo-ecological changes that affect physiological and behavioral states of pollinators.		We have modified the introduction accordingly
Gretchen LeBuhn	2	8	170		215	Perhaps this section could be removed and the section could start with 2.12 as these remarks are so introductory. Section 2.12 is fairly choppy with paragraphs on specific topics like logging and then overviews of generalities. I'm not sure that there is much reason to think logging will have a bigger effect than urbanization so, I was surprised that there weren't more paragraphs summarizing larger areas of research like urbanization.		This section has been now moved to section 2.2.2.5 under land management (section 2.2.2)

Julia Astegiano	2	8	171	12	377	<p>Section 2.1. presents key results and references evaluating the effects of changes in land cover on pollinator diversity, abundance and on pollination services. Although it is recognized in the main text that pollinators provide a pollination service to crops and wild plants, discussion about the consequences of land use change (i.e., fragmentation, habitat loss, etc.) on the reproduction of wild plants is absent. Moreover, as breeding systems have been shown to be a key trait determining plant response to habitat fragmentation (Aguilar et al. 2006), links with some ideas in chapter 1 should be included. These ideas are briefly discussed in Chapter 3; however, a deep discussion about effects on pollinators is given in Chapter 2. Full references to discuss these ideas: (1) Aguilar R, Ashworth L, Galetto L, Aizen MA (2006) Plant reproductive susceptibility to habitat fragmentation: review and synthesis through a meta-analysis. <i>Ecol Lett</i> 9: 968–980; (2) Aizen, M. A., Ashworth, L., &amp; Galetto, L. (2002). Reproductive success in fragmented habitats: do compatibility systems and pollination specialization matter? <i>Journal of Vegetation Science</i>, 13(6), 885-892; (3) Ashworth L et al. (2004) Why do pollination generalist and specialist plant species show similar reproductive susceptibility to habitat fragmentation? <i>J Ecol</i> 92: 717-719.</p>		<p>We thank the reviewer for the comment. Accordingly, we have now further developed the aspect of the effect of fragmentation on the reproduction of wild plants.</p>
Jochen Freund	2	8	171	28	1213	<p>To be consistent, section 2.1 should be entitled "land cover" instead of "land use", as land use also includes section 2.2 and other sections</p>		<p>The title of the section has been now changed to "Land cover and its changes"</p>

Teruyoshi Nagamitsu	2		171		1210	Land use and agricultural management are closely related each other, and thus, it is difficult to divide them clearly. These landscape modifications have both positive and negative effects on pollination systems. The positive effects are relevant to the under-use problem, which is a biodiversity loss due to the reduction of human activities such as traditional land use. In rural landscapes, logging, mowing, and burning tend to maintain foraging patches and nesting habitats of pollinators. These traditional land use activities may not be included in organic-farming. I would like to suggest to mention the positive effects of traditional land use on pollination systems in conclusions of either section.		taken care of in new structure
Thomas Steeger	2	8	176	8	177	by "services" they provide, do you mean pollination services or some broader suite?		this has been now clarified. Thanks for pointing this out.
Andreas Kruess	2	8	179	8	179	"Changes in land cover" means "Changes in land cover <b>type</b> "		Thanks. The expression has been now modified across the draft to follow the reviewer's comment.

Serena Heckler	2	8	179	8	214	<p>A short text could be add to show that traditional beekeepers have also perceptions concerning the impact of changes in land uses on pollinators and pollination services. It could be add from <u>line 210 page 8</u> : "Traditional beekeepers, who based their knowledge on the observation of their biophysical environment, had also noted the impact of changes in land uses on pollinators. In Southern France, the Cevennes National Park is a relatively well preserved area. Nevertheless, some traditional beekeepers had identified several threats, linked to changes in their territory cover, to bees' populations and their pollination services. They noticed a lack of vitality of bees which they attribute to several factors, such as the invasion of the territory by trees, the backward movement of flowers, or the decrease of pastures and meadows. According to them, these changes limit the access of bees to a "good food". Indeed, they noted that closure of the landscapes or forest plantations, which promote the disappearance of many species visited by bees, is very harmful for honey production (Elie, 2015 ; Velay &amp; Velay, 2015)." <u>Sources</u> : Elie Y. (2015). Abeilles noires et ruches troncs. Causses et Cévennes. Tome 23 : 163-174 [other published material] ; Velay G. &amp; Velay J.P. (2015) Souvenirs d'un rucher tronc. Causses et Cévennes. Tome 23 : 175-176 [other published material] ; Clément H. (2015). L'apiculture cévenole. Causses et Cévennes. Tome 23 : 191-195 [other published material]</p>		Thanks a lot for this comment and the information. This has been now included in the new revised version.
Dan Cariveau	2	9	180	8	210	<p>I think the authors should note that magnitude of land-use change here. Extreme land use has been shown to have a greater impact and moderate land use often has little effect.</p>		Following this comment, this is now mentioned elsewhere in the text.
Liette Vasseur	2	8	181	8	185	<p>not sure about the usefulness of this paragraph. What does it relate to in terms of pollinators and even the link with the following paragraph? I think I understand the purpose but you may want to add a sentence at the beginning stating that we need to know the types of land cover first to understand where pollinators are</p>		Following this and other comments, we have now reorganized this section, using it to provide a general framework of land cover change at the global scale.

Filiberto Pollisco	2	8	181	8	183	Year citations are already 15 years old. Maybe newer citations are in order	FAO has newer publications which can be used in this paragraph; Probably can be found in the Forestry sector Outlook Study of FAO 2011.	done. There has been one update of the manual: 2005. This has been now added.
Les Davies	2	8	184			Is a diagram (Figure 2.1.1) really necessary here - I think the text information is adequate for the purposes of this document.		the figure has been now excluded from the draft.
Erik Andersson	2	8	192	8	192	Exploited how? Can mean many different things, not least for pollinators.		this has been now clarified. Thanks for pointing this out.
Mario V Balzan	2	8	193	8	194	In some places specific land management practices may be important in sustaining particular patterns of biodiversity (Haines-Young, R. (2009) Land use and biodiversity relationships. Land Use Policy, 26, 178–186.). In the Mediterranean region, for example, rich biodiversity has existed for millennia in an agricultural setting (Godfray, H.C.J. (2011) Food and Biodiversity. Science, 333, 1231–1232; Medail, F. & Quezel, P. (1999) Biodiversity Hotspots in the Mediterranean Basin: Setting Global Conservation Priorities. Conservation Biology, 13, 1510–1513.)		The evaluation of land management and how it affects pollinators is now being addressed in section 2.2.2. We direct the reader to that section.

Leo Galetto	2	8	194	8	197	I agree with this synthesis, but all these activities (increased crop production associated with the replacement of forests, grazing that can lead to desertification, scrub encroachment and/or land degradation, logging that involves deforestation and then conversion to crop- and grasslands, etc.) are carried out under the dominant paradigm of the Western societies and they are analysed exclusively under our ideological view. There are examples of different cultures, positioned under different epistemological-ethical views, which showed they can manage the environment with better results or applied different solutions for ecological problems. If different knowledge systems can work in complementary and mutually enriching ways with the dominant one of the Western view, they can be mentioned and some examples added.		In this section, we present how land use can affect landscape and its land cover. These tendencies are global, and this does not mean that other processes do not occur. To clarify the idea that the here-mentioned processes are not the only that occur, we have now added an explicit mention to the fact that these transitions are dependent of the land management approach, which is culturally defined. Since this topic (ie, land management) is the topic of another section in this same chapter, the reader is now directed to it.
Filiberto Pollisco	2	8	195	8	196	"Logging often involves deforestation conversion to crop- and grasslands"...maybe this should be re-phrased because the "deforestation conversion".. Phrase makes it a little confusing	Also, this sentence focuses on logging as the sole culprit in deforestation but there are other drivers such as slash and burn farming of indigenous communities and oil palm plantations	The sentence has been now corrected accordingly. Also, note that the section on logging has been now moved to the land management section of chapter 2 (section 2.2.2).
Nadine Azzu	2	8	196	8	196	"desertification AND conversion"		corrected
Erik Andersson	2	8	197	8	197	Definitely, bu this is not always a bad thing from a pollinator perspective.		Indeed. This part of the text gives the background, and how these changes affect pollinators is treated later in the text.

Erik Andersson	2	8	199	8	210	I would like to see a few more sentences on structure and spatial distribution rather than just extent. New combinations of neighbouring land uses have been shown to have quite an impact on pollinators and pollination (as indicated later in the chapter).		Thanks for this recommendation. We have now modified the text to shortly introduce this idea. For the sake of clarity, we have decided to not expand on this at this time, but instead develop the topic later in the chapter.
Serena Heckler	2	8	199	8	204	<u>There are different ways to convert land, which will have markedly different ecological impacts. Small-scale conversion in a mosaic pattern may actually increase biodiversity and should be further studied. This is particularly true in swidden/fallow agricultural systems. See, instance, research by Bill Balee, Darryll Posey in the 1980s (Footprints of the Forest).</u>		Related to this, see comment 260.
Mercy Gichora	2	8	208	8	208	are associated 'with', replace 'to'		corrected
Thomas Steeger	2	8	208	8	209	replace ". . . associated to strong shifts" with "associated with strong shifts"		corrected
Colin Fontaine	2	8	208	8	210	two recent studies comparing the pollinating fauna among urban, agricultural and natural land uses could be cited here. They both highlight differences among insect orders, with for example a relative tolerance of hymenoptera to urbanization. References are: Deguines et al. (2012) The whereabouts of flower visitors: contrasting land-use preferences revealed by a country-wide survey based on citizen science. PLoS one, 7(9), e45822 and Baldock, et al. (2015) Where is the UK's pollinator biodiversity? The importance of urban areas for flower-visiting insects. Proc. B, 282(1803).		thanks so much! This is perfect!
Lennard Pisa	2	8	209	8	209	Community composition? Of what community?		thanks. This has been now clarified. We refer to the composition of biological communities.
Anne-Laure Jacquemart	2	8	210			In Europe, the loss of traditional farming induced higher forest coverage and decrease of open biotopes such heathlands, bogs, extensive grasslands ....		Thanks. This idea is mentioned later in the text, when talking about loss of grasslands, and recolonization by forest, and how this affects bees and honey production.

Andreas Kruess	2	8	212	8	212	In Table 2.1.1 In Column "Factor" "Patch size" must be replaced by "Declining patch size" if the resulting effects are as described		Thanks for pointing this. The Table has been now modified accordingly.
Felix Herzog	2	8	212	(Table 2.1.1)		Specify directions of the factors (except for "land use"): e.g. Patch size per se does not decrease diversity, but HIGH patch size does		Thanks for pointing this. The Table has been now modified accordingly.
Jochen Freund	2	8	212	8	214	The levels of confidence indicated here (Tab. 2.1.1) appear too high for many of these points (some of them are only supported by a single large study). Even for the better supported points it is not yet clear how general they are (worldwide, in crops vs. in natural habitats, etc.). Many of the "factors" should be more clearly defined to mitigate this problem. E.g. "patch size" is probably meant to refer to patches of natural habitats in agricultural landscapes, but this is not clear from the table; if it is interpreted as "field size", conclusions might change drastically. One idea to address this may be to add another column, which says whether it is "in (semi)natural habitats" or "in crop fields"		The table has been now reworked to address this comment and to clarify what and how the factors affect pollinators and pollination services. The levels of confidence have been also reevaluated and modified if appropriate.
Mario Marcos Espirito	2	8	212	8	212	Table 2.1.1 should be improved to a better visualization of what effects belong to each factor.		thanks. Will be done.
Dan Cariveau	2	9	212	9	212	Table 2.1.1 How do the authors make these confidence statements? This is not clear that these are accurate. For example, Kennedy et al. find a pretty weak effect of connectivity for social bees. Yes it is significant but it is really really small. Further this is the only study listed here. Also, the main point of the Winfree et al 2011 is that moderate land use has little effect. This is supported by a more rigorous meta-analysis in the Winfree 2009. Ecology. I suggest the authors rethink these a bit.		See answer to comment 269.
Andreas Kruess	2	9	215	9	217	replace "land cover" with "land cover type"		following a restructuring of the section, the title has been now changed.

Catrin Westphal	2	9	215	11		This chapter contains a lot of important information about local (within habitat) and landscape-scale effects (landscape heterogeneity). However, I would revise the structure and the terms used in this chapter, to clearly separate effects of landscape composition or landscape configuration, habitat fragmentation and degradation and their effects on pollinator diversity and abundance.	Fahrig, L., et al. (2011). "Functional landscape heterogeneity and animal biodiversity in agricultural landscapes." Ecology Letters 14(2): 101-112.	Thanks for this comment. We have now modified the structure of the section, taking this comment into account, and including the perspective that Fahrig et al. provide in their work.
Maximilian Weigend	2	9	215	13	441	I have a feeling that it should be clearly differentiated in how far which specific land use changes pose a threat to pollinator abundance and diversity where? The text does indicate that different ecoregions are affected very differently and maybe there should be a breakdown by ecoregion: Clearing of "forests" has a dramatically different in Europe vs. the tropics and many types of agriculture may actually alter pollinator communities for the better in semi-arid (steppe or semi-desert) settings		Since this relates more to a form of land management, this is treated in the land management section.
Lennard Pisa	2	9	215	9	215	The section title is a bit weird.		following a restructuring of the section, the title has been now changed.
Lennard Pisa	2	9	215	9	215	Changes in land use ARE spatial configuration changes, integrate the 2 or leave the spatial configuration out.		following a restructuring of the section, the title has been now changed.
Colin Fontaine	2	9	215	11	335	it should be acknowledged clearly that a very large part of the current knowledge is restricted to bees (interesting exceptions are cited). Similarly, it might be good to highlight that most of the evidences comes from spatial comparisons and not time series. this would clarify the difference between chap 2 and 3.		Following this comment, we have now included a sentence close to the beginning of the section, making this point clear.

Valerie Peters	2	9	215	11	335	Changes in land use/land cover sections covering effects of fragmentation, degradation, and habitat loss- could this section have subheadings and group main findings based on either effects on pollinator diversity and abundance (e.g. extinction, diversity decline, etc) or for each effect (e.g. fragmentation, habitat loss, degradation, edge effects, isolation)? For instance the line from 309 to 312 is about habitat loss and the rest of the paragraph is about connectivity and edge effects. Often the opening sentence of the paragraph in this section does not match the examples given or the theme of the rest of the paragraph.		This is now addressed with the new structure of the section.
Liette Vasseur	2	9	217			A large part of this section is quite general and not really directly applying to pollinators. It seems just speculative.		This feeling should disappear now that the structure of the section has been reviewed and reorganized.
Martha Groom	2	6	219	6	219	Again, "Land use" as a term is used too ambiguously. Perhaps this should be "Land use leads to land cover change that can fragment and alter the area and spatial arrangement of available habitats....."		done
Leslie Firbank	2	9	219		441	This would be much more useful if we had a sense of spatial scale of fragmentation / land use change that's important. As it is, this is not really helpful to decision makers		Related to this, we now make some references to the spatial scale of fragmentation and closeness of natural habitats in order to increase/guarantee pollination and crop yield
Erik Andersson	2	9	220	9	220	"Natural habitat"? Slightly arbitrary in these days. Perhaps rather "pollinator habitat", and the quality of this habitat (?)		Based on this, the use of the word "habitat" throughout the section has been reconsidered, and we now do not use it anymore as an equivalent of natural / semin-natural environment or area. The word h'abitat' it is only used when referring to the environment(s) allowing a species survival.
Thomas Steeger	2	9	221	9	222	sentence should read "This can lead to reductions in pollinator fitness (breeding success . . ."		Done.

Martha Groom	2	6	222	6	223	The emphasis in the paragraph gets shifted to focus on dispersal and connectivity by this last mention, when reduction in total area, fragmentation and isolation impacts, as well as degradation, do not get a similar call out. It might be very helpful in this opening to include quick references for each of these phenomena - or alternatively, to drop this single more specific reference in the opening. Autmentation of the examples would likely be best, however.		Following this comment, we have now dropped the reference to dispersal from this introductory paragraph. References to this area made later in the text.
Liette Vasseur	2	9	223	9	254	"There is a high confidence in the fact..." in the fact is not needed. It makes the text just heavier.		thanks. Corrected.
Andreas Kruess	2	9	225	9	235	Figure 2.1.2 visualizes the effect of declining area not the effect of fragmentation. Although fragmentation and habitat loss are partly linked processes, they are independent to some extent. For instance, little linear area loss may result in highly fragmented habitats, whereas large loss of area (restricted on a single large habitat) will not increase the degree of fragmentation. Fragmentation will obligatory lead to increasing isolation of remaining fragments, area loss of single habitats not. Since the effects of isolation and habitat loss on species could differ (affecting dispersal/migration/metapopulation dynamics on the one hand, affecting local population size on the other hand) they should be discussed seperately.		The figure has been now modified to clarify the message. Another Figure (Figure 1) has been also added to represent more clearly the intricate relationship between the different drivers we evaluate in this section.

Shalene Jha	2	9	225	9	225	this figure is a bit confusing (it is also not 'modified' as it is identical to the figure in the paper) and I think it could be more inclusive of the material in this chapter if it was formatted for more generalizability. Specifically, I think the 'Agricultural landscapes' box could include all human-altered landscapes (e.g., both ag and urban) as the 'land use intensification' gradient works in both contexts. I think you could include the concept of spatial scale by showing three images of habitat fragmentation at three spatial scales (that could go from smaller to larger along the x-axis, as it currently stands) and still convey the concept of increasing fragmentation and % natural habitat (that could go from more fragmented and smaller habitats as you move away from the origin on the y-axis, as it currently stands).		Thanks for the suggestions. Considering this and other comments, we have now reworked the figure. See also answer to comment 286.
Les Davies	2	9	225			A picture may be worth a thousand words but the meaning of Figure 2.1.2 is not immediately obvious - a lot of words in the legend are needed to describe what it means! Therefore, is it necessary?		See answer to comment 286.
Natacha Chacoff	2	9	226	9	231	Habitat fragmentation does not increase necessarily with increasing degradation. In a highly managed habitat, intensively used, habitat fragmentation is almost zero, because remnants of natural habitats are almost absent (e.g. a soybean plantation). The size of natural habitat remnants decrease but this does not mean that habitat fragmentation increase.		Based on the new structure of the section, as well as the modification of figure 2 and the adding of a new Fig 1, we make it now clear what the are in processes related to changes in land cover composition (eg, habitat degradation) and configuration (eg, fragmentation). we think that these modifications now address this comment.
Filiberto Pollisco	2	9	226	9	231	Caption is a bit long. Can be shortened or described / referred to in the discussion text		the legend has been shortened.
Joseph Tzanopoulos	2	9	230	9	231	"Habitat fragmentation" should be replaced by "Natural/semi-natural habitat fragmentation" as this applies only if we refer to natural/semi-natural habitats		This has been reworded, also considering comment 282. See also answer to that comment.
Thomas Steeger	2	9	233	9	235	Recommend rephrasing "There is strong support for the hypothesis that . . ."		done.

Shoko Sakai	2	9	233			Selective logging can negatively affect some pollinator populations such as stingless bees by removing their potential nest sites. (Eltz, Thomas, et al. "Determinants of stingless bee nest density in lowland dipterocarp forests of Sabah, Malaysia." <i>Oecologia</i> 131.1 (2002): 27-34; Samejima, Hiromitsu, et al. "The effects of human disturbance on a stingless bee community in a tropical rainforest." <i>Biological Conservation</i> 120.4 (2004): 577-587).		Thanks a lot for the references. They have been now added to the text
Nadine Azzu	2	9	233	9	233	not sure if this is a scientific way of saying things, but I would suggest to delete "the fact"- because if there needs to be confidence in something, it implies that it is not, indeed, a fact		thanks. This has been now corrected throughout the text
Jochen Freund	2	9	233	9	254	The wording "high confidence in the fact" (used in different places in the chapter) is somewhat misleading. Facts are certain and do not require confidence. Confidence can be usefully applied to predictions, conclusions, explanations; or as worded by an IPCC supplement one can describe "confidence in the validity of findings". Such wording may be important in how the conclusions of the assessment may be received. Other locations of this wording: p47 L2212, p5 L3, p13 L433		thanks. This has been now corrected throughout the text
Thomas Steeger	2	9	237	9	238	what sort of "habitat elements" is the sentence referring?		this has been now clarified. Thanks for pointing this out.
Jan Axmacher	2	9	238	9	240	This statement raises the issue that "unimproved grasslands, such as calcareous grasslands" are in large parts at least of Western and Central Europe an anthropogenic habitat. It would therefore in my view be much more convincing to use habitats that represent a more pristine, less severely altered state of the environment to illustrate this point.		See answers to points 299 and 300.

Marina Rosales Benites de Franco	2	9	238	9	238	Please, I would like to include before "for example" the following: Conservation of natural- and semi-natural habitats in agricultural landscapes to increase and protect bee's resources may be useful to improve pollination services.	Klein, Alexandra-Maria, Bernard E Vaissière , James H Cane , Ingolf Steffan-Dewenter , Saul A Cunningham , Claire Kremen , Teja Tcharntke. "Importance of pollinators in changing landscapes". Proc. R. Soc. B (2007) 274: 303–313. Published online 27 October 2006. Web. 24 Feb 2015. <a href="http://rspb.royalsocietypublishing.org/content/royprsb/274/1608/303.full.pdf">http://rspb.royalsocietypublishing.org/content/royprsb/274/1608/303.full.pdf</a>	This comment is more pertinent to the land management section. Such information appears in that section.
Thomas Steeger	2	9	238	9	240	what is meant by "unimproved grasslands"? Do you mean "native"?		to clarify this, the wording has been changed. We now refer to "unmanaged grasslands".
Anne-Laure Jacquemart	2	9	239			not only grasslands : add heathlands, wetlands, bogs ....		Added.
Leslie Firbank	2	10	239			beebread'?		Beebread is the technical word for the pollen ball that has been packed by bees, and that is mixed with honey and other secretions and used to feed the larvae.

Diane Castle	2	9	240	9	240	<p><b>Comment</b> More could be said about the trends and factors affecting extinctions rates. Ollerton (2014) reports that in the UK the period from the late 1950s to the mid-1980s showed a slowing of the extinction rate which is not easily explained in light of continued intensification of farming and suggests that the decline can be halted. Scheper et al report that the loss of preferred host plant species is one of the main factors associated with the decline of wild bee populations in The Netherlands. Bee body size was the the other main factor, which may also point toward food limitation as a key factor driving wild bee loss</p> <p><b>Supporting references:</b>  Jeff Ollerton, Hilary Erenler, Mike Edwards and Robin Crocket (2014) Extinctions in Aculeate Pollinators in Britain and the role of large scale agricultural changes Science vol 346 issue 6215 pp. 1360-1362 DOI:10.1126/science.1257259  *Jeroen Scheper, Menno Reemer, Ruud van Kats, Wim A. Ozinga Giel T. J. van der Linden, Joop H. J. Schaminée, Henk Siepel and David Kleijn (2014) Museum specimens reveal loss of pollen host plants as key factor driving wild bee decline in The Netherlands Proc. Natl Acad. Sci. USA vol. 111 no. 49</p>		Thanks for this comment. This is now addressed more thoroughly, and the references are now included.
Liette Vasseur	2	9	242	9	245	<p>There is an issue with the first sentence. Logging modifies land cover; it does not "remove", unless for you land cover means all the time forests. The next sentence is difficult to follow. It might be beter to state:"Tree removal leads to alteration of the light regime on the gorund and this has severe impacts on plant composition. It is therefore expected that pollinators will also be affected by logging."</p>		thanks. This has been now changed accordingly. The paragraph has been now moved to the land management section.

Marina Rosales Benites de Franco	2	9	242	9	242	I suggest to include the following: ... are particular important, specially for endangered and restricted distribution tree species.		The sentence has been now modified following comment 303. Also, we here refer to the effect of logging on all species, not necessarily trees only. Also, this paragraph has been now moved into the land management section.
Richard Corlett	2	9	242	9	246	Logging' is the harvesting of timber and should not be confused with deforestation, although the two are often linked. Logged forest can usually regenerate.		The sentence has been now modified following comment 304, and the meaning has been clarified. The paragraph has been now moved to the land management section.
Timothy Schowalter	2	9	242	9	252	Forest cover removal also increases albedo; leading to local and regional warming and changes in precipitation, e.g., Foley et al. 2003. <i>Frontiers in Ecology and the Environment</i> 1: 38-44.		thanks. This has been now changed accordingly, and the reference added. The paragraph has been now moved to the land management section
Anders Nielsen	2	9	242	9	252	Should be rephrased, the text is hard to follow. Nielsen & Totland 2014 could also be cited in that they found relative plant-pollinator network stability in forest patches of contrasting logging history. Nielsen, A., and Ø. Totland. 2014. Structural properties of mutualistic networks withstand habitat degradation while species functional roles might change. <i>Oikos</i> 122:222-222		thanks. This has been now changed accordingly, and the reference added. The paragraph has been now moved to the land management section.
Anne-Laure Jacquemart	2	9	243			leads to mineralization and then strong variation in plant composition		thanks. The sentence has been now changed accordingly. The paragraph has been now moved to the land management section.

Jan Axmacher	2	9	246	9	249	We observed a significant increase in geometrid moth diversity (a moth family which is widely neglected in pollinator research, but is extremely species rich and probably also quite important as a nocturnal pollinator taxon) in logged sites on Mt Kilimanjaro in comparison to pristine mountain rainforest - see Axmacher, J.C., Tünte, H., Schrumpf, M., Müller-Hohenstein, K., Lyaruu, H.V.M. & Fiedler, K. (2004): Diverging diversity patterns of vascular plants and geometrid moths during forest regeneration on Mt. Kilimanjaro, Tanzania. - Journal of Biogeography 31, 895-904.		thanks a lot! This has been now changed accordingly, and the reference added. The paragraph has been now moved to the land management section.
Marina Rosales Benites de Franco	2	9	249	9	252	I have some question. I understand this could happen in a management forest. The opposite occurs with illegal logging.		The paragraph has been now moved to the land management section. In that section, different types of forest management are treated.
Nadine Azzu	2	9	250	9	250	"logging", or "SELECTED logging"?		In this case, we refer to logging, since these studies evaluated both clear-cuts and selection methods. The paragraph has been now moved to the land management section.
Mario V Balzan	2	9	251	9	252	"... and that the pollination service does not change at low tree removal levels and compared to the intact forests". Is this an expectation based on the abundance of pollinators from previously cited works or have studies actually measured pollination service against tree removal from forests? In this case a citation would be required.		Because those studies had suggested that the service does not change, but have not actually measured it explicitly, we have now deleted the sentence. We thank the reviewer for pointing this issue. The paragraph has been now moved to the land management section.
Mario V Balzan	2	9	254	9	255	Can this sentence be rewritten to include the importance of plant species and functional diversity?		Done.

Mario V Balzan	2	9	254	9	261	<p>the approach adopted here appears to ignore resources in the 'agricultural matrix' (refer to Dennis, R.L.H. &amp; Hardy, P.B., 2006. Support for mending the matrix: resource seeking by butterflies in apparent non-resource zones. <i>Journal of Insect Conservation</i>, 11(2), pp.157–168; Dennis, R.L.H., Shreeve, T.G. &amp; Sheppard, D.A., 2007. <i>Species Conservation and Landscape Management: A Habitat Perspective</i>. In A. J. . Stewart, T. R. New, &amp; O. T. Lewis, eds. <i>Insect Conservation Biology</i>. Wallingford: CABI Publishing, pp. 92–126.) A number of studies have demonstrated that flowering resources in agricultural landscapes can enhance the invertebrate and pollinator diversity (E.g. Balzan, M. V., Bocci, G. &amp; Moonen, A.-C., 2014. Augmenting flower trait diversity in wildflower strips to optimise the conservation of arthropod functional groups for multiple agroecosystem services. <i>Journal of Insect Conservation</i>.</p> <p>Campbell, A.J. et al., 2012. Realising multiple ecosystem services based on the response of three beneficial insect groups to floral traits and trait diversity. <i>Basic and Applied Ecology</i>, 13, pp.363–370.</p> <p>Carrié, R.J.G., George, D.R. &amp; Wäckers, F.L., 2012. Selection of floral resources to optimise conservation of agriculturally-functional insect groups. <i>Journal of Insect Conservation</i>, 16(4), pp.635–640.).</p>		Done, following the CLAs' and Res' recommendations.
Thomas Steeger	2	9	254	9	256	Recommend rephrasing "There is strong support fot the hypothesis . . ."		thanks. This has been now changed accordingly.
Erik Andersson	2	9	254	9	254	Prehaps "resource rich" instead of "natural"? Connecting to what is written on L412 to L423.		Modified.
Nadine Azzu	2	9	254	9	254	suggest to delete "the fact"- because if there needs to be confidence in something, it implies that it is not, indeed, a fact		thanks. This has been now changed accordingly.
Dan Cariveau	2	9	254	9	254	The authors should mention the work of Kleijn here. Seems very relevant.		Reference added.

Natalia Escobedo	2	9	258	9	261	Recently we carried on a modest study in a highly heterogeneous mosaic of agricultural area, forest remains and urbanized land of Guatemalan highlands, and our results were also similar to what is said in this paragraph. We addressed landscape configuration, not distance from natural areas, since we were working with a composition of rather small landscape elements. It called to my attention that the mentioned studies were made in grasslands, probably because a highly heterogeneous landscape configuration is less often observed in agricultural lands in developed countries? I'm including this observation just in case this variation to what was addressed in the cited studies has not been reviewed yet.	See Escobedo et al., 2014. <a href="http://www.digi.usac.edu.gt/ojsrevistas/index.php/cytes/article/view/1/30">http://www.digi.usac.edu.gt/ojsrevistas/index.php/cytes/article/view/1/30</a>	We thank for the reference. However, since we have access to many reviews on this topic, and because we give priority to reviews over individual studies, we have decided to not add this citation. Thnaks, though.
Yann Clough	2	9	260	9	261	see also Clough et al. 2014 Ecol Lett for positive effects of grassland cover in the surrounding landscape on bee abundance and species richness in focal grasslands		the reference has been now added.
Marina Rosales Benites de Franco	2	9	261	9	261	I suggest to include after "richness": Tropical crops pollinated primarily by social bees may therefore be most susceptible to pollination failure from habitat loss. Quantifying these general relationships can help predict consequences of land use change on pollinator communities and crop productivity, and can inform landscape conservation efforts that balance the needs of native species and people.	Ricketts et al., 2008. (Line 649 - 651 of document)	The section has been now restructured, as an attempt to clarify how these different aspects relate to changes in land cover and land use.
Jochen Fruend	2	9	263	10	276	Related to above comment about the definition of fragmentation, other places also suffer from a vague concept of what is a habitat, and whether the focus of this report is pollination of crops or pollination of wild plants in (semi-) natural habitats. I have given an example where this should be improved by the line references.		thanks. The sentence has been now changed accordingly.
Dan Cariveau	2	9	263	9	276	This paragraph is confusing as it conflates degree of land-use change with "landscape" configuration metrics.		The paragraph has been reworded in order to independently address the different configuration metrics, and clarify their relationship with levels of land use.

Valerie Peters	2	9	263	10	276	Diversity is general term that could mean number of species or various evenness measures, or functional group diversity...in this section it is unclear what is being compared with diversity vs. evenness (L265) or where diversity, richness and evenness (L264) are listed as separate measures?		The sentences have been now reworded to clarify the messages. Also, note that these three concepts will be defined in the glossary.
Nadine Azzu	2	9	264	9	264	"continental scale analysis"- which continent?		this has been now clarified. Thanks for pointing this out.
Jana Vamosi	2	9	265			define "evenness"		Done in the first mention. Also, this term will appear in the glossary.
Dan Cariveau	2	9	266	9	267	I don't think Winfree et al 2011 states this or it is a very minor point. Also it isn't a meta-analysis.		See answer to point 328
Valerie Peters	2	10	269	10	269	the text here...with negative effects being most pronounced... is redundant with rest of sentence, should there be some threshold here instead?		That part of the sentence has been now deleted and the sentence reworded.
Valerie Peters	2	10	271	10	275	Paragraph here relates to connectivity and patch size and this review is effects of habitat loss? If the review is on habitat loss maybe move to a different section		the review conflates measures of habitat configuration and composition. Because we still consider that this review provides useful information, we have decided to still refer in the text, but clarify that point. The paragraph has been modified accordingly.
Thomas Steeger	2	10	273	10	273	sentence should read "..., with bees being the most negatively . . ."		Done.
Mario Marcos Espirito	2	10	274	10	275	Is there an explanation for vertebrates being less affected? Usually is the other way around.		The authors suggest that this can be due to differences in dispersion abilities or a bias in the datasets used. This has been now stated in the text
Penelope Whitehorn	2	10	274	10	274	Larger vertebrate pollinators' This is pretty much the only mention of larger vertebrate pollinators in this chapter - the rest of the chapter focusses on invertebrates. Some definition of which pollinators are being reviewed is needed at the beginning of the chapter to avoid confusion		See answer to comment 277.

Arathi Seshadri	2	10	275	10	282	Table 2.1.2. presented as it is now may be misleading. It may be nice to see the results presented as proportion of studies that are Negative, neutral and Positive with the actual numbers in parenthesis.		Taking this comment into consideration, the table has been now modified.
Anne-Laure Jacquemart	2	10	276			add behaviour change		we do not understand what the reviewer refers to with this comment.
Natacha Chacoff	2	10	279	10	280	Please indicate if the number includes reviews or meta analysis studies		these include only experimental studies. This is now stated in the figure legend.
Madeleine Chagnon	2	20	279	20	279	monoculture systems		we do not understand what the reviewer means with this comment.
Andreas Obrecht	2	10	283	10	284	I think this delay is very important to mention in the executive summary		Done.
Valerie Peters	2	10	283	10	305	Burkle et al. 2013. Plant-pollinator interactions over 120 years: loss of species, co-occurrence, and function. Science 339:1611-1615 found that rare and specialist bees, bees of higher trophic levels and cavity nesters were more sensitive to land use change		The study is now cited where we talk about how pollination networks are expected to change.

Marina Rosales Benites de Franco	2	10	284	10	284	I suggest to include the following: Fragmentation and degradation of near- and semi-natural habitats can be detrimental to bee communities.	Rathcke & Jules 1994; Kremen et al. 2002, 2004; Steffan-Dewenter et al. 2002, 2006; Larsen et al. 2005; Cane et al. 2006) In: Klein, Alexandra-Maria, Bernard E Vaissière, James H Cane, Ingolf Steffan-Dewenter, Saul A Cunningham, Claire Kremen, Teja Tscharntke. "Importance of pollinators in changing landscapes". Proc. R. Soc. B (2007) 274: 303–313. Published online 27 October 2006. Web. 24 Feb 2015. <a href="http://rspb.royalsocietypublishing.org/content/rspbs/274/1608/303.full.pdf">http://rspb.royalsocietypublishing.org/content/rspbs/274/1608/303.full.pdf</a>	Thanks for the comment and suggestion. Because the general structure of the section has been modified in order to separate measures of land cover composition and configuration, these references are thus cited in different parts of the text.
Thomas Steeger	2	10	285	10	285	replace "responding" with "declining"		changed.
Nadine Azzu	2	10	285	10	285	"responding faster"- as in, beoming extinct faster? So...negatively responding faster?		see point 340.
Mario Marcos Espirito	2	10	286	10	286	The term "eco-evolutionary" is weird. Using life-history traits (and removing life-history from the parentheses) would be better. Mobility and size are life-history traits, for example.		Thanks for this comment. We have now replaced "eco-evolutionary" by ecological and morphological traits, what to our opinion reflects more explicitly what we refer to here.
Thomas Steeger	2	10	292	10	293	"Weiner et al., 2014); however, there are exceptions (Bonmarco et al., 2010). It has been shown . . .		thanks for this suggestion. This has been changed accordingly.

Andreas Obrecht	2	10	292	10	293	land use intensification?		thanks for this suggestion. This has been now changed accordingly.
May Berenbaum	2	10	293	10	293	Other references demonstrating land-use effects on nutritional suitability of bee diet include G. DiPasquale, M. Salignon, Y. LeConte, L.P. Belzunces, A. Decourtye, A. Kretzschmar, S. Suchail, J.-L. Brunet and C. Alaux, "Influence of pollen nutrition on honey bee health: do pollen quality and diversity matter?," PLoS ONE 8 (8) (2010): e72016 (antioxidant content of pollen) and M. Girard, M Chagnon, V Fournier, 2012. Pollen diversity collected by honey bees in the vicinity of Vaccinium spp. crops and its importance for colony development. Botany 90: 545-555		Thanks for the references. They have been now integrated in the text.
Matthew Heard	2		293			unclear why Apis example here?		Thanks. we have now modified the sentence to render the link with the context clearer.
Marina Rosales Benites de Franco	2	10	295	10	295	I suggest to include before "This is because": It can expect declines, on average, in pollinators and crop pollination if further land use change increases the isolation of farms from natural habitat. These declines can be counteracted by conserving areas of natural or semi-natural habitat near farms, by managing farms themselves to support pollinators, or by adding managed pollinators to the landscape.	Ricketts et al., 2008. (Line 649 - 651 of document)	Thanks for this comment. It is the aim of this chapter to address drivers of change in pollinators and pollination services. Chapter 6 addresses these points and recommends actions, if necessary.
Martha Groom	2	10	297	10	297	Wording here could affect meaning - I believe the intention of those authors is to say "however exploited zones may still harbour..."		Based on this comment, we have reworded the sentence. It now reads: "This is because natural habitats are richer in nesting resources for above ground nesters (e.g., stems of perennial vegetation or dead wood) than degraded areas; whereas exploited zones still harbour suitable patches of undisturbed soil available to below-ground nesters (e.g., field margins; Roulston and Goodell, 2011)."

Andreas Kruess	2	10	300	10	305	There may also be a correlation between sociality and body size		Indeed. Dispersal ability is correlated with size. We mention this just before pointing the effect of sociality. Also, we already mention that there is variation within social groups, which is related to dispersal abilities. However, to make this more explicit, we have now clearly linked dispersal, size and foraging in the last sentence of this paragraph.
May Berenbaum	2	10	302	10	303	Does the statement that social insects are more sensitive to distances between patches of floral resources to honey bees?		we do not understand what the reviewer means with this comment.
G�rard Arnold	2		302		302	L 302. 'Since social insects are tied to a colony, they tend to be more sensitive than solitary pollinators to the distance between patches of floral resources'. This sentence seems somewhat understandable since the social bees such as the honeybee has a large foraging distance, up to several kilometers from their hive. See, for example EFSA, 2012: 'Concerning the foraging distance of the honey bee, it has been shown that, in natural conditions, it can vary between some hundreds of meters until 10 km or more from the hive depending on the available forage (von Frisch, 1987). Bees have been shown to collect nectar up to 13.5 km from their colonies (Eckert, 1933). The foraging distance varies depending on the environment, the colony strength, the needs, the genetics of the colony, etc. Several scientific publications (Visscher and Seeley, 1982; Beekman and Ratnieks, 2000; Steffan-Dewenter and Kuhn, 2003) have presented results on the mean, median and maximum foraging distances, respectively: • median distance: 1.6 km, 6.1 km and 1.2 km;• mean distance: 2.2 km, 5.5 km and 1.5 km;• maximum distance: 10.9 km, 12 km and 10.0 km.		Thnaks for the comment.
Matthew Heard	2		302			see Carvell Oikos 2011		Thanks. the reference has been now added.

Catrin Westphal	2	10	307	10	309	For instance, the first sentences of this section deals with spatial arrangement of habitats at landscape-scale, but then refers to within habitat heterogeneity, as far as I understand this sentence. Here I would refer to the landscape diversity (i.e. compositional aspect) and to the regional species pool (see Tschardt et al 2005, Tschardt et al. 2012).	Tschardt, T., et al. (2005). "Landscape perspectives on agricultural intensification and biodiversity - ecosystem service management." Ecology Letters 8(8): 857-874.; Tschardt, T., et al. (2012). "Landscape moderation of biodiversity patterns and processes - eight hypotheses." Biological Reviews 87(3): 661-685.	This has been now addressed through the new structure of the section.
Julia Astegiano	2	10	307	10	316	How the loss of more specialized pollinators may affect plant diversity? See for example results about plant dispersal ability and pollinator specialization in Astegiano et al. 2015, and discussion about plant diversity and pollinator specialization in Ebeling et al. 2011. Full references: (1) Astegiano J, Massol F, Vidal MM, Cheptou P-O, Guimarães PR Jr. (2015) The Robustness of Plant-Pollinator Assemblages: Linking Plant Interaction Patterns and Sensitivity to Pollinator Loss. PLoS ONE 10(2): e0117243; (2) Ebeling, A., Klein, A. M., & Tschardt, T. (2011). Plant-flower visitor interaction webs: temporal stability and pollinator specialization increases along an experimental plant diversity gradient. Basic and Applied Ecology, 12(4), 300-309.		Thnaks for this comment. This point has been now further developed in the text, and some of the references included.

Dan Cariveau	2	10	307	10	316	This paragraph could be a bit more focused. I would state in the topic sentence that this is about edge effects. Also, the second two sentences are simply about land use and not really spatial arrangement.		Based on the new structure of the section, this paragraph has now been moved into the part of the text that evaluates how land cover composition affect pollinators. We think that such a modification addresses the reviewer point.
Leo Galetto	2	10	307	11	328	I think this is an excellent synthesis and I can understand perfectly (as ecologist). Nevertheless, it is assumed that many of the complex concepts presented here can be understood by a general reader. My suggestion is to simplify the paragraph or/and to explain some of the concepts (for example, "spatial arrangement of habitats", "community processes that shape diversity", "levels of land disturbance", "habitat heterogeneity", "available niches", "homogenization of pollinator communities", "edge effects", "habitat interiors". "keystone species", "network modelling").		
Valerie Peters	2	10	309	10	312	Another citation to support this finding is Burkle et al. 2013. Plant-pollinator interactions over 120 years: loss of species, co-occurrence, and function. Science 339:1611-1615.		Thanks. the reference has been now added.
Liette Vasseur	2	10	310	10	312	generalists versus specialists. There is a need here to introduce the concept/hypothesis that increased disturbance leads to increase in generalists (if this is what you are really trying to bring here). There are good studies on this but it is also debated. this should be clear here. it seems we are too much assuming (unless it is in another chapter and at that point it would be good to refer to it).		

Colin Fontaine	2	10	312	10	313	Biesmeijer et al. 2006 and Carvaheiro et al. 2013 do not relate directly their results to habitat modification. These references are more appropriate in chap 3		Biesmeijer et al. suggest that specialist species are more sensitive than generalist to habitat changes. From this perspective, we consider that this reference is appropriate to justify that idea. The case of Carvalheiro et al is different, since they explicitly compare temporal datasets based on level of land use intensification. For these reasons, we have decided to keep these references here.
Mario Marcos Espirito	2	10	312	10	316	It seems that habitat edges as referred here are in fact "ecotones". Edge effects usually refer to the border of a natural ecosystem and an anthropogenic habits, such as a road or a plantation. Edge effects are usually detrimental to species diversity.		Thanks for the comment. The definition used here follows the one given by Reis et al., 2004 ("Edges are generally defined as boundaries between distinct patch types") This definition encompasses anthropogenic habitats, and for that reason we have decided to include it here. Because the concepts of ecotone and edge effect are related, we have now included the term "ecotone" when we refer to transitional zones that contain objects from differnt habitats.
Liette Vasseur	2	10	313	10	316	First, add a . After "crop field). Then for the sentence "Because edges..." you will need more references. While this is true for some species like plants and birds, pollinators may differ depending on the types of plants. At this point, this is not convincing		We have now clarified that Ries is a review, and thus include many studies. We have also modified the sentence according to the suggestion
Anne-Laure Jacquemart	2	10	313			you can add Somme, L., Mayer, C. & Jacquemart, A.-L. 2014 Multilevel spatial structure impacts on the pollination services of, Comarum palustre (Rosaceae). PLoS One, 9 (6) : e99295, 1-10. Doi: 10.1371/journal.pone.0099295.		thanks for the reference. It has been added.

Luisa Carvalheiro	2	10	318	10	328	other references would be appropriate in this section: Evans et al. Ecology Letters, (2013) 16: 844–852; Memmott et al. Proc. R. Soc. Lond. B (2004) 271, 2605–2611; Lever et al Ecology Letters, (2014) 17: 350–359		Thanks for the references. Some of them have been now added to the text.
Julia Astegiano	2	10	318	11	328	I suggest the inclusion of a figure describing a bipartite plant-pollinator network (by using a graph or a matrix) and the information we can obtain about the organization of interactions at species and assemblage level by using this approach. Results from the network approach are highlighted in main texts throughout chapters 1-3 but we do not see figures showing its potential to describe the organization and dynamics of plant-pollinator or pollinator-different antagonists interactions.		this type of information appears already in Chapters 1 and 3. A reference to those chapters is now made.
Jochen Freund	2	10	318	11	328	This paragraph presents several mostly unrelated findings. First, nestedness in pollination networks may often be explained by sampling effects and its effect on stability is uncertain. Second and more importantly, if pollination webs are truly nested, there is no evidence why the structurally important generalist species should be more sensitive to fragmentation and how this should be related to meta-population and meta-community patterns.		the paragraphs dealing with networks have been now reworded and the supporting references enriched.
Valerie Peters	2	10	318	10	319	Maybe change to...Small, isolated habitat fragments show a disproportionate risk of loss of keystone or important species compared to larger and more connected habitat patches due to smaller population sizes?		thanks. Changed accordingly.
Laura Burkle	2	10	318	11	328	for empirical examples of habitat loss (habitat size) on plant pollinator interactions, see Sabatino et al. 2010 (Direct effects of habitat area on interaction diversity in pollination webs. Ecological Applications 20:1491–1497), and Burkle and Knight 2012 (Shifts in pollinator composition and behavior cause slow interaction accumulation with area in plant-pollinator networks. Ecology 93: 2329-2335)		Thanks for the references. They have been now integrated in the text.
Luisa Carvalheiro	2	10	319	10	319	suggestion: replace 'disappearance' by 'local extinction'		the sentence has been now modified following comment 366.

Thomas Steeger	2	10	319	10	319	define term of art: keystone species		this term has been now added to the glossary.
Anna Traveset	2	10	321	10	322	Pollination networks tend to be modular too, a structure that provides them with stability to certain type of disturbances like the spread of a disease.		This idea has been added to the text.
Valerie Peters	2	10	321	11	328	Burkle et al. 2013 Plant-pollinator interactions over 120 years: loss of species, co-occurrence, and function. Science 339:1611-1615, can lend support here		Thanks. the reference has been now added.
Ignasi Bartomeus	2	10	322	10	322	The work linking "Nestedness" to stability is mainly theoretical. This theory is sound, but usually rely on untested assumptions. Hence I would say "nestedness is predicted to increase stability"		thanks. The sentence has been now changed accordingly.
Ignasi Bartomeus	2	10	323	10	324	This argument doesn't follow the previous sentence. As far as I am concern, Nestedness is not directly related to meta-communities.		Taking this into account, we have now reworded this paragraph. The paragraph dealing with networks has been in fact been largely modified in the new version.
Mario Marcos Espirito	2	11	324	11	325	This sentence can be improved. I suggest the following: "...survival of communities due to increased redundancy and decreased probability of keystone..."		thanks. The sentence has been now changed accordingly.
Joseph Tzanopoulos	2	11	327	11	327	".....comes from network modelling (e.g Memmott et al., 2004)..." authors can also add here "...and modelling of network plasticity (Petanidou, T., Kallimanis, AS., Tzanopoulos, J., Sgardelis, S., Pantis, JD. (2008) Long-term observation of a pollination network: fluctuation in species and interactions, relative invariance of network structure and implications for estimates of specialization. Ecology Letters, 11 (6). pp. 564-575)		thanks. The sentence has been now changed accordingly.

Thomas Steeger	2	11	327	11	328	by "experimental approaches" do you mean "empirical data showing actual extinctions"? Are these extinctions or extirpations?		Thanks for the suggestion. Based on this comment, we have now rephrased the sentence. In this part of the text, it was our aim to mention that most network approaches in the framework of pollination are mostly modelling approaches, while there is not a lot of data obtained from experimental approaches. This means that what is stated in the previous sentences referes mainly to expectations based on models, which need in the future to be confirmed with actual data.
Anders Nielsen	2	11	327	11	327	Mor references should be added		Done. See for example, answers to comments 371 or 375.
Marina Rosales Benites de Franco	2	11	330	11	330	I strongly agree.		thanks!
David Evans	2	11	330	11	330	Poor sentence construction - do you mean "Both the size OF THE patches and their low connectivity"?		thanks. The sentence has been now changed accordingly.
Valerie Peters	2	11	330	11	335	With specialists at higher risk compared to generalists- Packer at al. 2005. Conservation genetics of potentially endangered mutualisms: reduced levels of genetic variation in specialist versus generalist bees. Conservation Biology 19: 195-202.		thanks. The sentence has been now changed accordingly and the suggested reference added.
Marina Rosales Benites de Franco	2	11	331	11	331	... associated with reduced and lost genetic diversity.		We thank the reviewer for the comment. However, we think that the suggested change is redundant. For that reason, we have decided to keep the original text.

Catrin Westphal	2	11	337	12		In this chapter the term landscape heterogeneity again refers to different aspects of landscape composition and configuration. I suggest to differentiate between these two aspects, since they affect pollinator communities and their natural enemies differently (e.g. Steckel et al. 2014) and therewith also pollinations services (see different effects of distance to semi-natural habitats and proportions of semi-natural habitats; see references in this chapter)	Steckel, J., et al. (2014). "Landscape composition and configuration differently affect trap-nesting bees, wasps and their antagonists." <i>Biological Conservation</i> 172(0): 56-64.	Covered by the new structure, main terms defined in the glossary.
Yann Clough	2	11	337	12	377	Section 2.1.2.2. omits the effects of pollinators on wild plant communities. A meta-analysis has shown that habitat fragmentation reduces plant reproductive success via decreased animal pollination (Aguilar et al. 2006 <i>Ecol Lett</i> ). A European analysis has shown that low grassland cover in the landscape is associated with low relative cover of pollinator-dependent plants (Clough et al. 2014 <i>Ecol Lett</i> )		thanks for the comment. We have now expanded the discussion on pollination services of wild plants, and the references proposed appear now in the text.
Colin Fontaine	2	11	337	11	340	the first two lines of the section refer to pollination service to wild plant but the rest of the section only provide information about crop pollination. If the authors want to stick to crop pollination here, maybe changing "pollination service" to "crop pollination" in the title would make things clearer. otherwise some text and reference to the effect of land use changes on wild plant pollination would be welcome (some can be found in the habitat fragmentation section of Wilcock & Neiland (2002). <i>Pollination failure in plants: why it happens and when it matters. Trends in plant science</i> , 7(6), 270-277.		thanks for the comment. Pollination of wild plants is now covered more fully. See also answer to comment 391.
Jeff Ollerton	2	11	339	11	340	Wild plants also have "considerable economic value", e.g. as food and non-food products, as contributors to ecosystem services such as carbon sequestration, etc.		This point has been clarified and some examples of different types of pollination services have been now added.
David Evans	2	11	339	11	339	to insect-dependent wild plants and agricultural crops		thanks. The sentence has been now changed accordingly.
Anders Nielsen	2	11	339	11	340	Remove the sentence		Done.

Valerie Peters	2	11	339	12	377	Add in pollen limitation and loss of genetic diversity for wild plants in fragmented landscapes? Volpe et al. 2014. Functional connectivity experiments reflect routine movement behavior of a tropical hummingbird species. Ecological Applications 24: 2122-2131; Fuchs et al. 2003. Effects of forest fragmentation and flowering phenology on the reproductive success and mating patterns of the tropical dry forest tree Pachira quinata. Conservation Biology 17:149-157		Thanks for the comment. Following a restructuring of the section, this is now mentioned elsewhere in the text. The proposed references were not included, since they do not concern studies of pollinator-mediated pollination, but instead of other measures of pollination limitation and genetic isolation that can or not be due to pollinator shifts.
Ignasi Bartomeus	2	11	342	11	342	“heterogeneity in landscape” is vague. I would use the exact metric the studies test (e.g. distance to natural habitats)		We now followed this recommendation and this expression has been now changed into the more precise idea that is communicated in each particular mention
Colin Fontaine	2	11	342	11	377	it should be acknowledged clearly that a very large part of the current knowledge is restricted to bees		See answer to comment 277.

Leo Galetto	2	11	342	11	373	I agree with the factor discussed here to explain the differences among studies. Nevertheless, other factors not considered here can be also responsible for the variability of crop yield responses. In my opinion, is not easy to relate “pollinator richness” or “pollination” with “crop yield” because many processes are involved (see also the Conclusion section). My specific suggestion here is to clarify the assumptions for the general reader. My general suggestion for Chapter 1 was: 1.2. Pollination and Plant mating systems. What is pollination? I can easily follow the introduction presented in this introductory chapter and I can understand (as pollinator biologist) the differences between different biological processes (as pollination, fertilization, fruit and seed maturation, and plant (crop) yield) without details. Moreover, I can recognize the implicit assumptions, for example, between the “pollination” process and final “crop yield”. Nevertheless, my suggestion is to present to the general reader (e.g., stakeholders, producers, economists, etc.): (a) a clear explanation for each of these biological processes separately, (b) a graphical model show the links between them, (c) the implications (direct or indirect, according to each of these processes) of pollinators for each process, (d) other constraints (briefly) for each of these processes. In my opinion, a clear general context for biological processes allows, for example, a better link between pollination and crop yield. For example, this link is frequently mentioned throughout the entire assessment linking “naturally” pollinators with crop yields. It is possible to present this link, but many factors and constraints (in addition to pollinators and pollination) are affecting final crop yields and, in general, are not discussed in the different chapters. In summary, in my opinion, if all these processes and constraints are		A cross-reference to Chapter 1 has been now added.
Ignasi Bartomeus	2	11	344	11	344	The references refer only to crops, hence I would remove the mention to wild plants (or add references relating to non-crop plants)		We have now included more data on wild plants. For that reason, we keep referring to both crops and wild plants.
Anders Nielsen	2	11	346	11	351	Very long sentence containing too much detail		the sentences have been now shortened.

Natacha Chacoff	2	11	347	11	347	please delete "strong" from this tense. What is a strong exponential decay? Strong evidence of an exponential decay		thanks. The sentence has been now changed accordingly.
Andreas Kruess	2	11	350	11	352	The results of Klein et al. (2002) may be affected by other important pollinators (Diptera, Lepidoptera)		We do not understand what the comment refers to. Sorry.
Thomas Steeger	2	11	350	11	350	terminology such as "slightly more steeply" is vague; unless the difference was demonstrated to be statistically significant, the effect should not be noted. If it was statistically significant, then that should be stated.		
Maj Rundlöf	2	11	351	11	352	The lack of relation between distance to natural/semi-natural habitat and fruit/seed set may also be explained by sufficient pollination by the visitation rate even at the most distant sites (rather than supplemental pollination by managed honey bees). This could be mentioned as an alternative explanation.		thanks. The sentence has been now changed accordingly and now this other option appers in the text.
Thomas Steeger	2	11	355	11	355	delete "insufficient"		thanks. The sentence has been now changed accordingly.
Thomas Steeger	2	11	356	11	359	rephrase "... in all crops evaluated, similar to what had also . . . "		thanks. The sentence has been now changed accordingly.
Shalene Jha	2	11	356	11	359	in my recollection, the Garibaldi study does not look at distance from natural habitat -- which is what this sentence suggests -- the Klein citation is correct, but I think the rest of the sentence needs to be reworded		
David Evans	2	11	358	11	359	Very poorly constructed end to that sentence "as had previously been identified as a trend etc"		thanks. The sentence has been now changed accordingly.
Shalene Jha	2	11	359	11	360	This sentence is confusing -- I think the authors mean to say that the result held 'regardless' of honey bee presence.		thanks. The sentence has been now changed accordingly.
Thomas Steeger	2	11	360	11	362	One "possible" reason . . .		thanks. The sentence has been now changed accordingly.
Thomas Steeger	2	11	364	11	365	provide a "range of values" for what? Do you mean a range of values for what may be the minimum proportion of natural habitat necessary to maximize fruit set?		thanks. The sentence has been now changed accordingly.
Shalene Jha	2	11	364	11	366	this sentence needs reiteration that the % values are % natural habitat		see answer to comment 404.
Luisa Carvalheiro	2	11	365	11	365	indicate if these percentages refer to similar spatial scales (e.g. within a 2km radius?) and can therefore be compared		Following this comment, this has been now stated in the text,
Liette Vasseur	2	11	368			why "land scape" instead of landscape like in the rest of the text?		thanks. The sentence has been now changed accordingly.

Liette Vasseur	2	11	368	11	370	I would rework the sentence to integrate the footnote. The current sentence is difficult to understand. Do you mean the pollinators move away from original habitat? If so, when and why?		thanks. This and the following sentences have been now changed accordingly, and the footnote removed. See also answer to <a href="#">comment 415</a>
Lennard Pisa	2	11	368	11	369	Strange sentence, I see what you mean but can you write it more clearly?		see answer to <a href="#">comment 408</a> and <a href="#">415</a> .
Shalene Jha	2	11	368	12	377	I don't the distinction is clear here between 'spillover' and the decreasing pollinator diversity effects with increasing distance to natural habitat, described in pg 11 line 346		The term has been now explicitly defined and further explained, in order to make the distinction clear <a href="#">to the reader</a> .
Mario Marcos Espirito	2	11	368	11	377	I did not understand this part on spillovers very clearly. It is stated that they are spilling from crops to natural habitats. I believe this can only be true for managed pollinators. For wild pollinators, it would be the reverse direction. So spillovers are negative or positive?		The paragraph has been further developed in order to make clear that spill-over occurs both in crop and wild environments, and that it can be bidirectional.
Maj Rundlöf	2	11	368	11	368	The term "spill-over" can have many different meanings and could easily be replaced by the actual meaning, here by "...through pollinator movement between habitats".		see answer to <a href="#">comments 408</a> and <a href="#">410</a> .
David Evans	2	11	369	11	370	"but in that towards it moves" Terrible sentence.		see answer to <a href="#">comment 415</a> .
Scott Black	2	11	369	11	369	Revise end of sentence as it does not make sense.		see answer to <a href="#">comment 415</a> .
Thomas Steeger	2	11	369	11	369	". . .but rather towards which it moves"		Thanks a lot for the recommendation. The sentence has been now changed accordingly.
Mercy Gichora	2	11	371	11	371	Insert the word 'which' so that the sentence will read 'but that towards which it moves..'		Thanks! The sentence has been now changed accordingly.
Marina Rosales Benites de Franco	2	11	371	11	371	I suggest include "after": many tropical regions as high mountain.		We do not understand what the reviewer is referring to here.
Thomas Steeger	2	11	371	11	371	"there is a relatively high proportion"		Thanks. The sentence has been now changed accordingly.
Jana Vamosi	2	12	374	12	377	I would suggest some consideration of traits here. What habitat traits do pollinators require - in the land, in their floral resources? What traits of plants determine the relationship with pollinator diversity? Some have found no relationship w/diversity		For the moment, we refer to pollinator traits only. This will be added in a future revision.

Andreas Kruess	2	12	379	12	423	<p>The outcome of comparing urban and surrounding natural habitats greatly depends on the specific characteristics of urban areas (great differences of e.g. plant species richness and abundance between large cities and rural towns or villages) and surrounding landscape (ranging from near-natural to monotonous and intensively used). Time-scale is also important since some urban region will function as refuges for species suffering from intensification of formerly near-natural agricultural landscape. The long-term persistence, especially for specialised species, in urban areas is still unclear.</p>		<p>We agree that the outcome of comparing urban and surrounding habitats will vary depending on many factors and several of the points raised by the reviewer were covered in lines 428-431. However space limits the ability to discuss these points at length in this section. We have moved lines 428-431 to the third paragraph of the section so that these points are made more explicitly at an earlier stage. We have also added information about a recently published study (Baldock et al. 2015) which controlled for variation in urban and rural habitats. We agree that there have been no long-term studies of pollinators in urban areas and highlight this as a knowledge gap in a new final paragraph.</p>
Liette Vasseur	2	12	379			<p>I am surprised to not read anything about herbicide and pesticide as they are used a lot, except for some cities that have banned the use of cosmetic herbicides.</p>		<p>There are few studies that examine the effect of pesticides and herbicides on pollinators in urban areas. We have referenced the one study we knew of at the time of writing (Larson et al. 2013, L417) and have added a recently published study: Muratet &amp; Fontaine (2015).</p>

David Evans	2	12	379	13	433	Your discussion of urbanisation on pollination could also usefully comment on reports that there is a shortage of forage for urban (managed) beekeepers in many cities. This might be apocryphal, but the increase in interest in urban beekeeping is likely putting pressure on other pollinators, which may be exacerbated by a shortage of forage.		Although this may be widely accepted by beekeepers we would prefer to include information that can be backed up by the scientific literature. We also know of apocryphal reports of there being increased forage for honeybees in urban areas. Since the reports cannot be backed up by scientific evidence and opinions differ we will not add further information related to this comment.
Anders Nielsen	2	12	379	13	433	Urbanisation is a good example here but I believe the major effects on pollinators are operating in agricultural settings. I suggest including an example from agriculture, in addition.		The new structure of the chapter now considers urban management and urban habitats as part of the land management section. We think that this will balance the information about the different habitats and will thus improve the text.
Shoko Sakai	2	12	379			Most studies on effects of urbanization has been conducted in Europe, but studies in Asia, where largest megacities are presents, is relatively rare. One important exception may be Ushimaru et al. (Ushimaru, Atushi, and Kihachiro Kikuzawa. "Variation of breeding system, floral rewards, and reproductive success in clonal Calystegia species (Convolvulaceae)." American Journal of Botany 86.3 (1999): 436-446.) conducted in Osaka, Japan. It reports decreased pollination success in a self-compatible plant associated with decrease of pollinator visits, as well as changes of reproductive characteristics of plants.		Ushimaru et al. is not designed to test the effect of urbanisation on pollinators/pollination so we have not included it in the text. We agree with the reviewer that there is a research bias on this topic towards northern temperate cities and have added text to the final paragraph to acknowledge this key knowledge gap in urban pollinator research.
Dan Cariveau	2	12	379	13	433	Great to include urbanization! Nice section. However, is it really a case study?		Because what the reviewer suggests is probably true, ew have now moved this box into a new section within the land management section. See also answe to point 423.

Leo Galetto	2	12	379	12	433	My suggestion is to delete (or change) this example because it contains contradictory results and no clear effects can be appreciated (some sentences within this section that support the comment are: "The effect of urbanisation can vary between taxa... Little is known about pollinator efficiency of crops or wild plants in urban areas, although Leong et al. (2014) suggest that reduced seed set in urban areas relative to natural areas could be due to reduced pollinator efficiency caused by higher plant species richness in urban habitats... Studies have shown both positive and negative impacts of urbanisation on pollinators, although it is difficult to properly ascertain the effect of urbanisation on pollinators as no study has compared multiple replicate urban and non-urban habitats... To fully understand urban ecosystems, and residential landscapes in particular, requires an interdisciplinary approach that examines the link between social drivers and ecological outcomes across scales").		We disagree with the reviewer's comments in that even if there is no clear effect of urbanisation it is valid to report the evidence that exists and point out where gaps in the knowledge exist. We can't see any reason to change the indicated sentences and are not clear what the reviewer means by highlighting these sentences.
Erik Andersson	2	12	381	12	391	See also Andersson, E., Barthel, S., and Ahrné, K. (2007). Measuring social-ecological dynamics behind the generation of ecosystem services. <i>Ecol. Appl.</i> 17, 1267–1278.		This is a nice study comparing three urban green spaces (allotments, cemeteries, parks) in Stockholm in terms of various ecosystem services, of which bumblebee abundance is one service. Its focus is on management and it's underlying social drivers so it is not appropriate for inclusion in this section in its current form.
Anne-Laure Jacquemart	2	12	384			add street trees as important floral resources		We don't know of any references that specifically mention street trees as important floral resources so have not added this point to the text.

Arathi Seshadri	2	12	386	12	404	These paragraphs describing the change in species diversity with urbanization for different groups of pollinators is less impactful when presented as a text. A Table depicting the different directions of change for the different pollinator groups would get the message across in a much more powerful manner		We agree that a table would be clearer, but it would ideally be based on a comprehensive meta-analysis to capture the full range of variation across all taxa. This is beyond the scope of our section.
Shaju Thomas	2	12	386	12	386	with good vegetation	barren urban areas are plenty	It is not clear what the reviewer means and so we are not sure how to address this comment. We agree there can be urban areas that are 'barren' in terms of floral resources but we can only cite what studies have found and are not able to speculate on comparisons between 'barren' urban areas and other habitats.
May Berenbaum	2	12	386	12	404	Other studies showing differential impacts of urbanization on pollinator diversity include Winfree R, T Griswold, C Kremen, 2006. Effect of human disturbance on bee communities in a forested ecosystem. Conserv. Biol. 21: 213-223 (bee abundance and richness are greater in agricultural fields and suburban/urban developments than in extensive forests. Also Carper et al. 2014 Effect of suburbanization on forest bee communities. Environ Entomol 43:253-262 (higher bee abundance in suburban than natural forests,).		These references have now been added.
Nikolay Sobolev	2	12	386	12	386	Add after "...2008": "; Berezin and Beyko 1998; Volkova 2000; Levchenko T.V. 2009)"	Field data about high diversity of different pollinator groups (bumblebees, butterflies, solirarian bees) in Moscow, Russia	We can't find the papers mentioned by the reviewer as full citations have not been provided.

Gretchen LeBuhn	2	12	389			McFrederick and LeBuhn(2006) finds lower species richness in urban habitats than in surrounding natural habitats.		We have referenced the McFrederick and LeBuhn study on line 387. Looking at the paper again, it's more accurate to say that (bumble)bee abundance (and not richness) was higher in the urban parks than in the two nearby natural habitats. The study actually finds that the urban and natural sites are comparable in terms of species richness. We have corrected the text to make it clear that abundance, and not richness, was higher in urban sites.
Marina Rosales Benites de Franco	2	12	391	12	391	Therefore, future conservation measures should consider the importance of mass flowering crops and the need for management schemes at landscape level to sustain vital pollination services in agroecosystems.	Westphal et al., 2003 (line 695 - 696 of document)	Thanks for the suggestion. However, this type of recommendation is not appropriate to this section of the chapter. This type of information will be included, however, in section 6.
Valerie Peters	2	12	391	12	391	Add that telemetry with bumblebees show disproportionate use of urban areas by bumblebees compared to other land cover types? Hagen et al 2011. Space use of bumblebees revealed by radio-tracking. PLoSone 6: e19997.		We have looked at this study and don't feel that it is relevant to this section as it considers gardens in rural areas and is therefore outside the scope of the section.
Anne-Laure Jacquemart	2	12	391			link countryside with agricultural areas or intensive agriculture ..		Thanks for the recommendation. We think that the current structure of the chapter addresses these links. Furthermore, the fact that the urban box is contained a in section on its own and is related to the land management section makes this link more evident.

Liette Vasseur	2	12	393			Change many studies to other studies. There is an issue with logical order in this paragraph. We go yes, no, yes. This should be better integrated. In fact, the sentences of lines 406-410 should be before line 384.		We have changed 'many studies' to 'other studies'. We have changed the paragraph order as suggested, and also moved other paragraphs and text to improve the logical flow of the whole section. We cannot see a problem with the logical order in the paragraph.
Graciela Rusch	2	12	394	12	394	Check spelling of non-English names (e.g. Fernandez, is likely Fernández).		This has been checked and the only such name was Hernandez, which does not have an accent in this particular case.
Natacha Chacoff	2	12	399	12	399	the effect of urbanization can also depend on the nature of the surrounding habitats (a city near a tropical forest vs a city near a temperate zone)		We agree with the reviewer and lines 428-431 are intended to address this point. We have added 'surrounding landscape' to this sentence to make this point more explicitly.
Shalene Jha	2	12	401	12	401	Jha & Kremen 2013 (Bumble bee foraging in response to landscape heterogeneity, PNAS: 110, 555-558) showed negative impacts of impervious cover on bumble bee nesting density		We have added this reference.
Thomas Steeger	2	12	403	12	404	more sensitive in terms of what?		We have updated the text to clarify this point.
Georg Andersson	2	12	406	12	410	Gardens in the agricultural landscape can also provide habitats for pollinators and perhaps even increase pollination around the garden. (Samnegård, U., Persson, A.S., Smith, H.G., 2011. Gardens benefit bees and enhance pollination in intensively managed farmland. Biol. Conserv. 144, 2602-2606.)		We thank the reviewer for the comment. However, we didn't include the mentioned reference since the section is about the effect of urbanisation on pollinators. However, this type of information appears in the land management section.
Gretchen LeBuhn	2	12	406			Potter and LeBuhn (2014) shows there is adequate pollination service for full seed set in tomatoes in an urban setting.		We weren't aware of this study and have added it to the text - thanks to the reviewer for pointing it out!

Mario Marcos Espirito	2	12	412	12	423	In this paragraph, it is stated that habitat diversity and heterogeneity in urban areas are higher than in natural areas; and also that "In general, plant species richness increases in urban areas compared to natural areas". Maybe this is true for some temperate regions, but surely not for most of the tropical ecosystems. This generalization must be avoided.		We appreciate the points the reviewer makes and have reworded the text to avoid generalising from the available studies that have researched these points.
Anne-Laure Jacquemart	2	12	413			"natural habitats" : real natural ?		We have updated the text to add 'semi-natural' habitats.
Diane Castle	2	12	415	12	417	<b>Proposal:</b> Delete text ".....although neonicotinoid pesticide use in urban lawns has been shown to have a detrimental effect on bumble bee colony growth and new queen production" <b>Rationale:</b> The authors state that the systemic hazard appears to be transitory and the direct hazard should be avoided by adhering to use instructions not to apply to blooming plants. This does not constitute a significant route of exposure as suggested by the current text.		We have updated the text to address the reviewer's concerns and also added a recently published study (Muratet et al. 2015).
Anne-Laure Jacquemart	2	12	418			add agricultural and "natural" areas		Text updated to include agricultural areas as well.
Anne-Laure Jacquemart	2	12	419			"non-native species", add event sometimes invasive		We are not sure what the referee means by this comment. Non-native species can be invasive but we cannot see the relevance of mentioning this, especially when space is limiting
Jeff Ollerton	2	12	425	13	428	As the query suggests, Baldock et al. 2015 should be cited here as it does compare replicate urban sites. In addition, please look at Sirohi et al. (in press) Diversity and abundance of solitary and primitively eusocial bees in an urban centre.... Journal of Insect Conservation		We have added these two recently published studies at appropriate points in the text.

Colin Fontaine	2	12	426	12	429	two recent studies comparing the pollinating fauna among urban, agricultural and natural land uses could be cited here. They both highlight differences among insect orders with for example a relative tolerance of hymenoptera to urbanization. References are: Deguines et al. (2012) The whereabouts of flower visitors: contrasting land-use preferences revealed by a country-wide survey based on citizen science. PLoS one, 7(9), e45822 and Baldock, et al. (2015) Where is the UK's pollinator biodiversity? The importance of urban areas for flower-visiting insects. Proc. B, 282(1803).		We have added both of these references.
Graciela Rusch	2	13	429	13	429	The effect of urban areas is in addition likely to depend on the characteristics of the surrounding rural landscape (i.e. the degree of intensification, Samnegård, U., A. S. Persson, and H. G. Smith. 2011. Gardens benefit bees and enhance pollination in intensively managed farmland. Biological Conservation 144:2602-2606.		We agree with the reviewer and have added 'surrounding landscape' to this sentence, see point 439 above. We have not added the reference as it considers gardens in rural, rather than urban, areas.
Marina Rosales Benites de Franco	2	13	430	13	430	I would like to include before " as well as": .... and local policies of green urban areas		Suggested text incorporated.
Valerie Peters	2	13	430	13	431	And may be different results for different plant species: Frankie et al. 2013. Relationships of bees to host ornamental and weedy flowers in urban northwest Guanacaste Province, Costa Rica. Journal of the Kansas Entomological Society 86: 325-351.		The reviewer makes a good point but here we are considering the effect of urbanisation as a whole and assume that urban areas comprise both ornamental and <del>weedy species</del>
Dan Cariveau	2	13	431	14	433	This last sentence either needs more information or should be cut. I wasn't sure what it meant and wanted more specifics.		We have now deleted this text.
Liette Vasseur	2	13	435			Section 2.1.4: this section is very general and does not discuss in great detail pollinators movement and dispersal as well as diversity in function of fragmentation. I hope this is explained later since there are very interesting studies at the landscape <del>level</del>		This has been addressed with the new structure of the section.
Lennard Pisa	2	13	435	13	441	See my remark row 2 of this sheet.		I do not know what point that is :(

Lennard Pisa	2	13	435	13	441	Habitat defragmentation is just one element of changes in land use, you considered others like logging in the		The conclusion has been changed to better represent the content of the section. However, since this is a general conclusion on the topic, it only contains the main general messages of the section.
Lennard Pisa	2	13	435	13	441	main text. Make the conclusion contain all relevant information.		see answer to comment 457.
Catrin Westphal	2	12	437	12	441	Finally, in the conclusions only habitat fragmentation is mentioned. I think in the conclusions landscape heterogeneity effects should also be mentioned, since land use changes also affect landscape composition and configuration and not only habitat fragmentation and isolation.		see answer to comment 457.
Joseph Tzanopoulos	2	13	437	13	437	The statement that land use and land cover change leads to habitat fragmentation is a generalisation and in many cases does not respond to reality. Examples, include land use changes that lead to forest expansion (e.g. land abandonment due to changes in agricultural policies) and increased habitat connectivity. The authors could possibly consider the use of "the intensification of land use" as a more precise description to what they want to communicate		Thanks for the comments. The new structure of the section addresses and clarifies these concepts.
Arathi Seshadri	2	13	437	13	441	The Conclusion is a repeat of the Landuse paragraph on Page 5 Lines 3 to 7		see answer to comment 457. Also, now it contains an original wording, not present elsewhere in the report.
Marina Rosales Benites de Franco	2	13	437	13	437	I suggest to consider after "fragmentation": and destruction of ecosystem structures and its functions.		Thanks for the suggestion. However, this goes beyond the topic of the report. In the conclusion, we think that it is better to concentrate as much as possible on pollinators only.

Natacha Chacoff	2	13	437	13	437	land use is probably the most study driver of changes in pollinators and pollination. Landscape configuration, habitat loss, fragmentation affects pollinators and pollinators, the state that leads to habitat fragmentation is for me an over simplification of this issue. Habitat loss is not always accompanied by habitat fragmentation		see answer to comment 457.
Thomas Steeger	2	13	437	13	438	States like "there is high confidence in the fact" should be replaced by "there is evidence to support the hypothesis that"		This has been now modified following this comment.
Erik Andersson	2	13	437	13	441	And when land cover change introduce/re-introduce heterogeneity and new resources? Happens occassionally and could perhaps be more common in the future.		Thanks for pointing this. We now make clear the direction of the changes and the effects on pollinators/pollination that have been shown or predicted
Ignasi Bartomeus	2	13	438	13	438	Same here, you refer to habitat fragmentation, but that is not what was measured in the papers (which is again distance to natural habitats)		see answer to comment 457.
Nadine Azzu	2	13	438	14	438	suggest to delete "the fact"- because if there needs to be confidence in something, it implies that it is not, indeed, a fact		This has been now modified following this comment.
Anne-Laure Jacquemart	2	13	438			"richness" add behaviour		Although we agree with the reviewer, here, we want to be very general in our conclusion, and adding behaviour would mean that we would need to add other responses. The idea here is to give a general view of the most important trends related to changes in land cover.
Marina Rosales Benites de Franco	2	13	440	13	441	I would like to propose the following: What is of critical importance in wild and agricultural habitats to guarantee the food security, the ecosystem services and human welfare.		Thanks for this comment. A similar text has been now added to the conclusion.
Thomas Steeger	2	13	440	13	441	It's unclear what "they" refers to? Do you mean habitat fragmentation?		this has been now reworded.

Nikolay Sobolev	2	13	458	13	459	Insert between l. 458 and 459: "Berezin M.V., Beyko V.B. 1998. Species diversity of bumblebees (Hymenoptera, Apidae, Bombus) in a big city (by the example of Moscow). Moscow. Vol. 10, P. 89-102. (in Russian)."	See comment to p. 12, l. 386.	We do not understand what this point refers to. The pages and lines indicated correspond to the references section.
Jose Luis Aramayo	2	14	515	515		Observations of agriculturist say that the specie of bees (Bombus sp y A. millephera) are specie very active and territorial, they are observed visiting flowers from early hours of the day even before sunrise. Opposed native species (melliponinae) that are active in the morning		We do not understand what this point refers to. The pages and lines indicated correspond to the references section.
Nikolay Sobolev	2	16	599	16	600	Insert between l. 599 and 600: "Levchenko T.V. 2009. About Fauna of Bees (Hymenoptera: Apoidea) of the Krylatskie Kholmy Landscape Preserve (Moscow). Vestnik Mordovskogo Universiteta, Biological Sciences Series. N 1, p. 39-40 (in Russian) "	See comment to p. 12, l. 386.	We do not understand what this point refers to. The pages and lines indicated correspond to the references section.
Nikolay Sobolev	2	17	692	17	693	Insert between l. 692 and 693: "Volkova L.B. 2000. Urbotolerant butterflies and condition for saving them in city residential quarters // Proc. Conf. "Animals in the city". Moscow. P. 71-74 (in Russian)."	See comment to p. 12, l. 386.	We do not understand what this point refers to. The pages and lines indicated correspond to the references section.
Shaju Thomas	2	19	717	23	974	Add impact of Pesticidies	I appreciate, it is treated separately	We acknowledged that pesticides are treated in Chapter 2, section 2.3.1.
Shalene Jha	2	19	717	19	717	As it stands, it seems like 'Agricultural Management' should actually a topic within 'Changes in land use' first section. It seems like a more natural split would be a section focusing on just 'changes in land cover' which would focus on studies look at changes in the proportion of habitat in a landscape/region and the impacts on pollinator communities (this would include most of the current land use section) and a second section on 'land management' which would focus on specific aspects of two systems: 1) managment within agricultural systems, subsection titled 'Agricultural management' that would focus on land practices within agricultural contexts, and 2) management within urban landscapes, subsection titled 'Urban management' that would focus on land practices within urban contexts		We thank the reviewer's constructive idea. We have restructured the first two sections of the chapter accordingly.



Mario V Balzan	2	19	724	19	986	As suggested in the previous comment, managed and unmanaged uncropped areas in agriculture can provide important habitat for invertebrates and pollinators, and pollination services (E.g. Carvalheiro, L.G. et al., 2012. Creating patches of native flowers facilitates crop pollination in large agricultural fields: mango as a case study Y. Clough, ed. Journal of Applied Ecology, 49(6), pp.1373–1383, also kindly refer to references in the previous comment). The influence of these on pollinators and pollination services probably merits inclusion within this section.		A new subsection on the management of natural and semi-natural habitats is included. Study by Carvalheiro is included.
Dan Cariveau	2	19	724	20	785	This is a nice overview!		Thank you.
Peter Campbell	2	19	728		729	Need to add why the need for agricultural intensification ie this is needed to feed a growing human population. This context should not be forgotton and should be included in the text.		This issue is mentioned by indirect effect issues in the scope.
Leslie Firbank	2	19	728		742	Worth including the UK analysis of decline of nector providers from Countryside Survey data- Simon Smart		Thank you, your suggestion was considered, but finally due to lenght constraints not included.
Luisa Carvalheiro	2	19	728	19	743	other studies that would be interesting to mention are: Burkle et al Journal of Ecology 2010, 98, 705–717; Burkle and Irwin 2009. Oikos 118: 1816 1829, 2009		Included.
Andreas Obrecht	2	19	728	19	729	Formulation is unclear. Proposal: "... for example the total fertiliser use has incresed from the 1960's". Maybe ist possible to have some figures to that statement?		Corrected.
Hollis Woodard	2	19	730	19	730	Change to: "there is A"		Corrected.
Graciela Rusch	2	19	731	19	731	Indicate energy, and <i>resource</i> intensive (in addition to or rather than 'capital' intensive)?		Corrected.
Hollis Woodard	2	19	731	19	733	Missing some words in sentence		Corrected.
Andreas Obrecht	2	19	732	19	733	This sentence is hard to grasp. Maybe better: "However global increase in fertilizer consumption has slowed down, as fertilizer use (?) has decreased in Europe".		Corrected.
Nadine Azzu	2	19	732	19	733	"globally increases in consumption" - of what? "declines in use" - of what?		Corrected.
Graciela Rusch	2	19	732	19	732	Indicate that 'consumption' in this case refers to " <i>fertilizer</i> " consumption		Corrected.

Thomas Brooks	2	19	732	19	733	"increases in consumption have fallen" - does this mean "...have decelerated"?		Corrected.
Hollis Woodard	2	19	732	19	732	Change "suggest" to "suggests"		Corrected.
Thomas Steeger	2	19	733	19	734	"increases in consumption" of what?		Corrected.
Shalene Jha	2	19	737	19	738	This figure and citation seems oddly placed as it describes general relationships between floral resources and pollinators, not a scenario related to fertilization. Further, if we decide to include a single study that does not examine fertilizer effects for this citation (like the Ebeling study), then there exists many previous studies (before Ebeling) that would have documented these same patterns...		Figure 2.2.1. is deleted.
Natacha Chacoff	2	19	738	19	739	please provide a reference for this		Reference is provided.
Ignasi Bartomeus	2	19	739	19	739	See Burkle et al papers for a reference on N deposition effects. Burkle and Irwin, Oikos 2009doi: 10.1111/j.1600-0706.2009.17740.x, and Journal of Ecology 2010 (doi: 10.1111/j.1365-2745.2010.01648.x)		Reference is provided.
Felix Herzog	2	19	740	19	740	REPHRASE: "... nectar from plants grown under elevated N level, which ..."	I had to look at the original paper to understand this sentence	Corrected.
Lennard Pisa	2	19	740	19	741	Consume nectar from the elevated N level...what does that mean?		Corrected.
Lennard Pisa	2	19	740	19	741	And is it true, are Hoover et al reliable, as it sounds unexpected?		It is acknowledged now that it's only a case study.
Nadine Azzu	2	19	740	19	740	from the elevated N level "what"?		Corrected.
Anders Nielsen	2	17	741	19	741	I do not understand this sentence		Corrected.
Ignasi Bartomeus	2	19	741	19	741	I would take care when using small experiment using one plant species only as general statements. I would specify its a case study, and only make general statements when are backed up by several evidences, reviews, meta-analysis, etc...		It is acknowledged now that it's only a case study.
Thomas Steeger	2	19	741	19	742	It's unclear whether the author is saying that increased N levels causes bees to more more frequently?		Corrected.
Nadine Azzu	2	19	741	19	741	Add "For example", based on their larval....		Corrected.

Penelope Whitehorn	2	19	741	19	742	This sentence needs a little more explanation to be informative.		Corrected.
Thomas Steeger	2	19	742	19	743	rather than declined strongly, do you mean "declined more rapidly"?		Corrected.
Nikolay Sobolev	2	19	745	19	749	Add to the Fig. 2.2.1 mathematical formulas describing the expected dependences, with indicating the amplitude of possible deviations	Predictions them-selves as shown on the figure seem to be not enough convincing	Figure 2.2.1. is deleted.
Mario Marcos Espirito	2	19	747	19	747	Figure 2.2.1 shows a basic relationship that is not specifically related to agriculture. I believe it should be moved to section 2.1.		Figure 2.2.1. is deleted.
Liette Vasseur	2	19	752			Section 2.2.1.2: I would have liked to read more about how tillage changes soil structure which modifies habitat for ground nesting pollinators. I would expect that for some species, it would make life easier, while for others not.		This chapter deals with negative consequences of tillage systems, and positive ones (no-tillage) are included into Ch 6, which is <del>crossreferenced</del>
Andreas Obrecht	2	19	753	19	762	The interrelation between tillage systems and pollinators is not 100% clear to the reader.		Rephrased.
Penelope Whitehorn	2	19	754	19	763	Is there any information on how much tillage is still relied upon? As it stands this paragraph is not informative - it first suggests that since 60s intensive soil tillage has declined & then it talks about the problems with tillage - the latter is hard to put into context of the current situation.		Information added.
Anne-Laure Jacquemart	2	19	759			delete "weeds" as all wild plants are not weeds !		Deleted.

Felix Herzog	2	19	760	19	762	DELETE: "However, on the other hand, if conventional tillage ..."	When you look at the paper (Fig. 1) you see that perennial grasses increased all right, but that broadleaved plants did not decrease. They remained stable. So no decrease in flower resources, at least not based on this data.	Deleted.
Natacha Chacoff	2	19	760	19	762	please consider reviewing this sentence.		Sentence is removed, as suggested by comment 518.
Graciela Rusch	2	19	760	19	763	The argument about tillage affecting species composition may not be so relevant in this context, since the purpose of tillage is to control weeds (non-desirable (non-crop) plants). So the issue about species composition is not that of tillage but of cultivation, crop selection and weed control (as explained in the next section). I suggest to remove this statement. The question about nesting places is relevant, though.		Sentence is removed.
Hollis Woodard	2	19	760	19	763	Missing some words in sentence		Sentence is removed, as suggested by comment 518.
Anne-Laure Jacquemart	2	19	761			replace "weeds" by species		Sentence is removed, as suggested by comment 518.
Leo Galetto	2	19	765			I think a better title could be "Weed management" but best one could be "Plant diversity management" because the negative word "weed" is avoided.		Corrected.
Leslie Firbank	2	19	767			for balance, it would be good to include an organic weed control method, eg flaming, as well as the GMO one. The GM example specifically refers to herbicide tolerance, not other traits		GMOs are treated in a separate section, which is now cross-referenced here.
Natacha Chacoff	2	20	770	20	770	please provide a reference for this		Reference provided.
Lennard Pisa	2	20	770	20	771	Increase since when?		Information added.
Graciela Rusch	2	20	770	20	771	In which period?		Information added.

Martha Groom	2	20	770	20	771	These statistics omit the rise of glyphosate. Recommend noting this rise with something such as: " From 1990-2010 applications of glyphosate on maize, soy and cotton in the US have increased from near zero to ~90,000 tons/yr (USDA-NASS 2012)"		Added.
Hollis Woodard	2	20	771	20	773	During what time period did the increase occur?		Information added.
Ignasi Bartomeus	2	19	778	19	778	Rephrase. This sentence is unclear to me.		Sentence is deleted.
Luisa Carvalheiro	2	20	778	20	778	I find this sentence unclear. Maybe it can be removed without major loss of information		Sentence is deleted.
Thomas Steeger	2	20	779	20	779	terms of art (e.g., phenological patterns) should be defined initially.		Sentence is deleted.
Lennard Pisa	2	20	781	20	781	Inbreeding in which populations? The pollinators that are left?		Terms about inbreeding is deleted.
Lennard Pisa	2	20	781	20	781	How is pollinator population inbreeding connected to food availability?		Terms about inbreeding is deleted.
Andreas Obrecht	2	20	781	20	781	<u>pollinator</u> populations		Corrected.
Anders Nielsen	2	20	782	20	782	... the populations of pollinators?		Corrected.
Anders Nielsen	2	20	783	20	783	... for a short period, leaving pollinators...		Corrected.
Thomas Steeger	2	20	784	20	784	consider ". . .left to grow together with ruderal plants (i.e., those plants that grow on disturbed lands" . . ."		Corrected.
Graciela Rusch	2	20	785	20	785	Check spelling, it is likely Lagerlöf (instead of Lagerlof).		Corrected.
Shalene Jha	2	20	785	20	785	It seems that this would be a good spot to add a few sentences about edge-effects -- because while many past studies do not specifically examine the role of weed diversity or density, they do compare pollinators near field edges (where there are usually weedy buffer strips) with field centers		Included.
Serena Heckler	2	20	787	20	822	This section concentrates only on large-scale agricultural practices ("organic" vs "conventional") and does not mention indigenous or local traditional knowledge systems. <u>Suggest including reference to TEK here.</u>		ILK is included at some parts of the Chapter.

Serena Heckler	2	20	787	20	779	It is better to try to avoid ideologically laden terminology. The term "modern" carries a value judgment which prejudices against supposedly "non-modern" agriculture, although this report only deals with contemporary practices. Better terms might include large-scale, market or industrial agriculture.		Changed to industrial.
Thomas Brooks	2	20	787			Add a subsection on integrated pest management?		Mentioned in the text and relevant part of the chapter is cross-referenced.
Liette Vasseur	2	20	789			The first part of the sentence makes no sense.		Rephrased.
Martha Groom	2	20	789	20	822	This section needs a bit stronger an edit to more fully bring out the patterns across studies. The final sentence (line 820-22) is not obviously tied to the rest, and might be better omitted. Some redundancy could be eliminated if the two paragraphs were edited together. Clarify where evidence suggests where impacts of organic methods in terms of less toxic pest control (although some organic pest treatments may also have sublethal or even lethal impacts!) vs where increased habitat heterogeneity are important. Finally, it might be useful to cite Roulston & Goodell (2011): "Overall, there is a need for more careful experimental design to separate clearly the type of impacts that occur from organic and industrial agriculture (Roulston & Goodell 2011)." Reference: Roulston, T.H. & Goodell, K. 2011. The role of resources and risks in regulating wild bee populations. Annual Review of Entomology 56:293-312. doi: 10.1146/annurev-ento-120709-144802.		The final sentence is rephrased. The suggested sentence and reference is added.
Valerie Peters	2	20	789	20	822	How about breaking this section into 2 separate sections because some organic farms do not incorporate other agri-environment measures such as windbreaks, live fences, floral strips in crop margins, etc. Another section illustrating studies that compare these could be after organic vs. conventional and titled: <i>Intensive vs extensive managment</i> or if many studies in this chapter examine effects of both organic and other management practices together then maybe section heading could be changed to: <i>Organic and/or extensive versus conventional and/or intensive management</i>		The section is revised and extended.

Anders Nielsen	2	20	790	20	790	... can increase pollinator abundance,		Corrected.
Mercy Gichora	2	20	791	20	796	The sentence is very long and loaded with different pieces of information. Consider breaking it into more than 1 sentence.		Broken to two sentences.
Marina Rosales Benites de Franco	2	20	791	20	791	I suggest to include before "Certain": Insect pollinated plants benefit disproportionately from organic farming, which appeared to be related to higher pollinator densities in organic fields, whereas in the centres of conventional fields non-insect pollinated plants dominate presumably due to a limitation of pollinators.	Gabriel, D. & Tschardtke, T. (2007). Insect pollinated plants benefit from organic farming. Agriculture, Ecosystems and Environment, 118, 43–48. <a href="http://www.sciencedirect.com/science/article/pii/S0167880906001484">http://www.sciencedirect.com/science/article/pii/S0167880906001484</a> on February 26, 2015	Added.
Madeleine Chagnon	2	20	791	20	795	rephrase this section-difficult to read		Corrected.

Diane Castle	2	20	791	20	796	<p><b>Proposal:</b> This sentence needs to be edited to improve sense and better exemplify agri-environment schemes. Include additional information on the type of agri-environment management practices such as use of sown field margins, timing and frequency of cutting, and removal of cut material on vegetation composition, flower resource availability and pollinators.</p> <p style="text-align: center;"><b>Supporting references:</b></p> <p style="text-align: center;">*Pywell, R. F.; Meek, W.R.;</p> <p>Hulmes, L.; Hulmes, S.; James, K. L.; Nowakowski, M.; Carvell, C. (2011) Management to enhance pollen and nectar resources for bumblebees and butterflies within intensively farmed landscapes. Journal of Insect Conservation, 15 (6). 853-864</p> <p style="text-align: center;">*</p> <p>Woodcock, B.A.; Savage, J.; Bullock, J.M.; Nowakowski, M.; Orr, R.; Tallwin, J.R.B.; Pywell, R.F.(2014) Enhancing floral resources for pollinators in productive agricultural grasslands. Biological Conservation, 171. 44-51.</p> <p style="text-align: center;">* Richard F. Pywell, William R. Meeka, R.G. Loxtona, Marek Nowakowski, Claire Carvella, Ben A. Woodcock (2011) Ecological restoration on farmland can drive beneficial functional responses in plant and invertebrate communities. Agriculture, Ecosystems &amp; Environment Volume 140, Issues 1–2, 30 January 2011, Pages 62–67</p>		Agri-environmental schemes are dealt with in Chapter 6 (mitigation methods). The comment and suggested papers were shared with Chapter 6 team, thank you.
Thomas Steeger	2	20	792	20	797	this is a very long sentence and it is somewhat confusing; consider rephrasing.		Corrected.
Graciela Rusch	2	20	792	20	792	Agri-environmental schemes are not agricultural practices but a policy instrument. Maybe this can be formulated, as : "...and conservation practices included (or prescribed?) under policy instruments such as agri-environment schemes.		Corrected.
Jana Vamosi	2	20	792	20	793	Punctuation needs some help in this sentence. It does not read well.		Corrected.
Liette Vasseur	2	20	793			"or the lower level": again this sentence is difficult to read since it is very long with many terms overused.		Corrected.

Luisa Carvalheiro	2	20	796	20	796	another reference is Garibaldi et al. 2014. From research to action: enhancing crop yield through wild pollinators. Front Ecol Environ 2014; 12(8): 439–447		Added.
Natacha Chacoff	2	20	797	20	799	please consider reviewing this sentence.		Corrected.
Georg Andersson	2	20	797	20	797	Conventional farms do not necessarily have larger monocultures than organic ones. In e.g Sweden there are conventional farms that are as diverse as organic ones. However, organic practices usually require a bit more diverse cropping system. It depends on what type of organic system is referred to. Some organic or agro-ecological system can be very diverse and different from European certified organic system.		Included.
Liette Vasseur	2	20	798			Put a . after Altieri2013). Then the other sentence make it as a real sentence. It would be easier to read.		Corrected.
Jeff Ollerton	2	20	799	20	800	This sentence is confusing and needs re-wording. There are other areas in this whole paragraph where the grammar could be improved.		The paragraph is rewritten at several parts.
Georg Andersson	2	20	799	20	799	There might also be effects of farming system and landscape heterogeneity on pollinator community composition. (Andersson, G.K.S., Birkhofer, K., Rundlöf, M., Smith, H.G., 2013. Landscape heterogeneity and farming practice alter the species composition and taxonomic breadth of pollinator communities. Basic and Applied Ecology 14, 540-546.) Composition and trait diversity can also be important for pollination success of different crops.		Added.
Madeleine Chagnon	2	20	801	20	802	rewrite.. a study on canola seed set in Canada		Corrected.
Thomas Steeger	2	20	801	20	804	consider "...organic fields strongly correlated with pollination success; for example in a study of seed set of canola in Canada, there was 3 to 6 times ..."		Corrected.

Madeleine Chagnon	2	20	803	20	803	could this be a result of GMO crop's attractiveness ?		The authors acknowledged that "Pollinator exclusion experiments would be required to directly test the pollinator requirements of these canola varieties." No information was found on potentially different attractiveness.
Georg Andersson	2	20	803	20	805	This study tested the potential of strawberry pollination. It is the potential of pollination services at farms that was higher 2-4 years after conversion to organic farming.		Corrected.
Serena Heckler	2	20	807	20	812	The finding that organic monocultures (or low crop diversity) are not much better for encouraging diversity than high input agricultural systems suggests a need for a holistic evaluation of entire agroecosystems (not just individual pollinator/plant interactions), such as those done on traditional agricultural systems may provide important insights and models for further action (see ILK task force for references).		The problem of organic monocultures is included to the text.
Graciela Rusch	2	20	807	20	823	This paragraph needs revision to improve clarity. It would be recommendable to end with a clearer message/conclusion at the end of this section about the degree of uncertainty of the overall conclusion and about the degree of context dependency of the findings.		The paragraph is revised and also the conclusion sentences in its end.
Dan Cariveau	2	20	807	20	807	It might be helpful to define or use clearer terms than "local scale diversity". What does the diversity refer to? Kennedy is about diversity in crops so I would just state that.		Corrected.
Andreas Kruess	2	20	814	20	815	At European level, great differences exist in the implementation of organic farming between EU-countries (resulting in a wide span of landscapes ranging from extensively used and heterogeneous landscapes on the one hand to highly productive and monotonous landscapes on the other hand). See also Kleijn et al. (2006) Mixed biodiversity benefits of agri-environment schemes in five European countries.- Ecology Letters 9 (3): 242-254		Included.

Marina Rosales Benites de Franco	2	20	816	20	816	I agree with the organic management depends landscape context, the crop type, the management of the organic farm and the species considered. I think also the soil conservation is a crucial factor.		Included.
Felix Herzog	2	20	816	20	816	ADD SENTENCE (after "... organic farms."): On 205 farms in Europe and Africa, Schneider et al. (2014) found that at farm scale, the diversity of bees and of three other taxa was affected by the presence of non-productive habitats rather than by the farming system (organic or not).	Schneider M.K., Lüscher G. Jeanneret P., Arndorfer M, Ammari Y., Bailey D., Balázs K., Báldi A., Choisis J,-P., Dennis P., Eiter S., Fjellstad W., Fraser M.D., Frank T., Friedel J.K., Garchi S., Geijzendorffer I.R., Gomiero T., Gonzalez Bornay G., Hector A., Jerkovich G., Jongman R.H.G., Kakudidi E., Kainz M., Kovács-Hostyánszki A., Moreno G., Nkwiine C., Opio J., Oschatz M.L., Paoletti M.G., Pointereau P., Pulido F.J., Sarthou J.-P., Siebrecht N., Sommaggio D., Turnbull L.A., Wolfrum S., Herzog F. (2014) Gains to species diversity in organically farmed fields are not propagated at the farm level. <i>Nature Communications</i>	Added.
Andreas Obrecht	2	20	819	20	819	The sentence can be understood organic farming occurs more often in homogenous landscapes.		Rephrased.

Mercy Gichora	2	20	820	20	820	Spelling of the word 'moreover' is wrong. After it, insert the indefinite article 'a' so as to read - moreover a recent study...		Corrected.
Natacha Chacoff	2	20	820	20	822	I do not understand this. Why the differences in biodiversity could be explained by lower yields? . Probably management impact on biodiversity and or yields.		Corrected.
Thomas Steeger	2	20	820	20	820	replace "can be more expected" with "may be more likely"		Likelihood terms are avoided within the document, or used very explicitly according to the <u>uncertainty guidance document</u> .
Jana Vamosi	2	20	820	20	822	Most of this paragraph is quite interesting but this last sentence is a bit hard to penetrate.		Rephrased.
Felix Herzog	2	20	821	20	822	REPHRASE: "... and conventional fields are related to lower yields in organic fields rather than to specific biodiversity friendly management practices per se (Gabriel et al. 2013).	You quote the paper correctly but in this one sentence summary it cannot be understood. Organic and conventional usually HAVE different management practices, which usually lead to different yields, which are usually associated with higher biodiversity on OF.	Rephrased.
Madeleine Chagnon	2	20	821	20	821	Organic insecticides such as Spinosad (Entrust-Dow agrosience) are just as toxic to bee as insecticides from conventional farming systems.		Literature I have found could not really highlight this. Some suggested references would be useful.
Penelope Whitehorn	2	20	821	20	823	How do lower yields influence biodiversity? Not well explained.		The sentence is rephrased and clarified.
Anne-Laure Jacquemart	2	20	822			add some sentences about AES schemes in Europe ?		AES schemes are subject of Chapter 6.

								Title of the subsection is changed, and text is revised, extended.
Jana Vamosi	2	21	823	21	877	I might suggest having the factors discussed in this page to have headings more in line with the title of the chapter. Most of material prior to this point is focussed on the pollinators themselves and the section starting with "crop diversity" then offers a perspective more focussed on services provided by the pollinators but the shift in focus is too subtle.		Title of the subsection is changed, and text is revised, extended.
Leo Galetto	2	21	826			I think a better title could be "Crop diversity and management".		Retitled as Mono- versus polyculture systems.
Liette Vasseur	2	21	827			add a s at "influence"		Corrected.
Marina Rosales Benites de Franco	2	21	829	21	829	I suggest to include the following before "The diversity.." Ecosystem service of pollination was closely related to functional pollinator diversity, based on the species-specific traits that appeared to drive complementary use of floral resources.	Hoehn, P., Tschardtke, T., Tylianakis, J. M., Steffan-Dewenter, I. (2008). Functional group diversity of bee pollinators increases crop yield. Proc. R. Soc. B., 275, 2283–2291. <a href="http://rspb.royalsocietypublishing.org/">http://rspb.royalsocietypublishing.org/</a> on February 26, 2015	Added.
Maximilian Weigend	2	21	830	21	831	the statement "there have been no significant changes in the diversity of crops grown.." is possibly correct at species level, but certainly grossly wrong at cultivar/variety level. Since these may differ dramatically in their pollinator dependence, floral rewards, this change may be just as problematic for pollinators as changes in species cultivated - compare lines 836-842 on the same page.		This uncertain part of the sentence is deleted.
Serena Heckler	2	21	830	21	831	<u>I find the claim that there have been "no significant changes in crop diversity over the last 50 years" to be surprising. This is a very bold claim and, I would argue, requires more substantiation than one reference. If not, it should be qualified.</u>		This uncertain part of the sentence is deleted.

Leo Galetto	2	21	830	21	832	I do not agree with this general statement because it varies according to the different regions of the world. For example, in the case of Argentina and Brazil, main crops are very few with soybean as dominant since many years ago. For example, see Cáceres (2015). Cáceres, D. 2015. Accumulation by Dispossession and Socio-Environmental Conflicts Caused by the Expansion of Agribusiness in Argentina. Journal of Agrarian Change, Vol. 15 No. 1 pp. 116–147.		This uncertain part of the sentence is deleted.
Andreas Obrecht	2	21	831	21	834	These figures are very interesting and could even be mentioned more prominently, e.g. in an executive summary		These are more subject of Chapter 3.
Penelope Whitehorn	2	21	834	21	835	What has driven this increase? It would be nice to have an explanation here, even if covered in more detail in other chapters.		Probably nutritional reasons, or demands for more diverse food supply, but could not really find. Might be really covered in Chapter 3.
Nadine Azzu	2	21	837	21	837	"can influence pollinator foraging" what? Choices? Patters? Behaviour?		Deleted sentence.
Shalene Jha	2	21	837	21	837	specify instead of 'some specific crop species'		Deleted sentence.
Anders Nielsen	2	21	838	21	838	... of flowering plants can influence pollinator...		Corrected.
Andreas Obrecht	2	21	838	21	838	This is a very policy relevant statement. The subsequent two sentences and para which explain why this is the case are very helpful and could inform the conclusions and/or summary for <u>policy makers</u>		Thank you. We included this statement into the conclusions.
Dan Cariveau	2	21	838	21	838	The Cane and Schiffhauer study does not address variation in crops but in pollinators (nectar vs. pollen-foraging honey bees). Cane and Schiffhauer 1997. Journal of American Society of Horticultural Science 122:665-667 looks a differences in nectar production among cranberry cultivars		Deleted sentence.
Anders Nielsen	2	21	839	21	839	How can crop genetic diversity enhance pollination service? Explain		Explained more in the next sentences.
Liette Vasseur	2	21	840	21	842	You should get more references as many would not agree with you due to pollen competition. In fact it is a question of nectar production and especially flower size and height. And this can be related to other factors such as air temperature, flower position, soil moisture, etc. not just genetic.		Issue of pollen competition is included into the subsection.

Anne-Laure Jacquemart	2	21	840			you can add pear varieties		Could not find a good reference here.
Penelope Whitehorn	2	21	840	21	841	Is it the more genetically diverse varieties they prefer?		They prefer variety that provides more/better nectar and/or pollen.
Anders Nielsen	2	21	841	21	841	Explain briefly the findings from the Almond study		Done.
Liette Vasseur	2	21	844	21	856	I am very surprised to read the facilitation aspect but not the competition aspect. However it is well documented.		Included in the form of interspecific pollen deposition.
Anna Traveset	2	21	844			Somewhere in this paragraph I think it should also be mentioned that interspecific pollen transfer is a common phenomenon, with potential ecological and evolutionary consequences for the plants (Morales & Traveset 2008, Mitchell et al 2009, Muchhala et al 2010)		Included.
Anders Nielsen	2	21	845	21	847	Rephrase sentence		Corrected.
Felix Herzog	2	21	846	21	846	ADD SENTENCE (after "Moeller 2004."): On the other hand, the movement between con- and heterospecific flowers may lead to the deposition of more heterospecific pollen on cherry stigmas causing pollen clogging (block of stamens) or chemical inhibition of pollen tube growth (Wilcock & Neiland 2002, Schüepp et al. 2013).	Wilcock C, Neiland R. 2002 Pollination failure in plants: why it happens and when it matters. Trends Plant Sci. 7, 270–277. (doi:10.1016/s1360-1385(02)02258-6) // Schüepp C., Herzog F., Entling M. (2013) Disentangling multiple drivers of pollination in a landscape-scale experiment. Proceedings of the Royal Society B 281: 20132667. <a href="http://rspb.royalsocietypublishing.org/content/281/1774/20132667.full.pdf">http://rspb.royalsocietypublishing.org/content/281/1774/20132667.full.pdf</a>	Done.
Jeff Ollerton	2	21	846	21	846	"floral species" does not make sense - use "plant species"		Corrected.

Anders Nielsen	2	21	847	21	847	Here you could also refer to Hegland & Totland (2012), where they look at intraspecific competition and facilitation for pollinators on different spatial scales. Hegland, S. J., and Ø. Totland. 2012. Interactions for pollinator visitation and their consequences for reproduction in a plant community. Acta Oecologica 43:95-103.		Study by Hegland and Totland is cited.
Nadine Azzu	2	21	847	21	847	Slightly convoluted sentence		Rephrased.
Leo Galetto	2	21	848	21	852	I agree with these results, but it is necessary to clarify that this situation is very specific and not a general situation for sunflower crops. This situation describes the case of seed hybrid production for some companies (i.e., the production of commercial seeds of sunflower) and not the common situation for fields with this crop. Thus, it is necessary to include the context for these results.		Information added, thank you.
Luisa Carvalheiro	2	21	850	21	851	other studies with similar findings on honeybee behaviour that could be cited here are Carvalheiro et al. Ecology Letters, (2011) 14: 251–259; and		Cited.
Ignasi Bartomeus	2	21	853	21	855	Are this referring only to honeybees? If so, specify.		No, it refers to bee communities. Clarified.
Nadine Azzu	2	21	853	21	853	"flowering after each other" - in what sense?		In different times.
May Berenbaum	2	21	854	21	856	For what bee species is pollen of corn (a wind-pollinated species) nutritionally beneficial? Isn't it usually considered suboptimal and less-preferred?		Might be true for bumblebees, which seemed to ignore corn pollen in the study by Cutler and Scott-Dupree 2014. Ecotoxicology
Anne-Laure Jacquemart	2	21	856			"alternating planting rows" add or mixed rows (in pear orchards)		Corrected.
Anders Nielsen	2	21	857	21	857	Many orchard crops need cross pollination between varieties to give optimal yield. E.g. many raspberry varieties need pollen from a different variety to set fruit.		Added.
Leo Galetto	2	21	859			This title can be considered as part of the previous section.		Kept as separate subsections.
Shalene Jha	2	21	860	21	860	It seems odd for the topic sentence to emphasize Oilseed rape when the contents of the paragraph is more broad - a more general topic sentence would be better		First sentence is changed, giving a more general introduction to the subsection.

May Berenbaum	2	21	861	21	861	Do all oilseed crops provide readily accessible nectar and pollen? Maybe "edible oilseed crops"?		Corrected.
Erik Andersson	2	21	861	21	874	Mass flowering crops may hide or temporarily compensate for the effects of landscape change. In effect this may hide an increased vulnerability which become aparent when land use is changed from mass flowering crops. See Jansson, Å., and Polasky, S. (2010). Quantifying biodiversity for building resilience for food security in urban landscapes: getting down to business. Ecol. Soc. 15, 20.		Included.
Arathi Seshadri	2	21	864	21	866	In case of large fields of Canola/rape seed, the report says the crops benefits from cross-pollination resulting from the number of flowers visited by a bumblebee over each trip and total flowers per hour. It would be interesting to determine what is exactly the extent of 'cross-pollination' because for the most part, a single variety of Canola/rapeseed is planted across large stretches of land. How similar is each individual plant in the field to the other individual Canola plant? Is there a real sense of cross-pollination as defined in Chapter 1? Does this call for a mixed variety plantings?		Might be out of scope here.
Andreas Obrecht	2	21	865	21	865	Maybe it would be interesting to be more specific on the types of field management which can have an important effect		Specified.
Mercy Gichora	2	21	866	21	866	Break the compound word into two to read' pigeon pea' in Kenya		Corrected.

Catrin Westphal	2	21	867	21	868	The colonies were not placed at the edge of oilseed rape fields, but on old fallows in the centre of landscapes (represented by a circular radius of 3000 m) differing in the amount of oilseed rape (small vs large), so this is a landscape-scale effect and not a local effect of oilseed rape fields in the vicinity of the colonies. As currently written, the sentence is implying local and not landscape-scale effects. Whereas Holzschuh et al. clearly found local effects based on oilseed rape fields adjacent to the semi-natural grasslands. Thus, concluding from both studies oilseed rape can have positive effects on colony growth or number of brood cells at landscape and local scales, most likely depending on the species foraging/dispersal distances.		Corrected, thank you.
Nadine Azzu	2	21	875	21	875	should read "alterING"		Corrected.
Anders Nielsen	2	22	879	22	879	Add reference(s) at the end of the sentence		Added.
Leo Galetto	2	22	879	22	882	This is a nice example to link this section with the trade-off section of Chapter 6.		Chapter 6 is cross-referenced.
Timothy Schowalter	2	22	885	22	885	Where is the spillover subsection? Please identify here		Added.
Madeleine Chagnon	2	22	886	22	890	Would this be a good place to talk about potential GMO contaminations by pollinators ?		This seems to be more a legal issue and out of scope here.
Thomas Steeger	2	22	887	22	890	it is possible that increased reproduction may also result in higher numbers of progeny and insufficient floral resources to support them.		Reference provided.
Les Davies	2	22	889			In Figure 2.2.2 what do the plusses and minuses in the circles mean?		Plus means positive, minus means negative effect. Included into the figure legend.
Shalene Jha	2	22	891	22	891	this figure is a very simple rendition of this process -- can we replace it with something a bit more mechanistic? Otherwise, I think it should be excluded as it does not really provide any more information than what is provided in the text.		Figure is kept, but figure legend is specified.

Shalene Jha	2	22	891	22	891	I have the same comment here as for line 377 -- I don't really see the distinction between 'spillover' and the decreasing pollinator diversity effects with increasing distance to natural habitat, as described in pg 11 line 346 -- I think these are both issues of natural habitat availability providing a very localized increased pollinator density/diversity/service.		According to our opinion decreased diversity with distance and spill-over are different effects, which are both related to landscape. For more details Section 2.2.1 is cross-referenced.
Mario Marcos Espirito	2	22	892	22	894	The issue of spillovers is clearer with this figure. Consider moving it to page 11.		Figure is kept, but figure legend is specified.
								Included.
Marina Rosales Benites de Franco	2	22	897	22	897	I suggest to include: Fire is often use as management tool and land conversion or change land use in tropical forest,		Included.
Andreas Obrecht	2	22	897	22	908	The subchapter on fire seems to me a bit general. It is hard to draw policy relevant conclusions from it. If the findings of the Williams and Potts papers are of global nature, this should be mentioned explicitly		Fire section is considerably extended.
Laura Burkle	2	22	897	22	908	why is fire in the section on agricultural management? I understand that fire can be used as a management tool in agricultural systems, but it seems quite out of place and most of the studies cited are not from agricultural systems...		We have restructured the section. Fire is included now more like an issue of pastures and rangelands.
Scott Black	2	22	898	22	909	There is nothing wrong with the fire section per se and I know you are trying to keep this relatively short but there is a lot more information on fire. See below short review that I authored below doc. Happy to have you crib from it and happy to send citations		Thank you very much. Your suggested text is included into the Fire section.
Scott Black	2	22	898	22	909	Burns can also be detrimental to pollinator populations (e.g., Ne'eman et al. 2000; Panzer 2002).		Included.

Scott Black	2	22	898	22	909	<p>Burns during the growing season remove floral resources, host plants, and nesting materials, and can be detrimental to species with life stages that cannot fly to safety at the time of the burn. Burns during the dormant season can kill overwintering pollinators such as butterflies, moths, syrphid flies, and soldier beetles that overwinter at the base of plants, in leaf litter, or underneath the surface of the soil. A recent study on prescribed burning and the imperiled mardon skipper in California showed substantially fewer butterflies in the burned areas of meadows compared to unburned areas after 1, 2, 3, and 5 years following the burn event (Black et al. 2014). Queen bumble bees overwintering in small cavities just below or on the ground surface are at risk, as are a small number of ground-nesting bee species that nest in shallow burrows (Cane and Neff 2011). Solitary bees nesting in stems or twigs are unlikely to survive the heat of burns (Cane and Neff 2011), and stem-nesting bee populations will only recover postfire when the availability of suitable stems increases over time (Potts et al. 2005). The loss of bees due to a burn can lead to reduced fruit sets in plants in burned areas (Ne'eman et al. 2000). Though losses of bees following a fire can be catastrophic, bees may be able to recolonize burned sites and recover within a few years (Potts et al. 2003a).</p>		Included.
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Scott Black	2	22	898	22	909	<p>Recovery of pollinators following a burn varies between guilds. Habitat-dependent or -specialist species and those that are less mobile are most likely to be negatively affected immediately by a fire (Panzer 2002; Vogel et al. 2010). A pollinator's ability to cope with regular burns is dependent on there being adequate unburned adjacent areas that can provide sources of colonizers into the burned habitat (e.g., Harper et al. 2000; Swengel 2001; Panzer 2002; Hartley et al. 2007). Isolated populations of pollinators in small fragments may not survive repeated prescribed burns (Panzer 2002) because there are often no source populations available for recolonization once a population has been locally extirpated. Burning a small habitat fragment in its entirety could risk extirpating some species because of limited recolonization from adjacent habitat (Harper et al. 2000). This accentuates the need to leave substantial habitat when using fire as a management tool. Habitat patches should not be burned completely; rather, a mosaic of burned and unburned areas is ideal.</p>		Included.
Serena Heckler	2	22	908	22	908	<p>Relationship between pollinators and fire-dependent communities also relevant here - e.g. in western US anthropogenic fire favoured bear grass and its associated pollinator communities. Suggest to add "<u>Studies have shown that fire-dependent communities have indirectly and positively impacted pollinators by altering plant density and distribution (Van Nuland et al 2013, Charnley and Hummel 2011)</u>   REF: Van Nuland, Michael E, Elliot N Haag, Jessica A M Bryant, Quentin D Read, Robert N Klein, Morgan J Douglas, Courtney E Gorman, et al. 2013. "Fire Promotes Pollinator Visitation: Implications for Ameliorating Declines of Pollination Services." Edited by Paul Adam. PLoS ONE 8 (11): e79853. doi:10.1371/journal.pone.0079853.s001. / Charnley, Susan, and Susan Hummel. 2011. "People, Plants, and Pollinators: the Conservation of Beargrass Ecosystem Diversity in the Western United States." In The Importance of Biological Interactions in the Study of Biodiversity, edited by Jordi Lapez-Pujol, 127–27. InTechPublication.</p>		Included.

Anne-Laure Jacquemart	2	22	908			Fires in Mediterranean climates are necessary for seed dispersal and germination		Included.
								Included.
Liette Vasseur	2	22	910			I am surprised that you don't talk about the timing of grazing. This had a huge impact on flowering and pollinator presence.		Included.
Scott Black	2	22	911	22	911	<p>This section is called grazing and mowing but there is no information on mowing. This is from a review I authored. Happy to send citation if you want to use this. Mowing can have a significant impact on pollinating insects through direct mortality, particularly for egg and larval stages that cannot avoid the mower (Di Giulio et al. 2001). Mortality due to mowing when eggs and larvae are present is a threat to the persistence of some butterfly species (Thomas 1984; Wynhoff 1998). Mowing can also disturb ant nests, which in turn affects the survival of butterflies that rely on particular ant species (their final instar larvae feed in the ant nests) (Wynhoff et al. 2011). Caterpillars on the ground as well as caterpillars on vegetation are vulnerable to direct mortality by mower (Humbert et al. 2010). Mowing also creates a sward of uniform height and may destroy topographical features such as grass tussocks (Morris 2000) when care is not taken to avoid these features or the mower height is too low. Such features provide structural diversity to the habitat and offer potential nesting sites for pollinator insects such as bumble bees. In addition to direct mortality and structural changes, mowing can result in a sudden removal of almost all floral resources for foraging pollinators and butterfly host plants (Johst et al. 2006). The reduction in host plants and foraging resources can reduce pollinator reproduction and survivorship (Boggs and Freeman 2005), and pollinators will likely be forced to seek alternative habitat. Skórka et al. (2013) found that butterfly roadkill in Poland increased as mowing frequency increased; adult butterflies that dispersed to find new habitat after roadsides were mowed were more likely to collide with vehicles.</p> <p>The frequency and timing of mowing influences the composition</p>		Included.

Liette Vasseur	2	22	912	22	914	Rework the sentence since difficult to read. I would say: Grazing livestock (e.g. cattle) alters ecosystems through vegetation consumption, soil enrichment by feces, and trampling. These alterations affect potential plant production and the amount of floral food, and nesting resources available to pollinators thus influencing their abundance or diversity.		Corrected.
Hollis Woodard	2	22	913	22	915	Missing some words in sentence		Rephrased.
Marina Rosales Benites de Franco	2	22	918	22	818	I consider to include the following before "The precise..": Study on a steppe in eastern Mongolia shows overgrazing weakens ecological function through the impoverishment of forbs and consequent pollination over a wide area, and by unexpectedly weakening the flower–pollinator mutual structure (Yoshira <i>et al.</i> .,2008)	Yoshiharaa, Y., Chimeddorjb, B., Buuveibaataarc, B., Lhagvasurenc, B., Takatsukid., S.( 2008). Effects of livestock grazing on pollination on a steppe in eastern Mongolia. <i>Biological Conservation</i> 141, 2376 – 2386. <a href="http://www.sciencedirect.com/science/article/pii/S0006320708002589#">http://www.sciencedirect.com/science/article/pii/S0006320708002589#</a> on February 26, 2015	Included.
Liette Vasseur	2	22	919			Change "is likely to depend" to likely depends on the types of habitat...		Corrected.

Martha Groom	2	22	919	22	920	Will also depend on the selectivity of the grazers, and degree to which they reduce populations of flowering species. Could alter phrase in 920 somewhat to: "...the community, as well as the grazing intensity, selectivity, land-use history and climate..."		Added.
Georg Andersson	2	22	922	22	922	I lack a passus on that in some parts of, at least Northern Europe, there is also a problem of pastures being abandoned or not grazed enough with overgrowth as a consequence. This leads to that important habitat and foraging resources for pollinators disappear		Included.
Graciela Rusch	2	22	922	22	922	In northern Europe/nordic one of the major negative trends of semi-natural grasslands and meadows is shrub/tree encroachment due to abandonment of extensive grazing practices in these habitats. This change tends also to affect the habitats for pollinators (reduction of area of flower-rich habitats)		Included.
Thomas Steeger	2	22	924	22	924	replace "leasing" with "leading"		Corrected.
Leslie Firbank	2	22	925			Intensive grassland management includes frequent resowing of the grasses, which also keeps plant diversity down. Is it worth including here the use of more species-rich mixtures to support yield and resource use efficiency?		I do not feel it to fit here very well.
Thomas Steeger	2	22	927	22	927	define "swards"		Done.
Hollis Woodard	2	22	928	22	929	Sentence about bumble bees needs rewording		Rephrased.
Anne-Laure Jacquemart	2	22	928			"leguminous" add some refs		Corrected.

Thomas Walter	2	22	931	22	<p>add a new paragraph named "Harvesting technique": Frick and Flury (2001) have estimated bee losses due to rotary mowers. Their extrapolations resulted in losses in flowering white clover fields between 9'000 and 24'000 bees per hectare and in 90'000 in the case of phacelia. Mowing without a conditioner reduced the mortality by a factor seven. In order to avoid significant bee losses they recommend to refrain from mowing in periods of increased flight activity. Humbert et al. (2010) have analysed the direct impact on invertebrates of different entire hay harvesting processes. The use of a conditioner reduced the survival rate of orthopterans from 32 % to 18 %. Leaving uncut refuges and delaying mowing mitigate the impact (Humbert et al. 2012, Buri et al. 2012). Even though there is no evidence about the effect of such mortalities on the local population dynamics of the different pollinator or other athropod species and its impact on pollination services, it might obviously not be neglected.</p>	<p>Citations: Frick R., Fluri P. (2001) Bienenverluste beim Mähen mit Rotationmähwerken. Agrarforschung 8 (5): 196-201. Humbert J-Y., Ghazoul J., Richner N., Walter T. (2010) Hay harvesting causes high orthopteran mortality. Agriculture, Ecosystems &amp; Environment, 139: 522-527. Humbert J-Y., Ghazoul J., Richner N., Walter T. (2012) Uncut grass refuges mitigate the impact of mechanical meadow harvesting on orthopterans. Biological Conservation 152: 96-101. Buri P., Arlettaz R., Humbert J-Y. (2012) Delaying mowing and leaving uncut refuges boosts orthopterans in extensively managed meadows: Evidence drawn from field-scale</p>	<p>Thank you, included.</p>
							<p>This subsection was strongly revised and widened, empassising impacts in both directions.</p>

Leslie Firbank	2	23	933		956	An important change of tone here, in that the argument goes from impact of land use on pollinators, to value of pollinators on agriculture. You may want to rethink the order of the text		This subsection was strongly revised and widened, emphasising impacts in both directions.
Colin Fontaine	2	23	933	24	956	to shorten the text, the horticulture section could be reduce with a reference to chap 3.4 where the case of commercial bumblebees for gree house use is well explained		Chapter 3 is cross referenced.
Maj Rundlöf	2	23	933	23	950	In this paragraph it could be suitable to mention the potential problems with moving pollinators for crop pollination, e.g. pathogen transfer between managed and wild bees and introduction of new genetic material. Or refer to a section on this <u>elsewhere in the chapter/report</u>		This point is added and relevant other chapter section is cross-referenced.
Scott Black	2	23	934	23	956	Bring in info from disease section about bumble bee disease transfer to bees outside greenhouses.		This point is added and relevant other chapter section is cross-referenced.
Liette Vasseur	2	23	935	23	950	I think you really need to update this. for exmample, pollination is a huge challenge especially in China because of the overuse of pesticides.		Case study from Chine is added.
Andreas Obrecht	2	23	935	23	950	This subchapter leads me to the question that while pollinators face difficult surroundings in greenhouses, there seems to be still enough pollination going on to keep the greenhouses productive...		Probably yes.
Liette Vasseur	2	23	936	23	939	You may want to update your data. For example, China has now 2.7 million ha of greenhouses (I work there and I am aware of this too); South Korea, 57444 ha, Japan, 49049, Turkey 33615 and Spain 52170 ha. <a href="http://ag.arizona.edu/ceac/sites/ag.arizona.edu.ceac/files/WorldGreenhouseStats.pdf">http://ag.arizona.edu/ceac/sites/ag.arizona.edu.ceac/files/WorldGreenhouseStats.pdf</a>		Thank you for the data, some examples are included.
Natacha Chacoff	2	23	936	23	937	please give an idea of the increment of the area destined to horticulture.		Could not find a good reference here.
Anne-Laure Jacquemart	2	23	938			Southern France		Corrected.
May Berenbaum	2	23	940	23	940	Might be a good idea to use scientific names for crop plants (e.g., there are four genera of "melon")		Will be considered in the next revision in face of the general IPBES formatting and editing requirements.
Andreas Obrecht	2	23	940	23	940	Is there some data how often greenhouses are closed systems?		Could not find a good reference here.

Georg Andersson	2	22	942	22	943	Perhaps making a reference to page 55 line 2586, that there may also be some problems with using comercial e.g. bumblebee hives for pollination.		Cross-referenced.
Felix Herzog	2	23	943	23	950	DELETE: "They HAVE TO FACE ... Pitts.Singer 2008)."	Not relevant in our context	I would still keep this part, since the mentioned effects are drivers of pollinators and pollination within the greenhouses.
Luisa Carvalheiro	2	23	945	23	946	adding a reference for this sentence would be good		Added.
Anders Nielsen	2	23	948	23	949	Rephrase sentence		Rephrased.
Luisa Carvalheiro	2	23	952	23	956	as indicated by the author, this section needs to be extended; another option is to remove completely this paragraph, as it will be discussed in more detail in other sections of the book		Section is extended.
Valerie Peters	2	23	952	23	956	This section belongs below with agroforestry? Or a tree crops section?		According to the new outline this subsection is a distinct part of the land manegement secttion.
Anne-Laure Jacquemart	2	23	952			add "pears"		Added.
David Evans	2	23	953	23	957	Lots of useful stuff from Keith Delaplane on quality of fruit set +/- bees. Link also to demand for migratory beekeeping for Kent (and elsewhere) apple orchards.		Study from Delaplane and Mayer, 2000 is included.
Anne-Laure Jacquemart	2	23	955			add a paragraph about solitary bees and their efficiency for many species (wild and cultivated)		Added.
Martha Groom	2	23	956			Extension of this section should include the use of Osmia bees in orchards. Common and often can be more effective than honey bees. If help is wanted on this section, I am willing to support this - just let me know.		Included, thank you.
Claudia Maria Jacobi	2		956		956	looking forward to this extension, especially works in the tropics with stingless bees.		Cross reference ois added to Chapter 2.5.2. (Stingless bee management).
Anders Nielsen	2	23	957	23	957	Raspberries are grown in plastic tunnells with the potential effects they might have on pollinator visitation. This could be a moment for discussion here		Found only the abstract of one study on this issue, however, unfourtunately could not reach the paper.

Yann Clough	2	23	958	23	974	The section on agroforestry crops needs substantial work. (1) It needs to highlight the context that agroforestry crops are increasingly managed as monoculture plantations (coffee, cocoa, rubber...). (2) the results that are cited are casually referred to and it is not usually clear what the findings really were (3) It focuses only on bees, which obscures other things, for instance that agroforests are beneficial for the conservation of bats (e.g. Harvey et al. 2007 Biodiv Cons). (4) State-of the art studies on the relative importance of shade trees are available, yet not cited. For instance, the relative impact on tree cover in coffee crops over other management interventions is reported in Boreux et al. 2013 PNAS.		Both references were considered and included.
Serena Heckler	2	23	958	23	974	<u>Many, if not most, traditional agricultural systems are examples of agroforestry. Many studies have been done of the great variety of traditional agroforestry systems to be found around the world (extending well beyond coffee and cocoa).</u>		That is probably true, but can you provide a synthetic reference?
Serena Heckler	2	23	958	23	975	<u>A short text could be added concerning argan-based agroforestry system in Morocco and pollination, after the example of coffee and cocoa from line 975 page 23:</u> "In southern Morocco, local Berber populations use their traditional knowledge on honeybee management within an argan-based agroforestry system. Selecting a specific site to place their hives, they encourage bees to cover the cultivated areas in order to pollinate argan trees in agricultural zones. By this way, traditional beekeepers improve both honey and argan production (Simenel)." <u>Source</u> : Simenel R. Les miels des forêts d'arganiers : une mosaïque de territoires cultivés pour un florilège de pollens. In Revue en ligne de l'IRD Dossiers thématiques de l'IRD, Des forêts et des hommes. Numéro spécial : Le miel en forêt [Electronic only media] ; Simenel R, Adam A., Crousilles A. & Amzil. La domestication de l'abeille par le territoire : un exemple d'apiculture holiste dans le Sud marocain [article in press]		Can you provide the reference for the published document, and preferably in english?

Serena Heckler	2	23	958	23	975	<p><u>This section focus on the impact of agroforestry systems on abundance and diversity of bees, but does not contain information on their impacts on pollination services. A short text could be add from line 975 page 23, after the case of argan tree forestry for example</u>: "Concerning pollination services, especially honey production, some indigenous peoples have noted a negative impact of agroforestry systems, especially coffee plantations. This can be an observed decrease, even the disappearance of, specific honey production, related to the disappearance of typical melliferous species that do not grow under the shadow of coffee trees. For instance, Kechifo people in Ethiopia no longer produce white honey, a locally famous product, since coffee plantation became prevalent in their forests. White honey could also be seen as an indicator of a multiple use of the forest (Verdeaux). Likewise, in southern India, the Kodagu peoples noted that honey production by the species <i>Listea floribunda</i>, formerly plentiful, became rare since the introduction of coffee monoculture (Barlagne)." <u>Sources</u> : Verdeaux F. Le miel, le café, les hommes et la forêt dans le sud ouest éthiopien. In Revue en ligne de l'IRD Dossiers thématiques de l'IRD, Des forêts et des hommes. Numéro spécial : Le miel en forêt [Electronic only media] / Barlagne C., Bérard L., Garcia C. &amp; Marie-Vivien D. Miel, indication géographique et biodiversité Des liens émergents complexes [Non published material]</p>		Can you provide the reference for the published document, and preferably in english?
Liette Vasseur	2	23	959			<p>Need more references. E.g. Klein et al. 2003. Blackwell Publishing Ltd. Pollination of <i>Coffea canephora</i> in relation to local and regional agroforestry management. J. Applied Ecology 40: 937 (which you have in the reference but didn't use it); Priess et al. 2007. Ecological Applications 17: 407-417.</p>		There are a lot more references, but we are not reviewing the topic here, and therefore give only the refences that tend to synthesize it.
Scott Black	2	23	959	23	975	<p>There is more information that could be added as this is an important aspect of pollinator conservation. Happy to provide more if desired</p>		If this goes beyond coffee and cocoa, we are open to receiving more references.

Jerome Casas	2	23	959			point 2.2.8. Agroforestry. It is common knoweldge (sorry, I could not locate a reference for that, being away from work) that several temperate agroforestry systems provide additional food (syrphids on aphids in trees, pollen for bees and other pollinators) besides subsidiary help to natural enemies of pests. Maybe some elements are given in a paper of Dupraz et al. on natural enemies		Could you provide exact references?
Andreas Obrecht	2	23	960	23	974	This is a very intersting subchaper - if more examples of agroforestry systems can be included this would be great		Can you give precise examples?
Valerie Peters	2	23	960	23	962	add in something like- Agroforestry benefits biodiversity because most structurally similar to natural forest and for important food resources but global trend is still removal of shade and trees from crops like coffee/cocoa (Tschardt et al. 2011. Multifunctional shade-tree management in tropical agroforestry landscapes- a review. Journal of Applied Ecology 48: 619-629.		Included.
Natalia Escobedo	2	23	961	23	963	A few years ago we studied the diversity of bees that visit cardamom flowers in an agroforestry system that surrounds Lachúa National Park. We found 21 species of visiting bees and cardamom pollen was collected importantly for at least 13 species. We also found a seasonal pattern in the pollen use, suggesting that cardamom crops could be a complementary pollen source and a floral attractor for potential pollinators. Regrettably, we only have gray literature about this studies, but since there seems to be little information about the effect of agroforestry in pollinators, I thought it was worth mentioning.	You may look for my degree thesis here: <a href="http://biblioteca.usac.edu.gt/tesis/06/06_3017.pdf">http://biblioteca.usac.edu.gt/tesis/06/06_3017.pdf</a> I also have a few abstracts published in abstract books from international meetings. If you consider them useful, please contact me.	We will cite rather peer-reviewed papers that actually show such trend - thanks.
Valerie Peters	2	23	961	23	962	Maybe change to...The effects of these practices on the diversity of <i>pollinators and pollination services</i> have been studied principally for two tropical crops: coffee and cocoa. In addition there is a great table in Leaky 2014. The Role of trees in agroecology and sustainable agriculture in the tropics. Annual Review Phytopathology 52: 6.1-6.21, on page 5 and this could be modified for just the groups that may have role in coffee/cocoa pollination plus other studies could be added		Done - thanks.

Marina Rosales Benites de Franco	2	23	962	23	962	I suggest to use cacao instead of cocoa		Done.
Luisa Carvalheiro	2	23	962	23	962	Brazil nut is another interesting system that could be mentioned. Motta Maués M. 2002. Reproductive phenology and pollination of the brazil nut tree n Eastern Amazonia. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.245-25; Cavalcante et al. 2012 doi:10.1155/2012/078010		Interesting, though agroforestry is mentionned only marginally.
Anne-Laure Jacquemart	2	23	962			add more about "new commercial tropical fruits"		Unclear comment.
Valerie Peters	2	23	963	23	963	Maybe add in one sentence and citations before coffee paragraph regarding what is known in general for within farm agroforest management practices that increase pollinator diversity, and not just for bee studies? For example: Pollinator richness and abundance respond positively to increased species richness of shade trees, blossom cover of noncoffee flowering plants (Klein et al. 2003. Pollination of Coffea canephora in relation to local and regional agroforestry managment. Journal of Applied Ecology 40: 837-845), increased canopy cover (Jha and Vandermeer 2010 Impacts of coffee agroforestry management on tropical bee communities. Biological Conservation 143:1423-1431), the choice of shade tree matters too (Bhagwat et al. 2008. Agroforestry: a refuge for tropical biodiversity? Trends in Ecology and Evolution 23: 261-267- this paper also has some good figure options that might be examples for this section)		Done.
Liette Vasseur	2	23	964			Change (Ricketts 2004)... to Ricketts (2004) show that in Costa Rica...		ok
Valerie Peters	2	23	964	23	964	change to...actually a shrub that <i>benefits from</i> shade from the canopy trees...		done

Valerie Peters	2	23	964	23	969	<p>Maybe important to mention also that in some experiments bee diversity did not relate to increase of coffee fruit set but in some cases to coffee fruit weight. Different flowering phenology patterns of coffee may account for this- dense flowering reduces pollinator movements (increased fruit set in <i>C. arabica</i> should be from cross pollination). Bees still benefit coffee but may be due to increased fruit weight or size. Roubik (2002) found coffee pollination benefit was due to abundance of one species only and for coffee fruit weight (The value of bees to the coffee harvest. Nature 417). Classen et al. (2014) found bee benefit for fruit weight not fruit set. (Classen et al. 2014. Complementary ecosystem service provided by pest predators and pollinators increase quantity and quality of coffee yields. Proceedings Royal Society B. 281). In Peters et al. 2012, increase in bee diversity did not result in higher fruit set but fruit weight was not measured. Peters and Carroll 2012. Temporal variation in coffee flowering may influence the effects of bee species richness and abundance on coffee production. Agroforestry systems.</p>		<p>Interesting, though we are limited in space and cannot go in that many details.</p>
Marina Rosales Benites de Franco	2	23	965	23	965	<p>I propose to consider after "nearest forest": The diversity of social bees decreased with distance to forest, whereas the diversity of solitary bees was correlated with increasing light intensity and increasing percentage of flowering herbs within an agroforestry system.</p>	<p>Klein, A.M., Dewenter, S., Tschardtke, T. (2003). Pollination of <i>Coffea canephora</i> in relation to local and regional agroforestry management. <i>Journal of Applied Ecology</i> 40, 837–845. <a href="http://onlinelibrary.wiley.com/doi/10.1046/j.1365-2664.2003.00847.x/full">http://onlinelibrary.wiley.com/doi/10.1046/j.1365-2664.2003.00847.x/full</a> on February 26, 2015</p>	<p>Included</p>
Anders Nielsen	2	23	965	23	970	<p>Rephrase paragraph</p>		<p>Done.</p>

Penelope Whitehorn	2	23	965	23	970	What do the trees provide the pollinators? Nesting sites? Some explanation of why these correlations occur is needed here.		Done.
Liette Vasseur	2	23	966			is it Ricketts 2004 or Ricketts et al. 2004?		To be fixed.
Liette Vasseur	2	23	971			Same issue of reference: Hoehn et al. (2010)		To be fixed.
Yann Clough	2	23	971	23	974	The text should specify that the study of Hoehn on pollinator diversity effects on pollination was conducted in a cocoa agroforest but with pumpkins (one of a number of food crops cultivated in these agroforests).		done
Martha Groom	2	23	971	23	973	The paragraph misses an opportunity to directly cite a nice study showing pollinator limitation in cacao plantations. Could alter to read "There are fewer studeis on cocoa crops, though Groenveld et al. 2010 showed experimentally that pollen limitation greatly reduces yields in Indonesia, indicating that practices that could increase the midge pollinator populations could have large impacts on yield and farmer income. Further, Hoehn et al. 2010 found... (rest as written)"	Citation: Goeneveld, J.H., Tschardtke, T., Moser, G., Clough, Y. 2010. Experimental evidence for stronger cacao yield limitation by pollination than by plant resources. Perspectives in Plant Ecology, Evolution and Systematics 12:183-191.	Very good, thanks.
Valerie Peters	2	23	972	23	974	If this line is referring to coffee, it may not be true, and also bees are not important for cocoa, lots of other agroforestry system crops we don't know, maybe eliminate this statement?		Improved
								ok
Felix Herzog	2	23	973	24	986	(see comments above on Executive summary)		ok
Leslie Firbank	2	23	976	24	986	Rather bland and predictable. Is this true across the world, or does the evidence come largely from temperate systems? What about risks of land degradation and abandonment? You need to give decision makers more to go at than just intensive agriculture is bad		More details, recommendations on diversified farming systems, and issue of land abandonment is included.
Leo Galetto	2	23	977	23	987	This section can be increased with some conclusions and recommendation for management of biodiversity, pollinators and pollination.		Done.
Jana Vamosi	2	23	977			Can the conclusions get more specific with regards to suggestions? I.e., can something as simple as diverse hedgerows be a good way forward?		Some more concrete suggestions are provided.

Thomas Walter	2	23	978	23	978	replace treats by threats		Corrected.
Mercy Gichora	2	23	978	23	978	The word 'threat' is mis-spelt		Corrected.
Diane Castle	2	23	978	23	979	<b>Proposal:</b> Delete the word "nowadays" <b>Rationale:</b> Does not add any value		Corrected.
Nadine Azzu	2	23	978	23	978	"threats"not "treats"		Corrected.
Thomas Brooks	2	23	978			"treats"? - presumably "threats"?		Corrected.
Mercy Gichora	2	23	979	23	979	Remove the definite article 'the' from beginning of sentence.		Corrected.
Erik Andersson	2	23	979	23	987	I would like to have more details on why this is the case, which are the habitat dimensions affected by what changes? Food resources, nesting sites, ease ov movement and navigation... Details would help answering what is most critically needed <del>where</del>		More details are provided.
Anne-Laure Jacquemart	2	23	979			add some sentences about the increases in field sizes and in monocultures		Effects of monocultures, land sharing/land spering problems are discussed.
Mercy Gichora	2	23	980	23	980	Make the meaning of sentence more clear by inserting the word 'while' after biodiversity, removing the comma that follows and changing the tense of the next words 'influence' and 'reduce' to read 'influencing' and 'reducing' respectively. The phrase would thus read - decrease dramatically the biodiversity while reducing		Corrected.
Mercy Gichora	2	23	981	23	983	The sentence is very long and loaded with different pieces of information. Consider breaking it into more than 1 sentence.		Rephrased.
Mercy Gichora	2	23	982	23	982	The word 'moving' is mis-spelt		Corrected.
Nadine Azzu	2	23	982	23	982	you mean "remoVing"?		Corrected.
Mercy Gichora	2	23	983	23	983	The word 'flowering' is mis-spelt		Corrected.
Mercy Gichora	2	23	983	23	984	There is a gap in the sentence since it is not mentioned what is found in huge amounts. The sentence is incomplete.		Corrected.
Nadine Azzu	2	23	983	23	984	Could you rephrase this sentence?		Corrected.

Peter Campbell	2	23	984	24	986	The statement that a move towards extensive management practises eg Organic farming could be beneficial for pollinators needs to be balanced with a statement about the potential knock-on effect of needing to put more semi-natural land under cultivation in order to maintain yields and feed a growing population. More land under cultivation would not be good for pollinators. See Chapter 6!!! A group of researchers at Stanford University in the United States have reported that without the advances in agricultural technology since 1960 (ie extensive agriculture), we would need more than twice as much land (almost 2 billion ha more land) to grow all the food we produce today ( <a href="http://www.pnas.org/content/107/26/12052.">http://www.pnas.org/content/107/26/12052.</a> ) or 2 Billion people from todays global population that we would not be able to feed. When discussing options of extensive versus intensive agriculture for pollinators this global food security and land use context needs to be given!		With some extensions we have referred to it.
Richard Corlett	2	23	984			temporary not temporal		Corrected.
Diane Castle	2	23	984	24	986	<b>Proposal:</b> Modify sentence from "Extensive management practices eg organic farming has the potential..... " to "Creating a more diverse agricultural landscape through extensive farming practices such as organic farming or the use of agri-environment management practices has the potential....." <b>Rationale:</b> Better reflects the options discussed in the preceeding sections and other chapters (Chapter 2 page 20 line 807 - 822 and Chapter 6 page 23 line 276-300.)		Corrected.
Mercy Gichora	2	24	985	24	986	Use plural form of 'has' to read "have" and change order of the following words so as to read - 'have the potential to maintain rich..' ending sentence after the word 'plants'. Make a concluding sentence from remaining part of sentence as follows: 'Such gains, however, strongly depend...'		Corrected.
Anders Nielsen	2	24	987	24	987	Add reference(s) at the end of the sentence		Sentence is deleted.

Serena Heckler	2	29	1214	39	1793	This section would benefit from the inclusion of investigations into alternatives to chemical pesticide use. E.g. <u>2.3.8bis Traditional pest management approaches to protect pollinators are being investigated as alternatives to chemical applications. In Nagaland, India, for example, effective indigenous pest management practices used by beekeepers include cow dung (effective against wax moth, wasp, lizard) and newly developed innovations such as the use of polythene sheets to protect against lizards and tree frogs (Singh 2014).</u>   REF: Singh, A K. 2014. "Traditional Beekeeping Shows Great Promises for Endangered Indigenous Bee." Indian Journal of Traditional Knowledge, 1–7.	info added in section 2.3.6
Les Davies	2	29	1214	37	1674	I can't see any refererence to the toxicity of non-active ingredients in pesticide products to bees in this section - three is evidence that surfactants are toxic and recent research ( <a href="http://pubs.acs.org/doi/abs/10.1021/jf505634x">http://pubs.acs.org/doi/abs/10.1021/jf505634x</a> ) suggests that trisiloxane surfactants can be detected in a pollinator-related matrix (almond flowers)	added
Lennard Pisa	2	30	1214	39	1792	I guess it is a matter of choice but in my opinion part of the <u>pesticide use belongs to the section on agricultural</u>	aligned under agriculture section in newe layout
Lennard Pisa	2	30	1214	39	1792	practices. But in another way pesticides are different from other agricultural activity and urban biocide use is again different	see 730
Lennard Pisa	2	30	1214	39	1792	I see the problem of the authors making the division in sections, I have no suggestion	see 730
Lennard Pisa	2	30	1214	39	1792	Apart from: try to make the sections as coherent and mutually exclusive as possible.	see 730
Teruyoshi Nagamitsu	2		1214		2165	The effects of pesticides on pollinators have bee often reviewed recently. Evidence is summarized well based on these reviews.	thankyou
NagLaa Loutfy	2	29	1216	32		The chapter is well organized, providing a good coverage of main issues. Nevertheless, the report lacks some informative details and examples drawn from various parts of the world. This is particularly true in sections 2.3 and 2.7	

NagLaa Loutfy	2	29	1216	33	1421	Section 2.3 is probably one of the most important sections of the report portraying the impact of pesticides on pollinators. However, this section seems to give a sort of superficial view of pesticides impact. On the one hand it failed to include major pesticides that affect pollinators including fipronil, a phenylpyrazole pesticides with reported massive killing of bees.		need reference I can't find reference for massive killings beyond those identified in the incident section
Liette Vasseur	2	29	1216			Change "acaricides etc)" to acaricides, etc.)		ok
Liette Vasseur	2	29	1216	29	1225	This paragraph contains many run off sentences with few references. There is a need to improve its readability.		
Scott Black	2	29	1216	39	1799	I disagree with some of the fundamental assumptions made in the pesticide chapter. Case in point the chapter authors have an innocent until proven guilty methodology. I tried to honor the existing structure while responding to this and other concerns. That said I do think this is a departure from the rest of chapter 2 and I think you should strongly consider revising heavily. I also address chapter 6 pesticide issues and the figures all below.		
Jochen Freund	2	29	1216	46		The section about pesticides appears well researched and provides a lot of details, which warrants it to be a section separate from 2.2. I wonder whether the amount of illustrative material (figures and tables) could be slightly reduced to be more balanced with the rest of the chapter.		ok review at SOD
Mario Marcos Espirito	2	29	1216	39	1795	Section 2.3 is quite long and detailed. Consider reducing it.		ok review at SOD
Peter Campbell	2	29	1222		1224	"Indiscriminate pesticide use" is misleading and confusing term. I would suggest "Inappropriate pesticide use would be better"		ok -see also comment 745 wording amended
Scott Black	2	29	1223	29	1223	More pesticides are used in the US for nuisance mosquito control than for control of vectors		added
Liette Vasseur	2	29	1224			"Recently, the role of sub-lethal...": recently? It is over 20 years that researchers have been working on sublethal doses!		
Scott Black	2	29	1224	29	1224	Bee mortality has occurred with legal regulated pesticide uses as well as "indiscriminate use". Consider removing "indiscriminate."		ok -see also comment 742 wording amended

Martha Groom	2	29	1224	29	1224	Need to insert the word "decreased" before "foraging ability" to make meaning clear		changed to impaired
Les Davies	2	29	1224			Sentence re neonicotinoids is nicely put.		thankyou
Thomas Steeger	2	29	1226	29	1226	consider ". . . Such as impaired foraging ability."		changed to impaired
Scott Black	2	29	1227	29	1227	The final sentence in the topic paragraph tries to cover too much about this complex issue. I would suggest adding a few more lines of context. For example: "...Recently, the role of sub-lethal effects of pesticides, particularly the neonicotinoid group, as a driver of pollinator decline has undergone increasing scrutiny. This scrutiny is in part caused by their increasing use, their high toxicity, and their chemical properties which increase the potential for exposure to pollinators. Still, the knowledge gaps about neonicotinoids, combined with conflicting research results has led to a much polarised debate."		additional clarification added
Joseph Tzanopoulos	2	29	1228	29		If the authors want to use boxes such as the one starting at page 29 line 1228, they should consider using boxes on all the subchapters. The idea of using boxes such as this box (pesticide use in a nutshell) is a very good idea and it helps the reader to grasp the main message. I strongly recommend their use		ok for SOD
Flávia Viana-Silva	2	29	1228	29	1253	Box 2.3.1 covers only direct exposure to pesticides and HQ indicates risk related to exposure by contact. In fact there are other approaches depending on the route of exposure. So, even for foliar applied pesticides there are indirect exposures. In those cases, I suggest that other approaches being mentioned, as by e.g. ETR (Exposure Toxicity Ratio), which indicate risk by oral exposure related to the consumption of residues of the active ingredient. Reference: European Food Safety Authority, 2013. EFSA Guidance Document on the risk assessment of plant protection products on bees ( <i>Apis mellifera</i> , <i>Bombus</i> spp. and solitary bees). EFSA Journal 2013;11(7):3295, 268 pp.,doi:10.2903/j.efsa.2013.3295		ok text amended to include ETR

Maj Rundlöf	2	29	1231	29	1232	I would not say that toxicity has a fixed value (even if assuming that only one species and life stage is considered), because it can differ depending on for example how hard a bee needs to work during exposure (see Mommaerts et al. 2010). Mommaerts, V. et al. (2010) Risk assessment for side-effects of neonicotinoids against bumblebees with and without impairing foraging behaviour. Ecotoxicology 19: 207-215. It might be implied, but could be good to specify that this is true given the specific test conditions.		ok add under specified conditions
Scott Black	2	29	1233	29	1234	While this section is only risk in a nutshell it seems worth noting that there are other components of risk beyond the basic hazard (of an a.i.) + exposure = risk. Consider mentioning that a whole host of issues go into determining risk including the chemicals break down products (metabolites) as well as mixtures (tank mixes, full formulations, and environmental mixtures). The current focus on the active ingredient or active substance should be expanded. Furthermore, the statement that toxicity has a fixed value seems an oversimplification. Most risk assessors are moving towards probabilistic methods and not using a single toxicity value as they recognize toxicity also varies. Consider language such as "...is driven not only by the toxicity of the substance(s) at issue but also by chemicals' level of exposure to the pollinator. The exposure level is highly variable." NOTE: I raise this issue again later and provide a reference		Probabilistic risk assessment are based on species differences (SSD) rather than within species variability in toxicity. The paragraph will be rephrased to cover products as well as actives. The risk is based on the toxicity of the products or products in the case of tank mixes, environmental residues and the exposure to these
Piotr Medrzycki	2	29	1233			add "median" before "lethal" - twice in this line		ok
Keng Hong	2	29	1233	29	1234	Insert 'median' before a) "Lethal Dose" and b) "Lethal Concentration"; c) insert 'active ingredient (a.i.) of the chemical/' between "the" and "substance"; and d) add 'and irritancy' after "impairment".		ok

Gérard Arnold	2		1233		1234	L 1233. 'The risk posed by pesticides is driven not only by the toxicity (hazard) of the active substance, which has a fixed value, but also by the level of exposure of the foraging pollinator to the active ingredient'. This sentence is not clear and may suggest that only foragers could be exposed to the pesticide. This is not the case for social bees where the foragers are not the only insects exposed to pesticides. For example, in the case of systemic insecticides, pollen foragers relate the contaminated pollen back to the hive as they do not consume it. It will be stored and the amount consumed by the nurse bees and larvae will be related to their needs. In addition, pollen stored in the reserves could be used to insure the breeding of young bees after the wintering period. Nectar foragers consume only a portion of the contaminated nectar they collect which depends on the distance they have traveled and the energy they have spent to achieve these flights. The rest will be converted into honey and consumed by all the bees of the colony, especially for generating heat to maintain constant the brood temperature during the active season or to maintain the temperature of the colony during winter.		reword to expand beyond foragers as all stages may be exposed depending on the persistence of the residues
Scott Black	2	29	1234	29	1234	remove "foraging", as some exposures do not occur during foraging		ok
Thomas Steeger	2	29	1234	29	1234	"by the level and duration of exposure"		ok
Madeleine Chagnon	2	29	1235	29	1236	ADD cast (queen-worker) - the development stage		included within definition of individual
Scott Black	2	29	1236	29	1236	As sublethal effects are so diverse it seems worth adding a few more examples. Specifically, the sentence could state "...for example impaired memory, reduced foraging , reduced brood production and survival, and impaired navigation."		amended

Scott Black	2	29	1236	29	1236	Consider adding a sentence regarding how formulation and other factors can alter toxicity: "The toxicity of a formulated pesticide product can differ from that of the active ingredient and is important in understanding risk." Reference: Mullin, C.A. et al. In Press. The formulation makes the honey bee poison. Pesticide Biochemistry and Physiology. doi: 10.1016/j.pestbp.2014.12.026		added at L1364
Thomas Steeger	2	29	1236	29	1236	after sublethal effects consider "(i.e. , Effect Dose [ED <sub>50</sub> ] or Effect Concentration [EC <sub>50</sub> ])		ok
Marina Rosales Benites de Franco	2	29	1237	29	1237	I suggest to consider: ... behavior, biology and genetic of the pollinator species		added species, developmental stage etc and further elaborated
Madeleine Chagnon	2	29	1239	29	1239	and their métabolites		amended
Thomas Steeger	2	29	1241	29	1242	consider "Exposure may be to one or a mixture of pesticides, which can be applied in sequence or in combination (e.g., tank mix)		added
May Berenbaum	2	29	1241	29	1245	Exposures through contaminated soil or water?		expanded to include
Colin Fontaine	2	29	1242	29	1242	It is now acknowledged that most pollinators forage on numerous plant species. Ref Waser, N. M., Chittka, L., Price, M. V., Williams, N. M., & Ollerton, J. (1996). Generalization in pollination systems, and why it matters. Ecology, 77(4), 1043-1060		ok
Mercy Gichora	2	29	1244	29	1245	Box 2.3.1. Use plural form of word 'factor' to read 'factors'. Remove comma after 'management' and add the word 'and' before 'availability' . Insert an opening bracket before the word 'such'. This part of sentence will thus read - cropping management and availability of alternative untreated forage (such as ... )'		ok
Scott Black	2	29	1245	29	1245	It seems worth noting the importance of a chemical's properties to exposure: "The properties of the pesticide also affect exposure for instance the persistence of a pesticide impacts the amount of time the chemical is available for exposure." Volatility and systemic action are two other good examples.		included

Claudia Maria Jacobi	2		1247		1247	does Ha correspond to 'hectare'? It is usually abbreviated as 'ha'.		ok
Scott Black	2	29	1248	29	1250	The use of a Hazard Quotient is a very blunt measuring tool that could miss many important risks associated with a pesticide. As a first tier evaluation tool many chemicals of concern could be culled out of the assessment process, thus not addressed in later more refined risk assessment tiers. If a risk assessment methodology is being sought, consider reviewing <i>Assessing Risks to Endangered and Threatened Species from Pesticides</i> an National Research Council publication that applies a first tier risk tool that casts a wider net which helps ensure that chemicals of concern are not missed as they might be through the use of a HQ. As this report notes the risk of sublethal effects is much polarized, yet the use of an HQ does not evaluate sublethal effects.		need both HQ and TER- importance of validation -source document ordered
G�rard Arnold	2		1248		1250	L 1248. 'The Hazard Quotient (HQ) is used in risk assessment in Europe for foliar applied pesticides'. What is the point here to mention the HQ, which is only usable for the foliar applied pesticides (in Europe)? What about for systemic pesticides used in seed treatment, for example? If the question of risk assessment needs to be addressed here, it would be interesting to quote the EFSA Guidance Document on the risk assessment of plant protection products on bees (EFSA, 2013).		expanded and elaborated
Thomas Steeger	2	20	1250	29	1250	consider adding, "but in general such approaches rely on ratio of exposure to toxicity and typically rely on point estimates of each (e.g. , the highest estimated exposure value and the most sensitive toxicity estimate).		ok
Marina Rosales Benites de Franco	2	29	1250	29	1251	I suggest the following: what are the direct and sublethal effects of field - realistic levels of exposure and persistence on populations pollinators to pesticides under typical conditions?		ok

Graciela Rusch	2	29	1250	29	1251	It is important to provide a wider context of the problems related to the use of agro-chemicals, including the long-term effects (largely unknown because there is still not enough exposure time/evidence), relate to other fields of out-spread chemical and biological control of diseases that lead to pathogen/(or other organisms) resistance and effects on human-health. The field-realistic exposure is not the only challenge associated with the wide-spread application of agro-chemicals, the long-term effects (on pollinators and other organisms) is		unclear on how to deal with this comment; deals with interactions
Colin Fontaine	2	29	1250	29	1251	it should be acknowledged clearly that a very large part of the current knowledge is restricted to honeybees + few species of bees		ok
Scott Black	2	29	1252	29	1253	Consider changing the stated challenge. The current challenge is one very narrow component of the larger "pesticide risk" topic of the text box. Furthermore, the terms "field-realistic" and "typical conditions" are highly variable. Risk assessment is designed to respond to variability and manage uncertainty. Reviewing the chapter, the challenge that I see arising is at what point should we respond to risk? The reviews you cite in section 2.3.4.3 generally agree that there are sublethal effects but their conclusions beyond that differ some calling for regulatory action, and others calling for greater research. Therefore the statement could be: "The challenge, or area of greatest debate, is at what point is there sufficient evidence to respond to risk? For example, while sublethal effects are well documented, there is disagreement as to if these effects would be replicated in the field." Another challenge that could be raised is: "The challenge of pesticide risk assessment and regulation is to balance pest management needs with necessary protection for pollinators as well as broader ecological systems."		ok but where does balance sit in document of challenge of balance food security and pesticide use in report- this is drivers section
Colin Fontaine	2	29	1256	30	1293	this part could be reduced, not much information about pollinator or pollination is given		aim to set science on pesticide use

Maximilian Weigend	2	29	1257	39	1798	Overall a very nice summary, it would be nice to know whether - in the absence of hard data - there is an indication as to whether other pollinator groups are likely to be less, or more susceptible to all, or specific pesticides.		aim of box was to highlight exposure may be key factor
Flávia Viana-Silva	2	29	1259	29	1260	As we could see in FAOSTAT 2014, in Brazil the total tonnage of pesticides used in agriculture is also increasing over time. I suggest the inclusion of Brazil between the examples due to its importance as a crop producer country.		ok
Anne-Laure Jacquemart	2	29	1260			"stable " add since ? 60's ?		since the 90s FAOSTAT 2014
Liette Vasseur	2	29	1261			change "data is" for data are since data is plural (datum singular). And you have it right online 1263!		ok
Gérard Arnold	2		1261		1262	L 1261. 'the total tonnage of pesticides used in agriculture is stable or increasing over time'. On insect pollinators, which is most important is not only the quantity, but toxicity of the pesticides; e.g. an analysis of the relative toxicity (LD 50) of different insecticides on DDT shows that thiametoxam is 5400 times more toxic, fipronil 6475, imidacloprid 7297, clothianidin and deltamethrin 10 800 (Pisa et al., 2014).		ok -but this section relates to all pesticides not insecticides specifically which is highlighted in 2.3.2
Thomas Steeger	2	29	1263	29	1263	...data are incomplete"		ok
Anne-Laure Jacquemart	2	29	1263			add situation in Europe		already included as stable or increasing
NagLaa Loutfy	2	29	1265	30	1266	Add the following paragraph :Data from developing countries are very few and limited to information on some pesticides residues in honey, pollen and bees samples. Therefore it is hard to evaluate the situation regarding effect of pesticides on pollination services. In this respect, developing countries should have their own initiative, and to develop their capabilities to have their share in this endeavour.	the report should refer to the situation in developing countries regarding pollinators/pollination and pesticides effects	this is why there is a spotlight in Africa to address these issues

Scott Black	2	29	1265	29	1265	This section could recognize that tonnage is only one measurement of pesticide use trends. Tonnage is not representative of a reduction in overall risk. I raise this point as many new chemistries are effective at lower application rates. Lower efficacy rates against pests can also mean these lower amounts are also of concern to beneficials including pollinators.		ok -this is highlighted in 2.3.2 which is specific to pollinators
Thomas Steeger	2	29	1265	29	1265	consider replacing "uptake of" with "increase in"		ok
Thomas Steeger	2	29	1265	29	1267	Where data are available for developing countries, pesticide use has increased rapidly . . . over the broad spectrum of toxicity <u>some pesticides . . .</u>		unclear on how to deal with this comment;
G�rard Arnold	2		1267		1267	L 1267. 'international consensus over the level of hazard posed by some pesticides has often not been reflected'. What is the meaning of this sentence (reflected?). Not clear.		reworded
Nadine Azzu	2	30	1268	30	1268	unfinished sentence		ok clarified
Anne-Laure Jacquemart	2	30	1268			add sentences about "neonicotinoid "war" in Europe" and about the cumulative effects of several pesticides		this is dealt with later in section
Natacha Chacoff	2	30	1269	30	1269	It could be useful in this figure to see if there was an increase in the area cultivated with oilseed rape. The use of pesticides are for the year but if there was an increase in the cultivated area, then the use/ha probably did not change.		info added to figure 2.3.1
G�rard Arnold	2		1271		1271	L 1271. Figure 2.3.1. The Figure 2.3.1 has very limited value since it covers only one country (UK) and agricultural land greater than 100 ha, which excludes a lot of use. I kindly suggest that the authors consult the synthesis of Simon-Delso et al., 2014 which presents more general figures of interest and at a wider scale: e.g. Figure 2, which shows the comparative evolution of different amounts of neonicotinoid insecticides actually used since 1990, in 4 countries: Britain, Sweden, Japan and California. Or Figure 3, which shows cumulative data.		100 ha is not a high cutoff value for total usage of a pesticide when a single field may be 20ha; we also need to consider insecticides beyond neonicotinoids
Thomas Brooks	2	30	1272	30	1278	An additional important citation here would be Simon-Delso et al. (2015; <a href="http://link.springer.com/article/10.1007/s11356-014-3470-y">http://link.springer.com/article/10.1007/s11356-014-3470-y</a> ) in Environ Sci Pollution Res		added

Madeleine Chagnon	2	30	1276	30	1276	van der Sluijs et al, 2013		cited
Thomas Steeger	2	30	1276	30	1278	are you saying that the "root uptake by wild plant and crops" is contributing to persistence?		reworded
G�rard Arnold	2		1276		1277	L 1277. 'Their persistence in soil and water and through root uptake by wild plants and crops, into pollen and nectar potentially representing a significant source of exposure has led to concerns that they pose a potential unique, chronic sublethal risk to pollinator health'. It is strange at this point to mention 'Concerns' and not to indicate the ban of neonicotinoids and fipronil taking place in European Union, at least. Thus, the re-evaluation of three neonicotinoids and fipronil by EFSA led the European Commission to order a ban of these molecules for 2 years. This information seems to me important enough to be brought to the attention of the readers of the IPBES report. In France, as soon as 2003, after a two-year expertise by a scientific and technical committee, the French Ministry of Agriculture has suspended the use of imidacloprid and fipronil on some crops visited by bees (see Maxim and van der Sluijs, 2013).		moratorium already included in section; reviews elsewhere have not come to same conclusion, e.g. Australia
Liette Vasseur	2	30	1280			Change "appropriately, e.g. in an ..." to appropriately, for example, in...		ok
Nadine Azzu	2	30	1280	30	1282	Don't think IPM programmes see pesticides as an "important tool for the sustainable intensification of crop production"? FAO definition: Integrated Pest Management (IPM) means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.		reworded

Graciela Rusch	2	30	1280	30	1284	It is also important to stress that it may be difficult to define the 'appropriate' use level in biological systems when (sub-lethal) effects are long-term, side-effects not fully understood, and levels of agro-chemical contents technically difficult to detect.		this section is about the scale of any risk assessment globally; residue detection is not usually technically challenging it is the interpretation of the residues which is challenging in relation to effects on the colony or population;
Thomas Brooks	2	30	1280	30	1282	Another important citation here is Furlan & Kreutzweiser (2015) Environ Sci Pollution Res (open access at <a href="http://link.springer.com/article/10.1007/s11356-014-3628-7">http://link.springer.com/article/10.1007/s11356-014-3628-7</a> ).		reference added
Felix Herzog	2	30	1282	30	1283	DELETE: However, others consider pesticides ...	this is the case also in IP production. There are lots of other measures and pesticides come last and only if economically justified. See e.g. Lefebvre et al. 2015 DOI 10.1007/s13593-014-0237-2	reference added
Scott Black	2	30	1282	30	1285	This comparison of IPM to last-resort with mention of organic strikes me as an ineffective and incorrect comparison. Organic production can use IPM. Some conventional IPM plans have pesticides as an important tool yet still use them as a last resort. What is the goal of this comparison? I recommend cutting the sentences as the following sentence ("Around the world ...") could initiate the paragraph.		reworded

Gérard Arnold	2		1282		1282	L 1282.'When used appropriately: The issue is not only about proper usage, but also about the quality of the registration of pesticides. This last question is completely ignored here, while it is crucial to maintain the survival and activity of pollinators. Thus, a scientific opinion of EFSA (2012, <a href="http://www.efsa.europa.eu/en/efsajournal/doc/2668.pdf">http://www.efsa.europa.eu/en/efsajournal/doc/2668.pdf</a> ) has shown that e.g. for systemic insecticides used as seed treatment, the experiments carried out in semi-field and field conditions during the procedure for their registration were not appropriate. In Europe - and probably all over the world - the approval of these molecules was based on unsuitable toxicity assessment methods. This is why for the registration of such products, more appropriate methods must be developed and used in the future (EFSA, 2013).		the EFSA scientific opinion lays out options for risk assessment; it does not state that risk assessment approaches currently used was based on unsuitable toxicity assessments but adds layers; the EU bee guidance document is not yet adopted in Europe showing the challenges to adopt such an approach
Liette Vasseur	2	30	1283	30	1288	Rework this sentence. Too many ideas and references are all over the place.		reworded

Gérard Arnold	2		1284		1284	L1284. 'An important tool for the sustainable intensification of crop production. This issue is controversial, especially for the neonicotinoids. In France, for example, a large proportion of crops such as sunflower, maize and cereals were rapidly treated with seed-dressing products, even when pest control was rarely needed, as seen in the case of sunflowers and highlighted by the Technical Center for Oilseed Crops (CETIOM, France): 'sunflower has a low attractiveness for beetle larvae and the time lag during which the plant is sensitive to these larvae is relatively short'. Furthermore, for 'most of the areas where sunflower is cultivated in France', the risk is 'low or zero' (CETIOM, 2011, in Maxim and van der Sluijs, 2013). In France, after the ban of imidacloprid (and fipronil) on maize in 2004, the data available show that the seed-dressing ban is not directly correlated with productivity: 2007 was the best year in over a decade. For maize, production was worst not after 2004, when Gaucho® was banned on this crop and RégentTS® on all uses, but in 2003, when a major heatwave hit Europe. Beekeepers contended that, because not all maize crops in France were seed dressed, maize could be cultivated without seed-dressing insecticides (Maxim and van der Sluijs, 2013). In the UK, yields of oilseed rape were the same pre-1994 (when no neonicotinoids were available) as they are today, where almost 100% of the crops are treated by those products (Parry & Hawkesford 2010; Defra, 2012 cited by Goulson, 2013).		statement referenced and highlighted as may be considered and contrary view also proposed; losses in UK and Germany on individual fields /areas are up to 30-50% after the neonic restriction and some reduction in areas sown (yield only relates to plants that are not resown) <a href="http://www.seedtoday.com/articles/Neonic_Pesticide_Bans_Hitting_Europe_s_Oilseed_Rape_Production-146275.html">http://www.seedtoday.com/articles/Neonic_Pesticide_Bans_Hitting_Europe_s_Oilseed_Rape_Production-146275.html</a>
Scott Black	2	30	1287	30	1287	Consider changing the term "safe use" to "careful" or "responsible." EPA generally does not use the term safe as pesticide use is determined through cost benefits and some level of risk is expected and accepted in order to achieve the desired pest control		reworded
Nadine Azzu	2	30	1287	30	1288	the reference to FAO Document Repository is not a proper reference because it contains many FAO documents - which is the specific document?		citation removed

Leo Galetto	2	30	1290	30	1292	I agree that regulation of pesticide use is an important issue, but education and use control according to regulations can be also very important issues.		agree -added
Serena Heckler	2	30	1293	30	1293	It could be noted here that certain beekeeping practices are impacted more by pesticides than others - e.g. according to a survey by Choi and Lee (1986), 94.7% of Korean traditional beekeeper respondents had experienced damage to their bee colonies because of pesticide poisoning. Oh and Park (2002) found that Korean beekeepers considered pesticide damage to bees to be the most critical problem in apiculture, and native beekeepers were badly affected because they could not move their hives (dissimilar to modern beekeeping methods which were more portable). Suggested text to add: " <u>Native beekeepers in Korea have reported that they cannot escape the impacts of pesticide spray because their hives cannot be moved from the bees' habitat. (Park and Yeo-Change 2002).</u> "   REF: Park, Mi Sun, and Youn Yeo-Chang. 2012. "Traditional Knowledge of Korean Native Beekeeping and Sustainable Forest Management." Forest Policy and Economics 15 (C). Elsevier B.V.: 37–45. doi:10.1016/j.forpol.2011.12.003.		ok added to section 2.3.3
G�rard Arnold	2		1293		1294	L 1293. 'However, even when data on total pesticide usage are available, these rarely provide the information relevant.' I fully agree with this sentence, and I think that a conclusion must be drawn and mentioned in the report: there is a need to know the precise nature and timing of pesticide treatments carried out locally. This information should be made available after any treatment applied to the crops in order to have information on the potential exposure of bees present in the vicinity, in particular when there are cases of bee mortality/disorders.		add info re pesticide use globally
Felix Herzog	2	30	1296	31	1320	DELETE Box 2.3.2	not very informative, it shows the regulations (with many "may" and "least harmful"), but not the actual practice	this is the definition

Andreas Obrecht	2	30	1296	31	1320	I assume the source for all the text is the FAO?		correct
Thomas Brooks	2	30	1296	30	1318	It would be worth mentioning the variation in criteria for "organic" in different countries, and the confusion that this causes.		added
Thomas Steeger	2	30	1298	30	1320	box should indicate that the standards are reflective of FAO; some of the standards though are relatively vague and appear to be subjective; some would argue that any pesticide may be "essential for control of harmful organisms/disease (i.e., pests).		added
Colin Fontaine	2	30	1299	30	1318	box could be removed, there is no information on pollination or pollinator		adds info for organic standards to show pesticides are/can be used
Peter Campbell	2	30	1314	30	1318	Whilst the pesticides used in organic farming are usefully listed in this text there is no mention that many of these chemical and pesticides can be equally or even more toxic to insects such as pollinators as synthetic pesticides that are forbidden in organic agriculture. ie it should be made clear that these organic pesticides are not necessarily any safer to pollinators as many people my believe.		added
Thomas Brooks	2	30	1322	30	1325	What is included in "other insecticides", and what drove the massive spike in their use in 2008?		provide more detail for reference
Keng Hong	2	31	1322	31	1325	Fig. 2.3.1. provided graphs of groups of insecticides that act mainly on the nervous system. Nevertheless, the "other insecticides" group showed increase application over the years with a sudden drop after 2008. It will be interesting for readers to indicate/provide some examples of categories of insecticides (e.g. IGRs – especially chitin synthesis inhibitors, biopesticides) in the "other insecticides" group; and also possible reason(s) for the drastic fall in the application of "other insecticides".		provide more detail for reference
Ignasi Bartomeus	2	31	1327	31	1327	I think Box 2.3.3 is repetitive and the few new information can be integrated in text.		aim was to highlight non-european/NA perspective
Leslie Firbank	2	31	1329		1348	I've been told that one of the issues is that farmers rent hives of pollinators when required, and may not appreciate the value of wild pollinators. The issues are not always ecological		not sure how to reflect - further education?

Natacha Chacoff	2	31	1329	31	1350	the spotlight on Africa is useful, but I found that probably a survey over which countries or regions this situation of a lack of information is still missing would be more appropriate		info currently absent
Scott Black	2	31	1329	31	1352	This text box notes a need for greater research which is appropriate. Still, the text box fails to extrapolate from existing knowledge of risk in the industrialized world to better understand (and limit) impacts in non-industrialized nations. What we know of risk in the industrialized world seems to lend itself to expressing not only the need for research but also the value of applying a level of institutional caution; especially since pollinators are key to crops in Africa.		see graphic on Kenya Figure 2.3.2
Andreas Obrecht	2	31	1329	31	1329	I'm a bit critical about the added value of this box. To look at a whole continent in this context opens up many questions --> e.g. why is the situation of Morocco more similar to Madagascar than to Jordan?		aim to highlight lack of data

Serena Heckler	2	31	1329	31	1350	An example of the impact of pesticides as observed by traditional beekeepers could be relevant in the box called "Spotlight in Africa". A short text could be add from line 1343 page 31 : "The environmental impact of pesticides on pollinators can be observed by local farmers through the observation of the abundance of bees which populate their hives or through fluctuations in honey production. Traditional beekeepers in Burkina Faso have noted that their hives situated near cotton fields treated with pesticides were less inhabited and less productive than those which were kept farther away (Gomgnimbou, 2010)." <u>Source</u> : Gomgnimbou A.P.K., Savadogo P.W., Nianogo A.J. & Millogo-Rasolodimby J. (2010). Pratiques agricoles et perceptions paysannes des impacts environnementaux de la cotonculture dans la province de la KOMPIENGA (Burkina Faso). Sciences & Nature, 7 (2) : 165-175. [publicly available and peer-reviewed] . p171 : " <i>Les apiculteurs rencontrés affirment que la baisse de leur récolte de miel est le fait de la rareté des abeilles sur leur site de production et cela est imputable aux pesticides utilisés en culture cotonnière. Ceux du village de Kpodjari imputent également la réduction des abeilles dans les ruches à l'utilisation des pesticides dans les champs de coton.</i> " .		ok reference added + additional info
Shalene Jha	2	31	1329	31	1329	I was expected more cas-specific information regrading Africa in this 'spotlight on Africa' box and instead the text is very general -- it seems like it does not really require 'spotlighting'		aim is to highlight lack of information but additional info added

Martha Groom	2	31	1329	31	1348	Spotlight on Africa glosses too much over activity across the continent. The last sentence would need rewording to not have an implied reduction of the African continent to the status of a single country. Given few examples related to any African country, I recommend removing this box and incorporating the problem that very little information on impacts is available for less industrially developed countries - and cite Youm et al 1990 as one authority confirming this (although that is now an older reference). Then could highlight the real problem in so many nations - lack of studies and data. Could also incorporate some more specific information to give a flavor of some of what has been learned (most studies in Kenya, South Africa, but also other countries).	Alternatively, there are some more specific references that could be used if one wanted to highlight some of the good work being done. Here is a reworking of the final paragraph of the box that could be used here or moved into the main text. PROPOSED alternative text for final paragraph: Efforts to evaluate pesticide impacts on pollinators are needed throughout the African continent, as existing studies are widely spread and few, and some raise great concerns For example, Otieno et al. (2011) found pesticide use was negatively related to pollinator abundance in fields in Eastern Kenya. However, another study suggests impacts may not be severe in all	info added
Penelope Whitehorn	2	31	1329	31	1352	If the references cited in the middle paragraph of this box are not specifically relevant for Africa (they are not currently listed in reference section) then this box seems a bit pointless. It could be summarised in one sentence in the main text saying that there is a lack of evidence for this continent.		info added

Natacha Chacoff	2	31	1331	31	1334	This is not important here, is not particularly relevant for the box		edited
Richard Corlett	2	31	1332			There is only a single wild Apis species in Africa so 'sp.' not 'spp.'		edited
Andreas Obrecht	2	31	1333	31	1333	the fomulations "apparent decline" and "perceived impact" are not very informative since it is not clear who perceives the impact. The public? Or one of the cited authors?		edited
Graciela Rusch	2	31	1333	31	1333	Refer here to other parts of the report with reference to studies that have documented declines.		edited
Liette Vasseur	2	31	1335			change "Africa is" for Africa are		ok
Scott Black	2	31	1335	31		Some of the descriptors used cast unnecessary doubt. For example, pollinator declines are not "apparent." For example, new research sponsored by the Interntaional Union for the Conservation of Nature found more than 1/4 of N. American bumble bee species are at risk of extinction. Another example is the use of "perceived" to describe losses.		edited
Andreas Obrecht	2	31	1335	31	1336	Probably a policy recommendation could be derived from that sentence. Who would hold such lists? The pesticide producing companies? Who holds such lists in other countries/continents?		for Chapter 6
Liette Vasseur	2	31	1336			change Youm,et al to Youm et al.		ok
Madeleine Chagnon	2	31	1336	31	1336	anyhing more recent ?		edited
Thomas Steeger	2	31	1336	31	1338	"Data on . . . .pesticide use in Africa are . . ."		ok
Natacha Chacoff	2	31	1338	31	1338	specify the main crops for which pollinators service in Africa is relevant.		reference garibaldi et al 2013
Andreas Obrecht	2	31	1338	31	1338	Is the demand for pollination services in Africa higher than elsewhere?		lack of information is greater
Andreas Obrecht	2	31	1338	31	1338	[The following chapters are well strucutred and written]		thanks

Gérard Arnold	2		1341		1242	L 1241. 'Exposure may be to one, or a combination of pesticides, which can be directly applied to a wide range of crops visited by pollinators'. In the case of the honeybee, pesticide mixtures are not done only when foraging, but also within the colony, in the food supply and waxes which can accumulate pesticide residues, including acaricides used in the treatment against the parasite varroa.		assuming 1241-1242-reworded
Gérard Arnold	2		1343		1343	L 1343. 'Inappropriate use of pesticides (Pettis et al., 2013). See my comment for L 1282: The issue is not only that of a proper use, but also of good procedures during pesticide registration.		ok -registration procedures in Africa are unclear
Madeleine Chagnon	2	31	1345	31	1345	is this not difficult to obtain ? Ref line 1335		reworded
Serena Heckler	2	31	1345	31	1346	The text from the line 1345 page 31 could be : "However, there is clearly a lack of <b>studies</b> of the impact of pesticide use on pollinators and pollination services in Africa despite the economic importance of insect-pollinated crops."		reworded
Piotr Medrzycki	2	31	1345	31	1347	This sentence is suggesting that generally pesticides shouldn't be considered a factor which negatively influences pollinators. It is obviously not true. There are commonly recognised evidences of the opposite. The choice of giving an example of the region where there is a lack of such evidence, and ignoring all the internationally known research in this matter, makes think that the box was prepared in a biased way.		not prepared in a biased way but by independent African scientist; written to reflect need for information; section reworded to clarify
Luisa Carvalheiro	2	29	1346	29	1346	references for this could be: Steward et al. Agriculture & Food Security 2014, 3:5 and Archer et al Oikos 123: 401–407, 2014		ok thanks
Thomas Steeger	2	31	1347	31	1350	Is this to say that there does not appear to be an issue or that there are not sufficient data to determine whether there is an issue?		edited
Felix Herzog	2	31	1355	(Table 2.3.1)		line 5: "low acute LD50" >> should this not be "HIGH acute LD50"?		no, low acute LD50 = high acute toxicity

Jeff Ollerton	2	31	1356	31	1363	It would be worth mentioning that horticultural use of pesticides in private gardens has also increased but that there is virutually no data on how they are used or the amounts.		added
G�rard Arnold	2		1357		1357	L 1357 : Table 2.3.1. This table is difficult to understand and too simplistic. In particular, it does not separate enough the various application methods such as spray and treatment of soils and seeds, for example. You could build a new table with these two inputs which are the main modes of exposure. I just give an example, for column ‘Risk factor’ (Life history and population dynamics) and column ‘comments’ (High degree of sociality decreases impact as to population / colony as pesticide effects mainly on foragers). My opinion: this is not true for all modes of application; see my comment L 1234.		I cant see how the factors are different for the same pesticide applied as a foliar vs seed/soil treatment
Liette Vasseur	2	31	1360			This is confusing. The previous sentence states very limited data but then data from different countries. Also remove the s at <u>demonstrates (data plural)</u>		reworded
G�rard Arnold	2		1360		1361	L 1360. ‘There are very limited data available on actual usage of pesticides (as opposed to sales data) by farmers on crops attractive to pollinators’. I agree. See my comment L 1293. This is the reason why it should be clearly stated in the IPBES report that it is important to know the precise nature and timing of pesticide treatments carried out locally.		see comment re 812
Scott Black	2	31	1362	31	1363	awkward sentence. Consider rewriting.		reworded
G�rard Arnold	2		1362		1363	L 1363. ‘Data from Kenya, Brazil and the Netherlands demonstrates the differences between countries in the availability of pesticides which are inherently toxic to bees’. It is true on the figure, but nevertheless, it is also true that even in a more “developed” country (Netherlands), 25% of the pesticides used are toxic to the bees by themselves, and certainly more in case of co-exposure with other pesticides. This should be emphasized in the report.		difference between toxicity and risk - these data are LD50 -if exposure removed, e.g. not used on crops in flower then risk is reduced
Natacha Chacoff	2	31	1364	31	1666	Fig. 2.3.2. The moderately toxic color does not differenciate clearly from the highy toxic		ok after sOD
Martha Groom	2	32	1372	32	1372	Reference should be to Table 2.3.1		ok

Thomas Brooks	2	30	1374	30	1376	Another important citation here is Bonmatin et al. (2015) Environ Sci Pollution Res (open access at <a href="http://link.springer.com/article/10.1007/s11356-014-3332-7">http://link.springer.com/article/10.1007/s11356-014-3332-7</a> ).		added
Maj Rundlöf	2	32	1374	32	1374	The mentioned routes of exposure exclude some routes that are important for particularly wild bees, such as contact with contaminated soil in nests or nesting material (see figure 3.1 in EFSA 2012). EFSA (2012) Scientific Opinion on the science behind the development of a risk assessment of Plant Protection Products on bees ( <i>Apis mellifera</i> , <i>Bombus</i> spp. and solitary bees). EFSA Journal 10: 2668.		ok added
Arathi Seshadri	2	32	1376	32	1384	These sentences focus on the negative aspects of neonicotinoids which currently occupies the position of the most discussed insecticide. While I do not contest the negative effects of these compounds, a look at the Fig. 2.3.1 indicates that these neonicotinoids are at the bottommost part of the graph indicating that they are being used the least. However, the "Other insecticides" that are way up in terms of amounts applied are not discussed in this section on the potential impacts of pesticides. If the aim is to focus only on neonicotinoids, then I suggest to change the subheading to denote that. If not, then we need to also talk about the impact these "other insecticides" could have on pollinators. It seems to me that with increased focus on the negative impacts of neonicotinoids, we are seeing a resurgence of other insecticides but these are not getting the same level of exposure as neonicotinoids have. Is there any reason to think that 'other insecticides' cause less damage to pollinators than neonicotinoids do? If so this should be clarified. I do not think that any pesticide is safe for pollinators but with increased focus on one class of pesticides we are ignoring others and in due time these others will also reach toxic levels		ok section was aimed at balance

Gérard Arnold	2		1376		1377	L 1376. 'The direct exposure of pollinators to pesticides may occur through a number of routes primarily, ingestion of contaminated pollen, nectar or aphid honeydew, drift or overspray'. The bees may be exposed to water (droplets on leaves, axils, puddles in field, surface water) (contact and oral exposure), plant guttation (oral exposure) and dust during sowing operation (contact exposure). The water brought back by honeybee foragers in their colony is needed to maintain an osmotic balance in the adult bees, to prepare liquid food for the brood and to cool the hive during hot days. At the colony level, it is estimated that 20–25 litres of water are consumed annually (Weipple, 1928; Seeley, 1995). However, this amount is highly variable, depending on weather conditions. For example, for the entire spring/summer season, Michailoff (1961) found that a colony can use up to 42 L and, according to Farrar (1973), during the warm season on hot days, a colony can consume up to 20 L/week (or 2.9 L/day). Bees can collect this water from water surface, puddles, leave axils, droplets on leaves and guttation.		reworded
Gérard Arnold	2		1378		1378	L 1378. 'In flowering crops, systemic pesticide residues may be transferred into pollen and nectar collected and consumed by pollinators with the potential for adverse effects from chronic low-level exposure'. Again, the most recent and detailed review on this subject (Bonmatin et al., 2014), which was available for the experts of IPBES, is not cited, and must be cited. It presents a synthesis of the data on residues of neonicotinoids in nectar and pollen. The choice of the expression 'may be' is inappropriate and misleading because the transfer of these products in pollen and nectar is more a general than isolated phenomenon		add ref; the level of residues depends on the crop and the systemicity of the active ingredient; many that are used as seed treatments are less systemic than the neonicotinoids
Thomas Steeger	2	32	1383	32	1383	"For example, in one study of oilseed rape, the average . . ."		reworded

Gérard Arnold	2		1386		1388	L 1386. 'An additional route by which pollinators may be exposed to residues includes collection by bees of guttation fluid .....'. Among the review papers Bonmatin et al. (2014), and EFSA (2012) which gives a good description of this phenomenon and their possible consequences for bees.		added refs
Thomas Brooks	2	30	1390	30	1391	Good use of the Pisa et al. and Bonmatin et al. references. However, the latter citation is missing from reference list; add. <u>Also, the actual publication date of both is 2015.</u>		amended
Scott Black	2	32	1390	32	1390	For the 70% of solitary bees that are ground nesting, there is also a risk of direct exposure to bees and their nests from applications to the soil (i.e. soil drench). I recommend inserting a sentence here to highlight that additional route of exposure.		potential but no reference provided and included at start of section
Claudia Maria Jacobi	2		1392		1392	Please check sentence: problem with brackets.		amended
Piotr Medrzycki	2	32	1393	32	1395	The APENET report should be cited here as Italy was the first country where the dust escape from the machine was proved. In the APENET project it was also evidenced that even the best methods of dust reduction are insufficient in order to significantly reduce the exposure and thus the risk to bees.		ok added
Scott Black	2	32	1395	32	1397	While this section demonstrates how some of the issues of coated seed are being addressed, it is worth pointing out newer unaddressed concerns with coated seed. First to mind is the issue of how coated seeds might be impacting other beneficials beyond pollinators. You could state: "Neonicotinoid coated seeds have been linked with food chain effects which harmed other non-pollinating beneficial insects." Douglas, M.R., J.R. Rohr, and J.F. Tooker. 2014. Neonicotinoid insecticide travels through a soil food chain, disrupting biological control of non-target pests and decreasing soya bean yield. Journal of Applied Ecology. doi: 10.1111/1365-2664.12372.		outside remit of report

Gérard Arnold	2		1395		1396	L 1390. 'However, there is good evidence that appropriate technical measures can be adopted to reduce the associated risk of dust'. Deflectors can be fitted to drilling equipment which direct this dust at the soil surface and reduce the amount of powder drifting in the air by 50–95%, but then the active ingredient is on the soil surface (Biocca et al., 2011, cited by Goulson, 2013). The fact to reduce the risk does not mean that there is no more risk, including sublethal effect. Moreover what about risk for the wild bees which nest in the soil then?		on soil surface within ploughed field; the referenced study does not relate to deflector use
Claudia Maria Jacobi	2		1397		1399	This figure and its legend are not 100% clear. I suggest to, at least, expand the legend.		ok
Shalene Jha	2	32	1398	32	1398	I think this figure could be simplified and reorganized to save space and for clarity -- I think that it could be rendered in a line drawing instead of photos. You could have just one plant with the systemic pesticide and then one plant with the sprayed application and one bee in the middle with arrows pointing to it and from all of the potential sources		legend reworded- figure is from EFSA
Colin Fontaine	2	32	1401	32	1412	most test performed on honeybees. What about wild pollinator (and not only bees)		made clearer most data for honeybees
Thomas Steeger	2	32	1406	32	1407	"However, quantitative data . . . To pesticides are limited by being . . ."		ok
Liette Vasseur	2	32	1407	32	1408	This seems the same thing than the previous page and focusing on only one study. I am sure there are more than one study. E.G. Dively and Kamel. 2012. J. Agricult. Food Chem. 60:4449;		this relates to wild bees- Dively and Kamel relates to residues in squash pollen and nectar
Felix Herzog	2	32	1408	32	1411	DELETE "The overall likelihood of ... However it is clear"	too little evidence, just one study, not peer/reviewed	clear lack of data
Claudia Maria Jacobi	2		1408		1410	Please rephrase for clarity.		reworded

Peter Campbell	2	32	1416	32	1418	This sentence is constructed to suggest that pesticides are the main cause for reduced species richness at the landscape scale in bees and butterflies, and uses Brittain 2010 as a reference to support. However, in this Brittain 2010 reference it would be impossible to differentiate the effect of pesticide use from the effect of different agricultural practises and surrounding land use at a landscape scale. A more balanced representation of this work and of the general issue would be to say that intensive agriculture and land use was the primary cause for this difference in species richness observed and that pesticide use is one of a number of potential contributory elements but other include available nesting habitats, forage abundance and diversity in and around the sampling area etc.		ok expand to clarify
Thomas Steeger	2	32	1416	32	1416	"Exposure to pesticides may result . . . "		ok
Penelope Whitehorn	2	32	1416	32	1416	Bit of strange jump from pesticides to herbicides between sentences. Examples of pesticide impact on pollinators without <u>direct exposure would be better here.</u>		ok
Nadine Azzu	2	32	1417	32	1417	which is the section on "agri-management"?		Hope to have an improved structure now; cross links might sometimes still be missing or wrong due to the exhaustive rearrangements
Marina Rosales Benites de Franco	2	32	1418	32	1418	I suggest to include at the end of the paragraph: Lethal impacts of insecticides may reduce the number of pollination service providers and/or alter the community composition.	Brittain, C., Potts, S. G. (2011). The potential impacts of insecticides on the life-history traits of bees and the consequences for pollination. Basic and Applied Ecology 12, 321–331.	ok
May Berenbaum	2	32	1418	32	1420	Brittain et al. 2010 is a study of the impact of one insecticide; as cited in the text, it's unclear whether it's herbicide, insecticide, or <u>multiple pesticides</u>		ok

Flávia Viana-Silva	2	32	1419	32	1419	It is important to consider residues due to successive applications. In many crops, seeds are treated with an active ingredient and during its development, others applications (e.g. foliar or drench) may occur using the same active ingredient. This intensive use might lead to pesticides accumulation in the soil and on the plants might result in higher levels of residues in pollen and nectar.		ok expand to clarify multiple pesticide use
Serena Heckler	2	32	1419	32	1419	<u>Here, it could be added the case of pesticides used for eliminating pollinators. For example, Albert, Jaime and Cruz, Mónica. (2006). "El Decreto de la "pinyolà": Prohibido polinizar" in La Fertilidad de la Tierra n.25: pp. 41, present the testimony of owners of an organic farm where traditional and local knowledge about agricultural practices is being recovered and regenerated in the community of Valencia in Spain. They explained the problems with a law (called the "pinyolà" decree) that forbids pollinators in certain areas in this community, where plantations of clementines (non-native) have been introduced. Pollination of their plants generate seed in clementines reducing their market value, therefore pesticides are being used in order to kill pollinators.</u>		ok added as example
Colin Fontaine	2	33	1425	34	1506	it should be acknowledge that there is a great deficit in knowledge on the impact of many pesticide molecules in natural condition and on wild pollinator communities.		added
Thomas Steeger	2	33	1430	33	1431	" . . . a few nanograms (ng) per bee to several thousand micrograms (µg) per bee . . ."		ok
Liette Vasseur	2	33	1442	33	1451	This paragraph lacks references and seems to be more judgemental than factual.		additional references supplied for incident schemes
Penelope Whitehorn	2	33	1442	33	1442	Godfray et al 2014' - an original research reference would be better here than this review.		ok but very limited on disease effects on pesticide tox most pesticide effects on disease

Gérard Arnold	2		1442		1442	L 1442. '(Godfray et al 2014) and disease (Godfray et al 2014)'. The authors of this chapter cite 8 times the paper of Godfray et al., (2014); this seems to be a self-citation bias (two authors of this paper are in the Working Group). Several other recent reviews (2013-2014) are available and should be included to provide a more balanced view on this topic (van der Sluijs et al, 2013. 2014; Chagnon et al, 2014;. Pisa et al, 2014; Bonmatin et al, 2014), because these other reviews come to different conclusions than those exposed by Godfray et al. (2014). A fair assessment needs to take them into account.		these are for effects on pesticide tox not pesticide effects on other factors (which is covered in another section)
Nadine Azzu	2	33	1443	33	1443	"initiated" rather than "instigated"		no they were agreed, started and are carried on by governments
Peter Campbell	2	32	1444	32	1445	The sentence suggesting that the Government funded incident monitoring schemes will under report is an assumption not a fact and therefore should be deleted or significantly softened to reflect the uncertainty of this opinion. Otherwise it completely undermines the reported data that follows.		reference added
Penelope Whitehorn	2	33	1444	33	1444	acute effects of pesticides on pollinators' - I think it would be better to establish straight away that this paragraph is only referring to honeybees.		ok
Gérard Arnold	2		1444		1486	L 1444. These paragraphs (from L 1444 line to L 1486) which cover 42 lines are devoted to a anecdotal aspect, which seems secondary in relation to the current situation of the bees. Moreover, out of the 11 references cited about 2/3 are all from the same team (Thompson et al) which again suggests a possible self-citation bias		only information available for real use incidents and limited number of schemes becomes self selecting for references

Gérard Arnold	2		1446	1447	L 1446. 'there is potential for under-reporting due to reticence of beekeepers to report incidents and risk the loss of apiary sites with good forage often on land belonging to farmers'. There are other reasons for the under-reporting. Many beekeepers do not live near their hives and do not frequently visit them. When visiting their apiary it is easy for them to see if there are dead colonies. But, if there are only a few dead colonies, they are reluctant to take legal action, especially as they do not necessarily know the cause (pesticides, pathogens,...). If the incident concerns only a portion of the colonies (e.g. some hundreds or thousands of dead bees/colony), it is very possible that most of the dead bees have disappeared from the front of the hives (because of wind, rain, wasps, birds, ...), and the beekeeper may just find that the hive is sparsely populated without being able to know the reason. Moreover, in many countries (e.g. in France), beekeepers do not believe in the usefulness of reporting colony losses.		Incidents relates to dead bees not dead colonies- an incident can be only a few bees- explanation- unfortunately no reference provided but additional reference provided for issues identified in the document
Gérard Arnold	2		1448	1449	L 1448. There are honeybee colony mortality statistics in Europe (and probably elsewhere). Recently, the European Commission carried out a pan-european epidemiological study called EPILOBEE on honeybee colony Losses (2012-2013) to assess colony mortality with the prevalence of bee pathogens during winter and during the bee season, in 17 EU countries. During the wintering, the mortality rate exceeded 10% in 11 countries; the highest rates were reported in Belgium (33.6%) and the UK (28.8%). Mortality was lower in the beekeeping season (spring-summer period), although still high in some countries such as France (13.6%), the UK (9.7%) and Belgium (8.9%). Unfortunately the causes of these mortalities of colonies have not been fully investigated. Anyway, the 'major' incidents of bee mortality, although they are spectacular, are only part of the honey bee problems. Another big problem is the weakening of the colonies through the decreasing of the colony size and the low honey production.		this section relates to bee mortality due to pesticides directly not unexplained colony losses as per COLOSS

Peter Campbell	2	33	1449	33	1451	The refence "Cutler et al 2013" used to support the statement of canadian neonic mortalities is not in the list of references at the end of this section. There is a Cutler et al 2014 but this is a field study not an incident monitoring paper. Is this indeed a confirmed incident or is it an opinion?		confirmed incidents add reference for 2013
Thomas Steeger	2	33	1452	33	1453	". . .related to dust from abrasion of neonicotinoid-treated corn seed during planting (PMRA 2013; see <a href="http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/bee_mortality-mortalite_abeille-eng.php">http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/bee_mortality-mortalite_abeille-eng.php</a> )		add
Peter Campbell	2	33	1454	33	1455	Out of how many total samples submitted to this bee-kill scheme are the reported 8500 pesticide detections? ie would be useful to see what proportion of the total number of samples submitted to the scheme actually had no pesticides detected. Also of the 8500 samples how many were from bees compared to plants? This sort of residue occurrence data can be very misleading , since from the UK Wild Life Incident Investigation Scheme data it is clear that a very significant and very common sources of insecticide residues in bees is from either unapproved varroa treatments by the bee keeper or from misuse rather than from good agricultural practise.		info not available
Peter Campbell	2	33	1459	33	1460	Which incidents is this sentence referring too it is not clear from the text?		clarified
Mario Marcos Espirito	2	33	1459	33	1459	The term "varroacides" was used here before Varroa was mentioned. Please clarify the jargon.		ok
Gérard Arnold	2		1460		1461	L 1459. 'Identifying whether pesticides are a driver of acute bee losses can be challenging since detection of residues may not necessarily be related to an adverse effect'. This statement may be true in some cases, though obviously related to the toxicity of the residues to bees. However, it would be fair to recognize that the detection of pesticide residues may be challenging when those are rapidly metabolized or degraded in bees. Weather conditions, can be particularly important in that process, especially in dead bees found outside the hive.		ok clarify info on residue declines

Scott Black	2	33	1461	33	1464	If I am interpreting the language correctly, these incidents are from 1981 - 1991. I question the relevance of the data to current use, as pesticide use practices have changed dramatically since then. Case in point neonicotinoids, the most commonly used insecticides worldwide were not yet on the market during this timeframe		ok but do include pesticides currently used at high levels elsewhere globally, ops and carbamates
G�rard Arnold	2		1464		1468	L 1464. 'Between 1981 and 1991 many of the 545 incidents in the UK were due to farmers not complying with label instructions with uses in flowering plants'. The wording 'many' is vague; a proper number is needed to support the assertion. Beside misuse, what were the other causes of incidents? In general, in this part details are given on the ancient use of some old pesticides that are now banned. The general meaning of this paragraph seems that there is less acute mortality ('incidents') from pesticide use, now. But against this, the situation of social bees (honey bees, bumble bees) and solitary bees continues to worsen almost all around the world. The current issue is not the toxicity of the 'old' active ingredients, but the potential toxicity of the molecules currently used.		ok add info from reference; toxicity of insecticides is only partial link to likelihood of incidents - additional factor is exposure; banned in EU but not necessarily elsewhere
Scott Black	2	33	1465	33	1468	The use of the term "many" is vague. It would be more clear if you gave a percentage of incidents caused by label violations. Also, consider adding a line how the incidents caused by applications performed according to the label also inform regulation and enforcement. Question: has there been review of more recent incidents?		ok
Joseph Tzanopoulos	2	33	1468	33	1472	This sentence is not clear. Need rewriting as its message is confusing		ok reword
Liette Vasseur	2	33	1468	33	1472	This sentence does not make sense at all. It needs to be better defined. I guess we're talking about developing countries but not sure.		ok reworded
Colin Fontaine	2	33	1468	33	1472	need rephrasing		ok reworded
G�rard Arnold	2		1468		1468	L 1468. The reference Thompson and Thorbahn (2012) is not present in the list of references and can not be found on the web (Web of Science, Google scholar,...). All the cited references must be fully reported and listed to be considered.		present on google scholar but added to references as omitted in error
Jeff Ollerton	2	33	1470	33	1474	Confusing grammar - needs re-writing.		ok

Scott Black	2	33	1470	33	1474	First, this section is awkward and should be re-written. Second, relating to the substance of this section: none of the mitigation measures listed address concerns of systemic uses. Bee die-offs have occurred in the US weeks to months after pre-bloom systemic applications of nitro-containing neonicotinoids. The absence of a response to systemic concerns should be noted.		no reference provided- only incident I am aware of relates to foliar uses in flowering linden trees
Piotr Medrzycki	2	33	1472			It should also be mentioned that some newly developed insecticides (i.e. neonicotinoids) are often characterised by a rapid decomposition in dead bees. Thus it often occurs that even in strong poisonings caused by these aa.ii., no residue is found if the dead bees are sampled not immediately but one or more <u>days after death</u>		added but depends on analytical technology
Thomas Steeger	2	33	1474	33	1474	"These incident data have also been used in Europe to validate . . ."		ok
G�rard Arnold	2		1474		1476	L 1474. 'These incident data have also been used to validate the use of the hazard quotient.' The use of the HQ is controversial and criticized by scientists, which is not mentioned here. If the HQ can be useful (among other criteria) to assess the toxicity of sprayed pesticides, it is completely unsuitable for pesticides used in seed treatment (e.g. Halm et al., 2006).		ok -clarify TER used for systemics but not validated, no citation for criticism of HQ
Thomas Steeger	2	33	1477	33	1478	be careful of using adjectives such as "robust"; a single citation is provided to support this adjective and unless the paper demonstrates strong support, the use of robust may not be <u>appropriate</u> .		ok
G�rard Arnold	2		1477		1478	L 1477. 'There is robust evidence that....(Thompson and Thorbahn 2012)'. What is the justification for the use of the term 'robust evidence', whereas a single bibliographic reference is cited (Thompson and Thorbahn, 2012), while in addition, this reference is not present in the list of references, and can not be found easily in the web (Web of Science, Google scholar,...)? As it stands and without any further justification, the use of the term 'robust' suggests an a priori which is scientifically not valid.		change to good -based on 25+ years data
Thomas Steeger	2	33	1478	33	1478	". . .not mixed with ergosterol biosynthesis inhibiting (EBI) fungicides . . ."		ok

Piotr Medrzycki	2	34	1480	34	1484	It seems that pesticide related losses occur only in specific situations. Indeed in Italy, before the governmental ban of insecticide seed dressing in 2008, hundreds of incidents were reported yearly exactly during the sowing of high quality dressed maize seeds. It is reported in the APENET report 2009.		ok add Italy
Peter Campbell	2	34	1481	34	1482	Was this bumble bee incident related to the approved label use of the product (ie during flowering of the target trees)? Most insecticides are not aproved for use during flowering so I suspect this is an incident caused by bad practise/misue and should be stated as such		according to label
Jeff Ollerton	2	34	1482	34	1484	Bumblebee deaths require a reference		ok
Peter Campbell	2	34	1483	34	1484	The refence "Cutler et al 2013" used to support the statement of canadian neonic dust related mortalities is not in the list of references at the end of this section. There is a Cutler and Scott Dupreet 2014 reference but this is a field study not an incident monitoring paper. Is this indeed a confirmed incident or is it an opinion? Also this repeats what was already said in lines 1449 - 1451		2013 ref added
Thomas Steeger	2	34	1485	36	1486	consider ". . .from neonicotinoid-treated seed in Ontario, Canada . . .")		ok
Colin Fontaine	2	34	1486	34	1497	Do we know the proportion of pesticide that is used "inappropriately" or in accordance with "label recommendation"? If yes give the figure if not this should be acknowledge.		ok -unknown
Scott Black	2	34	1488	34	1488	Consider removing the statement "Thus there is strong evidence that if insecticides are used <i>inappropriately</i> they can severely affect individuals and populations of bees." (emphasis added) The statement is misleading as applications done in accordance with the label have also caused bee die-off incidents. Case in point, there were 7 confirmed incidents in Oregon that caused the death of bumble bees. Not all cases led to violations and 6 of the 7 followed the federal label. In my understanding, the significant honey bee incident during the 2014 almond incident was also was performed according to label insturctions. There is currently another incidetn under investigation in California that might not have had a label violation.		no reference provided- only incident I am aware of relates to uses in flowering linden trees

Piotr Medrzycki	2	34	1489	34	1491	This sentence was quite true before the development of highly toxic aa.ii. like neonicotinoids. In fact their high insecticidal activity makes extremely hazardous every treatment error or escape. The example above regarding sowing of dressed seeds in Italy, carried out in accordance to the label proves that this pesticide class has a general problem and the respect of the label is not sufficient to protect the environment and pollinators.		no reference provided but issue clarified
Scott Black	2	34	1491	34	1493	Continuing with the statement above (line 1488). The issue of what types of uses cause mortality is a good example of the polarised debate. It could be valuable to point this out as an area of disagreement. I recommend changing the lines to instead state: "There is disagreement as to whether applications in accordance with the label protect pollinators from lethal pesticide exposures. A review of national incident schemes (Thompson and Thorbahn 2009) and some field trials (Stadler...) demonstrate that when insecticides are used in accordance with label recommendations acute mortality can be reduced or excluded. Yet, incidents, including high profile incidents in Oregon and California, cast doubt on this claim as applications according to the label caused significant bee die-off incidents, including the largest reported native bee kill on record. (In the Oregon case, the applicator was found "negligent" under Oregon statute but the label was followed)		rephrase according to the availability of data; quality of information on the label is the key factor
Piotr Medrzycki	2	34	1491	34	1497	This sentence seems to be taken from an advertisement leaflet or a chemical industry and not from a serious scientific report on pollinators. The idea that "pesticides ... can enhance ... environmental health ... and ... improve abundance of butterflies and bumble bees" is somewhat new in a scientific publication.		balance of literature references

Gérard Arnold	2		1491		1493	L 1491. 'However, there is also good evidence .... that when insecticides are used in accordance with label recommendations such adverse effects can be reduced or excluded'. In a simple sentence, accompanied by some bibliographic references chosen to validate it, the question of the toxicity of approved pesticides is set: there is never a problem as long as the official recommendations are followed! Yet, there are numerous scientific articles and reviews, conducted by researchers independent of the pesticide producing companies that show the opposite. These papers are little (or not) cited in this report, or else when they are, their argumentation is weakly developed, while the reverse arguments are widely (eg from line 1444 to 1499 = 55 lines) to assert only one thing: the registered pesticides pose no problems if they are well used. At the level of EU, several reports recognize that the methods for assessing pesticides such as non-sprayed pesticides are not adequate. Thus, for examples: 1) in a report of the European Environment Agency (EEA), Maxim and van der Sluijs (2013) showed that, as soon as 2002, 'The Directorate-General for Health and Consumers of the European commission (SANCO) draft Guidance document on terrestrial ecotoxicology recognizes that the method for assessing the pesticides' risk assessment established is only adequate for spray pesticides. The use of HQ and its critical value had been obtained and included in regulatory demands based on data obtained on sprayed pesticides. In the same article, Maxim and van der Sluijs (2013) showed that 'The inadequacy of the current tests is recognized by official country-level bodies in OECD countries. Thus, the OECD (2010) survey showed that a large majority of countries indicate that current OECD toxicity studies designs do not adequately evaluate potential sub-lethal		text on alternative views with references; the risk assessment policy is a topic for chapter 6
Thomas Steeger	2	34	1493	34	1495	suggest ". . .direct consequences for crop yield from pesticide-induced pollinator losses . . ."		ok
Colin Fontaine	2	34	1494	34	1491	remove "exclude"		ok
Thomas Brooks	2	34	1494			This is an important point. However Oerke 2006 does not differentiate among different classes of pesticides - it would be useful to add references documenting this to the level of individual classes of pesticides.		ok but no references identified

Scott Black	2	34	1495	34	1499	This section regarding the benefits to pollinators from practices that include pesticides seems tangential. If you want to include the issue, the research should be further explored through a literature search.		literature search identified these references
Penelope Whitehorn	2	34	1498	34	1498	Muratet & Fontaine 2014 not currently in the reference list to check, but it is not clear from this sentence how pesticides used in combination with managed pollinators improves abundance of butterflies and bumblebees? Seems improbable! I think some rewording needed		as per reference- added
Thomas Brooks	2	34	1500			These two references missing from the citation list.		ok
Leo Galetto	2	34	1501	34	1508	My suggestion is to move this paragraph above, for example to 32, line 1415.		We have made quite some rearrangements, hope this also led to an improvement

Gérard Arnold	2		1501		1502	L 1501. There have been suggestions that long term exposure to certain insecticides (neonicotinoids) may result in delayed but direct mortality of honeybees (Sanchez Bayo and Goka 2014; Rondeau et al 2014). The papers of Sanchez Bayo and Goka (2014) and Rondeau et al. (2014), which were published in major scientific journals, have used published toxicity data to perform risk assessment of imidacloprid and other pesticides. Their two conclusions are clear: 'Extrapolating the toxicity scaling for honeybees to the lifespan of winter bees suggests that imidacloprid in honey at 0.25 mg/kg would be lethal to a large proportion of bees nearing the end of their life.' (Rondeau et al., 2014). 'Risks by ingestion of contaminated pollen and honey are of some concern for systemic insecticides, particularly imidacloprid and thiamethoxam, chlorpyrifos and the mixtures of cyhalothrin and ergosterol inhibiting fungicides.' (Sanchez-Bato and Goka, 2014). Readers of the IPBES report will not have a precise knowledge of these papers: 1.5 lines without explanation (compared, for example to my previous comment L1491: 55 lines to explain that pesticides pose no problems if used properly). In this report, there is unbalanced representation of view with a preference toward the publications that minimize the impact of pesticides, especially neonicotinoids on pollinators. This is a serious flaw for the IPBES report.		these papers were based on the Drucker equation which is contentious when used for neurotoxins; add references for contrary view (EFSA 2013)
Thomas Steeger	2	34	1502	34	1506	the Lu et al. 2012 study is relatively weak given multiple confounding effects.		but highlights high doses
Gérard Arnold	2		1503		1503	L 1503. 'However individual honeybees have been shown to clear imidacloprid rapidly (Cresswell et al. 2013)'. These results are interesting and quite surprising, and need to be confirmed by other researchers, because this single paper presents results which are inconsistent with those of several authors.		rapidly relative to bumble bees
May Berenbaum	2	34	1504	34	1504	Lu et al. 2012 is a very poorly designed, effectively unreplicated study; surely there are better references (e.g., Henry et al. 2012 <i>Science</i> 336: 348-350)		but high dose and addresses colony level
Peter Campbell	2	34	1505	34	1506	Pilling et al should be 2013 not 2014!		ok

Peter Campbell	2	35	1505	35	1501	Cutler et al 2014 refernce quoted here is missing in refernce list. Here is link to missing reference <a href="https://peerj.com/articles/652/">https://peerj.com/articles/652/</a> ie "A large-scale field study examining effects of exposure to clothianidin seed-treated canola on honey bee colony health, development, and overwintering success" G. Christopher Cutler <sup>1</sup> , Cynthia D. Scott-Dupree <sup>2</sup> , Maryam Sultan <sup>2</sup> , Andrew D. McFarlane <sup>2</sup> , Larry Brewer <sup>3</sup> , . PeerJ.		ok
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Gérard Arnold	2		1506		1508	L 1506. 'A similar lack of adult honeybee mortality following long-term (2-6 weeks) exposure of colonies has been reported for thiamethoxam and clothianidin (Sandrock et al 2014, Cutler et al 2014, Scott-Dupree et al 2013, Pilling et al 2014)'. I have mentioned previously (e.g. comment on L 1491) that, as regards to honeybees, in-use field testing protocols were inadequate to detect sub-lethal, chronic and long-term toxicity. This was confirmed by a meta-analysis of the literature (Creswell, 2011) which demonstrated that, based on the power analysis, the previously deployed experimental designs for field trails that reported no effect of neonicotinoids on honey bee colonies were unlikely to detect sublethal effects of trace dietary neonicotinoid of field realistic magnitude. As regards the 4 cited references line 1507: 1) Sandrock et al 2014: Contrary to what is written in the report, line 1506 ('Lack of adult honeybee mortality'), this publication does not concern honeybee. Nonetheless, the results of this work are interesting. The authors write 'In conclusion, our study of the solitary bee <i>O. bicornis</i> and several studies of bumblebees (Gill et al, 2012; Whitehorn et al, 2012; Larson et al, 2013) concordantly demonstrate a link between chronic sublethal exposure neonicotinoid and reduced life-time reproductive success. This conclusion is not reassuring for solitary bees exposed to sublethal concentrations of neonicotinoid. 2) Cutler et al 2014: Like the previous reference, and contrary to what is written in the report ('Lack of adult honeybee mortality'), this publication does not concern honeybees. This study is 'A field study examining the effects of exposure to neonicotinoid seed-treated corn on commercial bumble bee colonies'. The results suggest that exposure during pollen shed to corn grown from neonicotinoid-treated shed		sandrock et al 2014 is honeybees, Sandrock et al 2013 is solitary bees- will clarify sentence
Penelope Whitehorn	2	34	1507	34	1507	Sandrock et al 2014 - reference list suggests this is solitary bees, not honeybees.		no newer study is honeybee
Natacha Chacoff	2	34	1509	34	1513	Fig. 2.3.4. This figure is hard to understand. Requires more explanation. what are the numbers 1 and 2?		ok
Filiberto Pollisco	2	34	1509	34	1513	Caption is a bit long. The first two sentences can suffice.		ok
Shalene Jha	2	34	1509	34	1509	This figure is very confusing -- what do the circles mean?		ok

Claudia Maria Jacobi	2		1515		1516	Could the technical terms be kept to a minimum in Table 2.3.2? I see that in the Mode of Action there is an attempt for explanation, but still these terms are way too technical. Also, is this level of detail needed within the context of the chapter?		reviewed
Liette Vasseur	2	34	1522			Glad that here at least it is not "recent"		Good.
Thomas Steeger	2	34	1527	34	1527	replace "compound" with "insecticide."		Done.
Thomas Steeger	2	34	1530	34	1532	Not sure whether Chapter 1 was very clear in this regard. The issue remains that colony-level effects or effects on individual bees are difficult to link to population-level effects and overall declines.		Reference to chapter 1 was only for the decline, but has been suppressed.
G�rard Arnold	2		1530		1530	L 1530. 'After reviewing some of the documented sublethal effects of pesticides on bees, we examine the conclusions of the principal reviews on this topic with respect to the role of these pesticides in the decline of bees'. Why the review was conducted on only some effects? On what scientific basis was made the selection of those publications (what was the selection process and criteria used to screen and select/reject the studies)?		Actually the review has been exhaustive, but only some effects were presented in table 2.3.3. The criteria used to cite effects was to present the highest diversity of compounds, of effects and of species of bees.
David Evans	2	34	1531	34	1531	Here you talk about the decline of bees, earlier in the page you talk about the apparent decline. If Chapter 1 concludes there is a decline then it should be used consistently in subsequent mentions.		Considered.
Thomas Brooks	2	35	1537			Add Pisa et al. (2015) Environ Sci Pollution Res ( <a href="http://link.springer.com/article/10.1007/s11356-014-3471-x">http://link.springer.com/article/10.1007/s11356-014-3471-x</a> ), especially given that this considers species beyond bees		Included.
Thomas Brooks	2	35	1537			New research by Moffat et al. (2015) FASEB Journal "Chronic exposure to neonicotinoids increases neuronal vulnerability to mitochondrial dysfunction in the bumblebee ( <i>Bombus terrestris</i> )" explains the mechanisms underlying these sublethal effects		Thanks for the reference.

Gérard Arnold	2		1539		1539	L 1539. 'principal reviews (Thompson 2003; Desneux et al. 2007; Sluijs et al. 2013; Godfray et al. 2014)'. Some other 'principal reviews' are missing: e.g. Belzunces et al., 2012; Pisa et al., 2014.		Belzunces 2012 is cited and their conclusions are detailed below; the re has been added here. Pisa 2014 was not yet published when we wrote the FOD, but has been now added
Gérard Arnold	2		1547		1555	L 1548. The authors of the report recognize that: 'there exist a broad variety of sublethal effects, including individual physiological and behavioral effects as well as colony level effects'. But in their presentation, instead of highlighting, in a positive way, the current state of knowledge, their conclusion is narrowed down to the lack of knowledge for examples: 1) sublethal effects are known in the honeybee, but not in solitary bees, 2) sublethal effects are known with neonicotinoids, but few for other pesticides, 3) we know little about the possible interactions with other stressors. The fact that there are gaps of knowledge does not preclude that there is already evidence of effects in the honeybee. It would be more informative to write: 'various sublethal effects have been demonstrated in the honey bee at the individual and colonial levels, in particular linked to exposure to neonicotinoid insecticides' (and describe some of them and their possible consequence for the colony). 'However, gaps of knowledge remain for other bee species, especially solitary bees.'		We consider that this statement is well included in table 2.3.3 and the the sentence "there exist a broad variety of sublethal effects, including individual physiological and behavioral effects as well as colony level effects". However we included the sentence suggested, just underlining what was already written.
Nadine Azzu	2	35	1548	35	..	"but VERY (?) few with other..." (because in the previous phrase we already say "few (bumblebees)")		Done.
Thomas Brooks	2	35	1553			Add citation to Goulson et al. (2015) Science here		Good recent ref - included.

Gérard Arnold	2		1553		1553	L 1553. 'the interaction of pesticides at sublethal doses with other key pressures on pollinators (land-use intensification, climate change, alien species, pests and pathogens) is largely unknown.' This is not exactly true. I would say: strong evidence exist for interaction between pesticides (in particular neonicotinoids and fipronil) and infectious agents (in particular Nosema)(Alaux et al., 2010; Vidau et al., 2011; Aufauvre et al., 2012; Aufauvre et al., 2014; Retschnig et al., 2014; Doublet et al., 2014. For Nosema-fungicide (Pettis et al., 2013). For virus DWV-pesticide (Di Prisco et al., 2013).		This statement is implicit in the sentence we added due to the previous comment. Goulson 2015 ref considers most of the papers suggested here.
Anne-Laure Jacquemart	2	35	1555			parts too long relative to other chapters		Which part, relatively to which other chapters? Do you refer to chapter 2 as a whole?
Gérard Arnold	2		1563		1567	L 1567. At the end of the paragraph concerning the review of Thompson (2003), it should be useful to cite an important sentence of this paper (p 328): "there are a number of behavioural effects that could have a severe effect on colony development and survival but the longer-term impact on the colony is rarely reported"		Considered.

Gérard Arnold	2	1577	1597	<p>L 1577. In order to provide fair, accurate and complete information, the IPBES report must include all the important literature on the impact of pesticides on pollinators and ecosystem functioning, particularly those of the neonicotinoid family, which are the more widely used and the most recently studied, particularly for their sublethal effects. In the list of the 'reviews more specifically addressed the sublethal effects of these compounds', some important reviews have been omitted, in a surprising way. They are, in particular, several recent reviews written by a consortium of scientists who have examined over 800 scientific peer-reviewed papers on neonicotinoids published over the past two decades. In this sub-chapter 2.3, these reviews must be quoted, in the same way as the other quoted papers, and their main conclusions have to appear. A large part of these reviews concerns pollinators and, in particular, bees: Pisa et al. (2014) Effects of neonicotinoids and fipronil on non-target invertebrates. Environ Sci Pollut Res. doi:10.1007/s11356-014-3471-x. Simon-Delso et al. (2014) Systemic insecticides (neonicotinoids and fipronil): trends, uses, mode of action and metabolites. Environ Sci Pollut Res. doi:10.1007/s11356-014-3470-y. Chagnon et al. (2014) Risks of large scale use of systemic insecticides to ecosystem functioning and services. Environ Sci Pollut Res. doi:10.1007/s11356-014-3277-x. Bonmatin et al. (2014) Environmental fate and exposure; neonicotinoids and fipronil. Environ Sci Pollut Res. doi:10.1007/s11356-014-3332-7. Van der Sluijs et al. (2014) Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. Environ Sci Pollut Res. doi: 10.1007/s11356-014-3229-5. Extract of the conclusion of this paper: 'Overall, the existing literature clearly shows that</p>	<p>Pisa et al. 2014, actually an important reference, has been considered, including their main conclusion. Simon-Delso (2014) is now cited too. Van der Sluijs (2014) was already cited in detail. Chagnon (2014) and Bonmatin (2014) are not included in this part of the chapter as they do not deal specifically with sublethal effects.</p>
Gérard Arnold	2	1578	1580	<p>L 1578. It showed that levels of neonicotinoids residues in plants (specifically in nectar and pollen) tended to be lower than levels required to produce acute or chronic toxic effects on bees. It is not exact: numerous articles show the opposite (see, for example, the paper of Sanchez-Bayo and Goka (2014) and the review of Pisa et al. (2014).</p>	<p>We added a mention on the contrast between Blacquiere (2014) and Pisa (2014) conclusions, but did not cite Sanchez (2014) as the explicitly did not deal with sublethal effects.</p>

Diane Castle	2	35	1580	35	1581	<b>Comment:</b> Additional reference Norman L Carreck and Francis L W Ratnieks (2014) When The dose makes the poison: have “field realistic” rates of exposure of bees to neonicotinoid insecticides been overestimated in laboratory studies? Journal of Apicultural Research 53(5): 607-614 (2014) DOI 10.3896/IBRA.1.53.5.08		Ref added.
Diane Castle	2	35	1581	35	1584	<b>Proposal :</b> Include text " Laboratory studies on individual or queenless colonies require careful interpretation when assessing how they might translate to whole colony impacts for social bees in the field.  <b>Rationale:</b> More complete representation of conclusions from paper by Godfray.		Interesting observation, but not really in the core analysis of the paper.
Gérard Arnold	2		1582		1583	L 1583. ‘Despite a number of sublethal effects documented in laboratory studies, Blacquière et al. (2012) found that no effects were observed in field studies at field-realistic dosages’. From a general point of view, the fact that sub-lethal effects are not observed in an experiment does not necessarily mean that they do not exist, but that they may not have been tested with an adequate method. However, some effects were observed in field studies at field-realistic dosages; e.g. when using radiofrequency identification (RFID) methods to monitor the influence of sublethal doses of insecticides (clothianidin and imidacloprid) on individual honeybee foragers, Schneider et al (2012) showed that clothianidin led to a significant reduction of foraging activity and to longer foraging flights at doses $\geq 0.5$ ng/bee, and imidacloprid at doses $\geq 1.5$ ng/bee, during the first three hours after treatment. Using the same method, Henry et al (2013) showed that nonlethal exposure of honey bees to thiamethoxam causes high mortality due to homing failure.		We added a mention on the contrast between Blacquiere (2014) and Pisa (2014) conclusions, which finally contains this observation.
Claudia Maria Jacobi	2		1584		1584	Is 'non-farm' equivalent to 'natural' landscape in this setting?		Not exactly, but see Godfray's paper, which uses this expression.

Liette Vasseur	2	35	1586	35	1595	This paragraph raises some concern about the previous pages stating evidence and confidence that there is no effects if applied correctly but now we mention data not reliable. I would be a little more careful with statements in this case as data may show <u>different patterns</u>		We are reporting here mainly the conclusions of the synteses cited.
Scott Black	2	35	1586	35	1586	Consider changing the term "pertubation of ontogenesis" to "altering development" as the current term is more technical than the rest of the chapter. Although I realize "altering development" may not capture all you wanted to point out.		Done.
Peter Campbell	2	36	1594	36	1595	Studies carried out for marketing authorisation do take into account long term effects eg numerous field studies have been conducted for most of the neonicotinoids and such Field studies will follow exposed colonies for the entire associated flowering crop period and for some studies eg Pilling et al 2013 and Cutler et al 2014 will have followed exposed colonies for between 1 and 4 years. Whilst field studies will experience environmental variables as stated what is missing is that such field studies are more reflective of actual risk to bees from the use of these products under field in use condition, which is how such products are intended to be regulated under pesticide regulatory frameworks.		It is true that there are studies like these two ones on the long term effects of pesticides. But the statement of van der Sluijs (2014) is that such studies are not necessary for pesticides authorization.
Madeleine Chagnon	2	34	1597	34	1605	syngestic effects of pesticides wih pathogenes and parasites (and immune system) are mentionned here but not documented in this chapter nor the others		This aspect is dealt in 2.9.2. Case study 2: pathogens and chemicals in the environment. Ref to this section has been added.
Peter Campbell	2	36	1600	36	1600	There has recently been published another review of neonic effects on bees which concludes that most of the lab studies published suggesting neonics harm bees come from studies which use over-estimated and unrealistic exposures (compared to exposure under real in-use field conditions). The reference which should now be included is:- Carreck & Ratnieks, 2014. "The dose makes the poison: have "field realistic" rates of exposure of bees to neonicotinoid insecticides been overestimated in laboratory studies" Journal of Apicultural Research 53(5) 607-614.		Our sentence precisely intends to mention the controversy on what is a field realistic dose. To make this clearer, we included this cite.

Gérard Arnold	2		1600		1601	L 1600.'Clear consensus exists regarding the fact that bees are exposed to pesticides (through nectar and pollen, in the case of the neonicotinoids).'The exposure of bees to neonicotinoids insecticides is broader than only from nectar and pollen (see my comment L 1376), as the bees may be exposed to water (droplets on leaves, axils, puddles in field, surface water) (contact and oral exposure), plant guttation (oral exposure) and dust during sowing operation (contact exposure).		This is actually what Bonmatin (2014) mention as routes of environmental pollution in general. However, specifically for bees, the exposure is mainly through and pollen, as mention Pisa (2014). This even increases the risk since neonics may be more toxi when ingested, as reported in this same paper.
Mohammad Reza Kasraei	2	18	1602	22	1715	I think if you are able to communicate between indigenous knowledge and modern science, the results can be transferred to the beneficiaries and others that have a large impact on increase knowledge of indigenous,.Explanation of this relationship can be useful in this context.		This comment doesn't seem to refer to this line.

Gérard Arnold	2		1604		1605	<p>L 1605 'There is considerable uncertainty about how sublethal effects recorded on individuals might affect the populations of wild pollinators over the long term'. We must report the abuse use of the terms 'considerable uncertainty', 'significant uncertainty', 'clearly lack of direct evidence', 'limited evidence', 'no evidence', 'no strong evidence', 'evidence is still scant', 'largely unknown', 'not well understood', 'poorly understood', 'little understood', when it comes to report evidence of effects of pesticides, in general, and neonicotinoids in particular on bees. Here, I quote short excerpts from some recent publications published in reputable international scientific journals: Whitehorn et al., 2012 (Science) 'Treated colonies had a significantly reduced growth rate and suffered an 85% reduction in production of new queens compared to control colonies. Given the scale of use of neonicotinoids, we suggest that they may be having a considerable negative impact on wild bumble bee populations across the developed world.' Bryden et al, 2013 (Ecology Letters) "by formulating a mathematical model for colony dynamics ....we have shown that bumblebee colonies fail when exposed to sustained sublethal levels of pesticide, and that this can be explained by a decrease in colony function. Feltham et al., 2014 (Ecotoxicology): "This study demonstrates that field-realistic doses of these pesticides substantially impacts on foraging ability of bumblebee workers when collecting pollen, and we suggest that this provides a causal mechanism behind reduced queen production in imidacloprid exposed colonies." Gill and Raine, 2014 (Functional Ecology) "Our results show that neonicotinoid exposure has both acute and chronic effects on overall foraging activity.... The effects of chronic pesticide exposure could have serious detrimental consequences for both</p>		There is no such certainty, since important papers like Godfray (2014) or Blacquière (2012) arrive to conclusions very different of the one suggested. However we reformulated the paragraph considering the observations made here.
Leo Galetto	2	36	1609	38	1726	<p>This section presents many paragraphs that seem repetitive with previous sections. My suggestion is to reduce it drastically. The important point for this section is to synthetize the main ideas and present some significant examples. For example, see next comment</p>		ok will review and revise at final edit

Gérard Arnold	2		1611		1612	L 1612 "through a number of routes including collection of nectar and pollen from multiple sources...": See my comment above (L 1600).		ok but focus isnt only on neonics
Thomas Steeger	2	36	1616	36	1616	". ..of pesticide residues and are very limited . . ."		ok
Piotr Medrzycki	2	36	1616	36	1620	This discussion is not appropriate here. Aquatic toxicology has nothing to do with honeybees. I suggest to cut this part.		but read across of science is appropriate; at the end it is <u>interactions with enzymes</u>
Scott Black	2	36	1618	36	1622	As currently written the section is misleading as it state "at worst" combinations are additive but then acknowledges that there are synergistic effects. I recommend rewording slightly to represent the worst case is synergism. Then you can discuss increased toxicity of less than a factor of 2 - 3, additive and antogonistic effects.		reworded
Scott Black	2	36	1620	36	1622	The use of the terms "limited" and "very small number" for synergism is subjective. Consider removing. Also, the section should include that some neonicotinoids, can when mixed together, be synergistic. See: Andersch, W. et al. 2010. Synergistic insecticide mixtures. US Patent US 7,745,375 B2. Bayer CropScience AG		added

Gérard Arnold	2		1622		1624	L 1622 "This limited evidence of synergistic interactions..." It is an incorrect sentence. The companies that produce the pesticides, themselves, are familiar with the synergistic properties of molecules and they even apply for patents in that direction. Examples: 1) the patent filed by Bayer CropScience in USA in 2010 (n° US 7 745 375 B2) (Andersch et al.) specifies that : " It has now been found that mixtures comprising in each case at least two and in particular precisely two compounds from the series of the chloronicotinyl insecticides, act synergistically..." (column 2, line 40 of the patent), and " The invention claimed is....4 a synergistic composition comprising, imidacloprid and clothianidin..." (column 30, line 31). 2) the patent filed by Bayer CropScience in USA in 2008 (n° US 20 080 261 811 A1)(Krohn et al.) specifies that : " a compound comprising a synergistically effective mixture of at least one compound selected from the group consisting of (a) [fungicides] benalaxyl M and metalaxyl M and al least one compound selected from the group consisting of (b) clothianidin, imidacloprid, thiacloprid, thiametoxam...."		added
May Berenbaum	2	36	1626	36	1626	Johnson et al. 2006 is a study of synergism between a pyrethroid and an organophosphate, not an EPI fungicide and pyrethroid		ok
Gérard Arnold	2		1627		1627	L 1627. One important point that does not seem well developed in the report, is that when there is co-exposition of several pesticides (which is a common situation in agricultural areas) and pesticide residues already present in the colonies (insecticides and varroacides), detoxification of each toxic will be slowed down or prevented, because the detoxification enzymes will be solicited simultaneously by multiple molecules (competition).		is there evidence of this from realistic exposure levels? No reference provided
Penelope Whitehorn	2	36	1630	36	1641	These paragraphs should be combined into one.		ok
Peter Campbell	2	362.3.5	1631	36	1631	add "field" before "realistic"		ok

Les Davies	2	36	1633			Organophosphates' - apart from the mis-spelling, these compounds are not phosphates - better to collectively refer to them as 'organophosphorus insecticides' (as is done elsewhere in the document).		ok
Peter Campbell	2	36	1634	36	1635	It should be noted that the exposure method of Gill et al was not env realistic ie feeding station laced with imidicprid and placed onto bumble bee nest with filter paper surrounding it sprayed with lambacyhalothrin at 5 x the recommended application rate. So this statement about additive toxicity should be qualified with a question as to whether such a response under artificial conditions reflects what would actually occur under env relevant field conditions.		but likely to be additive whatever the doses
Serena Heckler	2	37	1640	37	1660	<u>A sentence could be added about traditional methods used to protect bees against pathogens at the end of the section, from line 1660 page 37</u> : "Traditional beekeeping could supply alternative methods of pathogen control which limit risks for bees. In southern Morocco for instance, Berber traditional beekeepers have noted that the harvesting of specific plants by bees influenced their behavior, and also their health by protecting them from parasites, including <i>Varroa</i> . By selecting the right place to build their hives according to the local flora, traditional beekeepers keep their bee colonies in good health (Crousilles, 2012 : Simenel, 2015)." <u>Source</u> : Crousilles A. (2012). La valorisation des vertus médicinales du miel. Rapport de stage de 5ème année de Pharmacie, option Industrie, en collaboration avec IRD/LPED, 25p. [Report-University/research centres-non available on internet] ; Simenel R. et al. (2015). La domestication de l'abeille par le territoire : Un exemple d'apiculture holiste dans le sud marocain" in Techniques et Culture, numéro 63 Pâturages. [article in press]		reference added
Penelope Whitehorn	2	37	1656	37	1660	This sentence would make more sense in 2.3.5		ok

Liette Vasseur	2	37	1662	37	1674	Is this subject being treated in another section or chapter? If so (which it is), I would remove from here since it is quite vague and short despite lots of information available. If not treated anywhere else, there needs to be expanded to include data, distribution, etc.		We have left it inside here for the time being, but might have to make better cross-links e.g. to chapter 3; we leave it inside because of the specific focus on pesticides in the monitoring context
Piotr Medrzycki	2	37	1664	37	1665	This sentence is biased. It is quite obvious that one of the most important factors of winter losses is Varroa. Seasonal losses should be discussed as well. The Italian national monitoring projects APENET and BEENET have evidenced the clear role of <u>neonicotinoids in these losses</u>		The sentence focusses on the pesticide aspect; it does not contradict the observation that Varroa is a key factor
G�rard Arnold	2		1666		1670	L 1666. 'A number of national monitoring approaches have been undertaken to directly address the role of pesticides in overwintering honeybee colony losses'. Some of these monitoring (e.g. German monitoring) have been seriously criticised by some scientists and beekeeping organization concerning their scientific/technical quality. Also, in some cases (Orantes-Bermejo et al., 2010 ; Van Engelsdorp et al., 2010), no dosage of the most frequently suspected pesticides (eg neonicotinoids) was realized with limits of detection (LOD) and quantification (LOQ) adapted. Did the experts of the WG have had access to the protocols and rough data to be sure of their quality?		We have modified the text accordingly; but Van Engelsdorp et al 2010 was not cited here

Gérard Arnold	2		1667		<p>1667 L 1667. "These have concluded that it is a multifactorial issue". Well, I have never met a bee scientist or a beekeeper who believe that there is only one factor (e.g. pesticide) and more precisely one type of insecticide (e.g. neonicotinoid) which is responsible of all the mortalities of the bee colonies, all over the world. But, this assertion does not mean that there is no hierarchy between the main factors (infectious agents, parasites, pesticides). Some factors, in a given context, could be more important than others (e.g. sometimes parasites, sometimes pesticides), and mainly which appears crucial is the interaction between these factors. Therefore the concept of multifactorial issue could be globally valid: there is not a unique factor everywhere, every time, which could explain the mortalities of the honeybees (or the bees in general), but some factors could be more important than others and some factors are more easy to regulate (e.g. pesticides) than others (e.g. infectious agents). Most, if not all, the national monitorings have only focused on the mortality of the bee colonies but not on their strength (size of the population of a colony) and their capacities to accumulate enough stores (honey, pollen). One of the biggest point concerning the bee colonies in the word is their capacity to develop and reproduce normally. This point is also crucial for the development of the beekeeping activity.</p>		We have modified the text accordingly
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Peter Campbell	2	37	1668	37	1669	Pareja et al 2011 reference that supports the conclusion that insecticides caused colony losses in Uruguay is not a robust paper. Only 8 apiaries were sampled representing "region of depopulated beehives" and these were not even located in the same geographical area as the healthy apiaries sampled. Also the 2 insecticides (fipronil and imidacloprid) blamed for the colony losses were only detected in 2 and 3 samples respectively. With such low numbers of +ve detects and the fact that there would have been many other variable differences between the depopulated hives and the healthy hives, this makes the general conclusion that insecticides cause colony losses in Uruguay very weak indeed and therefore does not merit special mention in a reputed IPES review. Indeed here is a quote from the conclusion of this paper itself "Hive depopulation and the overall dropping down of its productivity are a complex phenomena and a direct correlation with pesticide residue findings cannot be simply established." So why with such a conclusion from the paper itself is the contrary statement being made here?		We have removed this reference and the sentence from the text
G�rard Arnold	2		1668		1669	L 1668. "There is no strong evidence that pesticides, particularly the neonicotinoid insecticides, alone are responsible for these longer term colony losses". If there is no 'strong' evidence, however is there some evidence? If this is the case they should be mentioned. As mentioned above, I have never met a bee scientist or even a beekeeper who believe that the neonicotinoid alone are responsible for these longer term colony losses in the EU or US. The use of the term 'alone' seems tricky but pernicious, because does not help to clarify the question. The different main factors (pesticides, infectious agents, parasites) are important, sometimes alone, sometimes in interaction.		We have modified the text accordingly

Peter Campbell	2	37	1670	37	1670	The quoted van Engelsdorp et al 2009 refence is missing from section 2.3.10 (refernce list). Indeed I cannot find such a van Engelsdorp 2009 refernce that supports this fungicide statement. The only van engelsdorp et al 2009 reference I can find is <a href="http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0006481">http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0006481</a> which does not support the fungicide clonlony loss statement being made.		Citation is now provided
Peter Campbell	2	37	1670		1671	Simon-Delso et al 2014 reference is also missing from refernces in Section 2.3.10. When I found this reference <a href="http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0103073">http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0103073</a> the conclusion on fungicides was quoted as follows:- ".According to our results, the role of fungicides as a potential stressor for honeybee colonies should be further studied". Again this does not support the strong statement being made highlighting fungiicides as a factor in colony losses.		We have modified the text accordingly
Peter Campbell	2	37	1671	37	1674	Again the statement in this text does not reflect an important finding in this Yoder study as directly quoted in the following discussion extracted text from this paper "It is important to note that colonies were active and thriving during this time. Bee bread that was nearly devoid of fungi (Turlock samples) originated from active colonies. Bees appear to be capable of managing the effect of fungicide contamination at the level of the concentrations that are applied in the field in our study sites." This statement does nor seem to suggest a strong link from fungicides to colony losses as hypothesised in the current text in this section.		The present text just explains one mode of action of fungicides, but does not claim that it explains the colony losses.
Thomas Brooks	2	37	1671			Missing from reference list; also correct publication date to 2015		ok
May Berenbaum	2	37	1672	37	1677	I couldn't find vanEngelsdorp et al. 2009 or Simon-Delso et al. 2014 in the reference section		ok
Leslie Firbank	2	37	1684		1696	I don't think discussion of butterflies really helps this section		Paragraph shortened
Liette Vasseur	2	37	1684	37	1693	This paragraph needs to be reworked. Difficult to read. It seems <u>to have been done in a rush.</u>		Paragraph shortened
Anne-Laure Jacquemart	2	37	1684		1693	shorten or delete : too long relative to other chapters		Paragraph shortened

Thomas Steeger	2	37	1686	37	1686	"...pollinators has not been widely investigated."		Corrected
Natacha Chacoff	2	37	1688	37	1688	delete an open parenthesis		corrected
David Evans	2	37	1690	37	1690	What happened to the bracket??		corrected
Thomas Steeger	2	38	1700	38	1700	delete "like" prior to "e.g.,"		corrected
May Berenbaum	2	38	1700	38	1708	There are multiple recent papers on effects of selenium on honey bees that might be cited here (e.g., Hladun KR, Smith BH, Mustard JA, Morton RR, Trumble JT (2012) Selenium Toxicity to Honey Bee ( <i>Apis mellifera</i> L.) Pollinators: Effects on Behaviors and Survival. PLoS ONE 7(4): e34137		Thank you for the literature. Also non-heavy metals are now included in this section.
Thomas Steeger	2	38	1702	38	1702	it may not be entirely accurate to say that "bee larvae feed exclusively on pollen" since early in their development, they are feeding on royal/brood jelly and then transition to pollen. Also consider "thus, in polluted sites, they may consume food . . ."		Yes, you are right. I had in mind writing this sentence mostly solitary bees, which do eat mostly pollen with some addition of nectar. Corrected
Leo Galetto	2	38	1713	38	1717	In my opinion these reflections should be emphasised because they are very significant.		Rewritten
Anne-Laure Jacquemart	2	38	1715		1724	idem		If you mean that Moron et al 2013, than I prefer leaving this reference as it is, to avoid misunderstanding. Those are two separate papers.
Joseph Tzanopoulos	2	38	1726			Box 2.3.4 is not correctly placed in this chapter. I would suggest to move it before subchapter 2.3.7		still under consideration
Anne-Laure Jacquemart	2	38	1728			not in a box, put in the text		still under consideration
Anne-Laure Jacquemart	2	38	1728			box 2,4,1, - delete ?		still under consideration
Penelope Whitehorn	2	38	1728	38	1728	Mention unregulated domestic use somewhere in this box.		ok
Leslie Firbank	2	39	1729		1777	It would be good to see this put in the social and political context, the EU banning, public and industry responses etc		still under consideration
Lennard Pisa	2	38	1734	38	1735	Strange, unclear sentence.		reworded

Scott Black	2	38	1736	38	1739	As mentioned earlier the debate on whether neonicotinoids only cause mortality from accidents and abuse is not confirmed as bee die offs have been confirmed from labeled uses. I would cut from 1736 - 1739.		added context
G�rard Arnold	2		1736		1737	L 1736 (Box 2.3.4). "Apart from 'accidents' and 'abuse' of the neonicotinoids, where strict regulation is in force registration is only granted when no lethal effects to bees is foreseen". Many evidences show that neonicotinoids used in seed coating have been approved in many countries with test methods that were not adapted to these formulations (see my comments L 1282 and L 1491)		reworded
Scott Black	2	38	1739	38	1741	Suggested change to language: "One area of the debate that still has significant data gaps is in determining the impacts at the population level caused by the possibility of acute and chronic sublethal effects such as interference with orientation and learning abilities and other behavioural characteristics of pollinators, as well as with the (social) immune system. Also still needing further investigation is whether there is a risk of acute incidents from legal neonicotinoid use in places with strict regulation in force."		ok
Jeff Ollerton	2	38	1741	38	1741	What is "the (social) immune system"?		reword
Thomas Brooks	2	37	1742			Add citation to van der Sluijs et al. (2013) Current Opinion Environ Sustainability here		ok
Scott Black	2	38	1743	38	1743	remove "but there is no clear proof of guilt or innocence"		ok
G�rard Arnold	2		1743		1744	L 1743. 'Where declines in species and possible drivers have been identified but there is no clear proof of guilt or innocence, we need to carefully weigh the evidence, and identify which are the key gaps (e.g. Godfray et al 2014)'. The choice to refer only to the review of Gofray et al is highly questionable, because several other reviews have been published on this subject and led to opposite conclusions to those of Godfray et al. See, for ex: van der Sluijs et al. (2013), Pisa et al. (2014), Simon-Delso et al. (2014), Chagnon et al. (2014), Bonmatin et al. (2014).		added van der Sluijs ref
Thomas Steeger	2	38	1745	38	1745	the reference to Hill's epidemiological criteria should be further fleshed out in the text as readers may not be familiar with these criteria.		ok

NagLaa Loutfy	2	39	1748	39	-	<p>Add the following paragraph: The European Commission has endorsed a decision taken in 2013 to restrict the use of three of the most used pesticides of the group (clothianidin, imidacloprid and thiametoxam) for a period of two years according to EU regulation No 485/2013, (EU 2013 ). The Commission's action is a response to the European Food Safety Authority's scientific report which identified "high acute risks" for bees as regard exposure to dust formulation in several crops (EFSA, 2013). The decision was considered a lifesaving for pollinators and bees in particular, However, the decision was reversed, and neonicotinoids were back in the market despite the huge controversy of their use. Similarly, fipronil, a phenylpyrazole insecticides, (EFSA, 2013).has been acknowledged to pose high risks for bees.</p> <p>REFERENCE: EU (2013) Official journal of the European Union, L 139/12, 25.5.2013. EFSA, 2013: EFSA (European Food Safety Authority). 2013 - Conclusion on the peer review of the pesticide risk assessment for bees for the active substance fipronil. EFSA Journal 2013;11(5):3158 - <a href="http://www.efsa.europa.eu/en/efsajournal/pub/3158.htm">http://www.efsa.europa.eu/en/efsajournal/pub/3158.htm</a> <a href="http://www.efsa.europa.eu/en/efsajournal/doc/3158.pdf">http://www.efsa.europa.eu/en/efsajournal/doc/3158.pdf</a></p>	The report has emphasized the impact of neonicotinoids on bees that evoked a worldwide concern, and an EC decision to suspend the use of main pesticides of this group. Nevertheless, the EC decision was cancelled out and the pesticides in question are currently back in the market . In my view the decision to bring these pesticides back to the market could have been commented on in view of the proven side effects of these pesticides. ;one new reference is included in this paragraph "EU (2013) Official journal of the European Union, L 139/12, 25.5.2013". This reference should be add to page 41 line 1898.	this is for chapter 6
Scott Black	2	39	1748	39	1749	remove "(for example ... but now...?)"		ok
Marina Rosales Benites de Franco	2	39	1749	39	1777	I suggest to consider other key gaps: long term effects, heavy metal pollution and effects in non farm landscapes.		ok
Colin Fontaine	2	39	1751	39	1762	gaps in our knowledge are huge outside bees		ok
Mercy Gichora	2	39	1753	39	1753	Is one of the insects in brackets the May fly?		ok

Nadine Azzu	2	39	1753	39	1753	mayfly?		ok
Keng Hong	2	39	1753	39	1753	Insert a 'f' before "ly" to read as "fly"; and replace "," with a '.' plus space after " <i>et al</i> ".		ok
Keng Hong	2	39	1753	39	1753	References (if needed): a) Antifeeding effect of cypermethrin and permethrin at sub-lethal levels against <i>Pieris brassicae</i> larvae. KH Tan(1981) <i>Pesticide Science</i> 12 (6), 619-626. b) Irritancy response to temperature after sublethal action of pyrethroids against cabbage white caterpillars <i>Pieris brassicae</i> . KH Tan (1982) <i>Entomologia Experientia &amp; Applicata</i> 32, 151-154.		but not NNIs
Claudia Maria Jacobi	2		1753		1753	you mean 'mayfly'?		ok
Thomas Steeger	2	39	1755	39	1755	"Mayfly"		ok
Thomas Steeger	2	39	1757	39	1757	"Therefore, futher data are required. . ."		ok
G�rard Arnold	2		1760		1762	L 1760. 'For example, the potential for interactions between sub-lethal exposure to neonicotinoids and foraging efficiency resulting in effects at the colony level for species with low numbers of foragers are plausible.'The question is not whether the number of foragers is low or high. Even in the case of the honeybee, where the number of foragers can be high, a significant loss of foragers can cause their replacement by younger bees that have the function of nurses, and thus have negative consequences on breeding youth. Moreover, even if the queen can lay more eggs to compensate for the losses, the supernumerary laying and rearing causes an energetic and biological cost to the colony. The report's authors do not justify why it would be plausible in a case would not be in the other.		ok- modelling may inform

Scott Black	2	39	1766	39	1771	Due the persistence of most neonicotinoids which can allow build up from season to season any exposure assessments should also include: How concentrations within a plant increase over time following repeated applications; and how soil residues increase over time and how they are taken up into plants or crops that are subsequently planted. The section also states the need to quantify field-realistic levels. Field-realistic levels will vary as there are so many factors involved and therefore field-realistic will likely encompass a wide range.		ok
Gérard Arnold	2		1766		1768	L 1766. 'To quantify field-realistic exposure levels we need to estimate both the potential total intake of residues via pollen and nectar...' The field exposure is not limited to pollen and nectar even though they may be important. Concerning exposure, the most recent and complete synthesis should be cited (Bonmatin et al., 2014). It describes 'how environmental contamination occurs via a number of routes including dust generated during drilling of dressed seeds, contamination and accumulation in arable soils and soil water, runoff into waterways, and uptake of pesticides by nontarget plants via their roots or dust deposition on leaves. Overall, there is strong evidence that soils, waterways, and plants in agricultural environments and neighboring areas are contaminated with variable levels of neonicotinoids or fipronil mixtures and their metabolites : soil (ppb – ppm range), water (ppt -ppb range) and plants (ppb-ppm range). This provides multiple routes for chronic (and acute in some cases) exposure of nontarget animals.' Another important document concerning the routes of exposure is a recent EFSA Guidance Document (2013) which presents risk assessment scheme for honey bees, bumble bees and solitary bees.		add explanation of exposure vof individual vs exposure of colony

Gérard Arnold	2		1767		1768	L 1767. 'Since contaminated food will often form only part of the total available food resources within the landscape'. Evidently this assertion depends on the landscape where pollinators are located. In areas of intensive crops or orchards, which are many in the world, they can be exposed to very large amounts of nectar and pollen for intensive crop treated with systemic pesticides. Given the flowering times of different plots that can be shifted in time (e.g. corn, sunflower, rapeseed), exposure can last several weeks or more a month for the same crop.		add reference on importance of multiple food sources in single crop landscapes
Mercy Gichora	2	39	1769	39	1769	Use full word instead of the abbreviation 'vs'		ok
Thomas Brooks	2	37	1774			Add citation to Goulson et al. (2015) Science here		ok
Gérard Arnold	2		1774		1776	L 1774. 'the need to study the effects of realistic combinations and scales of stressors some of which are not readily manipulated, e.g. pesticides and disease within the honeybee colony'. Everybody agree that it is very important to conduct research on the question of the interactions between pesticides and infectious agents. However, many results have already been obtained in the honeybee. Synergy between <i>N. ceranae</i> and neonicotinoid insecticides (imidacloprid, thiacloprid), or fipronil, has been demonstrated (Alaux et al., 2010 ; Vidau et al., 2011 ; Aufauvre et al., 2012 ; Aufauvre et al., 2014 ; Doublet et al., 2014 ; Retschnig et al., 2014). Synergy also exists between <i>Nosema</i> and fungicides chlorothalonil et pyraclostrobine (Pettis et al., 2013). Clothianidin has the ability to reduce the immune responses of bees and therefore to induce replication DWV (Di Prisco et al., 2013). I saw that most of these references are cited in the section 2.9, but I think that they could be cited also in the section 2.3, in order that the reader of this section do not have the impression that the gap of knowledge on this subject is abyssal. We already have evidence of the synergistic effects of pesticides on infectious agents, although more research is needed.		not colony level exposure but added recent references as well
Lennard Pisa	2	38	1775	38	1775	In my opinion, but that is my opinion, we can and should continue lab testing for exposure levels and such but what would be very welcome		ok -add caveat

Lennard Pisa	2	38	1775	38	1775	are larger field trails with compounds and controls, having all other variability in check by means of design and sample size		see 1046
Lennard Pisa	2	38	1775	38	1775	A lot of studies are rather small considering sample size and subjected groups can vary in a lot of other things.		see 1046
Lennard Pisa	2	38	1775	38	1775	But bigger well designed field trails are very expensive if you want to look at sublethal effects (in bees).		see 1046
Anne-Laure Jacquemart	2	39	1779		1793	You can be more engaged and discuss the known results.		ok rework to highlight what we do know
Natacha Chacoff	2	39	1781	39	1793	For me after reading this section, it is clear that we still need much more research on this topic, but I would like to read at the end of the section some asertions, what it is more or less clear about pollinators and pesticides		ok rework to highlight what we do know
Leo Galetto	2	39	1781	39	1795	I agree. There is a high uncertainty in a field situation. Nevertheless, the focus is oriented to this kind of uncertainty (present in every complex system) present in ecological field conditions, but the knowledge obtained through experiments (in lab conditions or some at field conditions) is not considered at all.		ok rework to highlight what we do know

Gérard Arnold	2		1781		1795	L 1781 Conclusion of Subchapter 2.3. This sub-chapter gives me the feeling that, in many places - especially when it comes to the possible role of pesticides in general and in particular neonicotinoids - literature review appears incomplete and biased. I realized this with a very simple bibliometric study on the author names that are most often cited (as the first author of the publications). The first place is, by far, Thompson (mentioned 12 times), then, Godfray (cited 8 times) and Blacquièrè (4 times). This ranking is very surprising and in no way reflects the reality of the international bibliography in this field of research, nor the quality of the cited reviews. I have made some comments (above) on the cited publications of these authors: Thompson, in lines 1468, 1486, 1477, 1501, 1567, 1605); Godfray, in lines 1442, 1743); Blacquièrè, in line 1582. Thompson is a member of the WG, which may explain the many self-citations, is also from Syngenta. Original scientific publications and important reviews are not cited or superficially. I mentioned in my comment (L 1442) other recent review little (or not) listed, while they are generally based on more than 100 or 200 references. Discourse analysis of this subchapter - even very brief and basic - shows the language efforts that have been made to settle the doubt (I stress in my comments, e.g. L 1604) when evidence was provided on the toxicity of pesticides for pollinators (e.g. 'limited evidence', 'no strong evidence'). Unfortunately, it is not explained precisely how the ranking of the level of the evidence was obtained: 1) what is the number of publications that have led to this conclusion? 2) What is the scientific quality of these publications? Do the experts assessed for each publication the scientific robustness of the protocols and results? 3) Was there a potential 'funding-effect' of the study analyzed (Krimsky, 2005):		ok - sections were written by several authors and also reworked within the group; some of the highlighted reviews also have some alternative bias and the section should aim to reflect both approaches as reflected in all the comments received
Marina Rosales Benites de Franco	2	39	1782	39	1782	.....and the level of exposure and persistence		ok

Scott Black	2	39	1783	39	1783	As noted earlier, numerous factors impact risk including mixtures found in formulated products, tank mixes and environmental mixes. Pesticide breakdown products are also of concern. Therefore, the focus on the active ingredient or active substance <u>should be expanded</u>		ok
Marina Rosales Benites de Franco	2	39	1784	39	1784	I suggest to use Pesticides instead of Insecticides...		ok
Thomas Steeger	2	39	1784	39	1784	". . .the level and duration of exposure. . ."		ok
Scott Black	2	39	1785	39	1785	Insert "the chemical's properties" into the list of items that affect <u>exposure</u> .		ok
G�rard Arnold	2		1787		1787	L 1787. 'the sublethal effects of exposure under field-realistic conditions are less well understood'. The main question is not to understand well (or less well) all the mechanisms of the sublethal effects (e.g. at cellular or molecular levels), but, in priority, whether they have negative consequences or not on the bee colony. If it is the case, to draw the consequences in terms of protection of the pollinators. For example, the mechanisms of many diseases are not always well understood in humans, but this does not preclude trying to prevent them (for example by removing the causes, when possible)!		ok add recent references on interactions at colony level
G�rard Arnold	2		1788		1789	L 1788. 'A wide range of sublethal effects on individual behavior and physiology, and on colony functions in social bees, has been reported, though not always using field-realistic doses.' Not always means that some have been observed using field-realistic doses. So it is that they exist and confirm the laboratory results.		ok refer to recent publications

Scott Black	2	39	1789	39	1789	The definition of what constitutes field-realistic doses are under debate. Furthermore, field realistic exposures will not be fixed as there are significant number of variables that will affect the dose. While some reserchers purposefully use doses higher than what has been detected in the field, numerous research projects, that identified sublethal effects, used the best availalbe science to replicate field realistic doses. To not diminish the important findings of numerous researchers, I would remove "...not always using field-realistic doses."		ok
Thomas Steeger	2	39	1789	39	1789	"...using field-realistic exposure levels."		ok
Marina Rosales Benites de Franco	2	39	1792	39	1792	I suggest: (land use intensification and fragmentation....		ok
G�rard Arnold	2		1793		1795	L 1793. The interaction of pesticides with other key pressures on pollinators in realistic combinations and scales of stressors (land-use intensification, climate change, alien species, pests and pathogens) is little understood. This is not true in all cases. Many studies now exist on this issue (see my comment L 1774). Even if these mechanisms are better understood, it is not necessary to understand everything to take protective measures. The fact that their mechanisms are, in some cases, little understood is a secondary issue (see my comment L 1787).		refer to interactions section
Peter Campbell	2	41	1868	41	1869	Cutler et al 2014 refernce quoted above is missing in refernce list. Here is link to missing reference <a href="https://peerj.com/articles/652/">https://peerj.com/articles/652/</a> ie "A large-scale field study examining effects of exposure to clothianidin seed-treated canola on honey bee colony health, development, and overwintering success" G. Christopher Cutler <sup>1</sup> , Cynthia D. Scott-Dupree <sup>2</sup> , Maryam Sultan <sup>2</sup> , Andrew D. McFarlane <sup>2</sup> , Larry Brewer <sup>3</sup> , . PeerJ.		ok
Shaju Thomas	2	40	2040	40	2041	All caps	demands correction	ok
Shaju Thomas	2	45	2070	45	2071			

Peter Campbell	2	45	2084	45	2085	Simon-Delso et al 2014 reference quoted in 2.3.7 is missing from this references list		ok
Peter Campbell	2	46	2139	46	2139	van Engelsdorp et al 2009 is missing if this indeed is the right reference as the only 2009 reference I found did not support the statement being made in section 2.3.7, iehttp://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0006481		ok
Jochen Freund	2	47	2168	52	2465	Why is there a whole section assigned to GMO crops, if it is not shown to be one of the (direct) drivers of pollinator loss? It looks as if this could be included in other sections, such as 2.2 and 2.3, which could help in overall shortening.		This has been now addressed with the new structure of the chapter.
Jörg Romeis	2	47	2168	52	2463	I have three major general comments on chapter 2.4.		
Jörg Romeis	2	47	2168	52	2463	COMMENT I. Chapter 2.4 address different taxa of pollinators: Hymenoptera, Diptera, Coleoptera, Lepidoptera. This is in strong contrast to the rest of Chapter 2. There Lepidoptera are mentioned just once (p. 9, line 235) while Diptera and Coleoptera are not mentioned at all and the text focuses exclusively on bees. All questions concerning the potential impacts of GM IR or HT crops on Diptera, Coleoptera and Lepidoptera would similarly have to be addressed in other subchapters of chapter 2. For example if the use of herbicides in HT crops reduces weed biodiversity in crop fields and thus reduces pollinator biodiversity the same would be the case when herbicides are applied to non-GM crops. As it is now chapter 2.4 is very misleading. The currently grown IR GM crops produce insecticidal Bt toxins that specifically target lepidopteran or coleopteran pests. This known (and narrow) spectrum of activity is now used to construct risks coleopteran and lepidopteran pollinators. To be consistent the same would be true (and even much stronger) for the much less specific insecticides that are alternative pest control methods to the Bt crops.		It is not correct that our treatment of HT GMOs and their effect on weed availability for pollinators has been partially treated. In the version the reviewer received we had explicitly stated the similarity of HT GMOs and other conventional crops treated with insecticides (lines 2263 and 2254). This references are still present in the current version and allow directing the reader to a more thorough evaluation of the effects of herbicides on pollinators. Along with this, the topic of insect resistance has not been treated in this section, since this is a topic that affects pests and not non-target species such as pollinators. We do not think that adding such information is appropriate to the goals of this report.

Jörg Romeis	2	47	2168	52	2463	COMMENT II. A lot of the discussion in chapter 2.4. concerns non-Bt toxins that are much less specific compared to the currently used Bt toxins. This includes protease inhibitors, lectins, avidin, etc. I strongly suggest to delete any reference to those toxins as they are not commercialized and there is no evidence that pipeline products of companies produce such relatively unspecific insecticidal toxins. The focus of the discussion should be on the technology as it is used today and thus stick to the Bt crops.	The references listed in Table 2.4.1. concerning effects on Diptera and Coleoptera exclusively refer to data from the non-target testing with species that are valued as predators or decomposers. No evidence is given to coleopteran or dipteran pollinators.	We thank the reviewer for this comment. Based on the reviewer's suggestions, and since these crops are not currently commercialized, we have now decided to exclude them from the report. The references to tests on Diptera and Coleoptera have now been excluded from the table.
Jörg Romeis	2	47	2168	52	2463	COMMENT III. The impact of GM crops on food production and safety is discussed in 2.4.2.3. and elsewhere in chapter 2.4 (most prominently in the last sentence of the conclusions, p. 50, lines 2349-2350). Again this would have to be addressed in other subchapters of chapter 2. For example pesticides are known to contaminate honey and thus could cause a food/health safety issue. I strongly suggest to remove this topic from chapter 2.4. and make it a separate sub-chapter where the impact of different management options etc. on bee products could be discussed.	Food safety will be covered by the scope section in the beginning of the chapter. Statement in line 2349 should be deleted since that is out of scope here.	Based on this and other comments, we have now decided to exclude the treatment of food safety. This will be treated in a more general fashion at the end of the chapter.
Liette Vasseur	2	47	2170	47	2179	Combine in one paragraph and make sure more readable.		Done.
Maximilian Weigend	2	47	2171	50		a nice and objective review - GMO-problems are manifold and difficult to quantify, but main objections are unlikely to come from pollination ecology.		OK
Thomas Steeger	2	47	2173	47	2174	". . . are organisms which have been genetically engineered to introduce a transgene to their genome"		Modified. Thanks!
Claudia Maria Jacobi	2		2181		2181	I think that the use of 'Biotech crop' is misleading. I suggest changing it to 'GMO crop' or the like.		Changed.

Jörg Romeis	2	47	2186	47	2186	Replace "Most..." with "All currently grown..."	All IR GM crops that are approved for cultivation worldwide today produce insecticidal proteins from <i>Bacillus thuringiensis</i> (Cry or VIP proteins).	Done.
Andreas Kruess	2	47	2188	47	2188	Additional relevant literature: Holst et al. (2013) Increased mortality is predicted of <i>Inachis io</i> larvae caused by Bt-maize pollen in European farmland. - <i>Ecological Modelling</i> 250: 126–133		This reference has been now added, but it is mentioned that the results obtained in such studies are ambiguous and inconclusive.
Jörg Romeis	2	47	2188	47	2188	Replace "and/or" with "or"	The Bt toxins produced by today's GM plants target either Lepidoptera OR Coleoptera. There is no toxin in use that has activity against both insect orders.	Done.
Mercy Gichora	2	47	2191	47	2191	Is the word 'breadth' the one the author had in mind?		Yes! Corrected.
Jörg Romeis	2	47	2191	47	2191	Add information at the end the paragraph that none of these non-Bt proteins is produced by any of the GM plants that are approved for cultivation today.	I believe that it is important to place the information that is provided on these alternative toxins later in the chapter into context. These less specific non-Bt proteins are not in use today.	Yes. Although now we present this to inform the reader about the existence of such toxins, we explicitly state that they are not commercialized and that thus, they are not going to be treated in the text.

Jörg Romeis	2	47	2202	47	2210	I suggest to include the study by Babendreier et al. (2004) who have quantified the amount of maize pollen consumed by honey bee worker larvae that allows to assess the dose of insecticidal pollen-contained toxins on bees.	Babendreier et al. (2004) Pollen consumption in honey bee larvae: a step forward in the risk assessment of transgenic plants. Apidologie 35: 293-300	We thank the reviewer for this suggestion. Even though this is very important information for performing risk assessments, it is not central to this report. Indeed, the studies cited already mention this information on experimental design. For that reason, we have decided to not include it in the final
Jörg Romeis	2	47	2202	47	2202	replace "insecticidal transgenes" with "insecticidal proteins"	It's not the transgenes that were detected in pollen and nectar but the proteins that are encoded by the transgenes.	Thanks for this comment. Here, we are referring to transgene expression. Indeed, a protein is only present if the genes coding for it are expressed. In our opinion, this distinction is important, particularly in the case of gene escape, where a transgene can be present in the genome of the introgressed plant, but not expressed, leading to an absence of the transgenic protein in a molecular test. However, to avoid any misinterpretation, we have now excluded the word "insecticidal".
Keng Hong	2	47	2204	47	2204	Insert 'behavioural/' before "physiological".		done.
Teruyoshi Nagamitsu	2		2212		2224	Bt-toxins seem specific to lepidopterans, which are important pollinators of some taxa of rare plants, for example, lilies and orchids. In the case of such rare plants with specific lepidopteran pollinators, Bt-toxins could affect these pollinators and the reproduction of those rare plants.		Although this can be true, there are no published studies investigating and testing such questions. This idea is already mentioned at the end of the gene-escape subsection, and represented with a case-study in the box.

Jörg Romeis	2	47	2214	47	2215	Delete the references by Arpaia et al. (2011)	The study only report on pollinator behaviour and does not contain any information on the toxicity of Bt toxins. Also adapt the text in Table 2.4.1	The reference has been deleted from the main text, but maintained in the table. Indeed, bee behaviour is an important indicator of bee health. For that reason, we still consider it important to mention it in the table.
Jörg Romeis	2	47	2215	47	2216	Delete the reference by Mommaerts et al. (2010) here and in table 2.4.1	The study has not included any GM crop. The authors have tested the impact of two commercial Bacillus thuringiensis spray formulations for their studies.	Thanks for the comment. We state in the text that studies investigated GM crops OR toxins. In that study, the authors test the effect of the toxins on bumblebees. For that reason, we have decided to keep the references. Also, we have corrected the table, stating now that the tests refer to Bt-formulations.
Lennard Pisa	2	48	2223	48	2223	"and their colonies" is a bit weird and does not add to hymenopterans		this part of the paragraph has been now deleted. Also, see answer to <a href="#">comment 1073</a> .
Lennard Pisa	2	48	2223	48	2223	correct plural for hymenopterans would be hymenoptera, hymenoptera species.		this part of the paragraph has been now deleted. Also, see answer to <a href="#">comment 1073</a> .
Lennard Pisa	2	48	2223	48	2223	But ortography comments are outside my review		this part of the paragraph has been now deleted. Also, see answer to <a href="#">comment 1073</a> .

Jörg Romeis	2	48	2223	48	2223	Add the reference by Konrad et al. (2008) that have tested the impact of different insecticidal proteins (including Bt toxins) on <i>Osmia bicornis</i>	Konrad R, Ferry N, Gatehouse AMR, Babendreier D (2008) Potential Effects of Oilseed Rape Expressing Oryzacystatin-1 (OC-1) and of Purified Insecticidal Proteins on Larvae of the Solitary Bee <i>Osmia bicornis</i> . PLoS ONE 3(7): e2664	this part of the paragraph has been now deleted. Also, see answer to comment 1073. We have however added the reference to the text and the table. Thanks!
Mercy Gichora	2	48	2227	48	2228	Use plural form for effect and type, that is, 'effects' and 'types'		Done.
Filiberto Pollisco	2	48	2227	48	2231	Caption is a bit long. 2nd and last sentence can be omitted except the "legends" (i.e. E empirical; R review; and so on)	No need to point out that they are shown since they are already in the table	Done.
Claudia Maria Jacobi	2		2227		2231	explain Cry and Vip in the legend (full names).		Done.
Mercy Gichora	2	48	2229	48	2229	Use plural form ...effects were identified...		Done.
Natalia Escobedo	2	48	2229	48	2229	On table 2.4.1: I think the labeling could be more clear. At first I was confused by the "insecticide type" header (I thought it was about insecticides, not insecticidal proteins). I suggest a more straightforward description, i.e. in the first sentence of the table description: "Summary of results for tested negative effects of <b>inseticidal proteins</b> on..." Or maybe, change the header to something like "Insecticide type in proteins"		Done.

Gérard Arnold	2		2229		2234	L 2229. I think regarding the Insect Resistant GMO, the IPBES report should recommend that for their marketing authorizations, they should follow the same procedures as those used for the pesticides (see EFSA, 2013) since they have insecticidal properties, and therefore cause potential adverse effects on pollinators.		Thanks. This type of recommendation will be done, if necessary, in Chapter 6. Also, note that in this section we already establish the similarities we identified between IR GMOs and pesticides, and we refer to the appropriate section of chapter 2 (2.3.1).
Liu Biao	2	48	2239	48	2239	"relative" should be added between "wild" and "species".		We here refer to that actual wild ancestor of the cultivated species. In those cases, these species are actually wild. To clarify this, we have now added 'ancestor'.
Leslie Firbank	2	48	2241		2267	I'm surprised not to see reference to the uk farm scale evaluations of GM crops here re effects of weed removal on pollinators, see Phil Trans Royal Soc 2003 special issue)		Reference to one of these studies has been now added.
Lennard Pisa	2	48	2245	48	2246	"Overall global reduction in insecticide application" is there a reference for this?		A reference has been now added, based on a very recent meta-analysis.
Lennard Pisa	2	48	2245	48	2246	Brooks and Barefoot show that GMO crops decrease pesticide use, but is the overall global amount going decreasing?		A reference has been now added. See answer to comment 1102.
Scott Black	2	48	2249	28	2251	Did the reduction in pesticide use consider seed treatments. In US 98% of GM corn also uses seed treatments and seed treatments are sometime not considered insecticide application. Please clarify.		this is now clarified. See treatment is not significantly different between GM and non-GM crops.
May Berenbaum	2	48	2251	48	2251	"very small" isn't very informative; is there another, more quantitative, reference?		Done.

Jörg Romeis	2	48	2258	48	2259	The statement that refers to the meta-analyses by Marvier (2007) should be deleted as it does not refer to pollinators but parasitic wasps and ants.	The relevant quote from Marvier et al. (2007) is as follows: "Lastly, hymenopterans are less common on average in Cry1Ab and Cry3Bb maize compared with hymenopterans in non-GM, insecticide-free controls (Fig. 2, B and C, respectively). For the Cry1Ab comparison, data on hymenopterans mostly comprised parasitic wasps of the braconidae and ichneumonidae. For Cry3Bb maize, data included parasitic wasps and ants." A further meta-analysis of the data is provided by Wolfenbarger et al. (2008; PLoS ONE 3(5): e2118) and re-emphasizes the fact that hymenopteran parasitoids are reduced in Bt maize (due to the	Thanks for the correction. The sentence has been deleted accordingly. A short mention to the lack of effect in non-treated non-IR plants is given earlier in the sentence.
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Martha Groom	2	48	2260	48	2267	Should probably also re-connect to the potential for sublethal impacts from herbicides as well. Could add at end of first sentence at line 260-261: "and may cause sub-lethal impacts on pollinators (although these may be mild: Herbert et al. 2014)" Reference: Herbert, L.T., Vazquez, D.E., Farina, W.M. 2014. Effects of field-realistic doses of glyphosate on honeybee appetitive behaviour. Journal of Experimental Biology 217(10):2457-2464		A similar reference has been now added following this comment. A cross reference to the herbicide section is added here.
Mario Marcos Espirito	2	48	2261	48	2261	GMO crops may be "less harmful" to pollinators, but I don't see how they can be "beneficial" at all.		Considering that the insect communities are richer in IR-crops (through less insecticide treatments), there is some support to the idea that these crops could increase the number of pollinators. We clearly state here the limitations of these studies, and this is why we warn the reader against concluding on anything definitive.
May Berenbaum	2	48	2264	48	2264	"most pollinators exploit these weeds as pollen and nectar sources"--forbs, right? Not grasses?		Although insects get pollen and nectar from forbs, and forbs are many times insect-dependent for their pollination, insects can also visit grasses to obtain pollen. From that perspective, both grasses and forbs can be an important pollen source for insects. Because the statement 'weed' is encompassing, we have now kept it.
May Berenbaum	2	48	2267	48	2268	Here the authors (I think correctly) indicate that HT crops are "suspected" to reduce monarch populations; this level of caution isn't reflected in the chapter summary or in line 2350		Correct. The chapter summary has been now modified to reflect this level of caution.
Lennard Pisa	2	48	2269	48	2269	The subsection title should include "effect of GMO on use of agrochemicals" as that is what it is about?		Modified accordingly.

Lennard Pisa	2	48	2269	49	2288	Is the subsection on gene escape necessary or can it be left out?		Gene escape is a very central, but not much investigated, issue in GM-crops. This issue can have several unexpected ecological and evolutionary consequences for whole ecosystems and for pollinators in particular. For that reason, we think that it is necessary to maintain it in the text.
Lennard Pisa	2	48	2269	49	2288	As there is nothing known about it in relation to pollinators really, I suggest: shorten to remark and merge with earlier section		See answer to comment 1112.
Thomas Steeger	2	49	2288	49	2288	". . .introgressed plants, which favors . . ."		Changed.
Lennard Pisa	2	49	2290	49	2290	Title should maybe make the connection to pollinators?		The title has been changed to "effects on pollination services"
Liu Biao	2	49	2292	49	2292	"Any negative" should be "Most negative"	cotton bollworm is both the target organism of Bt cotton and a pollinator of cotton, the negative effect of Bt cotton on it will increase cotton produce.	Changed.
Graciela Rusch	2	49	2295	40	2297	This statement is unclear. Loss of herbivore pressure?		The sentence has been now clarified.
Anne-Laure Jacquemart	2	49	2299			add "honey"!		Food safety and production has been now excluded from this section. This is treated at the end of the chapter.

Liu Biao	2	49	2302	49	2303	The sentence is wrong and the reference "Shelton et al,2002" is too old,this sentence should be deleted.	First, Bt corn pollen harms monarch butterfly,which showed that some GM food are toxic to some animal;Second,future GM food may have negative effects on some animals.	This part of the text has been deleted. See also answer to comment 1118.
Nadine Azzu	2	49	2302	49	2303	<i>really?? (then - why is it so controversial? And for all the evidence that GMO food is not toxic, is there any saying the contrary?)</i>		<i>see answer to comment 1118</i>
Leslie Firbank	2	49	2305		2335	Is Box 2.4.1 really relevant?		We believe so, since it clearly represents the complexity and multifactoriality of the GM-crop factor on pollinators
David Evans	2	49	2305	49	2305	Do we need to state WHY it's controversial ... lack of public understanding and strong anti movement. NOT because of any doubt about the science.		We think that the topic is a complex and multifactorial one. For that reason, we want to make this clear using this very well-known example.
Scott Black	2	49	2305	49	2306	This sentence should be stricken. This is contriverisal and off topic (has nothing to do with pollinators) and to treat it in one sentence does not do it justice even if it is correct.		We disagree. The example is directly related to pollinators (a wild butterfly), and what pollinators represent from a cultural perspective. It also clearly demonstrates the complexity of the subject, and how multifactorial it is.
Thomas Steeger	2	49	2305	49	2305	"Although a very controversial topic, data indicate that GM food is ...:		see answer to comment 1118
Mario Marcos Espirito	2	49	2305	49	2306	I don't think this assessment should go into the general GMO food safety discussion. This can raise concerns about conflict of interest. For the pollinator products, the discussion is pertinent. In any case, the reference given for GMO safety is old, and questions can be raised about what was discovered after 2002.		see answer to comment 1118

Scott Black	2	49	2311	49	2311	You state the issue is "complex". I think this is a mischaracterization. Bt has little impact on pollinators whereas glyphosate tolerant crops have been shown to have a big impact do to loss of foraging (especially in monarchs). Not complex.		The idea of this box is to communicate the many aspects that should be considered when evaluating or even considering evaluating the effect of GMOs on pollinators. That is the complexity we refer to
Liette Vasseur	2	49	2312			I would add Canada, not only US and Mexico.		Done.
Jeff Ollerton	2	49	2314	49	2314	It may be worth adding that <i>Asclepias</i> spp. in North America are ecologically important as they are often very generalised in their interactions and support considerable numbers of pollinators that are used by other species within a community - see Wyatt R, Broyles SB. 1994. Ecology and evolution of reproduction in milkweeds. Annual Review of Ecology and Systematics 25: 423–441 and Ollerton & Liede (1997) Pollination systems in the Asclepiadaceae: a survey and preliminary analysis. Biol. J. Linn. Soc. 62: 593–610		Although we agree with the reviewer that <i>Asclepias</i> spp. Are important for pollination networks in N. America, we have decided to not include this information in the box. Indeed, we think that will direct the reader's attention into a topic that is not central to what we're trying to communicate with this box.
Jörg Romeis	2	48	2316	48	2316	Revise to "...close to or within crop fields..."	Milkweed also grows in teh field and is considered a weed.	Done. Thanks!
Jeff Ollerton	2	49	2317	49	2317	Should be <i>Asclepias</i> spp. (plural)		Changed.
Jörg Romeis	2	48	2322	48	2322	I suggest to add the publication by Sears et al. (2001) who has assessed the risk of Bt maize to Monarch butterflies.	Sears et al. (2001) Impact of Bt corn pollen on monarch butterfly populations: A risk assessment. PNAS 98: 11937-11942	thanks. Reference has been added.

Jörg Romeis	2	48	2322	48	2322	I suggest to add a separate sentence at the end of the paragraph to refer to the study by Dively et al. (2004) who has calculated that the Monarch mortality caused by Bt maize on a population level is about 0.6% and can be regarded as negligible.	Dively et al. (2004) Effects on Monarch Butterfly Larvae (Lepidoptera: Danaidae) After Continuous Exposure to Cry1Ab-Expressing Corn During Anthesis. Environmental Entomology 33(4): 1116-1125	Thanks for the reference. Although this is a useful reference, we consider that this information will not necessarily add to the general message of the box, and for that reason this has not been included.
Mercy Gichora	2	49	2325	49	2325	For clarity try...arriving from the USA to Mexico in recent years to replace ...in the last years.		Done.
Nadine Azzu	2	49	2327	49	2327	"...associated with this..." - this "what"?		clarified.
Scott Black	2	50	2333	50	2336	I would clarify this as their data is highly significant. Pleasants and Oberhauser (2012) found an 81% decline in milkweeds in Midwestern agricultural lands in the past decade, coincident with an increase in the use of the herbicide glyphosate on genetically modified, herbicide-tolerant corn and soy crops. They argue that the loss of milkweeds from agricultural areas is a major contributor to the monarch population decline observed at overwintering sites.		We now state that the estimates included strong values.
Felix Herzog	2	50	2337	50	2350	(see comments above on Executive summary)		Thnaks for the comment. This will be addressed in the last part of the chapter, where all factors are taken into account.
Liu Biao	2	50	2340	50	2340	"or both IR and HT at present"should be added to ")"	GM crops containing several IR and HT transgenes have come into use at present	done.

Jörg Romeis	2	50	2342	50	2343	The sentence is not backed up by the information provided earlier in the chapter. On p. 47 (lines 2216-2218) reference is provided to only one study that has reported sub-lethal effects on honeybee learning behaviour. These results need to be verified. Thus the sentence needs to be reformulated more carefully.		The conclusion has been now modified accordingly.
Jörg Romeis	2	50	2343	50	2344	It needs to be stated very clearly again that none of the non-Bt insecticidal proteins are produced by the IR GM plants that are approved for cultivation today. Also I'm not aware of any pipeline products by companies that contain such less specific compounds.	As suggested above I would strongly propose to delete reference to those non-Bt toxins altogether.	Following this, this section of the text has been now removed from the final draft.
Lennard Pisa	2	50	2344	50	2344	"different indirect effects have been studied" and was something relevant found?		This sentence has been now removed.
Scott Black	2	50	2345	50	2346	Bt-toxins are lethal -- just not to hymenoptera. Btk is lethal to leps and Bti is lethal to flies.		This is now clarified. Thanks for the remark.
Jörg Romeis	2	50	2345	50	2345	The wording "...which in turn may impact positively..." is incorrect. Meta-analyses of field experiments on the non-target effects of Bt crops have clearly shown that abundance of species significantly increases when pesticide use is reduced.	This is evident from the meta-analyses cited previously (Marvier et al., 2007; Wolfenbarger et al., 2008)	Agreed. The sentence has been modified accordingly.
Peter Campbell	2	50	2346	50	2347	is this conclusion as robust as suggested eg there is an unreferenced census study (see comment on 2.4.1 above) which challenges this modelling based statement?		The reference to that study has been now deleted, considering its correlational and little experimental nature.
Jörg Romeis	2	50	2346	50	2347	The statement is incorrect. The reduced presence of weeds in HT crops is not caused by a "higher use of herbicides" but by a more effective weed control in the HT crops.		Correct. The sentence has been now corrected.
Leslie Firbank	2	50	2349		2305	<i>This statement is false. Consequences of GMOs for food safety are very well known. This whole discussion fails to put GMO in the context of wider agricultural systems - are they really very different to nonGM systems, if so how, and under what circumstances?</i>		<i>The sentence has been now deleted.</i>
Lennard Pisa	2	50	2349	50	2350	"consequences .... Controversial" what has that got to do with pollinators and evaluation of their effect on pollinators?		The sentence has been now deleted.
Lennard Pisa	2	50	2349	50	2350	Conclusion is outside scope of text.		The sentence has been now deleted.

Jörg Romeis	2	50	2349	50	2350	The last sentence of the conclusion section is not at all supported by the data and information provided in chapter2.4. Consequently, it should be deleted.		The sentence has been now deleted.
Arathi Seshadri	2	50	2350	50	2350	Given the immense potential of genetic engineering, it may be worth considering if scientists must explore the potential for developing GM honeybees, GM monarchs etc. While this does seem like a joke, it is also precisely how natural selection works and coevolutionary processes have always been strong. So, it may be wise for scientists to consider this for the future since we need pollinators to be able to be competitive with the plant traits		We thank the reviewer for this comment. We have, however, decided to not address this point, since we want here to evaluate the effect of currently commercialized and used GM-crops on pollinators, and avoid expanding on potentially developed new GMOs.
Marina Rosales Benites de Franco	2	50	2350	50	2350	I suggest to consider the following: There are need to have more evidence of direct and indirect effects through more scientific studies and long term studies.		Following this comment, a similar wording has been now added to the sentence.
May Berenbaum	2	50	2350	50	2350	See above: does Pleasants and Oberhauser "explain the decline of moarch butterflies in North America"? Again, the study is correlational, based on a subset of available data, dependent on population projections with no life table data, and primarily addressing eastern North American monarchs		Yes. That part of the sentence has been now deleted.
David Evans	2	50	2352	50	2352	Contradicts statement made above - line 11 of this feedback. Yes, controversial, but certainly consequences for food production and safety are not little known.		The sentence has been now deleted.
Maximilian Weigend	2	53	2466			it's a bit weird to see "bee management" as title here, the more general heading might be "pollinator management" - even though bees are very nearly the only managed pollinator		Changed to Pollinator Management as suggested.
Colin Fontaine	2	53	2466	68	3256	I would suggest to integrate section 2.6 (desease) in 2.5. The issue of pollinator desease is strongly related to the management of pollinator, in particular those managed globally. The section invasive species could also be included in 2.5, at least for the insect side. Some coordination with chapter 3 is needed here to avoid repetitions		The two sections, 2.6 and 2.5 are closely linked but it is preferred to keep them as separate sections as opposed to combining them as suggested. Efforts will be made to avoid redundencies with Chapt. 3 and other Chapters.

Colin Fontaine	2	53	2466	53	2466	replace bee management by pollinator management		Changed to Pollinator Management as suggested.
Anders Nielsen	2	53	2470	53	2534	Too much place is given to diseases and parasites here. I suggest leaving this for the designated chapter (2.6)		Some mention of diseases here is necessary as diseases can affect bee management
Anne-Laure Jacquemart	2	53	2477		2487	delete ? Already presented elsewhere		Agreed that some of this is presented in Chapt 1 but again some redundancy is needed. Reduced the length of this paragraph
Nadine Azzu	2	53	2479	53	2479	human-made		changed
Lennard Pisa	2	53	2481	53	2482	Get refs in for management of florea and dorsata	Chinh, P.H., Minh, N.H., Thai, P.H., Tan, N.Q. (1995). Raftering: a traditional technique for honey and wax production from Apis dorsata in Vietnam, Bees for Development Journal. 36, 8-9.	removed the florea and dorsata sentence as it is covered elsewhere
Lennard Pisa	2	53	2481	53	2482	I personally would not distinguish/mention laboriosa from dorsata and andreniformis from florea	Hepburn H.R., Hepburn C. (2005) Bibliography of Apis florea. Apidologie 36 377–378	removed the florea and dorsata sentence as it is covered elsewhere
Lennard Pisa	2	53	2481	53	2482	I never saw good taxonomical arguments to do so, but I am not up to date with literature		Most taxonomist agree that there are two recognized giant and drawf honey bee species, removed this sentence as it is covered elsewhere.
Liette Vasseur	2	53	2489			Change "Grower" for Growing		Changed
Lennard Pisa	2	53	2489	53	2492	It reads like migration with bees is a modern phenomenon, it is not, it is thousands of years old.		We agree and some of the early movement of bees is covered in other areas; large-scale movement of bees is a rather new development with increasing agricultural scale

Lennard Pisa	2	53	2489	53	2492	maybe write it a bit more general and timeless.		added a sentence for clarification
Anders Nielsen	2	53	2489	53	2491	Sentence out of context		Sentence could go in disease section but wanted to give a concrete example of the effect of disease on pollination and tie in the role of <u>movable frame hives</u>
Thomas Steeger	2	53	2490	53	2491	was the hand pollination of orchards in Korea or China?		It has occurred in both but this example is from Korea, the China example is where pesticides has killed off native and managed pollinators and is not well documented only media reports.
David Evans	2	53	2499	53	2500	What evidence is there that bees lost in transit spread diseases? That is what the statement says. I don't doubt that the movement of bees to new areas spreads pathogens, but expect that those lost in transit rapidly expire.		In the US we could trace the spread of Varroa along major bee transportation routes as we assume (yes we have no direct evidence) that stray bees leaving the trucks found their way into hives in the area. Varroa mites followed these trucking routes and of course once hives were placed then local mite infestation were found but they were also found along the highways.
Anders Nielsen	2	53	2500	53	2501	Some more detail on the large scale beekeeping practices in the US could be included here		The citation given will provide the reader with additional information. DO not wish to dominate the chapter with US migration patterns.
Liette Vasseur	2	53	2502	53	2503	How? Why? There needs to be more explanation on how trade of wax, pollen, etc. can spread diseases.		added a sentence for clarification
Lennard Pisa	2	53	2505	54	2519	I miss the killer bee example, african bees gone feral, I know there is literature on competition with native pollinators		added more (eg Africanized bees) and the Roubik reference covers some of the competition issues but more is given later in the paragraph

Lennard Pisa	2	53	2505	54	2519	I miss the <i>Apis florea</i> example being an invasive species in Israel, Iran and Sudan		Did not cite this as it has not had major impact on local bees but it is a good example!
Serena Heckler	2	53	2505	54	2519	<u>This example could be added from line 2508 page 53 to illustrate the spread of a disease that threatens a native bee species, which was successfully managed by traditional beekeeping techniques for generations:</u> "For instance, in the seventies, modern beekeepers in Cevennes National Park (France) decided to introduce the Caucasian honeybee which was known as more profitable and less aggressive than the native black bee <i>Apis mellifera mellifera</i> . This movement of bee species was responsible for the arrival of the mite <i>Varroa</i> in Cevennes. Even if the local black bee is very resistant and well adapted to its environment, the parasite was especially aggressive against it, and today, the native black bee, previously so abundant and important for rural beekeepers is largely endangered in the region (Elie, 2015 ; Garnery, 2015)" <u>Sources:</u> Elie Y. (2015). Abeilles noires et ruches troncs. Causses et Cévennes. Tome 23 : 163-174 [other published material] ; Garnery L. (2015) L'abeille noire : sacrifiée sur l'autel de la productivité ? Causses et cévennes, Tome 23 : 177-179 [other published material]		Added this example and two references.
Teruyoshi Nagamitsu	2		2505		2512	As well as parasites, predators are also threats to introduced honeybees. For examples, Asian hornets are predators damaging managed colonies of European honeybees.		The Asian hornets are cited in the disease section
Anna Traveset	2	53	2516	53	2516	Another more recent reference that could be included is Dohzono et al. Ecology (2008)		added reference
May Berenbaum	2	53	2518	50	2521	Surprising not to see Diane Thomson 2004. COMPETITIVE INTERACTIONS BETWEEN THE INVASIVE EUROPEAN HONEY BEE AND NATIVE BUMBLE BEES. Ecology 85:458–470 cited here.		added reference
Liette Vasseur	2	54	2518			Is it completion or competition??		changed
Mercy Gichora	2	54	2518	54	2518	Change the word completion to read 'competition'		changed

Liette Vasseur	2	54	2521	etc.		I am very surprised to see very little references to pollination timing and flowering phenology. However this is very important when discussing pollinator survival and dispersal.		The timing of resource availability is covered well in many of the competition papers cited
Thomas Steeger	2	54	2522	54	2522	replace "completion" with "competition"		changed
Leslie Firbank	2	54	2524		2530	This statement is all very well, but is it cost-effective to have smaller plots? Are there other factors that need to be accounted for, eg economic use of machinery?		added some text for clarification that indeed many factors play into the scale of agriculture and the economics of plot size
May Berenbaum	2	54	2525	54	2534	Might it be relevant here to cite studies indicating the potential of managed bees to complement pollination services of native bees? E.g., Button L and E Elle, 2014 Wild bumble bees reduce pollen deficits in a crop mostly visited by managed honey bees? Ag Ecosyst Environ 197: 255-263. See also p. 71, line 3042		reference added
Jeff Ollerton	2	54	2527	54	2527	melons ARE cucurbits (i.e. members of the Cucurbitaceae)		changed in text
Leo Galetto	2	54	2531	54	2534	I agree with this recommendation (related to the first comment). It also can be presented (and developed a little more) in section 2.1.1 "Changes in land cover".		Thanks
Serena Heckler	2	54	2532	55	2584	<u>Stingless bees have been sustainably managed by indigenous peoples and local communities across the world for a very long time (for instance, as recorded in the Maya codices from before 1000 A.D.). This does not mean that they are cultivated, but there is a whole spectrum of management, from ensuring that seedlings of favoured tree species have space to grow in forest patches, to clearing out hollows that might be attractive to bees, to transporting individuals or colonies. See ILK task force for further references.</u>		Yes, you are right. However, we have certain page limits and focusing here not on the history but on the most recent effects of management.
Lennard Pisa	2		2532	54	2534	I would mention the taxonomical subfamily/tribe: Meliponini, to distinguish them from Apis		added

Colin Fontaine	2	54	2534	54	2534	it would be good to have figures about how many species does stingless bees there are and how many are managed. Are they more manage in a traditional way or industrial way		Yes, that would be good. Unfortunately, there are no statistics or description on which such a table could be sufficiently based. Especially concerning the traditional ways of bee management.
Anne-Laure Jacquemart	2	54	2534			add latin names to all common insect names		added
Shaju Thomas	2	54	2535	54	2535	Asia	Add references	added
Teruyoshi Nagamitsu	2		2537		2537	The use of stingless bees in greenhouse pollination has been tested, but I think that it is not so prevalent in Japan.		You are probably right, to be on the safe side I have deleted "and introduced".
Liette Vasseur	2	54	2539	54	2542	I completely disagree: this is not recent. We were doing this in Vietnam in the 1990's.		Please provide some reference to this. I could not find any information about it so I can add it to the next version. Thank you!
Anders Nielsen	2	54	2545	54	2545	How can economics be improved? Provide more detail		done
Natacha Chacoff	2	54	2546	54	2547	please consider reviewing this sentence.		done
Liette Vasseur	2	54	2547			remove the recently if your reference is 2000... 15 years ago is not recent in science.		Well, compared to honey bees, this is rather recent, but I removed it.
Jeff Ollerton	2	54	2547	54	2547	This should be "sweet pepper"		corrected
Nadine Azzu	2	54	2547	54	2547	suggest to delete "being" (...developed recently)		done
Anders Nielsen	2	54	2554	54	2554	"fruit" --> what kind?		corrected: orchards

Serena Heckler	2	54	2554	54	2567	<p>It has been also noticed that the <i>Apis Mellifera</i> is competing with the tradition of stingless beekeeping in the LAC region. Source: Cebolla Badie, Marylin. 2005. "Ta'y ñemboarái. La miel en la cultura mbya-guaraní." Resum del Treball de recerca de segon any presentat en el Programa de Doctorat en Antropologia Social i Cultural. Bienni 2002-04. Universitat de Barcelona. 14pp. <u>This text summarizes a doctoral project that dealt with the Mbya Guaraní, an indigenous people from the Paraná region. The author presents an ethnography focused on the knowledge and practices of this people in relation to honey and bees. She details the indigenous classification of bees, and explains how the <i>Apis Mellifera</i> (European bee) is seen as foreign to their environment. She describes the traditional practices of honey harvesting and its uses in festivities, as medicine and as food. The researcher points out how for locals the exploitation of <i>Apis Mellifera</i> is impoverishing the ecosystem, and how this, together with other introduced practices such as the use of pesticides, threatens their culture.</u></p>		<p>Thank you for this paper. Was it published in English in any form? This is a good addition to the honey bee management section as a possible negative influence of honey bee management. In this section we are looking rather the other way around: at the effects of stingless bee management on pollinators</p>
Mercy Gichora	2	54	2557	54	2557	honey producers		corrected
Natalia Escobedo	2	54	2558	54	2571	<p>Eunice Enríquez and others have been researching the traditional management of stingless bees in Guatemala, as well as its importance as an economic alternative for low income households in rural areas. Also, pilot research projects aimed to the technification of native stingless-bee management as well as stingless bee-products characterization have been carried on by our research group for about 15 years.</p>	<p>Information about our research projects and publications can be found in our site. <a href="http://sitios.usac.edu.gt/wp_biodiversidad/investigacion/">http://sitios.usac.edu.gt/wp_biodiversidad/investigacion/</a></p>	<p>Thank you for this information.</p>
Nadine Azzu	2	54	2558	54	2559	<p>suggest to delete "ABENA"-related phrase - I don't think we want to "adversitise" any private initiative here.</p>		done
Natalia Escobedo	2	54	2563	54	2565	<p>Similarly to Mexico, traditional stingless bee management is still practiced in Guatemala, but most bee species are hunted for their honey, especially species that are rarely domesticated and managed. This is common knowledge, but the extent of the practice has not been addressed in formal works, as far as I know</p>		<p>Thank you for this information.</p>
Thomas Steeger	2	54	2565	54	2566	<p>can more specific information be provided beyond "producing good results". What was this in terms of?</p>		rephrased

Claudia Maria Jacobi	2		2565		2565	correct to: Nannotrigona punctata		done
Anders Nielsen	2	54	2566	54	2566	What are "good results"?		added
Luisa Carvalheiro	2	54	2567	54	2567	the study of Cauich concludes that Nannotrigona testaceicornis is efficient and that more study is needed on N. perilampoides		YOu are right, corrected
Thomas Steeger	2	54	2567	54	2567	replace "taken" with "underway"		done
Liette Vasseur	2	54	2569	54	2571	integrate this sentence with the previous paragraph, unless you have more information.		done
Serena Heckler	2	55	2573	55	2573	Cortopassi and Suresh Kumar do not conclude that African continent bees are "rather hunted for their honey instead of being managed, which leads to the destruction of wild colonies". In fact, both references instead provide multiple examples of historically sustainable indigenous stingless bee techniques in Africa. Suggest striking this text. <u>Other examples of sustainable indigenous management techniques include practices in Uganda (Daniels 2007), Tanzania (Hausser 2004) etc.</u>   REF: Daniels, Lucy. 2007. "Nesting Biology of Equatorial Afrotropical Stingless Bees (Apidae; Meliponini) in Bwindi Impenetrable National Park, Uganda." Journal of Apicultural Research and Bee World 4 (December): 245–55; Hausser, Y., Mpuya, P., 2004. Beekeeping in Tanzania: when the bees get out of the woods...An innovative cross-sectoral approach to community-based natural re- course management. Game and Wildlife Science 21 (3), 291–312.		You are right, there was a mistake concerning the Kani people - they are in India. This sentence should be in the Asian section about stingless bees. However, Cortopassi-Laurino et al. 2006 does state generally in their review of global melliponi culture, that: "African stingless bee honey is mostly collected by harvesting from feral colonies, which subsequently destroys them. A few communities use hollow logs or clay pots as hives, and they harvest the honey in a more sustainable way." This does not mean, that there are no good practices. Unfortunately Kajoba (2007) Nesting biology... says nothing about management, only about the knowledge of species by indogeniuos people. Haussner is writing about general beekeeping. Could you also give some more details about the ref Daniels 2007 about Ugandan stingless bee keeping? Thank you.

Serena Heckler	2	55	2574	55	2574	Although I recommend modifying this text altogether to be more accurate (see comment above and below), the accepted wording is "indigenous peoples and local communities" rather than "communities and tribes".		done
Mercy Gichora	2	55	2579	55	2579	Use interst 'in' instead of interest ffor		done
Nadine Azzu	2	55	2579	55	2579	replace "pretty low" with "relatively low"		done
Mercy Gichora	2	55	2580	55	2580	Replace stingless bees' honey with... bee honey		done
Nadine Azzu	2	55	2581	55	2581	suggest to delete "http: aussiebee.com"-related phrase - again, I don't think we want to "adversitse" any private initiative here.		done
Hollis Woodard	2	55	2583	55	2583	Remove "pretty low" - too informal, and also how do you know?		You are right, corrected.
Mercy Gichora	2	55	2584	55	2584	Replace which and the comma before it with.. and still needs further studies.		done
Hollis Woodard	2	55	2586	55	2587	Remove hyphenation		ok
Andreas Kruess	2	55	2593	55	2599	Not only non-native invasive bumblebee species but also genetic pollution by imported non-native subspecies or genotypes of bumblebees commercially used, and escaping to the wild (e.g. <i>Bombus terrestris</i> from Turkey imported to Nort-West Europe (see Hulme (2007) Biological Invasions in Europe: Drivers, Pressures, States, Impacts and Responses. - Issues in Environmental Science and Technology 25: 56-80		Fixed, thank you.
Jeff Ollerton	2	55	2593	55	2593	Unclear what a "collective expertise" is. Ditto elsewhere in the chapter.		Removed.
Thomas Steeger	2	55	2593	55	2593	Suggest delete "During a collective expertise invited y the IUCN"		Removed.
Graciela Rusch	2	55	2593	55	2594	Problems related to competition and/or spread of diseases can occur with imported ecotypes/varieties of native commercial bumblebees (as can be the case of <i>Bombus terrestris</i> queens imported to Scandinavia from other parts of Europe and the example of the UK provided in the paragraph below.		Fixed.
Teruyoshi Nagamitsu	2		2593		2599	To avoid risks using alien bumblebees, some native bumblebees have been commercialized in North America and Japan.		True.

Scott Black	2	55	2595	55	2595	It might just be me, but I find table 2.5.1 very difficult to interpret and can gather very little summary information from it. Is it possible that the formatting is off?		We have now adjusted the table accordingly
Anne-Laure Jacquemart	2	55	2596			add Australia		ok
Scott Black	2	55	2597	55	2612	I think that this whole section could be rewritten for clarity. It seems that the authors are presenting 3 potential threats: 1. Competition for resources, 2. Competition for nest sites, and 3. Disease/pathogen transmission and that it could be laid out that way from the beginning, with summary paragraphs to follow.		Sentence introduced.
Mercy Gichora	2	55	2599	55	2599	Remove the semi-colon and use the word 'but' to replace 'however' so as to read ...but no studies.		Done.
Thomas Steeger	2	55	2603	55	2603	". . .non-bumble species; however, no studies have addressed interspecific competition for available resources."		Done.
Penelope Whitehorn	2	55	2603	55	2603	Disagree with 'no studies have addressed this aspect' - see Ings et al 2006 J Applied Ecology 43:940-948 & Inoue et al 2010 Applied Entomology & Zoology 45: 75		Fixed.
Thomas Steeger	2	55	2606	55	2607	"A recent study . . .referred to managed colonies as "Trojan hives" . . ."		Thanks.
Hollis Woodard	2	56	2606	56	2606	Change to: "In a recent study, Graystock et al (2013) called the.."		Done.
Scott Black	2	55	2607	55	2608	Not sure if it is worth mentioning the new restrictions that were put in place in the UK partially due to this study. <a href="https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/376743/bea-wml-cl22.pdf">https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/376743/bea-wml-cl22.pdf</a>		Considered.
Scott Black	2	55	2609	55	2610	This statement needs to be clarified.		Fixed.
Scott Black	2	55	2610	55	2612	It should also be considered that in many cases commercial bumble bees are used for open field pollination. This is also a noted limitation in all of the mentioned studies that used greenhouses as a focal point for the spillover hypothesis.		Good point.
Anders Nielsen	2	55	2611	55	2612	Reference to Murray is incomplete in the reference list		Will be fixed.
Scott Black	2	55	2614	55	2614	Think that this paragraph starts with an indefinite reference and should be clarified.		ok

Scott Black	2	55	2614	55	2678	(exclude box 5.1 from line numbers)Also worth noting that commercial bumble bees have been noted to have a higher prevalence of several diseases than their wild counterparts. Evidence in: Colla, S. R., M. C. Otterstatter, R. J. Gegeer, and J. D. Thomson. 2006. Plight of the bumble bee: pathogen spillover from commercial to wild populations. Biological conservation 129:461-467		Included.
Thomas Steeger	2	55	2614	55	2614	to what is "this" referring?		If this is in line 2610, it has been fixed.
Colin Fontaine	2	55	2617	56	2667	coordination with chapter 3 is needed to avoid repetition		Yes
Claudia Maria Jacobi	2		2617		2667	Could this box be more synthetically rephrased in accordance to its title?		Size will be adapted.
Liette Vasseur	2	55	2619	56	2664	Box 2.5.1: It is a very long case study which can be reduce by half. Not completely sure what are the number (5.3) (7.4) (6.2) on lines 2662 and 2663 are for.		The case is complex, and we think must be detailed. Added that numbers refer to other chapters' sections.
Georg Andersson	2	56	2635	56	2638	Bombus ruderatus seems to be able to, at least for the Alstromeria aurea, keep pollination services. (Madjidian, J., Morales, C., Smith, H., 2008. Displacement of a native by an alien bumblebee: lower pollinator efficiency overcome by overwhelmingly higher visitation frequency. Oecologia 156, 835-845 )		True.
Nadine Azzu	2	56	2636	56	2636	"in an old growth forest" - anywhere specific..?		We do not consider this information central, and rather try to shorten the text.
Scott Black	2	55	2648	55	2651	citations?		same as before
Hollis Woodard	2	56	2651	56	2651	Change "it" to "the species"		ok
David Evans	2	56	2654	56	2654	highly lethal! There is no scale to 'lethal' ... it's either lethal or it's not. It could of course be highly contagious, or virulent or pathogenic		Good point!
Scott Black	2	55	2655	55	2655	which species does "this species" refer to? The most recent reference is A. bombi.		changed
Luisa Carvalheiro	2	56	2658	56	2658	it would be nice to add a personal communication ref to indicate where this is under study		ok
Scott Black	2	55	2660	55	2660	Also spillover to B. ruderatus (and obviously B. dahlbomii)?		yes - fixed
Hollis Woodard	2	56	2662	56	2662	Remove "-currently under study-"; too informal, many things are currently under study		Done

Mercy Gichora	2	56	2671	56	2671	The words 'following importation' are repeated in the sentence. Remove them.		Sure
Anders Nielsen	2	56	2674	56	2676	Remove this sentence		Considered.
Penelope Whitehorn	2	56	2678	56	2678	Durrer & S-H - should be 1994 not 2014.		Absolutely true.
Martha Groom	2	57	2681	57	2681	This section needs to include an acknowledgement in the text that impacts on yield have not been addressed with these studies. Overall, the expectation is that introduction of bumblebees is enhancing yield, but where negative impacts on native pollinators have been observed, is the impact on yield similarly evaluated? Alternatively, this acknowledgment could be part of the conclusions section. I think it important to point this issue out - we assume yields are better due to the presence of these managed bees (shown to be true in many cases), but we do not know how much the impacts on other pollinators may detract from what could be occurring without these managed populations in most cases, or how alternative management might improve the overall level of pollination and yield if negative impacts on other pollinator species were reduced. (this would go in section 2.5.5)		Here we deal with management as a factor of decline. But a balance of its positive and negative is interesting to.
Jochen Freund	2	57	2683	57	2174	Tab. 2.5.1 and Tab. 2.5.2: The contrast constructed between many negative side effects by Bombus management vs. no negative side effects for solitary bee management appears to be over-emphasized. This is an interesting idea, but I think the evidence for this difference is relatively limited. Research for solitary bees is more limited than for social bees (as acknowledged in the text), so it is not surprising that less negative effects are known. On one hand, no known side effects despite decades of small-scale management does not give medium confidence to the belief that this practice (solitary bee management) is not affecting wild species. On the other hand, negative effects on some wild species do not make social bee (or bumblebee) management universally negative for all wild species.		You are right. We did change the conclusions, not to over-emphasize. Also revised the table and the confidence levels with the same intention for solitary bees.

Claudia Maria Jacobi	2		2683		2683	The last column is difficult to follow. Please check correspondence of lines, and make the appropriate division for each species.		Yes, we will give format.
Natacha Chacoff	2	57	2697	57	2697	table 4?		Should be Table 2.5.2 in the new version Table 2.4.3.3 - corrected right, corrected
Hollis Woodard	2	57	2698	57	2698	Remove "-similarly as most of other solitary bees-"		right, corrected
Thomas Steeger	2	57	2700	57	2700	to what does the statement "often provide better quality" refer, i.e. better quality "what"?		corrected
Arathi Seshadri	2	57	2702	57	2703	I tend to disagree with the part that managed solitary bees pose lesser risk. As said earlier, these are still in much smaller scale and if our experience tells us anything, the more a species is managed and spread in cultivation the more likely it is to become 'unsafe'. SO, rather than indirectly promoting increased management of yet another species, it may be good to be cautious in our recommendation. Increased selection of traits that are of interest to humans may not always be good for the ecosystem health		corrected
Ignasi Bartomeus	2	57	2702	57	2702	I would be very careful saying that solitary bees pose much lower risk. Competition for nests, resources and parasite spillover can occur among solitary species too. For example, we have no information on the effects of the raise of <i>Osmia cornifrons/taurus</i> on native <i>Osmia</i> species, but while this invaders are increasing in relative abundance, most native species show negative trends, including the also managed <i>O. lignaria</i> (Bartomeus et al 2013, PNAS <a href="http://www.pnas.org/cgi/doi/10.1073/pnas.1218503110">www.pnas.org/cgi/doi/10.1073/pnas.1218503110</a> )		corrected
Claudia Maria Jacobi	2		2702		2703	I failed to see where Table 4 is. Do you mean Table 2.5.2?		yes
Natacha Chacoff	2	57	2703	57	2703	table 4?		Should be Table 2.5.2 - corrected
Thomas Steeger	2	57	2703	57	2703	". . .' however, they also do well under greenhouse . . ."		corrected

Marina Rosales Benites de Franco	2	57	2707	57	2708	Please, I suggest the following: Disease spread by management solitary bees require further studies, specially studies on procedure for controlling pathogens and internal parasites, and its impacts on native bees.		corercted
Anne-Laure Jacquemart	2	57	2708			twice "especially"		corrected
Thomas Steeger	2	57	2711	57	2712	". . .requires further studies, especially given that formal procedures for controlling . . ."		sentence corrected
Jochen Freund	2	57	2712	57	2714	Tab 2.5.2: a minor point: Anthophora pilipes should be named A. plumipes, which would help make clear this is about this species and both its Asian and European subspecies		corrected
Hollis Woodard	2	57	2712	57	2712	Say "especially" twice..		corrected
Colin Fontaine	2	57	2713	57	2714	does this list include species that are managed according to local/traditional knowledge?		No, only managed ones and used for some time and bred an a larger scale. We still do not know enough about solitary be diseases/pathogens
Hollis Woodard	2	57	2713	57	2713	Not sure what "lack of control" means here		diseases controll - corrected
Lennard Pisa	2	57	2718	57	2718	Bee managment is a global, complex and ambivalent driver...of what??		pollinator loss - corrected
Lennard Pisa	2	57	2718	57	2721	I would ommit the coin metaphore again.		corrected
Serena Heckler	2	57	2718	57	2728	There is no consideration here of small-scale and traditional agriculture and traditional bee management techniques that can offer a middle ground between "large intensively managed croplands" with "natural conservation areas. Seems a strange conclusion to draw about solitary or stingless bees when the bulk of the evidence of sustainable management has not been taken into account.		There is not really to much information on how such traditional techniques impact the environment. If you have any reference or information about solitary and stingless bees, that would be nicve and could be added to the next version
Mercy Gichora	2	57	2719	57	2719	Remove the word 'while' from the beginning of the sentence.		corrected
Marina Rosales Benites de Franco	2	57	2719	57	2719	I consider to include: ... is one side of the coin, that can have serious impact on biodiversity and pollination services.		sentence was rewritten based on other comment

Mercy Gichora	2	57	2721	57	2721	Insert missing comma after the word 'bumble bees'		corrected
Colin Fontaine	2	57	2722	57	2724	i strongly disagree with this sentence. Local scale management of diverse pollinators should be encourage to avoid the negative impact of managed pollination, that is to say pathogens, genetic diversity loss, local knowledge loss...		Partially, you are right, but usually, management means mass breeding of certain species, which does have a negative effect e.g. diseases spreading or overdominance in the surrounding environment. It is not not said, that we shouldn't do it, but shoul be also cautious when managing a new species. nevertheless this part was edited to incorporate your suggestion.
Hollis Woodard	2	57	2722	57	2722	Not sure what "ambivalent" means here		having both positive and negative effects, sentence rephrased
Mercy Gichora	2	57	2723	57	2723	Use the right case for the word. Replace tip with 'tips'		corrected
Ignasi Bartomeus	2	57	2726	57	2726	Same as above here. The cautionary principle would be not to move species around, regardless of how safe it looks like. I would mention this, and the need of international laws regulating parasites loads in commercial bees.		Yes, right, it was modified, also look for the answer above.
Scott Black	2	57	2726	57	2728	An alternative to this conclusion is that we should be spending resources creating pollinator friendly habitat on intensively managed croplands instead of investing in improving the commercial bee trade. It is a much more sustainable outcome than the alternative presented here		added

Leo Galetto	2	57	2728	27	2725	I totally agree with these two sides of the coin but the privileged size of the coin is related to the goals of a society, and these specific goals depend on the privileged values of the society (see the first comment). For example “ <i>the necessity to pollinate large, intensively managed croplands - with no natural nesting habitats for wild bees - tip the balance in favour of continuing intense management in spite of the negative effects it has</i> ” is related with the economic prevalence of crops as commodities (in any other ethical scenario this view is unacceptable). I think it would be very important to highlight these relationships.		yes, you are right. This part was changed a bit also according to other suggestions.
Shaju Thomas	2	61	2900	61	2900	Journal missing	Add references	added
Martha Groom	2	61	2900	61	2900	The journal for this references is Journal of Economic Entomology		added
Julia Astegiano	2	62	2910	65	3116	Section 2.6 presents very valuable information about pollinators diseases, pest and other antagonists. I suggest including a figure summarizing all these in honeybees, bumblebees and solitary bees, in order to reinforce the main messages of the section. However, I think that there is some overlap with section in Chapter 3. Another point that I think that should be briefly addressed by authors is how the network approach may help to study diseases, pests, etc. See for example Otterstatter, M. C., & Thomson, J. D. (2007). Contact networks and transmission of an intestinal pathogen in bumble bee ( <i>Bombus impatiens</i> ) colonies. <i>Oecologia</i> , 154(2), 411-421.		Decided to not add figure but rather to let the text tell the story. Agree that many of the diseases overlap but specific data on spillover between species is lacking for many of the diseases
Jochen Freund	2	62	2910	68	3256	I suggest this section to be merged with section 2.5		Decided to keep the two sections separate but agree that there is a close relationship and some overlap in these two sections
Lennard Pisa	2	62	2912	62	2912	"By definition", I would not state that so hard and general. Some pathogens might be very common, affect individuals but have no impact on populations...weird statement to make...		Kept the wording "by definition" but the use of the word "some" notes that not all have major impact
Mercy Gichora	2	62	2913	62	2913	End sentence with a fullstop after the closed bracket.		changed

Lennard Pisa	2	62	2913	62	2913	Cornman article ONLY concerns honeybees, NOT other pollinators, Potts considers it to be 1 of the drivers		Will add one bumble reference to balance honey bee reference
Lennard Pisa	2	62	2913	62	2913	Statement is way to general		Changed to a more subtle statement about the potential as a driver of decline. In the remainder of paragraph give more specifics.
Lennard Pisa	2	62	2915	62	2924	2915 and 2924 kind of say the same thing.		added nutrition and pesticides to the last sentence to expand it and avoid redundancy.
Diane Castle	2	62	2915	62	2916	<p><b>Comment:</b> Pesticides are repeatedly cited/exemplified in this Chapter as increasing the negative impact of other stressors - in this case of increasing disease levels. Overall this gives a disproportionate emphasis on the contribution of pesticides. Clearly factors that affect the energy status of bees and other insect pollinators can affect their resilience and immune-response and more interdisciplinary research will help to better understand these interactions. However to limit the negative consequences of ongoing pollinator declines we need to understand the extent to which each factor contributes to ecological function, agricultural production, and human health. It would be more balanced to also include comments that put the effects of neonicotinoids reported in context with their use, general trends in pollinators and other factors.</p> <p style="text-align: right;">(i) The decline in the populations of many insect species in general and pollinators predates by some decades the introduction of neonicotinoid insecticides and there is some evidence of a recent abatement in the rate of decline for some groups (Godfray,2014)</p> <p style="text-align: right;">(ii)there is a poor geographical correlation between neonicotinoid use and honeybee decline (Godfray,2014)</p>		There are many good reviews on the topic of pesticides and pollinator health. The pesticide effects are covered more in depth in other sections and mentioned here to simply highlight that it has been shown that other factors like nutrition and pesticides can interact with pest and diseases.
Leo Galetto	2	62	2915	65	3121	This section (2.6) is partially overlapped with section 2.3. I think this section can be substantially reduced (or deleted).		reduced text but some overlap is needed

Hollis Woodard	2	62	2915	62	2915	This section is partially redundant with the previous section		Will try to avoid redundancy
Jeff Ollerton	2	62	2917	62	2918	This statement is debatable; pests and diseases will certainly have an impact on bee numbers, but variations in abundance are not the same as declines (which are trends over time). This perhaps needs more nuanced language, especially as it's repeated in the Executive Summary)		Here we only state that pest and diseases can impact pollinaotrs; changed language from direct driver to potential driver.
Liette Vasseur	2	62	2920	62	2924	"In addition to diseases...": the only one with bats and birds. The sentence starting Diseases and pests... is exactly the same as line 2913		Added more text to the final sentence
David Evans	2	62	2923	62	2923	I don't think the direction of transmission can be determined from published honeybee-bumblebee pathogen transfers		
Thomas Steeger	2	62	2923	62	2923	"...to the next ( <i>e.g.</i> , Deformed Wing Virus; DWV) . . ."		Changed
Peter Campbell	2	62	2928	62	2961	There are numerous papers (Dainan et al, 2012; Martin et.al, 2012; Guzman-Nova, et al, 2010; Szabo et al 2012 (bumble bees); Charriere & Neumann, 2010; Nazzi et al, 2012; Genersch, 2010; Rosenkranz et al, 2010) that state the primary reason for decline in honey bee health is the varroa mite and the diseases they carry. This section completely under plays the threat varroa mite presents to honeybee health and therefore should be expanded to include the above references and related		Added references on Varroa and text to point out the impact of Varroa on hive health and survival
Lennard Pisa	2	62	2928	62	2928	I know ortography and spelling are not the review target but...play host?		corrected text
Lennard Pisa	2	62	2928	62	2952	I miss any info on the Varroa story...now only existence and association with virusses is mentioned.		Added more on importance of Varroa
Lennard Pisa	2	62	2928	62	2952	Varroa's history in <i>A. mellifera</i> is a good example of what can happen moving bees around globally		agreed
Lennard Pisa	2	62	2928	62	2952	A lot of literature exists on this		added more citations
Liette Vasseur	2	62	2929			"other insects try to take..." I think you meant either other insects that try to take OR other insects trying to take...		corrected text
Liette Vasseur	2	62	2930	62	2932	split this sentence into two. It would make more sense.		modified for clarity
Mario Marcos Espirito	2	62	2933	62	2966	Be careful with the scientific names. Varroa and Nosema should be italicized all the times. spp. Or sp. after the genus should not be given in italic.		looked in text and corrected

Gérard Arnold	2		2933		2966	L 2933. 'A honey bee colony can play host to a wide variety of disease causing agents'. Bee colonies contain many infectious agents (e.g. bacteria, viruses, fungi ...) and parasites (e.g. Varroa). The term disease is often used too broadly. There is a disease when specific clinical symptoms are observed. When the bee colonies are asymptomatic, they may still contain more or less significant loads of infectious agents. Therefore, in my opinion, the term 'infectious agent' is more global than pathogen; because it does not prejudge if clinical signs will develop (disease), or not.		reduced the use of disease and substituted infectious agent
Gérard Arnold	2		2935		2937	L 2935. 'Nosema (or nosemosis) and is probably the most widespread adult honeybee diseases'. The fact that Nosema spores are present in colonies, sometimes in large numbers, does not mean that these colonies will show clinical symptoms. They can grow and harvest nectar and pollen. The prevalence of spores should not be confused with the prevalence of symptoms. Moreover, virulence data at both the individual bee and at the colony level are conflicting possibly because the impact of this parasite differs in different environments. Concerning Nosema, the paper of Fries (Journal of Invertebrate Pathology, 2010) should be cited.		again changed to reflect that presence of agent does not equal disease

Diane Castle	2	62	2940	62	2944	<p><b>Comment:</b> There is too little in this section about the significance of Varroa destructor in the transmission and enhancement of viral diseases in The Western honey bee and is seen as the most significant factor in increased colony losses . The global picture shows that regions with established honey bee parasitic Varroa mite populations (V. destructor) have consistently higher colony losses than those without (Neuman and Carreck 2010) The Varroa mite itself contributes to weakening colony health, but also facilitates secondary infections and destabilises the critical balance between viral pathogens and the bees’ defences, seems to be the (Nazzi et al 2012).</p> <p><b>Supporting references:</b></p> <p>*Neuman P and Carreck, N L (2010), Honey bee colony losses. Journal of Apicultural Research 49(1): 1-6.</p> <p>*Nazzi F, Brown S P, Annoscia D, Del Piccolo F, Di Prisco G, Varricchio P, Della Vedova G, Cattonaro F, Caprio E, and Pennacchio F (2012), Synergistic Parasite-Pathogen Interactions Mediated by Host Immunity Can Drive the Collapse of Honey Bee Colonies. PLoS Pathog 8(6): e1002735. doi:10.1371/journal.ppat.1002735</p>		Added more on importance of Varroa and new references
David Evans	2	62	2942	62	2945	<p>By listing alphabetically you potential mislead on the relative importance of these viruses. Either specifically state (in alphabetical order) or use prevalence data from the random apiary survey or equivalent perhaps. Probably best to state alphabetically as prevalence differs globally - no IAPV in the UK, but widespread in the US.</p>		Kept the alphabetic list as much debate centers on which viruses are important so stayed with list but noted below that DWV and Varroa are problematic

Diane Castle	2	62	2945	62	2946	<p><b>Comment:</b> A causal analysis framework (Staveley et al 2014) based on the weight-of-evidence, preliminarily categorizes the Varroa mite plus viruses as the "probable cause" of the reduced survival in honey bees, while nutrient deficiency was judged to be a "possible cause." The framework also helps identify data gaps and therefore can be used to guide the collection of additional data or novel research.</p> <p style="text-align: center;"><b>Supporting</b></p> <p><b>reference:</b>Staveley JP, Law SA, Fairbrother A, Menzie CA. 2014 A causal analysis of observed declines in managed honey bees (<i>Apis mellifera</i>). Hum. Ecol. Risk Assess. 20, 566–591. (doi:10.1080/10807039.2013.831263)</p>		Cited Staveley 2014
Diane Castle	2	62	2947	62	2947	<p><b>Comment:</b> Pesticides are repeatedly cited/exemplified in this Chapter as increasing the negative impact of other stressors - in this case of increasing disease levels. Overall this gives a disproportionate emphasis on the contribution of pesticides. It would be more balanced to also include comments that interactions between neonicotinoids and Nosema have been reported (Alaux et al. 2010; Pettis et al. 2012; Vidau et al.2011), although there are some inconsistencies in the findings with regard to spore production and infection levels at the colony level over time.Again it would be more balanced to also include comments that put the effects of neonicotinoids reported in context with their use, general trends in pollinators and other factors. For example there is evidence from recent monitoring studies in Europe looking at pesticide residues within bee colonies and the presence of pests and pathogens which found no clearly associated interaction between pesticide use and disease.</p> <p style="text-align: center;"><b>Supporting reference:</b> Thompson HM. 2012. Interaction between Pesticides and Other Factors in Effects on Bees. Supporting Publications 2012:EN-340. European Food Safety Authority. Available at <a href="http://www.efsa.europa.eu/publications">www.efsa.europa.eu/publications</a>. (accessed May 20, 2013)</p>		Added references on Nosema / pesticide interactions, other discussion on pesticide use and effects are in separate section

David Evans	2	62	2948	62	2948	I'd add the Dainat (2012) reference to DWV/Varroa and colony losses		added reference
May Berenbaum	2	62	2948	62	2952	Given the repeated association between multiple pathogens and colony decline, maybe this section on impacts of multiple pathogens can be expanded? In addition to the cited references, there's also Johnson et al. 2009 Proceedings of the National Academy of Sciences 106: 14790-14795, Dainat et al. PLoS ONE 7(2): e32151, Martin et al. 2012 Science 336:1304-1306. See also Doublet et al. Environmental Microbiology doi:10.1111/1462-2920.12426, which, among other things, shows interactions between BQCV and Nosema ceranae		expanded this area and added references
Liette Vasseur	2	62	2949			It seems again to be a repeat of a previous sentence and trying to live off of?		changed
Thomas Brooks	2	62	2954			"the "honey catchers" and "bee eaters""; I'm not sure what "honey catchers" are - add scientific name. Beeeaters are <i>Merops</i> sp.		added genus and removed honey catchers
Liette Vasseur	2	62	2956			It is not Villemanta but Villemant et al.		changed
Anne-Laure Jacquemart	2	62	2957			add sentences about the Asian invasive <i>Vespa velutina</i>		added
Liette Vasseur	2	62	2958			The small have... it think it is The small hive		changed
Natacha Chacoff	2	62	2958	62	2958	delete "have"		changed
Filiberto Pollisco	2	62	2958	62	2958	"...have beetle" is misspelled. Change to "hive beetle"	Since it is only one word, this might be overlooked during editing hence, I just included it here	changed
Lennard Pisa	2	62	2958	62	2958	I would not mention SHB in Italy...suspected Italian presence is very recent 2014 and debated, might be the wrong species		SHB is now confirmed in Italy and added reference
Lennard Pisa	2	62	2958	62	2958	Are you sure your refs mention SHB occurrence in Italy? I don't think so.		Added Italian reference
Lennard Pisa	2	62	2958	62	2958	Neumann and Elzen mention Portugal		Added
Thomas Steeger	2	62	2959	62	2959	"Birds can be problematic as using the "honey catchers" and bee eaters" are avian pests in managed . . ."		changed
May Berenbaum	2	62	2959	62	2959	Can scientific names and geographic distributions be provided for bee eaters and "honey catchers"?		added genus name

Liette Vasseur	2	62	2960	62	2961	This is now the third time this sentence is stated! To remove. Also if you mention vertebrates, please state at least one species.		changed
David Evans	2	62	2962	62	2962	small HIVE beetle		changed
Thomas Steeger	2	62	2962	62	2962	". . .is the small hive beetle (Aethina tumida); . ."		changed
Lennard Pisa	2	63	2964	63	2964	Antagonists are what? What do you mean? Also in title of <u>solitary bee pathogen subsection</u>		Changed to pests in 2 cases.
Scott Black	2	63	2969	64		Worth considering the results of this paper in this document: Manley, R., M. Boots, and L. Wilfert. 2015. Emerging viral disease risk to pollinating insects: ecological, evolutionary and anthropogenic factors. The Journal of applied ecology. Available from <a href="http://dx.doi.org/10.1111/1365-2664.12385">http://dx.doi.org/10.1111/1365-2664.12385</a> .		Added
Scott Black	2	63	2971	63	2971	In my opinion the relative importance of bumble bees is not controversial. Memmott J, Waser NM, Price MV. 2004. Tolerance of pollination networks to species extinctions. Proceedings of the Royal Society, London. Series B. 271:2605-2611; Goulson D. 2003. Conserving wild bees for crop pollination. Int. J. Food, Agric. Environ. 1:142-144 ; Stubbs CS, Drummond FA. 2001. Bombus impatiens (Hymenoptera: Apidae): An alternative to Apis mellifera (Hymenoptera: Apidae) for lowbush blueberry pollination. J. Econ. Entomol. 94:609-616 ; Free JB, Williams IH. 1976. Pollination as a factor limiting the yield of field beans (Vicia faba L.). J. Agric. Sci. 87:395-399 - many more examples		Soory for wording; the controversial relative importance is of the factors involved in decline, obviously not of bumblebees.
Hollis Woodard	2	63	2971	63	2971	I don't think their relative importance is controversial at all!		Same as above.
Penelope Whitehorn	2	63	2971	63	2971	Habitat loss is widely accepted as the main driver of declines - see Goulson et al 2008 ANNUAL REVIEW OF ENTOMOLOGY 53: 191-208		But there has been considerable research of the effects of pathogens and pesticides by then; see below other sections of this chapter.

Scott Black	2	63	2974	63	2974	Add [Arbetman, M. P., I. Meeus, C. L. Morales, M. A. Aizen, and G. Smagghe. 2013. Alien parasite hitchhikes to Patagonia on invasive bumblebee. <i>Biological invasions</i> 15:489–494.] to citation.		Added
Scott Black	2	63	2983	63	2983	Doesn't cover <i>Apicystis bombi</i> in S. America: Arbetman, M. P., I. Meeus, C. L. Morales, M. A. Aizen, and G. Smagghe. 2013. Alien parasite hitchhikes to Patagonia on invasive bumblebee. <i>Biological invasions</i> 15:489–494.		Done
Hollis Woodard	2	63	2983	63	2983	Remove "S. a" before "Cameron"		Yes
Liette Vasseur	2	63	2984			All of them: what is them?		Improved
Teruyoshi Nagamitsu	2		2987		2987	Sphaerularia		Fixed
Jeff Ollerton	2	63	2989	63	2989	All of what? Be precise.		Fixed
Thomas Steeger	2	63	2989	63	2989	"The aforementioned parasites/pathogens can infect . . ."		Fixed
Hollis Woodard	2	63	2989	63	2989	Change "all of them" - too vague		Fixed
Jeff Ollerton	2	63	2993	63	2993	First mention of <i>Psithyrus</i> (which is now considered a subgenus of <i>Bombus</i> ) so this needs defining.		Removed.
Hollis Woodard	2	63	2996	63	2996	"Play an important role".. In what? Need to articulate		Fixed
Scott Black	2	63	2997	63	2997	More papers that cover DWV and its effects on bumble bees: Fürst, M. A., D. P. McMahon, J. L. Osborne, R. J. Paxton, and M. J. F. Brown. 2014. Disease associations between honeybees and bumblebees as a threat to wild pollinators. <i>Nature</i> 506:364–366.  Genersch, E., C. Yue, I. Fries, and J. R. de Miranda. 2006. Detection of Deformed wing virus, a honey bee viral pathogen, in bumble bees ( <i>Bombus terrestris</i> and <i>Bombus pascuorum</i> ) with wing deformities. <i>Journal of invertebrate pathology</i> 91:61–63.		Included.
Scott Black	2	63	3000	63	3003	See Fürst et al. 2014 above.		Included.
Jana Vamosi	2	63	3005			With regard to bee diseases, data on genetic diversity of bees would be potentially an enlightening line of research		Certainly, but not exactly in the goal of this part.

Diane Castle	2	63	3006	63	3006	<b>Comment:</b> Useful review on disease and spillover with priorities for research identified <b>Supporting reference:</b> Robyn Manley, Mike Boots and Lena Wilfert Emerging viral disease risk to pollinating insects: ecological, evolutionary and anthropogenic factors Journal of Applied Ecology 2015 doi: 10.1111/1365-2664.12385		Added.
Lennard Pisa	2	64	3006	64	3027	I miss info on bumblebee mites like Locustacaris.		Added.
Scott Black	2	63	3007	64	3040	More information needs to be added here about Bombus dahlbombi in S. America. See Arbetman et al. 2013 in above comments.		Ref added to text box in the bumblebee management section.
Thomas Steeger	2	63	3007	63	3009	This section reads like the introduction to the next paragraph; recommend making it the topic sentence however, need to be clear as the the "four patterns".		Done.
Thomas Steeger	2	63	3014	63	3016	"Studies show . . ." (delete "Many")		Done.
Liette Vasseur	2	64	3018	64	3027	This paragraph lacks of references. Needed		added
Thomas Steeger	2	63	3021	63	3021	do you mean "expanding" rather than "decreasing to a distance of 10 km?		Fixed

Diane Castle	2	62	3023	64	3025	<p><b>Comment:</b> Pesticides are repeatedly cited/exemplified in this Chapter as increasing the negative impact of other stressors. Overall this gives a disproportionate emphasis on the contribution of pesticides. It would be more balanced to also include comments that put the effects of neonicotinoids reported in context with their use, general trends in pollinators and other factors. For example in bumblebee colonies adjacent to single oilseed rape fields grown from seeds that were treated with clothianidin, imidacloprid no relationship between the oilseed rape treatment and insecticide residues was observed, presumably because the bees were foraging over spatial scales larger than a field.</p> <p><b>Supporting reference:</b> Thompson H, Harrington P, Wilkins W, Pietravalle S, Sweet D, Jones A. 2013 Effects of neonicotinoid seed treatments on bumble bee colonies under field conditions. See <a href="http://www.fera.co.uk/ccss/documents/defraBumbleBeeReportPS2371V4a.pdf">http://www.fera.co.uk/ccss/documents/defraBumbleBeeReportPS2371V4a.pdf</a>.</p>		This topic is dealt in detail in other sections of this chapter (chemicals and combined effects of stressors).
Thomas Steeger	2	64	3038	64	3040	need to be consistent throughout the document on whether <u>viral/bacterial diseases are capitalized</u>		We try to get it standardised
Joseph Tzanopoulos	2	62	3042			Chapter 2.6.3 is organised and further divided into four sub-chapters (viruses, fungi, prokaryotes and others). For consistency and presentation purposes, the previous chapters on Pollinator diseases (i.e. 2.6.1 and 2.6.2) could have been organised in a similar way		We have now rearranged this accordingly
May Berenbaum	2	64	3044	64	3044	"Apinae" is a subfamily, not a family		Right, corrected
Mario Marcos Espirito	2	64	3045	64	3045	peponapis not Peponapis.		corrected
Hollis Woodard	2	64	3062	64	3062	Remove hyphenation		corrected
May Berenbaum	2	64	3067	64	3062	A. aggregate should be A. aggregata		corrected
Thomas Steeger	2	64	3070	64	3072	". . .chalkbrood disease, solitary bees were found to also harbour large numbers of other fungi, . . . Saccharomyces species; however, the role of most . . ."		corrected

Anne-Laure Jacquemart	2	65	3070			please use the same structure (viruses, fungi, prokaryotes, other parasites and predators" in each part, for all main pollinator groups		
Liette Vasseur	2	65	3073			Alimentary canals: do you mean midgut? What do you mean by frass or provision collected for the larvae? Does not seem connected.		Yes midgut, corrected. It was a mistake, naturally frass was not collected, but excreted, sentence corrected, taking into account other comments too
Jeff Ollerton	2	65	3075	65	3075	What "others"? Aside from Eubacteria, the only other prokaryotes are Archaeobacteria (which are not disease-causing as far as I am aware).		You are right (it was working title left accidentally), corrected
Thomas Steeger	2	65	3078	65	3078	some readers may not be familiar with the term "frass"		corrected
Thomas Steeger	2	65	3082	65	3082	" <i>Bacillus</i> and <i>Paenibacillus</i> were . . ."		corrected
Thomas Steeger	2	65	3084	65	3084	". . .for these bacteria, which are virulent to . . ."		corrected
Liette Vasseur	2	65	3086			parasies: do you mean parasites? Why do you have predators? Your single paragraph is on parasitoids mainly and I would remove predators. It should have been however a topic but would need for all pollinators (bees and bumblebees) and could include birds, etc.		Predators were left as a mistake in the text, now removed. Parasities corrected
Filiberto Pollisco	2	65	3086	65	3086	spelling of "parasites"		corrected
Claudia Maria Jacobi	2		3086		3086	correcto to: parasites		corrected
Thomas Steeger	2	65	3099	65	3099	"...were also introduced to North America, . . ."		corrected
Thomas Steeger	2	65	3101	65	3101	". . .requiring specific intervention has, so far, been observed in . . ."		corrected
Thomas Steeger	2	65	3104	65	3104	"Yet, no effective method of pest control is available."		corrected
Peter Campbell	2	65	3109	65	3116	Surely Varroa mite and the diseases they carry needs to be mentioned in the conclusion as a major threat to honeybees (see comment above relating to 2.6.1). Otherwise the credibility of this section with beekeepers and most balanced bee scientists will be questioned		Still in consideration



Les Davies	2	67	3257	73	3461	<p>This extensive discussion could also allude to the negative impact of introduced <i>Apis</i> bees on other native non-insect species; in Australia, feral <i>Apis</i> bees proliferating on canola are displacing threatened bird species (and some small marsupials) from their tree nesting hollows, while their stings can kill small pollinating native birds.</p>	<p>While there are some studies showing or inferring competition with native pollinators, data is actually quite limited and overall there is a mixed picture. Some key Australian examples are contained within the cited reviews. The revised paragraph in the section on alien honey bee impacts now reads: "Whilst these alien honey bee populations have become integrated into the pollinator communities there is only sparse evidence that direct competition for food and nesting resources has reduced survival or densities of native pollinators, with no extinctions recorded (Dohzono and Yokoyama, 2010; Goulson, 2003; Moritz et al., 2005; Thomson, 2004; Traveset and Richardson, 2006). Behavioural interactions between alien honey bees and native pollinators (bees and birds) have been documented both reducing and enhancing pollination of native plants, including crops (Brittain et al., 2013; Dohzono and Yokoyama, 2010; Greenleaf and Kremen, 2006; Traveset and Richardson, 2006)".</p>
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Andreas Kruess	2	69	3257	75	3598 The indirect effects of invasive plant pathogens on pollinators/pollination by altering plant physiology, growth or flowering are not addressed (plant-pathogen-pollinator literature: e.g. Roy, B.A. (1994) Ecology 75 (2): 352-358; Gilbert G.S. (2002) Annu. Rev. Phytopathol.40:13-43; Shykoff & Bucheli (1995) J. Ecol. 83: 189-198		Thank you for this point. I have added a short paragraph to highlight the potential risk from invasive plant pathogens. It is potential as this has not yet been a documented impact of invasive plant pathogens on pollinators or pollination. It reads: "Novel plant pathogens may be directly introduced through human trade movements (e.g. crops) or associated with high-levels degree of anthropogenic environmental impact, including the human-mediated spread of invasive plant species, in the recipient ecosystem (Santini et al., 2013). There is some understanding of how plant pathogens are spread by insect vectors, including pollinators (Shykoff and Bucheli, 1995), and how plant pathogens can influence pollinator visitation to affect pollination in co-flowering yet uninfected neighbouring plant species (Roy, 1994). Thus there is potential for invasive plant pathogens, potentially introduced along with invasive plants, to affect plant physiology or flowering and disrupt native plant-pollinator
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NagLaa Loutfy	2	69	3263	71		The chapter is well organized, providing a good coverage of main issues. Nevertheless, the report lacks some informative details and examples drawn from various parts of the world. This is particularly true in sections 2.3 and 2.7		The process of focussing in turn on metaanalysis, systematic reviews and reviews before considering the primary literature may have reduced the appearance of citation of particular articles from certain regions. Nonetheless in section 2.5 (in the previous document section 2.7) by focussing on metaanalyses/reviews we do cover a range of UN world regions (N & S America, Europe, Asia, Oceanic Islands, Australasia) including the global scale (see table 2.7.1 where the main sources of evidence used in the assement in 2.5 are summarised). Limited space meant that not every primary article could be included, and these are generally added if they add something particlaurly important or offer a nice illustration of a general point. I sincerely hope this clarifies our position and addresses your question.
Anna Traveset	2	69	3267	69	3270	The reference Traveset & Richardson (2006) would be more appropriately cited in the next sentence.		Moved citation as suggested.
Natacha Chacoff	2	69	3268	69	3270	please consider reviewing this sentense.		We have restructured this sentence and split it into two so that it is now clearer.
Joseph Tzanopoulos	2	69	3269	69	3269	insert "such as" after the "affected by invasive allien"		We have restructured this sentence and split it into two so that it is now clearer. Therefore this precise edit is no longer needed.

Thomas Steeger	2	69	3270	69	3270	". . .can become invasive and can alter. . ."		We have restructured this sentence and split it into two so that it is now clearer. Therefore this precise edit is no longer needed.
Ignasi Bartomeus	2	69	3272	69	3272	2.7.1. Ignores the effect of invasive plants on pollinators. I think this deserves a full paragraph on itself. This effect may be positive for a few pollinators that can use the invaders, but negative for the pollinators that can not use them, specially if the invader reduce the abundance of native plants. Some of this ideas are reviewed in Stout and Morales 2009 (ApidologieDOI:10.1051/apido/2009023)		I have redrafted and moved text in subsection 2.5.1 (previously 2.7.1). Within this redraft I have included a sentence: "Invasive plants are expected to adversely affect pollinators either ill-adapted to exploit the alien food resource or those dependent on native plants outcompeted by the invader (Bjerknes et al., 2007; Stout and Morales, 2009)". I have also brought two paragraphs together so that impacts of plant invasions on diversity/abundance sit alongside impacts on networks, which then leads onto visitation and native plant pollination/reproduction. hopefull these additions and the restructuring goes some way to redressing the perception that this topic has not been treated well enough (given space limits).

Anne-Laure Jacquemart	2	69	3274		3277	Please add other hypotheses about invasives, not only Enemy Release Hypothesis (also EICA, plasticity, reproductive success, Novel weapons ....)		Thank you for your valuable comment, I have restructured this sentence and included additional hypotheses and citations, it now reads: Introduced alien plants may establish and prosper because they: i) escaped biotic constraints; ii) occupy a vacant ecological niche - either pre-existing or via ecosystem disturbance; iii) possess novel weapons or phenotypic plasticity conferring ecological advantage; iv) evolved increased competitive ability following colonisation (Bossdorf et al., 2005; Cappuccino and Arnason, 2006; Catford et al., 2012; Mack et al., 2000; Uesugi and Kessler, 2013)
Arathi Seshadri	2	69	3284	69	3286	Citation Naug D, Arathi HS. Receiver bias for exaggerated signals in honeybees and its implications for the evolution of floral displays. <i>Biology Letters</i> . 2007;3:635-7. talks about mechanisms by which novel floral traits may be incorporated into a pollinator's repertoire. A good citation to include		Thank you for the suggestion, I have decided to add this citation along with addition of text re large floral displays in the existing sentence.

Jeff Ollerton	2	69	3289	69	3292	<p>There are a lot of exceptions to this and specialised plants can also be invasive if they evolve selfing or co-opt specialised pollinators: for example see Ollerton, J., Watts, S., Connerty, S., Lock, J., Parker, L., Wilson, I., Schueller, S., Nattero, J., Cocucci, A.A., Izhaki, I., Geerts, S. &amp; Pauw, A. (2012) Pollination ecology of the invasive tree tobacco <i>Nicotiana glauca</i>: comparisons across native and non-native ranges. <i>Journal of Pollination Ecology</i> 9: 85-95.</p>		<p>Thank you for pointing this out. While there are indeed many exceptions the prevailing trend revealed by various meta-analyses/reviews is that generalised species traits tend to help invasion. That said, I have restructured the text so that there is less emphasis on generalised traits and the role of selfing in the early stages of colonisation is emphasised. I did not add the suggested cite because given space limitations I felt the existing citations covered the point. The text now reads: "Insect-pollinated plant species often dominate lists of invasive alien plants, but at least in the early stages of colonization the ability of these plants to self-pollinate enables establishment and spread (Pysek et al., 2011). Over time, other invasive plant traits (e.g. flower morphology, copious nectar or pollen, large floral displays) lure and co-opt pollinator species whose phenotypes are pre-adapted to the floral resources the invasive plant offers (Jones and Gomulkiewicz, 2012; Kleijn and Raemakers, 2008; Naug and Arathi,</p>
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Felix Herzog	2	69	3293	69	3293	INCLUDE: "... there may be a potential risk - BUT ALSO BENEFITS - to pollinator health ...	or can you exclude this? Many of our crops stem from elsewhere ...	I have refined this sentence to acknowledge the potential benefit as well as risk, it now reads: Therefore, while alien pollen and nectar may provide an additional food source for pollinators adapted to exploit them, there may also be a potential risk to pollinator health if alien pollen is nutritionally poorer than that from native plants
Thomas Steeger	2	69	3294	69	3294	"Invasive plant species thus integrated . . ."		I presume the reviewer has a problem with the phrasing so I have re-written to clarify and link to the preceding sentence. It now reads: "In this way invasive alien plant species can become integrated into the ecosystem and dominate plant-pollinator interactions (cites)."
Anne-Laure Jacquemart	2		3294			Add more about floral resources quantity and quality (diet modification)		This point has been expanded, it now reads: Therefore, while alien pollen and nectar may provide an additional food source for pollinators adapted to exploit them, there may also be a potential risk to pollinator health if from alien pollen dominating loads of pollen collected and consumed by bees is nutritionally poorer than that from native plants (Stout and Morales, 2009).

Anders Nielsen	2	69	3295	69	3296	"such as pollen transport" --> what does this mean?		Now revised to read: "For example, pollen loads carried by transport insects may become dominated by alien pollen and hence potentially reduce conspecific pollen transfer among native plant species (Citations)"
Anne-Laure Jacquemart	2		3296			add references from van Kleunen et al. and their metanalyses		I have added citation of Chrobok T., et al. & van Kleunen M. (2013). Effects of native pollinator specialization, self-compatibility and flowering duration of European plant species on their invasiveness elsewhere. Journal of Ecology, 101, 916-923. to the preceding paragraph in a couple of relevant places. But I am sorry I dont see the connection with the line reference supplied by the reviewer and the various meta-analyses by van Kleunen. More specific help needed here if important in next review.
Anne-Laure Jacquemart	2		3302			add reference : Cawoy et al. 2012. Do the abundance and the proximity of the alien Impatiens glandulifera affect the pollination and reproductive success of two sympatric co-flowering native species? Journal of Pollination Ecology 10 (12) :130-139		Added reference
Liette Vasseur	2	69	3304			Unless you spend an extra sentence to explain what is Hedge's d and the values, I would omit them and just put in words a decrease of pollination to native plants. Note: many ivasive plants are selfing, so it would be important to also explain the % and tyne of plants being invasive		I have removed the numerical values as three reviewers have made this point and reworded accordingly.
Natacha Chacoff	2	69	3304	69	3305	Morales & Traveset		Corrected throughout this section.
Anna Traveset	2	69	3304	69	3304	remove 'Laura'		Corrected throughout this section.

Natacha Chacoff	2	69	3306	69	3307	If the figure from this paper is relevant please include in the document, otherwise I found that a reference to a figure in another paper is not much helpful		I have removed the reference to the figure in the cited paper and I have also reconsidered the sentence to make the point more general.
Anna Traveset	2	69	3308	69	3308	I think the following could be added here: "The negative effect that alien plants can have on pollination and reproductive success of natives has been shown to increase at high relative alien densities and is most detrimental when alien and native plants have similar floral traits (specifically, flower symmetry and color). Besides floral abundance, floral "trait matching" has been proposed as an important property, making aliens strong interactors with pollinators (Bjerknes et al. 2007)".		Many thanks for the offer of text linked to the already cited paper. I have gratefully incorporated some of the wording into an existing sentence as part of redrafting this subsection.
Thomas Steeger	2	69	3309	69	3314	Hedge's d would need to first be defined before the values presented in this section can be put into context.		I have removed the numerical values as three reviewers have made this point.
Anders Nielsen	2	69	3310	69	3311	Too specific no need to include numbers and specific indices		I have removed the numerical values as three reviewers have made this point.
Ignasi Bartomeus	2	70	3310	70	3321	See Carvalehiro et al 2014.doi: 10.1111/ele.12342 which show that invaders are not different for being invaders, it just depends on which traits they have.		Thank you for the suggested citation which somehow I missed. Luisa also pointed this out and I have highlighted the findings of this paper in two respects, the one you have highlighted but also the role of pollinator identity in shaping the outcome. See my more detailed response to her in L1436.
Natacha Chacoff	2	70	3311	70	3311	Morales & Traveset		Corrected throughout this section.

Liette Vasseur	2	70	3312			what do you mean by "predominating"?		Replaced with 'Primary and meta-analyses suggest that pollinator visitation rates to native plant species can tend to decrease with plant invasion, suggesting that competition for pollinators may be the prevailing process..'
Natacha Chacoff	2	70	3314	70	3314	Morales & Traveset		Corrected throughout this section.
Anna Traveset	2	70	3314	70	3314	remove 'Laura'. This review reference could also be added here: Traveset and Richardson 2014	Traveset A and Richardson D.M. 2014 Mutualistic Interactions and Biological Invasions. Annu. Rev. Ecol. Evol. Syst. 2014. <del>45:89-112</del>	Corrected throughout this section. And the suggested citation has been added here and there in the section.

Luisa Carvalheiro	2	70	3315	70	3315	our recent meta-analyses suggests that impacts of co-flowering species are mostly mediated by resource abundance and accessibility, as well as by phylogenetic proximity (possibly a proxy for unmeasured important traits). The origin of the plant was shown to be unimportant. These results suggests that invasive plant (native or alien) have similar probabilities of impacting the visitation/pollination of co-flowering species. Carvalheiro et al. 2014 Ecology letters; <a href="http://onlinelibrary.wiley.com/doi/10.1111/ele.12342/epdf">http://onlinelibrary.wiley.com/doi/10.1111/ele.12342/epdf</a>		Thanks for highlighting this paper synthesising across multiple studies. I have cited it in the revised section "Furthermore, the level of impact on flower visitation may be contingent on the composition of the pollinator community because of differential responses of pollinator groups (e.g. flies versus bees) to the invasive plant (Carvalheiro et al., 2014; Montero-Castano and Vila, 2012)" and "The negative impact that alien plant invasions can have on native plant pollination and reproductive success is increased when alien and native plants are related, have similar floral traits (flower symmetry, color and phenology) and at high relative alien flower densities (Bjerknes et al., 2007; Brown et al., 2002; Carvalheiro et al., 2014; Morales and Traveset, 2009; Pysek et al., 2011)"
Natacha Chacoff	2	70	3319	70	3319	Morales & Traveset		Corrected throughout this section.
Anna Traveset	2	70	3319	70	3319	remove 'Laura'		Corrected throughout this section.

Liette Vasseur	2	70	3320	70	3321	Is it true? If for example the flowers are the invasive produce larger flowers or more nectar, it might not be the case. I think there is a need for more references.		The related sentences now read: "The negative impact that alien plant invasions can have on native plant pollination and reproductive success is increased at high relative densities of alien flowers and/or when alien and native plants are related or have similar floral traits (flower symmetry, color and phenology) or large floral displays (Bjerknes et al., 2007; Brown et al., 2002; Carvalheiro et al., 2014; Morales and Traveset, 2009; Pysek et al., 2011). Only if some or all of these conditions are met will the extent of pollinator sharing between the native and the invasive plant species rise to the point where there is an impact, positive or negative, on the native plant (e.g. Thijs et al., 2012).
Thomas Steeger	2	70	3320	70	3321	If there is contradictory evidence in the refereces cites (e.g., Brown et al.) the nature of those contradictions should be identified.		I think the original wording of the text may have implied a contradiction where there was not one. Hopefully the rewording of the text ( see row 1439 in this excel sheet) makes this clearer
Liette Vasseur	2	70	3323			what do you mean by "porous"? Weird choice of words.		Changed to permeable
Claudia Maria Jacobi	2		3323		3323	Is the term 'porous' used in network analysis? Otherwise i suggest using 'permeable'.		Changed to permeable as suggested

Ignasi Bartomeus	2	70	3327	70	3327	May be is worth mentioning that Vilà et al. find that Nestedness is robust, while Albretch et al. Also show nestedness is robust, but that that modularity is altered.		The text has been substantially altered (see my response to your comment in row 1414 of this spreadsheet) to bring together the paragraphs on impacts on abundance/diversity and networks, within this revision I have added a little detail on the types of network properties altered by invasion, space constraints prevent too much detail but I hope to convey the key message.
Thomas Steeger	2	70	3329	70	3329	". . .are porous to invasive plants, this did not change . . ."		This now reads"While pollinator community networks are permeable to plant invaders..." in response to queries from two other reviewers over the use of "porous". I presume that was the point of this comment? The whole paragraph has been heavily revised anyway and the latter half of the sentence has totally changed.
Natacha Chacoff	2	70	3332	70	3334	please consider reviewing this sentence.		These three sentences have been reviewed and indeed were separated during the revision. Hopwefully it reads more clearly now, but I am happy to hear further feedback should the reviewer have it
Ignasi Bartomeus	2	70	3334	70	3334	Note that this networks also contain invasive pollintors. This should be mentioned for completeness.		Done and cross referenced to below section2.5.3 where more details

Natacha Chacoff	2	70	3339	70	3339	some information in this section was introduced and developed on the effects of grazing (section 2.2.6)		That is partly true. The only cross-over is this sentence "For instance, cattle introduced to Patagonian forests represent an invasive alien herbivore, which through trampling the vegetation indirectly altered pollinator network structure, visitation and the reproductive success of certain plant species (Vazquez and Simberloff, 2003, 2004)". This is needed in the invasives section as the Vasquez studies are quite unique for recording livestock as an invasive impact on pollinators and pollination. The other text/citations are different between this section on invasives and the other on agricultural practice.
Martha Groom	2	70	3341	70	3343	Aren't large herbivores also able to trample nesting habitats, thus posing an additional stress?		This sentence now includes reference to nesting resources more explicitly "Mammalian herbivores, such as ungulates (e.g. cattle, goats, deer etc), through consumption of floral or vegetative plant tissues or by direct trampling, have the potential to affect the floral or nesting resources available to pollinators (Traveset and Richardson, 2014). "
Anna Traveset	2	70	3343	70	3343	Change 2006 for the most updated reference Traveset and Richardson 2014		Done.

Liette Vasseur	2	70	3345			how much is this section different from livestock and grazing described before?		It is very different. The only cross-over is this sentence "For instance, cattle introduced to Patagonian forests represent an invasive alien herbivore, which through trampling the vegetation indirectly altered pollinator network structure, visitation and the reproductive success of certain plant species (Vazquez and Simberloff, 2003, 2004)". This is needed as the Vasquez studies are quite unique for recording livestock as an invasive impact on pollinators and pollination. The other text/citations are different between this section on invasives and the other on agricultural practice.
Scott Black	2	70	3345	70	3345	Parasitoids should be added to this section. There is a large body of evidence of potential impacts to leps from introduced biological control.		A sentence has been added "Alien parasitoids have been deliberately introduced worldwide for biocontrol of exotic agricultural pests. In many cases, these parasitoids have also reduced populations of indigenous non-target insects, including butterflies, moths and flies that are potential pollinators of native plant species (Louda et al., 2003)."
Anders Nielsen	2	70	3347	70	3349	Too long sentence, rephrase		There were actually three separate sentences alluded to to by the reviewer. I have however reduced word redundancy to shorten the sentences

Liette Vasseur	2	70	3351		<p>what do you mean by "but considered likely"? It seems that the sentence is not complete. In fact I would split this paragraph into two: one for the large vertebrates and a second one for the insect herbivores. I have the feeling that there are more than one study. E.g. Kenis et al. 2008. Biol. Invasions; Susan C. Cook-Patton, Anurag A. Agrawal. (2014) Exotic plants contribute positively to biodiversity functions but reduce native seed production and arthropod richness. Ecology 95:6, 1642-1650; Peter A. Hambäck, Brian D. Inouye, Petter Andersson, Nora Underwood. (2014) Effects of plant neighborhoods on plant–herbivore interactions: resource dilution and associational effects. Ecology 95:5, 1370-1383. etc.</p>		<p>Sentence now reads "A recent review considered it likely this disruption of native plant-pollinator signals and pollination may arise as a result of herbivory by invasive insects, yet there has been little study to date on this aspect of invasion ecology (Desurmont et al., 2014)". As suggested I have also split the vertebrate and invertebrate paragraphs. I considered the suggested cites, but as this section deals with effects of invasive herbivores on pollinators and pollination and I did not find content suggesting they fitted well here.</p>
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NagLaa Loutfy	2	71	3365	71	<p>-</p> <p>Add the following paragragg: The external parasitic mite, Varroa destructor, is the most serious threat to apiculture globally. Recognised as an invasive species, it has shifted hosts from A. cerana to A. mellifera. About the size of a pinhead, it feeds on bees' circulatory fluid and spreads from one hive to another. The parasite can spread viral diseases and bacteria. If left uncontrolled, it will almost certainly lead to the premature death of colonies within three years. Discovered in Southeast Asia in 1904, today it has spread nearly worldwide (UNEP 2010). Similarly, the small hive beetle (SHB) (Aethina tumida, Coleoptera: Nitidulidae), with its roots in sub Saharan Africa, has emerged as one of the harmful parasites of European honeybee subspecies ( Neumann and Elzen 2004). SHB is now reported to attack bees colonies in USA, Australia, Egypt, Portugal, Canada and Sudan (Guzman et al., 2010). Reference :  UNEP, 2010 Global Honey Bee Colony Disorder and Other Threats to Insect Pollinators. <a href="http://www.unep.org/dewa/Portals/67/pdf/Global_Bee_Colony_Disorder_and_Threats_insect_pollinators.pdf">http://www.unep.org/dewa/Portals/67/pdf/Global_Bee_Colony_Disorder_and_Threats_insect_pollinators.pdf</a>  Guzman Lilia I de, Amanda M Frake, and Thomas E Rinderer (2010). Seasonal population dynamics of small hive beetles, Aethina tumida Murray, in the south-eastern USA, Journal of Apicultural Research and Bee World 49(2): 186-191.  Neumann, P; Elzen, P J (2004) The biology of the small hive beetle (Aethina tumida, Coleoptera: Nitidulidae): Gaps in our knowledge of an invasive species. Apidologie 35: 229-247. <a href="http://dx.doi.org/10.1051/apido:2004010">http://dx.doi.org/10.1051/apido:2004010</a></p>	<p>*Section 2.7 is meant to depict a generic view of invasive species, and their relation with pollinators. However, this section has made no, or very little reference to Varoaa mite Varroa destructor Anderson and Truemann, one of the major invasive species that attack bees, causing significant damage to colonies. A considerable body of information indicates that Varoaa is the world most devastating pest, and is also one of the major causes for the use of pesticides as the common tool to control this pest. Varoaa mite is originally an Asian pest that moved to several parts of the world. Similarly, the small hive beetle, an originally African insect</p>	<p>I do not disagree with the comments of the reviewer, but the issue of pest and diseases including the various invasive alien ones are dealt with in the preceding section. To make this explicit I have added a sentence to the introduction of 2.5: "The effects of invasive alien pests and pathogens of pollinators are dealt with separately in the preceding section (2.4) on pollinator diseases and management."</p>
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David Hembry	2	71	3378	71	3400	Some concern has been expressed, based on mathematical models, about the evolutionary effects (microevolutionary timescales) of <i>A. mellifera</i> on wild species. As super-generalists which have been widely introduced, <i>A. mellifera</i> may select for (and therefore promote) convergence in flower traits across many species, thereby altering the structure of plant-pollinator networks. Guimarães PR, Jordano P, Thompson JN. 2011. Evolution and coevolution in mutualistic networks. <i>Ecology Letters</i> 14: 877-885		I had this reference but thank you for pointing out this relevance here. I have reduced word redundancy elsewhere and now include this sentence here: "There is potential, however, for micro-evolutionary effects on wild plant-pollinator networks arising from <i>A. mellifera</i> introductions. Mathematical models have predicted that the widespread introduction of this super-generalist honey bee may promote convergence in flower traits across many wild species, which may alter the functioning and structure of wild plant-pollinator communities (Guimaraes et al., 2011). "
Lennard Pisa	2	71	3378	71	3400	Aha here is the info on killer bees		Yes
Lennard Pisa	2	71	3378	71	3400	So here I would mention <i>Apis florea</i> being invasive in Israel/Iran/Sudan as well		Added: "The intentional and accidental movement of different honey bee ( <i>Apis</i> ) species continues (e.g. <i>A. mellifera</i> globally, <i>A. florea</i> into Israel, Sudan and Iran)" with citation of Moritz R.A., Haddad N., Bataineh A., Shalmon B. & Hefetz A. (2010). Invasion of the dwarf honeybee <i>Apis florea</i> into the near East. <i>Biological Invasions</i> , 12, 1093-1099.
Lennard Pisa	2	71	3378	71	3400	<i>A. cerana</i> can be considered potentially invasive in Australia as well		I couldn't find documentary evidence through google scholar. It is probably sufficient given space limits to have mentioned the documented expansion of <i>A. florea</i> as an example.

Lennard Pisa	2	71	3378	71	3400	Cerana presence was monitored in ports in North Australia but they stopped that due to lack of money I think		I couldn't find documentary evidence through google scholar. It is probably sufficient given space limits to have mentioned the documented expansion of A.florea as an example.
Teruyoshi Nagamitsu	2		3378		3416	This section focuses on effects of alien pollinators on native pollination systems. Thus, competition between alien and native pollinators is not sufficiently explained although there is evidence in honeybees and bumblebees. Some references that verified such competition can be cited in 2.5.1 and 2.5.3 (Thomson 2004 Ecology 85:458-470, 2006 Oikos 114:407-418; Nagamitsu 2010 Popul Ecol 52:123-136).		I have added the reference of Kenis et al 2009, a review which discusses the Thompson 2004 study among others to a revised sentence which now reads: "Whilst alien honey bee populations have become integrated into pollinator communities there is relatively sparse evidence that direct competition for food and nesting resources has reduced survival or densities of native pollinators, with no extinctions recorded (Dohzono and Yokoyama, 2010; Goulson, 2003; Kenis et al., 2009; Moritz et al., 2005; Traveset and Richardson, 2006). Although the potential for alien honey bee invasions to have contributed to historic yet unrecorded declines of native pollinators, such as observed in oceanic islands (Magnacca, 2007), cannot be ruled out. Behavioural interactions between alien honey bees and native pollinators (bees and birds) have been documented both reducing and enhancing pollination of native plants, including crops (Brittain et al., 2013; Dohzono and Yokoyama, 2010; Greenleaf and Kremen, 2006;

Nadine Azzu	2	71	3382	71	3388	ok, I may be missing a point here, so forgive me, but - so are we saying there is NOT a problem affecting the status? Because if not, then not sure why it needs to be discussed?		The extent to which introduced honey bees compete with or displace native congeners ( other honey bee species/sub species) is complicated by whether the ecological space is already partly occupied by indigenous spp or not but also there is evidence of negative, positive and neutral impacts. As a result is it hard to summarise categorically and to do so only invites readers to point out the exceptions or the gap in knowledge. This is why it has to be discussed I am afraid.
Mario Marcos Espirito	2	71	3384	71	3406	The genus name should be abbreviated after the first citation. Apis mellifera should be cited as A. mellifera after the first citation in the whole document. All scientific names should be revised following this rule.		Done for section 2.5 all abbreviated to A. mellifera etc. Also for Bombus.
David Hembry	2	71	3390	71	3397	It's not clear whether introduced honeybees compete with native bees in oceanic island communities, e.g., Hawaii, but the potential is considered likely based on natural history evidence. Magnacca KN. 2007. Conservation status of the endemic bees of Hawai'i, Hylaeus (Nesoprotopis) (Hymenoptera: Colletidae). Pacific Science 61: 173-190.		Added a line in revision: "Although the potential for alien honey bee invasions to have contributed to historic historic yet unrecorded declines of native pollinators, such as observed in oceanic islands (Magnacca, 2007), cannot be ruled out "
Jeff Ollerton	2	71	3396	71	3399	It is possible that any extinctions occurred long before anyone took notice, perhaps shortly after the introduction of honey bees to other parts of the world,		Indeed, a short line has been added touching on this point: "Although the potential for alien honey bee invasions to have contributed to historic historic yet unrecorded declines of native pollinators, such as observed in oceanic islands (Magnacca, 2007), cannot be ruled out "

Leo Galetto	2	71	3403	71	3406	The evidence showed in Garibaldi et al. (2013, Science) showed a different pattern (this work is cited in other section of this Chapter).		I am familiar with the Garibaldi citation, but I am not sure what point the reviewer is making here? The text referred to makes no judgement on the efficacy of wild pollinators for pollination services, instead it simply remarks that the introduction of managed bumblebees has had some negative
Mario Marcos Espirito	2	71	3414	71	3415	Change to: "Many of these life-history traits (e.g., nesting flexibility,...)". Also, what the authors mean by "ecological tolerance"? Environmental tolerance seems to be the correct term, although it is quite vague.		Done, also deleted the vague term.
Anna Traveset	2	71	3415	71	3415	I suggest adding the following after this sentence: "The competitive displacement of native pollinators by alien ones can promote processes leading to inbreeding depression (by enhancing selfing) or hybridization (by moving pollen across closely related alien and native plants) and ultimately reducing plant fitness (Morales & Traveset 2008)."	Morales, C L. and Traveset, A.(2008) 'Interspecific Pollen Transfer: Magnitude, Prevalence and Consequences for Plant Fitness',Critical Reviews in Plant Sciences,27:4,221 — 238	I have merged the suggested wording with the preceding sentence and added the reference - thank you.
Marina Rosales Benites de Franco	2	71	3416	71	3416	I consider important to include the following paragraph: The western honeybee, <i>Apis mellifera</i> , has been globally transported for honey production and pollination for hundreds of years and is often kept in large numbers in beekeeping operations. Concern has been expressed that it might act as an invasive species with large impact on biodiversity.	Moritz,F.A., Härtel, S., Neumann, P. (2005).Global invasions of the western honeybee ( <i>Apis mellifera</i> ) and the consequences for biodiversity.Ecoscience 12(3):289-301. <a href="http://www.bioone.org/doi/abs/10.2980/i1195-">http://www.bioone.org/doi/abs/10.2980/i1195-</a>	I point the reviewer to the fact that this section on alien pollinators (2.5.3) starts with a very similar statement, I have added some of the provided wording. The reference provided is already extensively cited and underpins much of the discussion in these paragraphs.

Lennard Pisa	2	72	3421	72	3422	That is a hard statement with no ref, that antropogenic and disturbed habitat are more prone to invasive species		It now reads: As invasions are primarily a human-mediated process anthropogenic and disturbed environments are likely to be prone to the immigration and establishment of alien species, for example where human activity creates or makes accessible new niches (Catford et al., 2012; Mack et al., 2000)
Lennard Pisa	2	72	3421	72	3422	Sounds plausible, but is there any theory or ref tho back it up?		This now reads: As invasions are primarily a human-mediated process anthropogenic and disturbed environments are likely to be prone to the immigration and establishment of alien species, for example where human activity creates or makes accessible new niches (Catford et al., 2012; Mack et al., 2000)

Lennard Pisa	2	72	3421	72	3422	I don't see how that connects to the next sentence statement of Montero-Castano and Vila 2012		This has been clarified in the revision, now reads: A recent global meta-analysis suggested that the tendency for invasions to reduce pollinator diversity or abundance was both statistically non-significant and did not differ between forest, shrubland, and grassland ecosystems (Montero-Castano and Vila, 2012). While these broad ecosystem classifications were necessary for this meta-analysis due to data limitations, they were therefore lacking important contextual information (e.g. level of disturbance or human activity, carrying capacity of recipient habitat, mainland vs island, etc) (Mack et al., 2000).
Nadine Azzu	2	72	3422	72	3422	"...the response of pollinators to invasions does not differ among global ecosystem types..." - so, are we saying that they all DO respond, or..?		This has been clarified in the revision see row 1471 above
Thomas Steeger	2	72	3428	72	3428	". . .most prone to invasive species."		this text has been deleted and revised see row1473
Ignasi Bartomeus	2	72	3450	72	3450	I don't think we have evidence that deleterious impacts rarely occur. For example, Palladini and Maron (2014) <i>Oecologia</i> (2014) 176:789–798 DOI 10.1007/s00442-014-3028-1) provide one of the few examples of effects of exotic plants (mainly <i>Euphorbia esula</i> ) on the reproduction of a solitary bee species ( <i>Osmia lignaria</i> ). For this species, the number of nests established and offspring production per female was positively related to native plant abundance and negatively related to exotic plant species. See also Nienhuis et al. 2009 (DOI:10.1051/apido/2009005) showing social bumblebees are more common in invaded sites than solitary bees.		reworded as: This can have major consequences for the function, structure and stability of pollinator networks, negative impacts on particular native pollinator species and less commonly reductions in overall pollinator abundance or diversity. I have also added the citation of Palladini and Nienhuis earlier in the revised text.

Nadine Azzu	2	72	3450	72	3450	so we are concluding to say that invasions do not have a negative impact on pollinator abundance or diversity?		reworded as: This can have major consequences for the function, structure and stability of pollinator networks, negative impacts on particular native pollinator species and less commonly reductions in overall pollinator abundance or diversity
Scott Black	2	72	3456	70	3456	I do not think you have presented evidence that they rarely have deleterious effects.		reworded as: This can have major consequences for the function, structure and stability of pollinator networks, negative impacts on particular native pollinator species and less commonly reductions in overall pollinator abundance or diversity
Marina Rosales Benites de Franco	2	72	3458	72	3458	I suggest to consider: ... and the pollination service, further <del>may be exacerbated or altered</del> when it occurs in combination with other threats,		Adopted suggested change

Scott Black	2	72	3458	70	3458	There is some evidence that herbivore insects do impact. Happy to follow up with all references. The Eurasian weevil ( <i>Rhinocyllus conicus</i> ) was introduced to North America in 1969 to control exotic thistle species in the genus <i>Carduus</i> . Less than 10 years later it was detected feeding on flower heads of native thistles (Reese 1977), and eventually expanded its host range to three genera of native thistles (Louda et al. 1997). The beetle also moved beyond the initial release sites, and can now be found in over 25 States (Louda et al. 1997). The weevil can cause substantial harm to native thistles by significantly reducing seed production and may be a threat to rare thistle species (Louda et al. 1997; Louda and O'Brien 2002). Native picture winged flies that feed on native thistles declined as beetle density increased (Louda et al. 1997). Butterflies, moths, bees, wasps, beetles, and flies all visit native thistles; one species of bee, <i>Melissodes desponsa</i> , specializes in the pollen from <i>Cirsium</i> species.		Thank you for this useful example. There is surprisingly little work that documents a cascading effect of invasive insect herbivory on pollinators/pollination, reflecting the complexity. I have used one of the supplied references in revision "Similarly, invasive insect herbivores by attacking plant roots or shoots can reduce floral resources to potentially impact on an array of pollinator species (Louda et al., 1997; Traveset and Richardson, 2006)". Unfortunately, I don't have more space to elaborate the specific story as you have outlined.
Natacha Chacoff	2	74	3533	74	3533	Morales, Laura (Laura is the Name)		Corrected
Peter Campbell	2	76	3599	82	3955	There is no mention in this text about the well known weather effect on honeybee colonies ie combination of harsh winter and long wet spring is not good for honeybee over-wintering success particularly in temperate climate regions. Is this information somewhere else in the IPBES Review if not can it be inserted here?		As this is a weather effect and we are not aware of data on this relationship in the context of climate change (i.e. are these conditions for example becoming more widespread?), we did not include this here. We however could imagine some effects and as soon as studies become available it would be worth mentioning

Maximilian Weigend	2	76	3599	82	3955	This is a nice evaluation, but it would be good to try to categorize the likely impact CC will have in different ecoregions and under different geographical setups and in how far anything is known about the effect of habitat continuity on the ability of particular species to migrate and in how far assisted migration might be a means of mitigation.		Material for a systematic comparison of ecoregions seems to be too scarce right now, but as recommended by some other reviewers, we try to at least integrate more information on other regions, e.g. on Asia. Also the treatment of the continuity issue is tricky, unless we rely on a lot of butterfly examples (which we did in the envelope modeling section), but the understanding is that we wanted to use them only in a few cases. The assisted migration topic should go to chapter 6 - but we have to check whether it shows up there in the next draft round.
Jan Axmacher	2	76	3599	86	4196	While the example of a migratory bee species from Indonesia is already included here, it can be assumed that climate change-induced shifts in phenology will be a particularly pronounced problem for migratory species in temperate regions, with numerous lepidoptera, but also other insect groups, being well known for their extended migrations. I would urge the authors to include some further deliberations on this issue.		We did not come across further climate change related studies, but we have included a statement that this might be an important gap to be closed (maybe someone in the second review round know of an example)
Jochen Freund	2	76	3599	86	4196	This section may profit from trying to apply a world-wide focus and consider potential effects in the tropics more often. Most of this seems to be based on Europe & North America, which is understandable because that's where most research has been performed, but I feel that some statements could be double-checked as to how well they would apply e.g. to tropical regions. I realize that some examples from the tropics are included, but they might be better connected to the more general statements.		We have included one more study on figs from Singapore, but otherwise have not been very successful in finding further references.
Liette Vasseur	2	76	3603			remove "for" between and and drastic		done, thanks

May Berenbaum	2	76	3608	81	3918	Climate change in this section appears to relate only to warming temperatures. What about drought frequency and severity? There are many studies on effects of El Nino-associated droughts and pollinator/plant synchrony, as well as papers on drought effects on volatile release, both of which are likely to change with global climate change. <a href="http://adsabs.harvard.edu/abs/2011AGUFM.B51P..05P">http://adsabs.harvard.edu/abs/2011AGUFM.B51P..05P</a>		We have mentioned other factors in a few places, but also have added the proposed study by Penuelas and colleagues.
May Berenbaum	2	76	3608	81	3918	Another dimension of global climate change is the effect of elevated carbon dioxide on plant volatile and nectar chemistry, which can influence pollination (Hoover SER, Ladley JJ, Shchepetkina AA, Tisch M, Gieseg SP, Tylianakis JM (2012) Warming, CO2, and nitrogen deposition affect a plant-pollinator mutualism. Ecol Lett 15: 227-234		The reference is used in the multiple factors section, but also have now explicitly mentioned it in the climate change part under "Further climate change impacts on pollinators". Thanks for the hint.
Natalia Escobedo	2	76	3608	76	3616	I'm not sure where to place this observation within the section. Maybe I missed something, but I even when the effect of climate change in interactions and interaction networks, the subject of susceptibility of rare or highly specialized pollinator species to changes in ranges and composition of plant communities is not clearly addressed, in my opinion.	I. e, see: D Goulson, B Darvill, 2004. Niche overlap and diet breadth in bumblebees; are rare species more specialized in their choice of flowers? Apidologie, 35:55-63 and Williams, P. 2005. Does specialization explain rarity and decline among British bumblebees? A response to Goulson et. al.	We have included this aspect in the section "Observed changes in species range and abundance"; although the references add to the fact that the section is rather out of date (as stated in comment 1459)
Richard Corlett	2	76	3613	76	3681	This section is rather out of date. There have been several more recent studies.		We have added new literature, especially papers which have been recommended by other reviewers; if further important papers are missing, we hope for more specific comments on this in the next review round.

Colin Fontaine	2	76	3613	76	3613	suggestion of title: phenology change and interaction mismatch		Thaks, we have adopted this title
Liette Vasseur	2	76	3618	76	3620	why having these few references? It seems quite selective. I would be a little careful. In fact I am not sure why this way since no other sections had just listed papers. I would rather integrate these references into the text at the right places.		This is indeed selective - but only has the idea to give some key references to the general topic (more typical for an assessment not to be complete but to show some representative examples) - and comment number 1462 actually supports this approach
Hollis Woodard	2	76	3622	76	3622	Nice work on all the references! Just want to say :)		Thank you!
Liette Vasseur	2	76	3624			This snetence is very general and does not really mean anything. It's very well known but what is needed here is to quantify and qualify such a statement. And the next sentence is more or less true. There are studies and very good ones. However it is true with lots of variation.		We were tempted to remove it (especially having a more scientific text in mind, but then we thought it is good to have this as a framing for the interested stakeholder (while it might be too optimistic to expect that many of them really read the detailed text - but you never know)
Georg Andersson	2	76	3633	76	3636	Statements lack references		Gordo and Sanz, 2005 added as reference
Hollis Woodard	2	76	3641	76	3643	Reword, sentence reads strangely		We have treid some re-wording

Liette Vasseur	2	76	3643	76	3647	This paragraph needs to work and it is missing a huge part: timing of soil temperature rise in the spring as well as snow (or lack of) depth are important factors. E.g. 2013 in Canada very early blooming of some fruit trees (e.g. pear and crabapple) but no pollinators emerged and therefore low fruit production that year. So the variation is more complex than just air temperature and will greatly depends on years and if plants are degree days or not.		We have covered some of these aspects in lines 3662-3667, where we highlight that it is not just temperature alone; there we explicitly state that "snow cover is a more important factor than temperature per se" (and you have noticed yourself, as becomes obvious in comment 1470). If some references for the Candian case would have been provided, we could have included this as well (could not find ourselves);
Anders Nielsen	2	76	3655	76	3656	We did not conclude that plant and pollinators would shift together! We point to the empirical evidence for linear relationships between phenological events and temperature in both plants (e.g. first flowering) and pollinators (e.g. first emergence date). However, we emphasise the fact that this might still lead to temporal mismatch due to the varying slopes of the linear relationships in the two mutualistic partners		This refers to line 3648 (Hegland et al); we have adjusted the text accordingly
Thomas Steeger	2	77	3658	77	3658	"Since most larval butterfly species . . ."		line 3651: now modified: "Since most butterflies use herbs and grasses as host plants..."
Liette Vasseur	2	77	3663			Change "and can hence effect" to and can affect ...		we kept the original wording which seems gramatically correct and expresses the statement as a consequence of the previous part of the sentence

Liette Vasseur	2	77	3664			As I mentioned, northern hemisphere, not only arctic.		Thanks, we have adjusted this and wrote in "temperate, arctic and alpine", because there might also be cases in the southern hemisphere (while we don't know where you have mentioned this, as we do not go through all the comments someone might have made throughout the assessments - it wasn't in our chapter)
Thomas Steeger	2	77	3664	77	3664	"This view is supported by empirical data (Willmer 2012) which . . ."		wording modified
Jochen Freund	2	77	3669	77	3676	The many sources of very high uncertainty in this study should be mentioned (unobserved interactions, flexibility, etc.). Caution is advised whether this can be taken as good evidence for expected extinctions.		Text was rewritten, integrating new references and comments 1472-1474
Dan Cariveau	2	77	3669	77	3676	I would refrain from providing this much text to this study. This was a nice first step however, there are a number of problems. Nico Bluthgen went into detail on this in his Basic and Applied Ecology paper in 2010 - one of which is that sampling effects and rarity are both confounded with specialization.		Text was rewritten, integrating new references and comments 1472-1474
Laura Burkle	2	77	3669	77	3676	following this modeling study, there was an empirical study, re-sampling that highly resolved network (Burkle et al. 2013). They find empirical evidence that climate change over the last 120 years resulted in phenological shifts that caused interaction mismatches between flowering plants and bee pollinators. Many bee species were extirpated from this system, potentially as a result of climate-induced phenological shifts.		Text was rewritten, integrating new references and comments 1472-1474
Ignasi Bartomeus	2	77	3681	77	3681	May be this is not necessary, but there is also some evidence that daily activity patterns may change with climate change e.g. Rader et al 2013 Global Change Biology, doi: 10.1111/gcb.12264		Thanks for hint; we included this element
Natacha Chacoff	2	77	3681	77	3681	Probably the review by Burkle and Alarcon (2011) is a good reference for this section. Article published in American Journal of Botany		Thanks for hint; we included this reference

Colin Fontaine	2	77	3683	78	3723	it should be acknowledge that most of the knowledge does not come from pollinators		We have added further references for pollinators (e.g. as proposed by comment 1478), but also thought that keeping some general information in there is appropriate
Anders Nielsen	2	77	3688	77	3688	To references can be added here: Kjølhl, M., A. Nielsen, and N. C. Stenseth. 2011. Potential effects of climate change on crop pollination. FAO, Rome. Hegland, S. J., A. Nielsen, A. Lázaro, A.-L. Bjerknes, and Ø. Totland. 2009. How does climate warming affect plant-pollinator interactions? Ecology Letters 12:184-195.		Thanks for hint; we included these references
Liette Vasseur	2	77	3690			This seems very general and not really related to pollinators. It would be good to make a comparison, do we see the same trends for them than the other species?		While in line 3690 there is exactly an example on pollinators, we can see the point of the statement and have added further references for pollinators (e.g. as proposed by comment 1478), but also thought that keeping some general information in there is appropriate, while it seemed hard to make real comparisons (which however we then did in the modelling examples further down)
Keng Hong	2	77	3693	77	3693	Insert 'to' prior to "produce".		Done; thanks
Serena Heckler	2	77	3695	77	3695	Could strengthen here with examples from other regions and communities. E.g. " <u>Kullu Farmers who practice traditional beekeeping with <i>A. cerana</i> in the Himalayas report the effects of climate change on pollinators have included changes to swarming times (preponed by at least a month) and also population size (Sharma 2004).</u> "   REF: Sharma, Harish K. 2004. Cash Crops Farming in the Himalayas: the Importance of Pollinators and Pollination in Vegetable Seed Production in Kullu Valley of Humachal Pradesh, India. ICIMOD.		Thanks for hint; we included this element
Hollis Woodard	2	77	3696	77	3697	Missing words in sentence		Sentence was adjusted; thanks

Liette Vasseur	2	77	3698			I would put locally or globally extinct. In fact I believe that local extinctions are coming faster than global. The following sentence seems a repeat of the beginning of the section.		We have added the local aspect as it is indeed very important, but left the following sentence as we could not find a similar one at the beginning of the section
Claudia Maria Jacobi	2		3704		3708	While temperature changes will cause uphill and polarward displacements, I believe it would be appropriate to mention here or further down in Section 2.8 (or even 2.9.1) that in tropical countries desertification (due to rain changes, synergically with land use) may be a serious problem, since it is not clear where there would be 'refuge habitats' like in the uphill or polarward cases. I failed to see desertification mentioned in the text. I believe it is an important issue to mention or speculate on, even if there are currently few or no data.		We have now included desertification into the following sentence: "The "uphill and poleward" view of species range shifts in response to warming is a simplification of species response to changing climate, since response to climate change is also conditioned by changes in precipitation (incl. desertification), interactions with land use, and possibly many other factors " This sentence also states that the upward shift is a simplification.
Thomas Steeger	2	77	3708	77	3708	delete "including" just prior to e.g.,		Done; thanks
Leslie Firbank	2	77	3717			Which species?		modified into "plants and animals"
Nadine Azzu	2	78	3722	78	3723	"...thus leading to...respectively" - please, what does this mean to they lay person?		re-worded; thanks for highlighting
Colin Fontaine	2	78	3723	78	3723	212 and 135 should be the other way around		this is right, although it may seem contrainuitive at first sight
Anne-Laure Jacquemart	2	78	3723			what about plant migrations ?		We heard of similar studies done with plants, but did not come across any published reference (might be due to our own limitations)
Richard Corlett	2	78	3725	79	3763	See the paper by Pacifici, M. et al. just published on-line in Nature Climate Change for a thorough review of methods for assessing species vulnerability to climate change,		We have referred to this review now

Thomas Steeger	2	78	3728	78	3730	It's uncertain whether the data are sufficient to have the level of precision which these numbers suggest.		We assume this refer to lines 3721-3723; these are the calculated overall values for communities, but no statmenet on precision is possible
Luisa Carneiro	2	78	3730	78	3730	given that environmental drivers are unlikely to change in parallel, such assumption is irrelaistic, potentially biasing model results		sorry, reference unclear; same as comment 1492?
Joseph Tzanopoulos	2	78	3733	78	3735	This sentence can be omitted		We agree and omitted the sentence
Anders Nielsen	2	78	3734	79	3770	Be more precise in what results the different case studies provide.		referecne to lines is unclear; within the given line range we felt to have referred to the precise results quite often
Liette Vasseur	2	78	3750	79	3763	Another issue that must be discussed here is the possibility that pollinators gradually change their target plant species rather than moving with their current species. The issue of novel ecosystem should be discussed in this part.		We have isnerted a sentence to deal with this after line 3763 of the FOD version
Andreas Kruess	2	79	3765	80	3839	Box 2.8.1 please correct spelling: "grid" instead of "grind" several times		Thanks; done
Jochen Freund	2	79	3765	80	3846	Have solitary bees been sufficiently considered (many species prefer warm climate, with rang expansions being observed in Germany). I would doubt that the mostly cold-adapted bumblebees are representative of climate sensitivity of all bee species.		We agre that bumbe bees are not representative of all bees, but in the case of the other bees you may find the same trait constellations as for some of the more warm loving bumble bees (those which expand, like Bombus zonatus under full dispersal); but see also comment 1502
Jochen Freund	2	79	3765	80	3846	Was worldwide distribution considered in the study by Rasmont et al. 2015a (Fig 2.8.1)? The example of Bombus incertus may not be understood if it just focused on European distribution.		Due to data availability only European data could be used, which is a shortcoming of all of these approaches; but because it deals with scenarios the focus always should be on relative changes

Anders Nielsen	2	78	3772	79	3846	Too much details on the results from particular studies		We have some redundancies, which we will remove; but would like to stay to this example because we need some optical ways to bring across a few key messages - and it should be clear what it meant in the example
Liette Vasseur	2	79	3772	80		Box 2.8.1: great example but can be reduced in length.		We have some redundancies, which we will remove
Claudia Maria Jacobi	2		3800		3802	I agree that converting this information (Table 2.8.1) to a graph will be more convenient.		We will convert this for the next round
Georg Andersson	2	80	3812	80	3815	Perhaps include a note on that Solitary bees might benefit more as they are sometimes adapted to drier and warmer climates, showing higher diversity in e.g. mediterranean regions.		Thanks for the proposal, we have included such a note
Anne-Laure Jacquemart	2	80	3815			migration ok but they still need floral resources !		We have added this in parentheses
Claudia Maria Jacobi	2		3823		3826	Yes, please redraw Figure 2.8.1 and also explain only once (either in figure or legend) the meaning of HHR etc.		We will redraw the figure in the next round - when we will have the graphical standards at hand; then the explanations will be given only once, also in order to save space!
Natacha Chacoff	2	80	3824	80	3824	I couldnt understand this figure. The colors legend are not provided, and maps with current distribution is needed. However I find much more desirable this kind of figures than tables.		The complete final version will have all the necessary elements; as it is a lot of work we first wanted to see whether it survives the FOD, which it did; see also comment 1504
Anne-Laure Jacquemart	2		3837			How many species ?		Exact figures are hard to tell, because it depends on which criteria then would be used; at the moment the orientation was along the criteria used today
Ignasi Bartomeus	2	80	3839	80	3839	I think Box 2.8.1 can be shortened		We have some redundancies, which we will remove

Luisa Carvalheiro	2	80	3841	80	3842	there are considerable differences in larval resources among these groups, so I think this statement has a very high level of uncertainty associated. In fact, published work shows that bumblebees and butterflies are far more prone to local and regional extinction than other bees or hoverflies (Cravalheiro et al. 2013 Ecology Letters doi: 10.1111/ele.12121		Thanks for the important point which has espæd our attention. Text is now modified accordingly
Joseph Tzanopoulos	2	80	3845	80	3846	Another unknown but very important parameter that is often omitted, is policy changes as a result of major shifts in market supply-demand change (especially of agricultural products) which for sure will be affected by climate change.		You are right, but we did not include such very indirect effects - too speculative
Anne-Laure Jacquemart	2		3846			Add effects on plants and on floral resources		We have added this; thank you
Marina Rosales Benites de Franco	2	80	3852	80	3852	I suggest to include: .....with pesticide application, new diseases, water security or <b>water stress</b> and stress...		We restricted the drivers to the ones of more direct relevance for pollinators and thus left the text as it was, but mentioning "other stress"
Anders Nielsen	2	80	3855	81	3896	This section should be rewritten. Har to follow due to strange wording		We have tried to improve the text
G�rard Arnold	2		3857		3860	L 3857. 'Climate change might contribute by modifying the balance between honeybees and their environment'. In this part, it would be useful to inform the readers of the IPBES report about the great capacity of the honeybee to regulate the temperature inside the colony (hive) by thermogenesis or cooling. Therefore, this species seems not directly threatened by <del>global warming</del>		Thanks; we have made this more explicit in the text.
Liette Vasseur	2	80	3859	80	3862	This sentence does not make a lot of sense.		We have tried to improve the text
Luisa Carvalheiro	2	80	3865	81	3866	that would be expected only for the rare cases of high specialization. Indeed in Carvalheiro et al. 2013, we reanalyzed the data from Biesmeijer et al. 2006, and found that declines are <del>not parallel in time</del> .		Text adjusted
Nadine Azzu	2	80	3865	80	3865	"compare results of Biesmeijer"... Who is going to compare? The reader?		Text adjusted

Georg Andersson	2	81	3868	81	3869	However, note that many insect pollinated crops are grown in many areas in the world with different pollinator communities but still being pollinated. New communities does not necessary mean reduced services as many crops can be pollinated by a variety of pollinators. How wild plant-pollinator interactions and services are affected might be different.		Text adjusted
Colin Fontaine	2	81	3871	81	3911	could be much reduce as it does not have much information on pollination		We first considered to reduce, but then we decided to keep this as it provides a general overview of general relevance, which miht also help the non-specialist to understand some stetmetns better.
Marina Rosales Benites de Franco	2	81	3880	81		I consider important to include: ....the habitat matrix outside of protected areas to enhance the ecosystem connectivity, as a key and guarantee to migration .....		Text adjusted
Marina Rosales Benites de Franco	2	81	3887	81	3887	I suggest: ....on habitat quality and functions.....		Text adjusted
Andreas Kruess	2	81	3891	81	3911	It has to be mentioned that the estimation of extinction and the comparison of extinctions vs. new species is difficult due to the delayed extinction of "climate losers" but fast immigration of "climate winners"		Here it is not about the calculations of extinctions vs. New arrivals (invasions); it is just about the interaction of climate change an dinvasive species as combined drivers

Richard Corlett	2	81	3900	81	3911	You need to be wary of projections based purely on correlative models without mechanistic support. For most pollinators it is surely implausible to assume that they are less able to move in response to climate change than the plant they depend on.		Why should it be less plausible - it depends upon the degree of dependencies, but surely the pollinators can't move quicker in response to climate change than their plants? We think that we have treated correlative models with caution, while the interaction of plants and pollinators have quite a mechanistic component? But we also have made some slight adjustments along these lines in the text.
Natacha Chacoff	2	81	3913	82	3925	I found this section very useful and interesting, I suggest to add for the other drivers a section on how to reduce/mitigate the impacts of the driver on pollinators/biodiversity		This section goes to chapter 6, as it is not intended according to the scoping to be included here
Marina Rosales Benites de Franco	2	81	3918	81	3918	I consider: ...of microclimatic and <b>ecosystems</b> heterogeneity		This section goes to chapter 6, as it is not intended according to the scoping to be included here
Anne-Laure Jacquemart	2	82	3923		3925	Too optimistic! Natura2000 areas could really face to all other troubles, including climate changes ? Not a real network with everywhere functional connectivity for all species		This section goes to chapter 6, as it is not intended according to the scoping to be included here
Anders Nielsen	2	80	3926	81	3927	The majority of changes in pollinator density and diversity can be attributed to altered land-use...		This is right, but is not dealt with here; there was no judgement on the relative importance of drivers here, as here we only refer to climate change
Liette Vasseur	2	82	3934			Conclusions: there are lots of assumptions that pollinators must move to survive and the question of adaptation is not really tackled here.		We also had the shift in phenology as a major point there and included one more statement that not all shifts lead to an interruption of ecosystem functions.

Gérard Arnold	2		3934		3962	L 3934. In conclusion, it should be mentioned that the honeybee does not appear directly threatened by climate change because of its large capacities of thermoregulation.		Thanks, we have included this.
Marina Rosales Benites de Franco	2	82	3937	82	3937	I suggest: ---change will both alter ecosystem <b>structure</b> and functions		We have picked up this suggestion.
Thomas Steeger	2	82	3938	82	3938	". ..will likely continue to so so in response . . ."		We have picked up this suggestion.
Anders Nielsen	2	82	3938	82	3938	Add some references to case studies and/or reviews showing the ongoing processes.		We did this in the main text; these here are just the conclusions from the previous text
Richard Corlett	2	82	3943	82	3946	I don't think it is true that 'many pollinator species' are expected not to be able to track climate change. We have no evidence for this being generally likely that I know of. The biggest general risk is fragmented habitats and this has been barely investigated.		While the message was intended as proposed by the reviewer, we have now rearranged the paragraph in order to make this clearer.
Jochen Freund	2	82	3943	3951		What is the evidence for this, especially specific to pollinators? I would suggest to either downtone here (and possibly elsewhere) or support by more references. It seems to slightly contradict with L3717-L3723.		We have rephrased the text accordingly.
Ignasi Bartomeus	2	82	3945	82	3945	I think speed of migration unknown for most species, including bees, for wich foraging range once the nest is established is known, but not its dispersal ability. I would rephrase that to reflect this unknown.		We have rephrased the text accordingly.
Anne-Laure Jacquemart	2		3951			add explanation about boreo-alpine relicts (in bogs etc) ...		We have rephrased the text accordingly.
Richard Corlett	2	82	3953	82	3953	I would say 'MAY face increased extinction risk...'. We really don't know.		We have rephrased the text accordingly.
Thomas Brooks	2	87	4203			Add citation to Goulson et al. (2015) Science here		Added

Liette Vasseur	2	87	4205			I believe that the best way to integrate things together would be to develop a diagram where many of the factors being discussed in this chapter are linked. There are a few examples (e.g. Zimmerman 1988 for some aspects) that can serve as a basis but adding climate change, land use changes, pesticides, etc. would give a global idea of how the factors may or not interact and affect both plants and pollinators.		Figure edited taking into account various suggestions of all reviewers.
Jeff Ollerton	2	87	4207	87	4229	Another very recent paper discussing multiple effects over time is: Ollerton, J., Erenler, H., Edwards, M. & Crockett, R. (2014) Extinctions of aculeate pollinators in Britain and the role of large-scale agricultural changes. Science 346: 1360-1362		Added
Anders Nielsen	2	87	4207	87	4210	Rephrase sentence		Split the sentence helpful reads easier now: "For instance, different drivers might act directly or indirectly on pollinators and pollination according to the spatiotemporal scale of the impact. Alternatively, drivers may comprise a chain of events such as when an indirect driver (e.g. human population growth) modifies the effect of a direct driver (e.g. agricultural intensification) of changes in pollinators and pollination (Figure citation) (González-Varo et al., 2013; Ollerton et al., 2014; Potts et al., 2010; Vanbergen and the Insect Pollinators Initiative, 2013).
Les Davies	2	87	4208			Figure 2.9.1 is very complex; a modification of the simpler schematic at <a href="http://operaresearch.eu/files/repository/20111024172617_bee-health-facts-and-figures.pdf">http://operaresearch.eu/files/repository/20111024172617_bee-health-facts-and-figures.pdf</a> (page 25; Fig. 6) might be easier to understand		Figure edited taking into account various suggestions of all reviewers

Felix Herzog	2	87	4211	87	4211	REPLACE "reduced" by "altered"	mass flowering crops can become abundant (e.g. canola for bio-energy) and provide lots of resources	done
Anne-Laure Jacquemart	2	87	4211			"reduced pollen and nectar food resources" : this notion needs to be introduced and explained earlier in the chapter. It a crucial point in pollination interactions		I agree it is crucial. In fact nesting and forage resources were mentioned several times in the Executive summary and the sections on habitat fragmentation and loss and agricultural management. I will liase with my coauthors to ensure this is given the correct coverage.

Anne-Laure Jacquemart	2		4219		4222	add sentences about eutrophication (main source of biodiversity losses in several areas around the world, see Sassa et al. 2000)		<p>Neither a google scholar or Web of Knowledge search turned up the suggested citation. However I have inserted a line on nitrogen eutrophication as a driver of vegetation changes and possible impacts on pollinators: "One additional driver that has received relatively little attention to date (Burkle and Irwin, 2009; Burkle and Irwin, 2010; Hoover et al., 2012) is atmospheric nitrogen deposition, which can reduce the diversity and cover of flowering plants that provide pollinator foods (e.g. Burkle and Irwin, 2010; Stevens et al., 2011). The individual impact of nitrogen deposition on pollinators, networks and pollination may be relatively weak (Burkle and Irwin, 2009; Burkle and Irwin, 2010). Nonetheless, nitrogen in combination with climate warming and elevated CO2 produced subtle effects on bumble bee nectar consumption and reduced bee longevity (Hoover et al., 2012). Further work is required to elucidate the potential of nitrogen deposition as part of a multifactorial pressure</p>
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Gérard Arnold	2		4221		4223	L 4221. This inherent complexity (Figure 2.9.1) means that, to date, this phenomenon of a multifactorial impact on pollinators. Everybody agrees with the idea that, internationally, the responsibility of a single factor is meaningless, and that several important factors can be invoked (e.g. biological, chemical, or, in some cases, climatic disturbances). Given the wide variety of regional and local situations and the variety of pollinators, it is illusory to establish a general rule. This evidence of several factors on a global scale should not obscure the fact that under certain conditions, a single factor (e.g. a parasite or a pesticide) can be the cause of bee disorders. In other cases, several factors (e.g. an infectious agent and a pesticide) may act in combination (additively or synergistically). This notion of the possible existence of a single causal factor to explain some bee disorder in a given context should be recalled in this chapter, and in particular in this sub-section 2.9. The origin of disorders of bees is not all the time multifactorial.		I totally agree with you, but also think that a multifactorial impact can occur at fine local scales ( e.g. different components of agri intensification plus disease or climate change for instance), and this is little studied. So is not just a relevant concept at international level. However to strengthen the existing text in line with your comment I have amended it thus: "It is not possible to rule out a single, proximate cause for changes in pollinators and pollination in a particular locality, for a given species or under a certain set of circumstances. However, it seems likely that in the real world a complex interplay of factors is affecting pollinator biodiversity and pollination but the precise combination of factors will vary in space, time and across pollinator species."
Nadine Azzu	2	87	4222	87	4222	suggest maybe conclude the sentence to say "so all deserve equal consideration"- to ENCOURAGE the fact that these need to be considered at the policy level - both in their "disaggregations" and also maybe by encouraging research into collecting more data on the "combined pressures"		Thank you for your suggestion. I have added: "Therefore science and policy need to equally consider the separate and combined impacts of the various drivers affecting pollinators and the pollination service they provide. "
Jochen Freund	2	87	4227	87	4231	Figure 2.9.1: This figure should make clearer which pathways are based on sufficient evidence and which are potential		Figure edited taking into account various suggestions of all reviewers,

Shalene Jha	2	87	4227	87	4227	This figure could be improved by making the arrows grey-scaled and instead convey the percent of studies that indicate a positive effect (darker grey) or negative effect (lighter grey) on pollinator abundance and number? I think the categorical (yellow and red) is misleading because that is not actually how the studies sort (for example, there are many more studies that show that wild plants have a positive effect on pollinator number and abundance than studies showing otherwise).		Figure edited taking into account various suggestions of all reviewers,
Les Davies	2	87	4227		0	See comment in row above		Figure edited taking into account various suggestions of all reviewers,
Claudia Maria Jacobi	2		4227		4231	Could you use different colours for the + - and +/- interaction text in Fig. 2.9.1? Signs are not easy to see.		Figure edited taking into account various suggestions of all reviewers,
Jochen Freund	2	87	4233	87	4236	Tab 2.9.1: Why should solitary bees be more sensitive to chemicals than social bees? Even if evidence is scarce, there should be some basis for this to be speculated.		Ref added. It is based on a study on ants and pollution (Maavara V., Martin A.-J., Oja A. & Nuorteva P. (2007). Sampling of different social categories of red wood ants (Formica s. str.) for biomonitoring (In: Environmental Sampling for Trace Analysis, Ed. B. Markert) Wiley-VCH Verlag GmbH, Weinheim, Germany.)
Jochen Freund	2	87	4233	87	4236	Tab 2.9.1: I doubt that there is "high confidence" in what the interactive effects of land use and climate change may be. It is further unclear which of the statements in this table cell the "high confidence" is being assigned to.		References added to the table. Also cell was edited to make it more clear.
Natalia Escobedo	2	87	4234	87	4234	On figure 2.9.1: I think the arrow between climate change and land use practices should go both ways, given that land use (as in change in forest cover) is known to be important in CO2 removal from the atmosphere. Also, land use practices should also be connected to availability of nesting places, since some species (like some stingless bees) nest in trees, and have a hard time finding nesting places in agricultural lands.		Corrected and figure edited taking into account various suggestions of all reviewers

Leo Galetto	2	87	4245	88	4290	I think that both drivers (land use and climate change) are very well presented (and documented) in previous sections. Thus, this example is not necessary and can be omitted.		Thank you for the comment. I have looked again at the climate change section and don't see large overlap in content and we do cross reference. I will refrain at this point from doing as you suggest, but I will bear your recommendation in mind when consulting with colleagues as we edit the next version .
Ignasi Bartomeus	2	87	4246	87	4246	I would stress here that pollinators tend to be generalized in its diet, and most are able to switch host if necessary.		Thanks I have added: "While pollinators with broad diets have the capacity to switch to alternative food plants, thereby maintaining populations and pollinator network structure (Kleijn and Raemakers, 2008; Valdovinos et al., 2013); other evidence suggests specific food-plant diets may underpin pollinator declines (Biesmeijer et al., 2006; Scheper et al., 2014). "
Anders Nielsen	2	87	4252	87	4252	Add reference also to Hegland et al. (2009)		Added
Anne-Laure Jacquemart	2	88	4252			and what about plants ?		Now reads: plant-pollinator communities

Richard Corlett	2	88	4259	88	4259	Phenological mismatches are an academically interesting idea but real-world support for this being a MAJOR problem is lacking.		I agree so far this area has been dominated by simulation modelling because of the absence of long-term time series that would enable an empirical test. However the cited Burkle study does provide empirical evidence consistent with the phenomenon. I have revised the text to reflect this nuance: "Such phenological mismatches may contribute to losses of species, particularly specialists (Burkle et al., 2013), which simulation models of network data predict could occur by diminishing or curtailing nectar and pollen food supplies (Memmott et al., 2010; Memmott et al., 2007). Data limitations mean, however, that direct empirical evidence for plant-pollinator phenological mismatch is lacking."
Mario Marcos Espirito	2	88	4274	88	4274	Replace "eco-evolutionary" by "life-history".		Done
Richard Corlett	2	88	4282	88	4283	This is really the key point. In systems with many species of flowers and pollinators, pollination services are likely to be maintained whatever happens to individual species.		yes I agree, I reconsidered and strengthened this sentence: "A major source of uncertainty lies in whether such a combined impact lowers the inherent robustness or resilience of pollinator networks (diversity, modularity etc) to the point where pollination service delivery is affected".

Jana Vamosi	2	88	4283			may wish to see Adderley & Vamosi 2015 and Steffan-Dewenter & Tschardt 1999 with regard to fragmentation effects on different pollinators		This was not really the point I was making here. I have restructured the sentence in line with a comment (row1591) and the sentence now reads: "A major source of uncertainty lies in whether such a combined impact lowers the inherent robustness or resilience of pollinator networks (diversity, modularity etc) to the point where pollination service delivery is affected".
Nadine Azzu	2	88	4285	88	4285	what about CCD, in considerations in this section? (would that be of any relevance here?)		CCD and colony loss is generally best covered in the managed pollinators/diseases section, although you are right that causality has not been proven and was possibly a combination of factors to do with bee management, nutrition and disease
Leo Galetto	2	88	4286	88	4290	In case authors think that the example is important and it is maintained, the conclusion do not said that there is enough evidence that shows if we continue with the same practices the future is not commendable. In summary, I agree that there is uncertainty associated to better understand complex systems (as agri-ecosystems) but we know very well the risks associated with current practices (and drivers).		There may be some line number confusion as the comment appears to refer to the preceding sentence L4282-4283? If so see my reply to comments in Row 1591&1592 in this sheet.

Leo Galetto	2	88	4292	89	4353	I think that these drivers (pathogens, chemicals, diseases and managed pollinators) are very well presented (and documented) in previous sections. Thus, these two examples are not necessary and can be omitted.		thanks for your comment. The sections on pesticides and pollinator diseases deal with interactions among different chemicals and different infectious agents, respectively. Here in this section, we deal with interactions between classes of driver, in this instance pesticide x disease interactions. As we edit and revise the second draft we will as a team consider your viewpoint as to where the best place is for this text.
G�rard Arnold	2		4294		4295	L 4294. The combined impacts of pathogens and insecticides have implications for the physiological health of honeybees. See my comment (L 2933): the term 'infectious agent' is more global than 'pathogen'; because it does not prejudge if clinical signs will develop (disease), or not. This seems particularly important in the case of interactions infectious agents and pesticides, since the presence of the infectious agent alone cannot cause clinical signs, while the arrival of a pesticide in the colony - and thus combination of the two agents - can cause the onset of disease.		We will as a team decide on how to deal with this comment as it cuts across the Chapter sections, so I shall not respond by editing the text at this stage. Also our initial feeling while your point is valid, that is might not help here to complicate the language given the target policy audience. While use of "pathogen" may miss certain valid scientific nuances it is at least easily recognisable to everyone in this target audience.

Peter Campbell	2	88	4297	88	4298	<p>Petis et al 2013. There were some reservations around the robustness of this research ie</p> <ul style="list-style-type: none"> <li>• A complete lack of transparency in the paper on the data/analysis/results that support the authors main conclusions ie fungicides increase susceptibility to Nosema</li> <li>• Epidemiological based statistical analysis used for the above analysis are questionable and need to be tested</li> <li>• The nosema analysis part of study is a very simplistic bolt on lab bioassay, which has questionable field and hive/colony relevance.</li> </ul>		<p>The paper and data were peer reviewed and as presented seem sound to us, the effects of all compounds were shown whether they had a positive or negative effect and the authors do not go beyond the data i.e. they do not suggest colony/field effects but raise the possibility that fungicides might have a role in bee health. There always different analytical approaches but it does not mean this one is necessarily invalid and it is well justified in the paper.</p>
Thomas Steeger	2	88	4303	88	4308	<p>The increased incidence of Nosema in neonicotinoid-treated [individual] bees did not appear to be dose-responsive and the findings did not [to my knowledge] extend to the colony level, i.e., there was no difference in Nosema loads between treated and untreated colonies.</p>		<p>This sentence has been revised to be clear, exposure to pesticide was through colony exposure at two doses, there was no difference in pathogen levels between doses but only between control and pesticide exposure. There was no colony effect, rather exposure was at colony level not individual level. Sentence now reads: "Currently, there is limited evidence of disease-pesticide interactions at colony levels, a single study (Pettis et al., 2012) has shown that colony exposure to a sub-lethal levels of neonicotinoid (imidacloprid) resulted in higher N. ceranae infection levels in individual honey bees." I hope this is more accurate.</p>

Diane Castle	2	89	4339	89	4346	Supporting reference: Robyn Manley, Mike Boots and Lena Wilfert Emerging viral disease risk to pollinating insects: ecological, evolutionary and anthropogenic factors Journal of Applied Ecology 2015 doi: 10.1111/1365-2664.12385		I had recently picked this reference up, thank you for pointing its relevance out. It is cited in two places following revision. But this section is now being relocated to the revised section on disease and managed pollinators: section 2.4 in the revised chapter structure.
Nadine Azzu	2	89	4348	89	4361	In referring to the entire "conclusions" section - can we say something more than just research-oriented? We need to let science speak to policy makers, so maybe say something related to agricultural practices? Or policies? Or land-use/land planning/land management?		Good point. The terminal sentence in the conclusion now reads: "Aside from this important challenge to advance knowledge of the multifactorial pressure on pollinators and pollination, there is an urgent need for decision makers to [re-]consider how policy decisions are framed with regard to pollinators and pollination services, this may require joint framing across policy and other sectors (e.g. science, business, NGOs) and should be broader to capture the individual and combined effects of different drivers. The result may lead to more inclusive policy development taking into account of the needs of various stakeholders and advances in science.

May Berenbaum	2	89	4354	89	4354	Would the authors consider including a discussion of interactions between nutrition and pesticide tolerance/detoxification and/r nutrition and disease resistance? At least for honey bees, nutrition issues seem to influence responses to most other stressors		Yes, I we have now decided to move the small section on interactions between diseases and managed polliantors to section 2.4 and replace it here with a new sub-section that deals with the potential for negatvie effects arising from a combination of nutritional stress and pesticide and pathogen exposure.
Leo Galetto	2	89	4355	90	4368	Here is presented an obvious summary and repetitive with was presented above. I think this is a very important section that relate many drivers and showed the complex picture for agri-environments, pollinators, pollination, and crops. Thus, I think important messages (as a synthesis) should be placed here.		This has now been edited and rephrased abvoiding unnecessary repetition.
Marina Rosales Benites de Franco	2	89	4356	89	4356	I consider to include: ... their different biology, genetic and ecology...		I removed biology and replaced with "...different genetics, physiology and ecology"
Marina Rosales Benites de Franco	2	90	4361	90	4361	I consider very important to include: Also, improve our knowledge on multifactorial effects on processes and mechanisms of pollination service in natural habitats.		Now reads:... multifactorial pressure on pollinators and pollination services because of the potential consequences for future food security, human health and natural ecosystem function
Les Davies	2	90	4444			Emerging issues and key uncertainties: The focus of much bee research has been on the sub-chronic effects of neonicotinoids; one issue is the lack of parallel investigation of other classes of pesticides (especially older classes) in the same tests, possibly leading to an undue focus on one particular class. Older pesticides were not previously examined in these new tests.		This section did not remain in the text for the time being
Valerie Peters	2	92	4444	93	4503	all questions in this section are great, especially important is question f		FAQs will be derived from the existing text during the time of the SOD review

Valerie Peters	2	92	4444	93	4503	Another FAQ idea: How robust is the ES of pollination to pollinator loss?		FAQs will be derived from the existing text during the time of the SOD review
Richard Corlett	2	92	4448	92	4448	Tipping points are fashionable but seem unlikely with many interacting species, each with different thresholds.		FAQs will be derived from the existing text during the time of the SOD review
Leo Galetto	2	92	4452	92	4470	I think that other sources of uncertainty can be discussed here because most of the typological sources presented in Table 6.6.1. can be identified. I can help to develop a little more this section (if authors want). Moreover, the final message is unenthusiastic and I think it would be encouraging to promote new ideas and practices. Finally, these messages, as were presented, open the "door" to maintain actual practices that are nor recommendable for pollinators and pollination.		FAQs will be derived from the existing text during the time of the SOD review
Thomas Steeger	2	92	4461	92	4461	". . .process as yet, but for most precess, increased warming tips the balance . . ."		FAQs will be derived from the existing text during the time of the SOD review
Liette Vasseur	2	92	4464			I would add the following questions: What are the rates of adaptation to climate and environmental changes for plants versus pollinators? How much bats, birds, etc. can contribute to alleviate the challenges of insect pollinators under climate change scenario? I would also look at other emerging issues that should probably not be discussed in the chapter but certianly mention here such as the wind mills and solar panels close to agricultural fields, the effects of spraying versus drip irrigation in crops on pollinators, etc.		FAQs will be derived from the existing text during the time of the SOD review
Natacha Chacoff	2	92	4464	92	4464	which drivers deserve more attention or more research? Either because of the variability in the response of pollinators and or because it is a novel or understudied driver (GMO's and IR). Incomplete data of the use of pesticides in developing countries or in regions (Asia and Africa)		FAQs will be derived from the existing text during the time of the SOD review

Julia Astegiano	2	92	4464	92	4464	I would suggest incorporating the following questions: (1) How pollinator decline may influence the incidence of cascading effects in plant-pollinator communities?; (2) How these cascading effects may affect the pollination service of crops and wild plants?; (3) How pollinators vulnerability to partners loss is related to species centrality in plant-pollinator networks?		FAQs will be derived from the existing text during the time of the SOD review
Maj Rundlöf	2	92	4464	93	4503	Really good idea to include this section on FAQ - I look forward to read the thoughts on these in the final version of the report!		FAQs will be derived from the existing text during the time of the SOD review
Les Davies	2	92	4464			Are FAQs necessary in this document? The answers will just repeat information provided in the comprehensive chapter sections and in the detailed 'Executive summary'. The push should be to reduce the size of the chapters, not increase them.		FAQs will be derived from the existing text during the time of the SOD review
Jochen Freund	2	92	4465	92	4465	probably my number one question would be: "what is the relative importance of the different drivers?" Other ideas would be "(how) does the effect or importance of drivers differ between the objectives of a) crop pollination, b) wild plant pollination and c) pollinator species conservation?" and "does the effect or relative importance of drivers differ among regions of the world, e.g. developing and industrial countries or temperate and tropical regions?"		FAQs will be derived from the existing text during the time of the SOD review
Jana Vamosi	2	92	4465			with regard to good future questions, these are my suggestions: 1) How does the diversity in floral diet of bees related to bee health? Are monocultures contributing to the decline in health (recent study by Irwin and colleagues (proc roy soc 2015) on tobacco and pathogens is intriguing in this respect. 2) How much is known regarding the genetic diversity of bees and how it affects their ability to adapt? David R. Tarpy, Dennis vanEngelsdorp, Jeffrey S. Pettis. Genetic diversity affects colony survivorship in commercial honey bee colonies. Naturwissenschaften, 2013; DOI: 10.1007/s00114-013-1065-y		FAQs will be derived from the existing text during the time of the SOD review
Thomas Steeger	2	92	4468	92	4468	". . . bifurcations, a problem that is well known in climate science."		FAQs will be derived from the existing text during the time of the SOD review

Andreas Obrecht	2	92	4468	93	4502	- What other effects on pollinators is expected from climate change?		FAQs will be derived from the existing text during the time of the SOD review
Keng Hong	2	92	4468	92	4473	As regards to question a) in my opinion are i) deforestation – for agricultural and/or land use for urbanisation, or solely for extracting timber without proper reforestation programmes; ii) intensive and extensive spraying of and indiscriminate use of pesticides/herbicides (especially those with mode of action on the nervous system); and, of course, iii) climate change. As to how they interact – is dealt with in the chapter text.		FAQs will be derived from the existing text during the time of the SOD review
Keng Hong	2	92	4475	92	4476	<p>Pertaining to question b) - In many developing countries, “the pesticide conspiracy” is still evident. Many farmers or growers are entrapped, either through ignorance or easy credit to purchase pesticides (sales are not properly regulated in most developing countries), are wittingly caught in the insecticide treadmill of ever greater and frequent applications of more toxic insecticides. As a result, many insecticides (even the neonicotinoids – hotly debated topic as mentioned in the text) have induced insecticide resistance - (see link: <a href="http://ricehoppers.net/2009/03/imidacloprid-from-hero-to-zero-in-the-control-of-brown-planthopper/">http://ricehoppers.net/2009/03/imidacloprid-from-hero-to-zero-in-the-control-of-brown-planthopper/</a>). The extensive and intensive sprayings/applications of insecticides may cause significant severity to the trend and survival of pollinators.</p> <p>Depending on the target insect pest species, if an effective pheromone or a very potent attractant exists for the species, there is a good possibility of combing an insecticide as a toxicant with the pheromone or attractant using the “attract and kill” technique at point sources or in traps.</p>		FAQs will be derived from the existing text during the time of the SOD review

Keng Hong	2	92	4478	92	4478	The importance of invasive plant species has been dealt with to some degree in the text. As to invasive animals, especially insects, more studies should be encouraged to evaluate the importance of the invasive species to pollination in the local context. More should be done to determine the effect of an invasive species which is known as potential/actual pollinators in its native habitat.		FAQs will be derived from the existing text during the time of the SOD review
Thomas Steeger	2	92	4479	92	4479	replace "spreading" with "transmission"		FAQs will be derived from the existing text during the time of the SOD review
Anne-Laure Jacquemart	2	92	4482		4489	Needs a part about plants ! Pollinators do not live alone ..		FAQs will be derived from the existing text during the time of the SOD review
Richard Corlett	2	92	4491	92	4491	I don't understand this sentence.		FAQs will be derived from the existing text during the time of the SOD review
Shaju Thomas	2	92	4492	93	4495	How to quantify the ecosystem services of pollinators?		FAQs will be derived from the existing text during the time of the SOD review
Thomas Steeger	2	92	4501	92	4501	"Ecosystems represent the machiner to deliver things . . ."		FAQs will be derived from the existing text during the time of the SOD review
Serena Heckler	2	93	4503	93	4503	As also noted earlier in notes on this chapter, the section on opportunities could include investigation of traditional management approaches to protect pollinators - ranging from traditional agricultural practices to reduce impacts from modern agriculture to traditional pest management alternatives to chemical applications. There is extensive literature on this. See ILK task force for references.		FAQs will be derived from the existing text during the time of the SOD review

Keng Hong	2	93	4503	93	4503	Opportunities for better managing ecosystems – Responsible authorities/governments should ensure advance planning and discussions between stakeholders under any perceived/pending changing drivers. For i) agroecosystems: Indiscriminate use of pesticides should be totally discouraged; and sale of pesticides, particularly those that affect the nervous system, should be properly regulated. Implement sound and effective Integrated Pest Management programmes (via encouraging relevant research, and education of stakeholders) where large scale spraying of pesticides is the last resort to enhance/encourage biological/natural control of a target pest species as well as avoid contaminating/polluting the natural environment. ii) deforestation for land use: Proper environmental impact assessment (EIA) should be conducted by qualified, credible and non-partisan experts/scientists; and the EIA report be open for public discussion before a permit for any large scale deforestation is issued by the relevant authorities.		FAQs will be derived from the existing text during the time of the SOD review
Thomas Steeger	2	93	4506	93	4506	by "knock-on" do you mean "related"		FAQs will be derived from the existing text during the time of the SOD review
Thomas Steeger	2	93	4509	93	4509	". . .adaptive actions . . ."		FAQs will be derived from the existing text during the time of the SOD review
Peter Campbell	2	49	4950	50	2333	There is another reference that has not been quoted here that challenges both this apparent reduction in Monarch butterfly populations and the role of in-direct effect of herbicides:- Reference is :- Andrew Davis , 2012 ; "Are migratory monarchs really declining in eastern North America? Examining evidence from two fall census programs" ; Insect Conservation and Diversity (2012) 5, 101–105. This is a study based on field monitoring whereas the study referenced is a modelling study. So is this conclusion as robust as is stated?		Added in the GMO section.
Anne-Laure Jacquemart	2	29	Box 2.3.1			uniformise : too many boxes in this part, no box in chapter 1 for example		will be adapted following second review if needed





































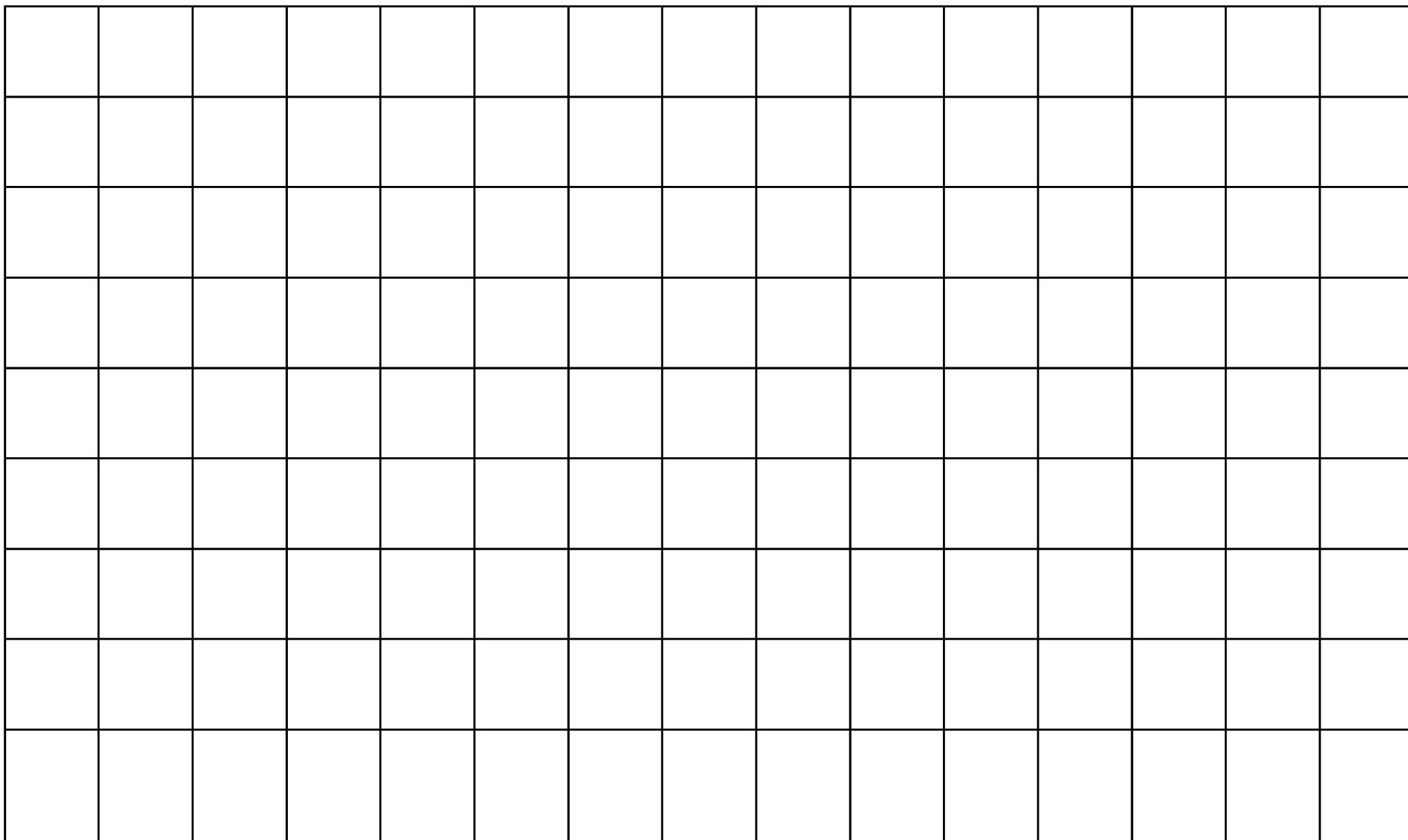




























































































































































































































































































































































































































































































































































































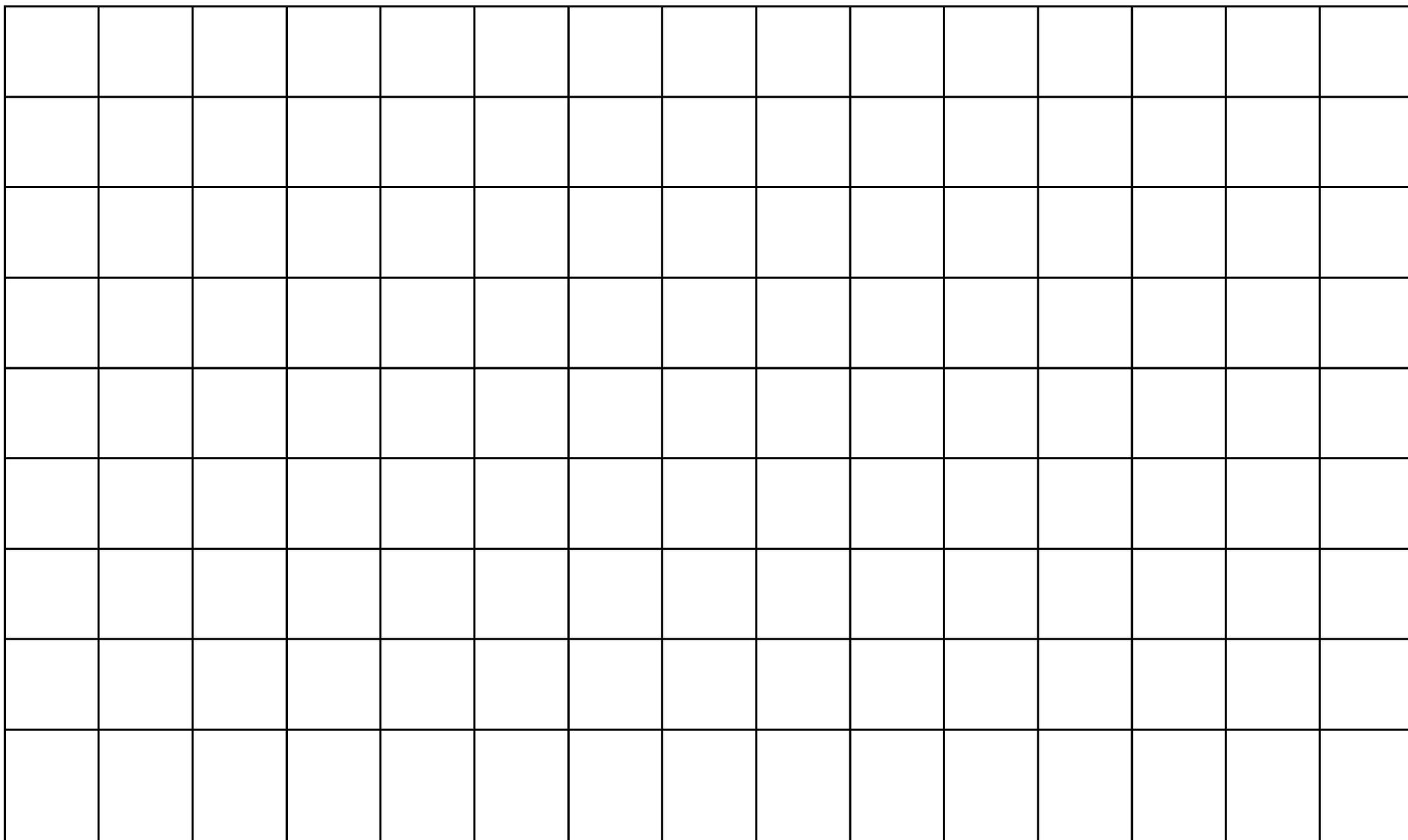




























































































































































































































































































































































































































































































































































































































































































































































































































































































































































































































































































































































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