

Comment form for 1st Review Phase of the Deliverable 3c) Fast-track methodological assessment on scenarios and models Chapter 8 ‘Improvements’

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Joel Houdet (JH)

Jasper Montana (JP)

Audrey Coreau (AC)

Hans Keune (HK)

Louise Gallagher (LG)

Thomas Brooks (TB)

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
1.	Key messages					Key message 7 would benefit if there were recommendations for doing so consistently, to increase the potential for comparable results from different assessments. TEEB has produced various reports and guidelines on stakeholder engagement, but TEEB is barely referenced in the chapter.	Florian V. Eppink (FE)	We have now revised section 8.3.1 to provide more guidance on how stakeholders should be engaged. We also added a reference to one TEEB report on stakeholder engagement (Wittmer et. al, 2013).
2.	All chapters					There appears to be much potential for overlap with chapter 6. I would recommend that during the revision, Chapters 8 and 6 coordinate closely in terms of topics addressed and recommendations given. I think Chapter 8 does a better job at discussing and addressing the relevant issues, so it might	Florian V. Eppink (FE)	Some amount of overlap is to be expected in this synthesis chapter. However, our focus here is strongly on improvements. Since some of the improvements involve linkages among models, some overlap with Chapter 6 is

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						take the lead in this respect.		inevitable. Because the issue of linkages is identified as critical (by us, the rest of the assessment, and several reviewers), we do not think the small amount of overlap we have with Chapter 6 is a major issue.
3.	All chapters					<p>I am not aware of IPBES decisions on this topic, but in my view it is vital to separate the concepts of biodiversity and ecosystem functions (and services). The disparity in the weight given to species models and models of ecosystems and their processes seems to support the idea that these are in fact different concepts, at the very least from a data and modelling viewpoint.</p> <p>Figure 8.1, for instance, gives the impression biodiversity and ecosystems can be lumped together. How does this relate to the IPBES framework?</p>	Florian V. Eppink (FE)	The IPBES conceptual Framework (Díaz, S., et al. 2015. Current Opinion in Environmental Sustainability 14: 1–16.) integrates biodiversity and ecosystems, including ecosystem functions, into the same conceptual “box”. It is the ecosystem services that are in a separate category. Figure 8.1 has been removed and replaced by Table 8.1.
4.	All chapters					I think the chapter would gain if the discussions are more closely tied in with the structure provided by the distinct information gaps discussed in 8.1.2	Florian V. Eppink (FE)	The structure provided by the distinct information gaps discussed in 8.1.2 is too restrictive for the whole chapter. In the rest of the chapter, we discuss improvements beyond the data gaps discussed here, so it would not be possible to tie the structure of whole chapter to these data gaps.
5.	All chapters					There are several good points made in this chapter, but many are hidden in the middle of long paragraphs. I suggest the main points are given a more prominent place.	Florian V. Eppink (FE)	We thank the reviewer for recognizing the several good points we make. As decided in the 3rd author meeting, highlight boxes will be inserted throughout the chapter in the final draft.
6..	8	-	-	-	-	<p>Also noted in comments on Chapter 2 ‘Decision making’:</p> <p>A more extensive assessment of the role of visual communication for model and scenario outputs would be valuable (see for example McInerney et al. 2014). In particular how planning of final visual outputs can be embedded into the development and production stage of modeling and scenario activities.</p> <p>(McInerney, G J, Chen, M, Freeman, R, Gavaghan, D, Meyer, M, Rowland, F, Spiegelhalter, D. J, Stefaner, M, Tassarolo, G, and Hortal, J. (2014). Information</p>	Jasper Montana (JP)	This has been added in section 8.3.3

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						visualization in science and policy: engaging users and avoiding bias. Trends in Ecology & Evolution. 29. 148-157. DOI : 10.1016/j.tree.2014.01.003)		
7.	8					Also more generic IPBES ambitions could be evaluated, such as those included in the deliverable on divers conceptualizations of valuation. A generic framework could also be found in Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M. et al. (2003) 'Knowledge systems for sustainable development', PNAS, 100/14: 8086–91: CRELE indicators.	Hans Keune (HK)	We do not understand what "generic IPBES ambitions" are. In any case, this comment seems more relevant for Chapter 1 than Chapter 8.
8.	8					It seems to lack a participatory evaluation perspective: quality, also of models, partly is non-technical, being normative or preference dependent; therefore evaluation cannot in all respects be objectified, thus involving different actor perspectives is legitimate and wise. Performance indicators could be developed in a participatory manner	Hans Keune (HK)	We have expanded the participatory (section 8.3.1) and qualitative or non technical knowledge (section 8.2.2) components of models and scenarios development.
9.		General comment				<p>Congratulations to the writing team on producing an excellent set of recommendations.</p> <p>One specific comment is that I think the section 8.3.2/3/4 are particularly good and should be used to improve other chapters in Deliverable 3c.</p>	Louise Gallagher (LG)	Thank you for these nice comments.
10.	8	General	General	General	General	A key message in addition to those already incorporated might be that encouraging the development of multiple models, or differing complexities and types, is important. The trade-off between model complexity, precision, and generality is described later in the document, but the consequences of this (the need to have many model types) are not reflected in the 'key messages'.	UNEP-WCMC	We added a key recommendation (#2) on this.
11.	8	General	General	General	General	Most of the chapter proceeds according to the assumption that the 'species' will be the focal point of interest (for example, in 8.2.1.1 thematic gaps). Given that ecology is moving towards functional groups as an important unit of analysis, and that the linkages between ecosystems, functioning, and services may be easier to elucidate using these approaches, this assumption should be revisited and alternatives explored.	UNEP-WCMC	We added a paragraph and several references to section 8.2.1.1 on functional group (trait-based) approaches.
12.	8	General				There is a lot of material in this chapter, but a fair amount of it is quite general. There is also evident overlap with other chapters that needs to be addressed soon so an updated	UNEP-WCMC	Some overlap is to be expected in this synthesis chapter. See also comment 2.

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						chapter has more precise targeting.		
13.	8	General				This chapter – as with other chapters looked over – suffers a bit from the state of the IPBES process overall where its not 100% clear what the questions to be answered are, and what the policy input required by governments is. There is a danger for this chapter (and deliverable 3c overall) of being a very general review of everything, without clear targeting and direction. This seems important to try and resolve soon.	UNEP-WCMC	This is beyond the scope of this Chapter and is addressed somewhat in Chapter 1.
14.	8	General				The EBV and BIP indicators frameworks are the ones singled out here. Which is good. But it might be worth elaborating a bit around how these relate to Drivers, State, Pressures, Response, Benefits? At least to make it clear that we have reasonable measures of some of these and very few / very poor measures for others. In particular pressure and benefits are poorly done compared with some aspects of state and response. Would perhaps align the chapter better with international process. Alternatively, the chapter could argue why the DSPRB framework is bad and needs to be replaced by more holistic approaches that bring different things together so that change in pressure has a known effect on state.	UNEP-WCMC	Thanks for pointing out this unintended omission. We added a paragraph on DPSIR to section 8.1.1.
15.	8	General				Should the chapter outline the challenges / lack of agreement on the most suitable biodiversity metric. Like species richness vs range rarity vs threatened richness vs phylogenetic diversity etc. This can be boiled down into a few things, but it might be worth mentioning it as IPBES modelling will need to grapple with this	UNEP-WCMC	We have added a few sentences in section 8.1.1 on the challenge of choosing the appropriate metrics to assess changes in community composition and a few references.
16.	8	General				Some of the material in the chapter (on data availability for example) is not well linked to the title of the chapter. Overall this needs checking and the text needs aligning better. Some of the (good) material here might be better in other chapters perhaps? This is something to be checked over	UNEP-WCMC	Revised structure and introduction to the chapter (new Figure 1) addresses this comment.
17.	8	General				Some of the material in Chapter 3 on participatory scenarios and the differences between locally derived and global scenarios might be relevant in this chapter in the sections on challenges and solutions	UNEP-WCMC	We now provide more details on the development of participatory scenarios in Section 8.3.1. Please note that that most of chapter 3 has been re-organized and that some degree of overlap between chapter 8 and other chapters is expected.
18.	8					General comment. I think in this document the emphasis is placed in computer	Marcela Brugnach	See comment 6.

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						models in their predictive role. And, it leaves aside simulation games and role play games that are not computer based and not predictive but that have proved very good as tools to support decision and policy making. I suggest looking if this material is worth including.	(MB)	
19.						<p>I outline some material that can help understand my comments and support some of the arguments to be done:</p> <ol style="list-style-type: none"> 1. Voinov, A.A. and Bousquet, F. (2010) Modelling with stakeholders: position paper. In: Environmental modelling and software, 25 (2010)11 pp. 1268-1281. 2. Jakeman, A.J., Letcher, R.A., Norton, J.P., 2006. Ten iterative steps in development and evaluation of environmental models. Environmental Modelling & Software 21, 602-614 3. Hulme M (2010) Problems with making and governing global kind of knowledge. Glob Environ Chang 20:558–564 (Critics on global knowledge) 4. Arnstein S (1969) A ladder of participation. J Am Plan Assoc 35(4):216–224 5. Brugnach, M. and H. Ingram, 2012. Ambiguity: The challenges of knowing and deciding together. <i>Environmental Science and Policy</i>, 15: 60-71. <p>Brugnach M., M. Craps and A. Dewulf, 2014. Including indigenous peoples in climate change mitigation: addressing issues of scale, knowledge and power. Climatic Change. DOI 10.1007/s10584-014-1280-3</p>	Marcela Brugnach (MB)	We have added the suggested references to section 8.3.1.
20.	8	1	1	26	30	<p>The document is missing any articulation about why models and scenarios are useful in a policy environment – there is no policy level analysis that identifies which outcomes require the outputs from models. The chapter needs to be re-structured to identify which policy needs require model outputs & then how these needs can be met.</p> <p>I would suggest re-structuring:</p> <ol style="list-style-type: none"> 1. Identified Policy outcomes and needs that can be addressed using models & scenario analysis. 2. Outputs from models that can address those needs. <p>Discussion of modelling options</p>	Piers Dunstan (PD)	We added a sentence to Introduction and a paragraph to section 8.3.2.1 to clarify how models and scenarios can be useful in a policy environment. We believe further articulation of this is the outcome of the whole assessment, but not this chapter, which focuses on improvements. We also believe restructuring the chapter would not help. So, we decided to maintain current structure but added the sentence about the policy relevance of scenarios.

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						3. Key limitations of those models 4. Data gaps and facilitating data access		
21.	8	1	1	26	30	The chapter is generally weakly referenced with only a few references for each section. I am concerned that it does not represent the breadth of options in each section. Examples are listed below (for areas where I have expertise) but I would suggest that a broader review is necessary	Piers Dunstan (PD)	We have expanded the number of references by c. 40%/
22.	8	1	10	2	10	The key messages focus on models, not on scenarios. For instance, 130. could add : and (v) futures studies / scenario building and analysis. We also need to evaluate scenario building processes, to improve our capacities, to reinforce the community. This chapter has a section “improving models” and a section “improving utility”. A section “improving scenarios” is needed.	Audrey Coreau (AC)	We have revised key messages to also focus on scenarios. Section 8.3 was revised to make it clear that it is about improving the scenario building process, and now it is named “Improving Scenarios”.
23.	8	1	15			Change “scenario analysis and modelling” to “decision support”. Scenarios and modelling are means to an end, and valuable but not necessary in mediating the interface between data and decision support.	Thomas Brooks (TB)	We added "with the ultimate objective of decision support" to the relevant key message.
24.	8	1	22	1	38	Is it really the place of an assessment to make recommendations like these regarding specific IPBES mechanisms? These recommendations seem to be both too specific and time-bound a recommendation, and also to overstep the bounds of the assessment process – shouldn't such recommendations lie with the IPBES bodies, not the assessment, especially given their implications for the highly-overstretched resources of IPBES. Also, there are no parallel recommendations anywhere else in this assessment. I recommend deleting the sentence on line 22, the clause on lines 24–25, and the clause on lines 37–38.	Thomas Brooks (TB)	We (and all other chapters) were asked by the Chairs and the MEP representative to provide key recommendations for IPBES. The language used in these key recommendations was standardized during the 3rd author meeting, so the new format will be implemented in the final draft.
25.	8	1	27	1	30	How about also including new approaches to dealing with uncertainty (both in modelling and reporting)?	EJ Milner-Gulland (EJMG)	We restructured the key messages and no longer give specific examples of research directions in key recommendations.
26.	8	1	27	1	30	How about also including relationships between indicators and the systems they are representing, robustness of indicators, rules of thumb and proxies?	EJ Milner-Gulland (EJMG)	This is indeed an interesting topic, but we felt it was not as critical in terms of new directions and improvements as other issues we have to cover in the limited space available for this chapter.
27.	8	1	27	1	30	Note: it seems to me that these two areas are a bit underrepresented in the report as a whole, which is why they	EJ Milner-Gulland	This is addressed in the two previous comments.

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						are not included in the key messages.	(EJMG)	
28.	8	1		2		Overall I think the key messages section is very good, and the overview of the report is clear and lays out the structure of the report very well.	EJ Milner-Gulland (EJMG)	Thank you for these nice comments.
29.	8	Section 8.1				Identification of common variables is confounded by (a) the needs of different models for different input types, and the ability to output different predictions, and (b) the agreement within the ecological community on what these essential variables are. These points may need to be raised as potential challenges.	UNEP-WCMC	We have now added a couple of sentences on the challenges in the identification of the appropriate metrics and the need to consider the interoperability between different models.
30.	8.1.1	2		4		How do make sure that end users can use these “common indicators”? how would you match valuation outputs with specific business applications for Instance? This is what we struggle with in the Natural Capital Protocol... model outputs are not useful in most applications if non-depth thinking is done on fitness-for-purpose among other aspects	Joel Houdet (JH)	We have added a couple of sentences on the importance of engaging users in the choice of common indicators.
31.	8	2	1	2	4	“IPBES should identify all stakeholders relevant at the scale of the problem, including scientists, decision-makers and people with different types of knowledge, and engage them early in the modeling and scenario analysis process”. I have the following comments regarding the above sentence: 1. What are relevant stakeholders at the scale of the problem. To what scale does this text refer to? How and by whom is the scale of the problem defined? Please see also the comments on scale below: Comment # 23 2. Why are policy makers not added in the list? 3. What does people with different type of knowledge refer to? See also comments # 31 May be this sentence reads better if written in more general terms, something like: <i>all actors concerned with the problem should be identified and engaged as early as possible in modeling and scenario analysis processes.</i> The issue of who these actors are is central in participation and collaboration, and deserve special attention in the text, particularly when participatory modeling approaches are promoted. See also comment # 31	Marcela Brugnach (MB)	These questions are related to the definition of stakeholder. We now provide a definition of stakeholder in section 8.3.1. This definition is also part of the glossary. Section 8.3.1 now makes explicit that we include policy-makers or governments as stakeholders, and the importance of matching the spatial scale of the ecosystem assessment with the spatial scale of the stakeholders and governance mechanisms (Figure 8.3). We have now replaced “people with different types of knowledge” with “people with local and indigenous knowledge”.
32.	8	2	13	2	16	Having in mind that this document is meant to support	Marcela	We have rewritten this sentence for clarity,

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						and facilitate the Dialogue between policy and science, I think the following terms require clarification: What does <i>more effective solutions</i> mean in this context? The term effective is not a neutral term that may encompass different meanings (e.g., economic effective? Fast?), also effective for whom?	Brugnach (MB)	and no longer use the wording “effective solutions”.
33.	8	2	18	2	25	Regarding point three of objectives: Institutional changes. Please read also comments # 41	Marcela Brugnach (MB)	We have revised this text, and no longer mention institutional changes in the introduction.
34.	8	2	30	2	39	This is all modeller-centric, written as if the needs of the modellers are the “right” needs, and data collectors, etc just need to understand the needs of the modellers better and then adapt to them. In fact, if anyone’s needs are the “right” needs, it is the needs of the assessors, and legitimacy and relevance are at least as important as the “credibility” that comes from the scenarios. Besides, the IPBES regional assessments, unlike the IPCC assessments, are not <i>primarily</i> about plausible or possible futures. These are the <i>first</i> regional assessments, and their overarching goal is to establish current benchmarks (and I say this form significant involvement with some parts of IPBES planning). So this needs to be rewritten and possibly rethought – to reflect a much more give-and-take attitude of the modellers, rather than a tome of “here’s how other people should change to serve our needs better”.	Jake Rice (JCR)	We recognize this section is somewhat modeller centred. But we have now added a few sentences in the end of section 8.3.1 on the need to engage end users in the choice of metrics and indicators so that user needs are adequately served.
35.	8	2	30	4	35	8.1.1 Identification of common metrics. This section is not well integrated with the rest of the document & seems to sit outside the scope of the chapter. I would suggest removing it or clearly identifying where these metrics are needed for models.	Piers Dunstan (PD)	We have revised this section by expanding on how the metrics connect to models and by replacing former Figure 8.1 with Table 8.1, where this link is also made explicit.
36.	8	2	30	4	34	From reading 8.1.1 I At the end of the paragraph, where biodiversity indicators/indices are presented, the authors state that the indicators approach is powerful because it provides large scale validation and calibration of scenarios. Which may go very well with the recommendation at the beginning of the next paragraph (page 4, line 28) of using a small set of indicators (see also comment #7). As a reader, I would like to know better what are pros and cons of	Marcela Brugnach (MB)	We have now expanded on the relative advantages of having more aggregated indices versus using more disaggregated variables.

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						using one approach versus the other? How do these two approaches relate, if they do so? Can the indices built on the variables approach? It seems that both approaches are needed, can their complementarities or divergences be pointed out?		
37.	8	2	32			It would be good to add a statement here saying that not all quantifications of ecosystem services are valid. e.g., there are many debates over the quantification of cultural services...	William Cheung (WC)	We have added such statement and a reference.
38.	8	2	35	2	36	“...there is lack of harmonization and integration across observation communities and countries.” This sentence is not completely clear. What do you mean by harmonization? What is it what needs to be harmonized? What is the difference between harmonization and standardization? I also think that the term observation community, used along with countries, is confusing. Do you want to say that observations are differently done in different countries because of lack of standardization procedures regarding how observations need to be carried on? Following paragraph talks about the identification of common metrics that could be used by the modeling and the observation communities But how is changed being monitored? “...there is lack of harmonization and integration across observation communities and countries.”	Marcela Brugnach (MB)	The sentence was rewritten to explain what are the observation communities. Harmonization is less strict than standardization, and allows for different methods to be used as long as the data collected can still be integrated together (e.g. there is several possible approach to estimate a common bird index in a country, but as long as the methods are harmonized the outputs can be integrated).
39.	8	2	36			I think this means observations made by different research communities, government and inter-governmental bodies. Suggest to make it more explicit.	William Cheung (WC)	We now make it explicit (see also Comment 42).
40.	8	2	37			I think you mean key observational data that are needed to develop and apply models for biodiversity and ecosystem services assessment. Please consider stating this explicitly.	William Cheung (WC)	This sentence has been deleted.
41.	8	2	39	2		Identification of common metrics or common monitor schemes, or both?		Here the emphasis is on common metrics, although common metrics can also foster common monitoring schemes.
42.	8	3	6			Add “...and supported by the Biodiversity Indicators Partnership (http://www.bipindicators.net/)...” before “to assess”.	Thomas Brooks (TB)	Added to a later paragraph in this section.

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43.	8	3	7			Nicholson's point is that these indicators need to be robustly tested.	EJ Milner-Gulland (EJMG)	We have added a sentence: "Finally, metrics or indicators should be chosen so that they are able to detect biodiversity trends reflecting changes in pressures or policy and management (Nicholson et al. 2012)."
44.	8	3	Fig 8.1			Would it be worth defining metrics, indicators, proxies and explaining their relationships to essential biodiversity variables (and pros and cons of different degrees of abstraction/amalgamation)? This could be a new section in the report.	EJ Milner-Gulland (EJMG)	We have added Table 8.1 which establishes a relationship between EBVs and indicators. We have also expanded the discussion of this relationship in the text.
45.	8	3	Fig 8.1			Everything in the two inner circles are about the natural environment. The whole justification for the ES in IPBES is that the human dimension and what biodiversity means to humanity is part of the expectation of IPBES - just as the IPCC, WG 1 was primarily about the natural world, WG 2 the interface between the natural world and human needs, and WG 3 primarily about the social and economic world. And there were projections in at least WG 3 more important to policy dialogue than and of the projections in WG 1. Tucking the human world in one phrase in the 3rd circle as "ecosystem service valuations and other data" (suggesting they haven't even been thought about very seriously) is more than a lost opportunity. No meaningful policy dialogue can be held based only projections of biodiversity trends – whatever they make look like – without projections of their implication for humanity (like IPCC WG 2) and how human needs for ecosystem services are expected to evolve and would have to change to reduce pressure on biodiversity (like IPCC WG 3). This tremendously limits the value of the whole modelling and projection effort.	Jake Rice (JCR)	This figure has been removed. We also mention in the text that an effort to identify essential variables for ecosystem services is on-going.
46.	8	3	26			Changed "and remote sensed data" to "results". Remotely sensed data might be used as a model input, but it cannot fill gaps in population datasets in its own right.	Thomas Brooks (TB)	See #51.
47.	8	3	26	3	28	Indeed they can be used that way. However, there are many easy ways to use such gridded data and have low power to reject bad models. It would be important to put in a few more lines of guidance on the need to ensure the gridded data AND het ways they are used have high power to reject bad models, and the explicit requirement that such power be actually demonstrated before models are called "validated"	Jake Rice (JCR)	This is addressed in comment 161 of 2nd review.

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48.	8	Section 8.1.2				Starts to become a bit of a list of different issues and pieces of work done. Maybe tabulate?	UNEP-WCMC	We moved this text on gaps and biases into a Box.
49.	8	4	4	4	4	The classes of “ecosystem structure” and “ecosystem function” are impossible to challenge as appropriate; they are also very hard to actually capture with a small number of variables – particularly if the same variables are to be used for terrestrial, freshwater, and coastal ecosystems. This has always been a problem for the credibility of GEOBON, and I would hope IPBES would take it seriously rather than just assume GEOBON has solved it.	Jake Rice (JCR)	We hope that Table 8.1 which now provides specific examples of EBV metrics, indicators, and models associated with these two classes, demonstrates how these two classes can be treated.
50.	8	4	9	4	10	Again, concern about whether it is the role of such an assessment to make specific recommendations for IPBES mechanisms. I don't think so; suggest deleting this sentence. The important issue for the assessment is the recommendation that this happens, not how it happens.	Thomas Brooks (TB)	See comment 24.
51.	8	4	10			Is it worth looking also at the work of the PREDICTS project?	EJ Milner-Gulland (EJMG)	We added references to the PREDICTS project in Table 8.1 and in section 8.1.2.
52.		4	11		26	The issue of information lost by aggregating variables into an index deserves more attention as a trade off.	Florian V. Eppink (FE)	We have added a paragraph on the trade-offs between using an aggregated index or disaggregated variables.
53.	8	4	11	4	26	This repeats the narrow view that only goal of IPBES is to assess and project biodiversity status and trends, and nothing about the services provided by biodiversity, nor status and possible trends in how the needs for those services may develop in future. These higher level indicators are so aggregate and abstract that I cannot imagine a scientifically sound way to convert them into services or needs of humanity.	Piers Dunstan (PD)	We tend to disagree. This paragraph does end with a couple of sentences on indicators of ecosystem services. We have now further expanded this part of the paragraph. Furthermore, many ecosystem services depend on aspects of biodiversity captured by many of the indicators or EBVs.
54.	8	4	14			Add citation to Butchart et al. (2010) Science before that to Tittensor et al. (also correct spelling of the latter).	Thomas Brooks (TB)	Done
55.	8	4	17			Actually regional or taxon-specific LPs are more used I think, and much more meaningful.	EJ Milner-Gulland (EJMG)	We added a sentence: “Indicators at regional scales or for specific groups of taxa (e.g. taxa vulnerable to a specific driver) may be more likely to do so than generic global indicators.”
56.	8	4	18			Delete “endangered”. The Red List Index incorporates data on the slide towards extinction of all species, not just those already assessed as threatened (or Endangered specifically).	Thomas Brooks (TB)	Done

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57.	8	4	18	4	19	Change “a few thousand” to “>20,000” – this now encompasses all mammals, birds, amphibians, and reef-building corals.	Thomas Brooks (TB)	Done
58.	8	4	25		26	Need to clarify and explain this sentence	EJ Milner-Gulland (EJMG)	We have removed this sentence.
59.	8	4	40	4	40	Revise word use: ‘pristine... areas’. The concept of ‘pristine’ nature is contested.	Jasper Montana (JP)	We replaced pristine by non-urban.
60.	8	4	28	4	28	I don’t disagree with this sentence or the development that follows. However it is just delivered <i>ex cathedra</i> . An equal case could be made that for each type of ecosystem (and possibly divided more finely than TFC [terrestrial, freshwater, coastal]) the ecosystem services most important to human well-being should be identified first (and they may not be the same in TFC systems), then the set of variables with the greatest power to track those services should be selected. And if needs for human well-being differ among the regions (and given the different stages of development globally, they may well) that should be taken into account, Now I’m not arguing that is the RIGHT approach, but merely asserting ‘everything should be done the same way everywhere’ with no rationale (except the obvious rationale that such an approach is easiest for the scientists) invites questions. More rationale needed.	Jake Rice (JCR)	We have revised the first sentence. Instead of a small set of indicators we now propose a set of common metrics should be used. The entire section develops the rationale for the need of common metrics.
61.	8	4	28	4		<i>IPBES should report results of models and scenarios using a small set of indicators. Why?</i> In the report it reads as if this may not be possible because not all indicators are amenable to simulation. Please, explain the rationale behind the statement done.	Marcela Brugnach (MB)	See #70.
62.	8	4	28		34	But there are issues of how well indicators actually represent change - there’s a danger in deciding on a small set of indicators without testing their ability to represent processes of interest. e.g. LPI and SRL are used by CBD because they were available not necessarily because they were the ideal indicators that would have been used if we were starting from scratch.	EJ Milner-Gulland (EJMG)	See comment 26.
63.	8	4	30			It would be good to also highlight that this needs a research community effort, to discuss common metrics, data and protocol to develop the scenarios and outputs.	William Cheung (WC)	We have added a sentence.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
64.	8	4	33	4	34	Same point as above on not prescribing IPBES mechanisms. Suggest deleting this sentence.	Thomas Brooks (TB)	See comment 24.
65.	8	4	40	5	9	We recently published a description of the PREDICTS database (Hudson et al., 2014), which will be made publicly available in June of this year. This addresses to some extent the first three biases listed here: we contain many samples of non-pristine environments (this was the main aim), we represent invertebrates and plants as well as vertebrates, and we have high resolution but global coverage (although not consistent global coverage).	Tim Newbold (TN)	A sentence was added to the paragraph with a short description of PREDICTS.
66.	8	4	34	7	45	This section does not describe a process that IPBES can do that will support improved access to data. What processes and framework will IPBES lead that will improve data availability?	Piers Dunstan (PD)	Data access is discussed in the next section.
67.	8	4	40	4	41	“pristine” – nonsense; wealthy and accessible - absolutely	Jake Rice (JCR)	See comment 68.
68.	8	5	6	5	9	It is certainly true that for some modelling approaches, there is a need for high resolution, global data, But as the paragraph concludes, such data are rare, and there are lots of modelling methods that do NOT have such high data demands, this text again takes the tone that the needs of the modellers come first – rather that guiding the modellers in how they can made best use of the types of data that are most likely to be available	Jake Rice (JCR)	A sentence was added at the end of the paragraph.
69.	8	5	10		16	Very interesting insight - maybe say a bit more about why demographic vars are particularly important for projection?	EJ Milner-Gulland (EJMG)	We added a sentence.
70.	8	5	16			Can generation length be monitored? I think it is estimated from models mostly. May be using another example, e.g., body size.	William Cheung (WC)	Generation length is calculated based on monitored variables such as survival and age of first reproduction (we added a phrase to make this explicit), which are available in some data sets (such as AnAge, Compadre, etc.) that are listed in Box 8.2
71.	8	6	2	6	5	I'll risk self-citation in noting that Brooks & Kennedy (2004) Nature discussed the trade-offs among temporal coverage, geographic coverage, and ecological coverage, and could be worth mentioning here.	Thomas Brooks (TB)	The reference was mentioned and added to the reference list.
72.	8	6	4	7	24	Imputation only works if the relationships that already exist	Piers	All approaches mentioned here (or in the rest

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						in the data also cover the missing data. However, if that assumption is broken the imputation will lead to very strange outcomes. It is a circular argument & it should be used with extreme caution.	Dunstan (PD)	of the chapter, for that matter), not just imputation, have advantages and disadvantages, and rely on various assumptions. Unfortunately, there is not enough space to discuss all the pros and cons of each approach. We do conclude, however, that overall, imputation is a useful approach. See comment 162 of 2nd review.
73.		6	5		27	The issue of monitoring programmes should be separated out from the discussion of dealing with data gaps. How does box 8.1 relate to other 'strategies', such as having SMART indicators? The later discussion on timely warning of regime shift seems to warrant a consideration of simpler strategies than the proposed one which includes, e.g., 'statistically sound methods'. I would argue that recommendation is one step ahead of the current situation, where it may be preferable to fill existing, large data gaps with whatever data can be collected.	Florian V. Eppink (FE)	We tend to disagree. We believe monitoring programs should be designed to fill data gaps and therefore the two topics are not separable. We think that repeated measures are in many cases the missing ingredient of biodiversity observations.
74.	8	6	10	6	10	I know it is just an illustration, but it illustrates my pervasive concern with the approach so far. Also by definition species in a Red List are going to be some combination of rare, highly specialized or declining substantially. They are unlikely to be the species most important for providing ecosystem services of greatest importance to humanity.; and arguably may not even be particularly powerful indicators of trends in biodiversity overall.	Jake Rice (JCR)	This is just an example regarding taxonomic sampling; we do review other approaches that give more weight to abundant species, such as LPI. Also, another reviewer thought this was a great point.
75.	8	6	11		13	Great point!	EJ Milner-Gulland (EJMG)	Thank you!
76.	Box 8.2 and 8.3					It might be useful to add a box with the few databases for ecosystem functions and services. Are these examples to be taken as recommended datasets? Is ecoinformatics a second, separate recommendation, or just an approach that also gets a mention?	Florian V. Eppink (FE)	Box 8.3 was expanded by adding databases sources on ecosystem functions and services. These are not recommended datasets, but example datasets, as stated in the legend. Ecoinformatics is an approach to managing ecological information.
77.	8	6	12	6	15	No NO NO. Future IBPES assessments would benefit most from monitoring programs designed to have high power in	Jake Rice (JCR)	A sentence was added about monitoring programs and ecosystem services:

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						inferring trends in ecosystem services of most importance to human well-being; and particularly human well-being in the parts of the world where poverty, food deficits etc are highest and needs for such service is arguably highest		"It would also be beneficial if monitoring programs would expand their efforts in observations of ecosystem services of most importance to human well-being, and if the data were more accessible (see section 8.1.3)."
78.	8	6	17		20	These are approaches to getting data not to building & curating datasets	EJ Milner-Gulland (EJMG)	Design of the project and getting data were added as part of citizen science. Indeed getting data + building, and curating can be done also with citizen science and crowd sourcing.
79.	8	7	4		24	Great paragraph	EJ Milner-Gulland (EJMG)	Thank you!
80.	8	7	4	7	24	At the very least, there should be text for each of these data-gap-filling options which discusses how little or much power (in the statistical sense) each of the alternative methods would have in producing data from which trends in ecosystem services as well as in biodiversity could be estimated.	Jake Rice (JCR)	We think a detailed discussion is beyond the scope of the chapter and cited references provide a discussion of pros and cons. See comment 163 of 2nd review.
81.	8	7	9	7	12	The allometric relationships have been used quite widely in many applied applications, such as in fisheries population dynamics. It may be just the theorists who have under-utilized them.	Jake Rice (JCR)	We edited this sentence and added a reference on the use of allometric relationships in marine food web models.
82.	8	7	25	7		Remove "a"	Marcela Brugnach (MB)	Done.
83.	8	7	29	7	31	Others worth mentioning include the Committee on Earth Observation Satellites (http://ceos.org/) and the Earth Observation Network (http://earth-observation-network.org/).	Thomas Brooks (TB)	Both database references were added to Box 8.3 (now 8.4).
84.	8	7	35		45	The big problem with mapping approaches like InVEST is their static nature, which makes them unsuitable for forward projection and scenario modelling, particularly when modelling the effects of policy interventions which themselves are likely to alter the system. Is this worth saying?	EJ Milner-Gulland (EJMG)	InVEST can be linked to land-use models to provide forward projection and scenarios. See comment 164 of 2nd review.
85.	8	7	35			I think there is an imbalance in coverage of the topic, with much less coverage on ecosystem services modelling. This should be balanced in the next order draft.	William Cheung (WC)	A paragraph about ecosystem services modelling was added.
86.	8	7	37	7	39	Ensure consistency between this sentence and the wide range of ecosystem service tools presented in Chapter 5 –	Thomas Brooks	The statement was modified to be consistent with Chapter 5.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						not just one specific one.	(TB)	
87.	8	8	37		40	Increasingly data archives like e.g. figshare give datasets an ISBN number so that they can indeed be formally cited. I don't think that limited citation numbers really should preclude proper citation of sources.	EJ Milner-Gulland (EJMG)	This is now addressed in comment 157 of the 2nd review
88.	8	7	40	7	41	Which is EXACTLY why there is a need to acknowledge that modelling trends in biodiversity alone is NOT an end in itself, but a means to the end of modelling trends in ecosystem services provided by biodiversity. The former without the latter is only relevant to a policy dialogue about conservation with human-welfare not part of the discussion. As much as some conservationists might like the policy dialogue to only be about conservation of biodiversity, that is NOT why IPBES has been supported by States.	Jake Rice (JCR)	We disagree. Modelling biodiversity is an end in itself. And the ES part is also an end in itself. Both are tied to human values as mentioned in the IPBES conceptual framework.
89.	8	7	43	7		I think this must not be restricted to institutions, but should also include governance, where the different actors and networks are taken into account. (See also comment #41)	Marcela Brugnach (MB)	The statement was added to the text.
90.	8	Section 8.1.3.2				It is not clear that inviting individual data collectors to be involved in the data analysis can overcome the problems associated with citing large numbers of data sources in journals with limited space – i.e. it may not be feasible to include all data collectors as co-authors, or to be able to coordinate an analysis with such potentially large numbers of people.	UNEP-WCMC	We added limitations of this approach in the text.
91.		8		9		All of section 8.1.3.1 (mis-numbered as the first of two 8.1.3.2) is written as if “data” are only generated by scientists and collaborators with similar training. The issue of traditional knowledge is very important to IPBES and even more so to the global policy world. Noting that the real 8.1.3.2 make address this, it is still a shortcoming for the entire section that other knowledge systems seem to be treated as irrelevant by the modelling community. This is very myopic modelling, and even more myopic modelling if the products are to be used by policy makers and not just by other scientists	Jake Rice (JCR)	We agree with the comment. We added some sentences in the text.
92.	8	8	5	9	6	This Section 8.1.3.2 is a useful discussion, but could be strengthened with discussion of Creative Commons licensing, to clarify that “open access” comes in many varieties. For instance, many institutions make data available	Thomas Brooks (TB)	We added some sentences in the text of 8.1.3.2.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						open access for non-commercial use, but establish data licensing policies for commercial use, to strengthen data quality and currency. It would also be worth mentioning that the emergence of web services has removed some of the long-standing challenges with parasitic repositing and redistribution of data, because users can now consume APIs and thus retain currency and attribution back to the original data source. (This comment is also relevant to Section 7.5.4.4.)		
93.	8	8	8	8	14	Ensure consistency between this sentence and the wide range of ecosystem service tools presented in Chapter 5 – not just these two specific ones.	Thomas Brooks (TB)	This seems to refer to Box 3.2. We have expanded the tools in the Box.
94.	8	8	15	8		“Archiving more data can possible reduce uncertainty in the urgent situations in environmental management. “ What do you mean by more data: data redundancy would reduce uncertainty? Or is this meant as data availability?”	Marcela Brugnach (MB)	This sentence was removed.
95.		9		10		All of section 8.1.3.2 fails to address the issue of other knowledge systems and their relevance to IPBES and modelling done by IPBES. IPBES is a <i>global</i> initiative, not just an initiative of the rich, developed countries, and cultural diversity is part of biodiversity – even for the CBD, and certainly for the global policy world. All of 8.1.3 is written as if there is only one type o knowledge that is legitimate, and only one type of knowledge that is relevant to modelling of biodiversity and ecosystem services. Both of those assumptions are false and a major shortcoming in the approach.	Jake Rice (JCR)	We added some sentences in the text of section 8.1.3.1. Also, we touched this issue in section 8.1.3.2. See comment 104
96.	8	9	20			Should be “the direct application of existing data”	William Cheung (WC)	Corrected.
97.	8	9	23			Add “...in the IUCN Red List of Threatened Species (http://www.iucnredlist.org),” after “those archived”.	Thomas Brooks (TB)	Corrected
98.	8	9	26			This may relate to the common and agreed language, definitions and framework, on ecosystem services, making it more challenging to coordinate development of large ecosystem services database. Perhaps this can be further highlighted and that IPBES/other international initiatives can take the lead on coordinating this.	William Cheung (WC)	We added some sentences in the text. Note this also links to Section 8.1.1.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
99.	8	Box 8.3				Would be good to include other ecosystem services database e.g., FAO Fishstats, Sea Around Us project catch data.	William Cheung (WC)	Corrected
100	8	10	Boxes 8.2, 83			Extremely useful boxes	EJ Milner-Gulland (EJMG)	Thank you!
101	8	10	Box 8.2 part A			Again, we would be delighted if the PREDICTS database could be mentioned here. This is a global database of the occurrence and abundance of terrestrial species in different land uses (http://www.predicts.org.uk ; Hudson et al., 2014; see previous comment).	Tim Newbold (TN)	The database was added to the examples of Box 8.3
102	8	10	Box 8.2 part B			Another new database that is relevant here is EltonTraits (Wilman et al., 2014). Wilman, H. et al. (2014). EltonTraits 1.0: Species-level foraging attributes of the world's birds and mammals. <i>Ecology</i> 95 : 2027-2027.	Tim Newbold (TN)	The database was added to the text and the reference to the reference list.
103	8	10	Section 8.1.3.1	11		Another good and interesting section	EJ Milner-Gulland (EJMG)	Thank you!
104	8	Section 8.2.1.1				In the section 'Species interactions and community dynamics', there are models that are addressing some of these issues, and do not fall into the limitations listed such as only being limited to a few species, or well-studied interactions. These models (e.g. Christensen & Walters 2004, <i>Ecological Modelling</i> ; Harfoot et al. 2014, <i>PloS Biology</i>) explicitly include many trophic interactions and dynamic interactions.	UNEP-WCMC	We added text and references to section 8.2.1.1.
105	8	11	3	11		..., it <u>is</u> important	Marcela Brugnach (MB)	Corrected.
106	8	11	4	11	5	Specific that it needs multidisciplinary and interdisciplinary skills and knowledge. Thus, I think comprehensive Ecosystem Services database would require a consortium to develop and manage.	William Cheung (WC)	We added some sentences in the text.
107		11	5	11		Here the word stakeholder is first mentioned. I think it	Marcela	We replaced "stakeholders" in some parts of

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						is a little out of context. I would use the word “users”, stakeholder being a particular case of users. As I mentioned before, the role stakeholders may have, is a central point of discussion in participatory modeling. But as it is structured the chapter now, this topic enters only later on.	Brugnach (MB)	the text with “users”.
108	8	11	6	11	14	Developing and (sustainably) managing data-user interfaces that are user-friendly and can need the needs of the users are expensive. Perhaps this can be raised as a challenge that needs to be addressed.	William Cheung (WC)	We added some sentences in the text
109		11	16			I remember colleagues in Potsdam telling me that the user support for LPJmL takes up enormous amounts of time – time that their superiors do not rightfully acknowledge compared to publication pressure and project deadlines. If appropriate accreditation is important, that aspect deserves mentioning in this context as well.	Florian V. Eppink (FE)	We very much agree with the comment. We added some sentences in the text.
110	8	11	35	11	36	A minor but significant wording error. It says “This is the type of basic science research carried out by most academic ecologists.” which is not true. What would be true is the statement “Most research of this type is included in the basic science research carried out by most academic ecologists.”	Jake Rice (JCR)	We replaced with the suggested alternative.
111	8	11	35		36	More than just ecologists - interdisciplinary scientists?	EJ Milner-Gulland (EJMG)	We added "scientists in related disciplines".
112	8	11	35	11		Ecological systems or socio ecological systems? I think when ecosystems services are addressed, then the discussion must be done in terms of socio- ecological system.	Marcela	We added “social-ecological”.
113	8	11	41			Project flows of ecosystem services not just ecological processes	William Cheung (WC)	We added "ecosystem services".
114	8	12	1	12	26	This completely ignores all the work done on size based models of aquatic systems. That work has been done at spatial scales from local to the scale of entire LMEs, includes community-scale interactions and sometimes environmental forcing explicitly, and has been used in many scenario development applications. Whether size-based approaches perform in robust ways when applied to T ecosystems is an open question, but the approach has not	Jake Rice (JCR)	We added text and references to marine models.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						been shown to be inapplicable. It has been shown through fairly robust tests to be predictive in both marine and lotic ecosystems. This section highlights a species-based preconception that again this has been done by ecosystem modellers with a very narrow perspective, and not thinking creatively or hard about what features of community structure really matter for ecosystem functioning or ecosystem services.		
115	8	12	13	12	14	Ecosystem models are much well developed in the marine biomes. Need to balance the review on this. e.g., Fulton, E. A. (2010). Approaches to end-to-end ecosystem models. Journal of Marine Systems, 81(1), 171-183.	William Cheung (WC)	See comment 128.
116	8	12	16	12	17	This is not clear. What do you mean? My understanding is that: our understanding about community ecology is much less than population ecology of single species, thus making it difficult to develop models that have sufficient skills to directly inform policies and management. If this is what the sentence means, perhaps it should be stated more explicitly.	William Cheung (WC)	We added a sentence to clarify.
117	8	12	19	12	25	And what have the decades of harvesting (and sometimes overharvesting) of marine and large lake fish communities been, if not experiments where both the treatments are fully quantified (catches and bycatches) and the communities have been monitored with annual surveys one scales unlikely to be replicated in any academic experiments	Jake Rice (JCR)	See comment 128.
118	8	12	26			Generally, need to balance the review on models for marine ecosystems, which have made substantial progresses in large-scale ecosystem modelling in recent years.	William Cheung (WC)	See comment 128.
119	8	12	27	13	7	Again seems to show no awareness of the extensive amount of research done on marine ecosystems, including analyses of multi-decadal time series of oceanographic and fish community data from systems like the Bering Sea, North Sea, Baltic sea and Barents Sea, where regime shifts and tipping points have been studied explicitly since the late 1990s and much has been learned and methods have been developed.	Jake Rice (JCR)	We added another marine example.
120	8	13	14			This small section on extreme events is a bit better, but “the stability of biological systems” should be replaced by “the properties of biological systems”. I thought the 1980s	Jake Rice (JCR)	We changed to "stability" to "properties of biological systems (including their persistence and variability)".

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						concept of biological systems as “stable” had been replaced quite a while ago by more realistic concepts that acknowledged a substantial amount of natural variation, bounded by resilience parameters.		
121	8	13	19		26	Linking indicators to models - you could cite Nicholson et al on this, and perhaps even give an example from that paper?	EJ Milner-Gulland (EJMG)	We added a citation.
122	8	13	24	13	26	Addressed this awesome hubris earlier. The key is NOT for the rest of the world to change in ways that serve the needs of modellers better. It is to identify the indicators of most power and relevance to policy-makers of biodiversity and ecosystem services and then for modellers to develop ways to forecast them reliably.	Jake Rice (JCR)	Please see comment 37. Here, we added a sentence to emphasize the importance of modellers to develop ways to forecast existing indicators reliably: "Another research direction is for modellers to develop methods to forecast existing indicators reliably." In addition, this section will be restructured in the final draft.
123	8	13	26			Would be useful to include a recent works on marine ecosystem models and indicators for ecosystem-based management.	William Cheung (WC)	We added a sentence and citations in size-based community-level indicators in marine systems.
124	8	13	30	13	32	I agree that need exists. However, there is clearly a need for academic modellers and ecologists to become more familiar with applied fields of research like forestry, fisheries, and some parts of agriculture, where a great deal of both policy relevant and theoretically relevant process and modelling knowledge has been acquired and applied (including in projection models at scales relevant to IPBES.	Jake Rice (JCR)	We added a few sentences and references (e.g. see end of section 8.2.1.1).
125		13	31		34	I think global assessments would need data and model support from sub-global and small-scale assessments to fill knowledge gaps, so the apparent dismissal of such assessments might prove counterproductive.	Florian V. Eppink (FE)	We added a sentence to clarify the importance of sub-global assessments.
126	8	13	40	14	9	I think this is THE most important gap, and much as I think what you have written here is excellent, it does come from an ecologist’s perspective. It might be worth involving a writer from the social science side, to give a bit more breadth of insight into what’s really important from the human side. For example one key issue is the linkage between changes in ecosystem services and wellbeing, and then from wellbeing	EJ Milner-Gulland (EJMG)	We have added a few sentences on this and some references: "Understanding the linkages between the ecological and the social components and identifying the underlying feedbacks and cascades are vital to understanding the dynamics of the coupled system. Understanding how people perceive that their wellbeing is affected by environmental conditions, how policies are

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						into behavioural change towards the environment - these linkages are poorly understood but vital for scenario modelling. Similarly to the ecological side, it is also really important to understand scale-dependence in these linkages; between individual behavioural change and large-scale modification of the environment, modulated by institutions.		designed and accepted, and how people may change their behaviour as their environment changes are essential components of scenario modelling (Perrings 2014). ...there is only a limited number of models that attempt to predict the impact of ecological changes on human well-being (for some examples see Pattanayak et al. 2009; Bauch et al. 2015). "
127	8	14	5	14	14	This is written as if little has been done on this. Again, the authors seem out of touch with extensive applied research in the resource management field (not all is great, but some of it is of extremely high quality, exactly like research in academic and conservation biology communities), and out of touch with the extensive and very high quality work being done by groups like the UNDESA. The choice of references perpetuates this bias against research done by any experts not working solely in the conservation biology community. The sentence on lines 13-14 is simply untrue. DO such models need more development – absolutely. Has significant progress been made by applied teams in UN IGOs and national agencies with socio-economic mandates – Absolutely; and none of it is acknowledged.	Jake Rice (JCR)	We have toned down the sentence and added a couple of recent references. We now say: "As the previous chapters have emphasized (e.g., see Chapters 4, 6), there is only a limited number of models that attempt to predict the impact of ecological changes on human well-being (for some examples see Pattanayak et al. 2009; Bauch et al. 2015). " It is important to note that our assertion is about models, and not about general assessments of the relationship between ecosystem change and human well-being.
128	8	14	9	15		The fact that space is spent listing policy makers and stakeholders as members of these teams, but not specifying that the necessary “scientists” need to include economists and social scientists, not just the natural scientists who dominate the citations so far needs to be corrected not just here, but through the thinking in the entire chapter. And the entire sent of 8.2.1.2 shows a very impressive familiarity with the literature on modelling tools for the sake of making modelling better but little or no awareness of the actual relevant modelling that is being done by national and intergovernmental agencies on BES linkages to human well-being. This is not the terra incognita (and mare incognita) that the section implies.	Jake Rice (JCR)	See comment 142. In addition, we explicitly stated the need for economists and social scientist: "Developing such integrated models, tools, and methods will require basic research involving multi-disciplinary teams of scientists (including economists and social scientists, in addition to natural scientists) as well as policy makers and other stakeholders (see section 8.3)."
129	8	14	9			One of the challenges to note is that existing models are usually one-way linked, which may not capture the non-linear dynamic linkages between different components of biodiversity and ecosystem services. (ref. to Ch. 6).	William Cheung (WC)	We added a sentence and additional text elsewhere emphasizing this challenge.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
130	8	14	11	14	33	In my opinion, the biggest gap here is the linkage to the “supply side” of ecosystem services, or “realized” and “essential” ecosystem services, which is currently just briefly mentioned in Chapter 5.	Thomas Brooks (TB)	This is now mentioned and a reference is provided.
131	8	14	11	14		What are policy options? This should be clarified and also linked with the material of other chapters.	Marcela Brugnach (MB)	We revised this sentence, deleting the phrase "policy options".
132	8	Section 8.2.2.1				More complex models need more verification: this need not necessarily be the case. Complexity need not be added for no reason, but comparison of models of different complexity against independent data requires the same level of rigour but will provide the ability to determine whether additional complexity is justified. The authors say that there is a gap in our understanding of the link between model complexity and predictive accuracy – this is because there need not be a link. Both complex and simple models can fit well to data, and vice versa. It may also be worth mentioning that emergent effects from more complex models can actually be a benefit, since they can inform about the potential for unexpected outcomes that would not necessarily have been detected using simpler models.	UNEP-WCMC	Right. We remove this statement and in respect to comment 156, we changed the text so that adding new processes may also add new uncertainties that may propagate further. We also added that emerging effect from more complex model can help understanding of ecological processes.
133	8	15		16		All of section 8.2.2.1. I agree with pretty much all that is said here. However, there is no mention whatsoever of the complexity of linking biodiversity models to models of how needs of human well-being will evolve over time, or even the conversions of biodiversity forecasts to dynamics of ecosystem services and of the ecosystem services to human well-being. THOSE are the places where model validation will most severely needed. The status quo is that the high end journals like Science and Nature are increasingly polluted by articles that include protections of some ecosystem property (fully explained and carefully reviewed) that can then offer pretty much any speculations they want about what this will mean for human well-being. If IPBES is to be a serious policy engine, it needs to focus first on more rigour in the transfers from biodiversity to services and services to well-being. The other stuff is secondary – but dominates the work here.	Jake Rice (JCR)	This is addressed in comment 141.
134	8	15	13	15	27	This section on evolving evaluation of models and scenario methodologies could be developed. In	Jasper Montana	We reviewed the reference, and did not find it particularly relevant to this section. More

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						particular a review of the related literature. O'Neill and Nakicenovic (2008), for example, have identified a set of recommendations to enhance learning from scenario development and comparison exercises. (O'Neill B.C. and Nakicenovic N. (2008). Learning from global emissions scenarios. Environmental Research Letters. 3)	(JP)	importantly, this section is making the obvious point that research progress (discussed and elaborated in all the previous chapters) means that research priorities will change in the future.
135	8	15	24		27	Great idea.	EJ Milner-Gulland (EJMG)	Thank you!
136	8	15	24	15	27	A good recommendation, as long as it makes clear that Task Force should have a membership with more or less equal parts policy makers, applied natural resource modellers and researchers, and the academic / conservation biology modellers, and of ecological, economic, and social scientists, and not primarily ecologists.	Piers Dunstan (PD)	We added a sentence to make this point.
137	8	15	24	15	27	Same point as above on not prescribing IPBES mechanisms. Suggest deleting this sentence.	Thomas Brooks (TB)	See comments 151 and 152.
138	8	16	Section 8.2.2.2			<p>It might be worth thinking about other approaches, which work for datasets which are less quantitative. It seems from my review of chapter 3 that there is a big push towards participatory modelling and approaches to generating models and scenarios. This has major implications for the validity and uncertainty of the models produced. So perhaps you should have a section on ways to incorporate different types of uncertainty, e.g. delphi methods for expert opinion?</p> <p>A paragraph reflecting on the strengths and limitations of participation in terms of model uncertainty (incl perception biases, citizen science etc) would be helpful, as well as one that reflects on the social side of modelling.</p> <p>Another thing that would be handy would be to have a box that uses e.g. the Regan typology, and gives explanation and examples of each type of uncertainty from the specific perspective of IPBES.</p>	EJ Milner-Gulland (EJMG)	<p>[Note that Sections 8.2.2 and 8.3.3.2 have been merged and incorporated into a new Section 8.2.3.]</p> <p>We have reshaped our paragraphs and have incorporated other types of uncertainty as suggested by the reviewer. We have also added a table describing the different uncertainty from Regan.</p>
139	8	16	8	16	45	8.2.2.2 Again, this is a reasonable treatment of how to deal with the propagation of <i>parameter</i> uncertainty through	Jake Rice (JCR)	We have added specific points on ensemble modelling and on process uncertainty in the

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						ecological models, given the overall size constraint on the chapter. However it does not mention explicitly anything about the propagation of <i>process</i> uncertainty in models. That is at least as big a challenge in ecological models (particularly those working above the species level) and a massive challenge for the biodiversity to services and services to human well-being parts of projections. Things are standard as ensemble modelling are not mentioned. Yet again, far less that is needed to do a thorough job of modelling for IPBES>		new section 8.2.3.
140	8	16	9	16	13	First paragraph under 8.2.2.2. I agree that quantifying, incorporating and propagating uncertainty is a key issue. However I disagree with the statement that uncertainty in complex models can be dealt with probabilistic techniques. Uncertainty in a model has may different origins (measurements errors, system variability, parameters, lack of complete understanding about the system, ambiguous or conflicting knowledge, the modelers belief and experience). And some of these uncertainties may not be amenable to statistical or probabilistic treatment. For example, framing issues, and the ambiguity that they generate, would require a very different treatment than a probabilistic one. Here, I am not talking about the subjectivity associated with preferences and values (which it could be argued that can be partly represented using Bayesian approaches) but about the way in which a model is framed (the question it addresses, how it is addressed, the theory that incorporates, its boundaries, etc.).	Marcela Brugnach (MB)	Fully addressing this comment would go beyond what we could write within our page limitations. However, we tried to discuss these aspects briefly. As suggested by another reviewer, we have added a table defining the different sources of uncertainties that allow teasing apart epistemic and linguistic uncertainty. See also Comment 154.
141	8	16	9	16	13	Also in the same paragraph I think the sentence: "...decipher epistemic uncertainty as a consequence of model prediction" is very unclear. For the following reasons: 1. What is meant by: <i>decipher uncertainty</i> ? 2. What is mean by <i>epistemic uncertainty</i> ? A model is an abstraction built based on what we know about reality, so almost all the different types/sources of uncertainty are epistemic. 3. What is uncertainty <i>as a consequence</i> of model prediction? I think that given the importance uncertainty has in	Marcela Brugnach (MB)	We have rewritten the whole paragraph to address all these comments. We have now a part 8.2.3. focusing on uncertainty.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						modeling, this paragraph requires to be rewritten to address the issue in more depth, going beyond data and parameter uncertainty to include also the structural and subjective aspects of modeling uncertainty.		
142	8	16	9	16	43	This section ignores almost all statistical theory & practice. It needs to extensively reference the work done in statistics. A good starting point is Bayesian Data Analysis (2004) Gelman et al., or any other book on statistics.	Piers Dunstan (PD)	This section did not ignore statistical theory. It was meant to be general and not only on statistical approaches. We have now added a complete paragraph showing that Bayesian calibration, comparison and averaging might be the way to go for some applications..
143		16	10			Propagate can also mean the spread of uncertainty, which perhaps is not something IPBES should aim to do.	Florian V. Eppink (FE)	Point taken. See also comment 156.
144		16	23		26	In this context, a more critical perspective of INVEST elsewhere in the text might be appropriate.	Florian V. Eppink (FE)	We have added a sentence and a reference (Schulp et al. 2014) on the current limits of models to map ecosystem services.
145	8.2.2,3					If model validation is a top priority, perhaps it should not be hidden as a subsection of a subsection. Can stronger recommendations be given? The absence of long-term datasets that cover a wide range of relevant drivers and variables is arguably not best-placed in a section on model validation.	Florian V. Eppink (FE)	There are several top-priorities issues, which make difficult to have them all put upfront. We do not understand why the absence of long-term dataset used for validation is not best placed in the model validation section.
146		16		17		The relation between validation and uncertainty has not been addressed and I think in this context it could be useful to do so. Looking in particular to how the activities of uncertainty and sensitivity analysis and validation relate and together contribute to the acceptability and credibility a model may have for its users. Regarding these issues the work of Andrea Saltelli (from JRC) and colleagues can be useful, they have been extensively working on topics related with uncertainty, sensitivity analysis and validation.	Marcela Brugnach (MB)	We have added clear recommendations at the end of the new section 8.2.3. about integrating both uncertainty and validation through Bayesian frameworks (it also answers another comment from another reviewer).
147	8	16	Section 8.2	17		This section is great but very limited to the biological side. How do you validate models that focus on ES and scenarios of human behaviour?	EJ Milner-Gulland (EJMG)	We have tried to make the part more general and less context dependant. .

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
			.2. 2					
148	8	16	35			Uncertainty estimates are often not available with land-use model predictions, which is an additional challenge.	Tim Newbold (TN)	Right. We have added a sentence discussing this issue.
149	8	16	35			Suggest that we can draw experience from climate modelling community in address uncertainties.	William Cheung (WC)	Done. We have also suggested to use multiple models and multiple realisations as done in climate research modelling.
150	8	17	1		9	Can you highlight the ideal of quantitative validation (as per this para) but also the possibility of qualitative validation which may be more realistic in some circs?	EJ Milner-Gulland (EJMG)	We have added this possibility and explain that it could indeed be quite useful.
151	8	17		17		A general comment. I feel uncomfortable with is how the term stakeholder is used in the text. In the first part of the document it seems to be a replacement of (end)-user, which in some cases could be fine. However, the document reads as if all what there is consists in getting the results of a model right for informing stakeholders, suggesting a very linear relationship between science (modeling) and policy. For example, page 17, lines 2-3, states that validation is essential for the credibility of the scientific community towards stakeholders. But this is just a tiny part of the problem of bridging the gap between the modeling and policy making communities. Stakeholders are just one group of actors who may use model results and eventually also participate in the modeling activities, but they are not the means to an end of policy-science interactions. The relationship between science and policy is very complex, and far away from being linear. Underlying policy-science interactions there are processes, procedures and structures beyond (neutral) science delivering information to policy, as this document in its current form suggests There is a lot of recent literature in this topic, and many workshops and discussions have recently been organized surrounding this topic. I urge the authors to address this issue in more depth.	Marcela Brugnach (MB)	We now capture the process of developing scenarios as an iterative cycle of four steps: (1) engaging stakeholders; (2) to linking policy options to models and scenarios; (3) communicating results; (4) decision-making (see Figure 8.1 and page 3). See also comment 32. We have also revised the usage of the word stakeholders, and have in some places replaced it with “users”.
152		17		17		Under the title of Improving models, it can be useful to add a section on modeling practice also.	Marcela Brugnach (MB)	That would indeed be a good task for IPBES. However, we feel that it will ask for a specific task force on it given the breadth of

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
								biodiversity and ecosystem service models. We have however suggested that we need guidelines and a best-practice for modelling.
153	8	17	1	17	40	Again, there is a lot of experience, lessons learned, and tools developed and tested in applied fields like forestry and fisheries – and at least some ties to services and well-being. Yet again the most relevant sources of information and experience are being discriminated against.	Piers Dunstan (PD)	This is addressed in comment 158 of the 2nd review.
154	8	17	11		16	Great paragraph	EJ Milner-Gulland (EJMG)	Thank you.
155	8	17	32			Add “the IUCN Red List of Threatened Species: http://www.iucnredlist.org ” after “e.g.” – the Red List spans five decades now, and so comprises much the longest term global biodiversity initiative.	Thomas Brooks (TB)	Done.
156	8	17	40			Somewhere, the challenges of using data to assess models that are used for scenario development should be raised. Particularly, under climate change, most systems are driven by factors that are at level outside of historical ranges. This provides additional challenges to determine whether models that fit historical data well are equally good for projections.	William Cheung (WC)	Done. We have added some discussion about the drawback of using historical data for validating models projected into the future.
157	8	17	42	17		Title <i>Improving Utility</i> . I suggest to use other term than utility (it sounds too economic). The term <i>usefulness</i> may be better: Improving the usefulness of modeling for policy and decision making.	Marcela Brugnach (MB)	The section is now named “Improving scenarios”.
158	8	18	7	18	30	This section is weak. The section is on how best to engage stakeholders but there are no real recommendations. Given the importance in an assessment of this step I'm perplexated as to why its not more promonate and more extensively referenced. There doesn't seem to be much reference to any management theory or practice.	Piers Dunstan (PD)	We have revised this section by including several references and by providing more recommendations (see also comment 19).
159	8	17	43			<i>Tackle</i> sounds too informal, may be use: <i>address</i>	Marcela Brugnach (MB)	Replaced as suggested.
160	8	18	5	18	30	Issues of scale. What does scale refer to? temporal scale, spatial scale or governance scale (at which scale processes are organized to cope with a particular problem)? This last one very important from the point of view of governance and also when stakeholders are meant to be involved in the modeling process.	Marcela Brugnach (MB)	We have now expanded on the issue of scale, including by adding a figure (Fig. 8.3) explaining how matching the spatial scale of ecosystem assessment with the spatial scale of governance.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
161		18	5	18	30	<p>“Credibility requires that the assessment meets standards of scientific rigor and technical adequacy.” (Lines 23-24)</p> <p>While scientific rigor is one aspect of credibility, it is not the only one (particularly when talking about participatory processes and stakeholder’s involvement). Including a diversity of stakeholders means including also those whose knowledge may greatly differ with that of science (i.e., indigenous knowledge). It also means that science is not privileged over other types of knowledge.</p> <p>From this view point: How do you define credible, salient and legitimate? And, credible, salient and legitimate for who?</p> <p>I urge the authors to review the assumptions made with regard to stakeholder involvement and knowledge validity. If stakeholder participation is to be taken seriously, the integration of different types of knowledge –including indigenous knowledge- and the role models and modeling processes may play in it, must be addressed.</p>	Marcela Brugnach (MB)	We have revised the sentence to make clear that the integration of different types of knowledge, including indigenous knowledge, is important. We have also improved the incorporation of local knowledge issues across our chapter (e.g. section 8.3.2) and make links to Chapter 7.
162	8	18	7	18	29	<p>It is fine to see to see this need acknowledged, with two provisos. First sources like the UN Assessment of Assessments (its Chapter 4 - AofA), for example, already have made extensive use of the very professional literature on what gives an assessment “influence” in its Part 4, and although the third paragraph here is a reasonable synopsis of the high level messages, the first two are not a particularly powerful implementation of the best practices in this area..</p> <p>Second, it is the policy-makers who really need to be the <i>primary</i> interface here. THEY are the ones who have the mandate to choose what roles to give the various perspectives/interest groups in policy-relevant assessments. I am NOT saying the modellers should be going to the policy community for something like permission ot engage stakeholders. But in this text they seem left out of the loop pretty close to entirely, whereas they should be the central point around which the modellers and stakeholders (and other parts of IPBES) are structured</p>	Jake Rice (JCR)	We have defined stakeholders in the beginning of the section to make explicit that policy-makers is one of the key stakeholder groups. We have also added Figure 8.1 to show the importance of engaging stakeholders for the decision making process in an iterative process. We have also revised section 8.3.1.1 (now 8.3.1.2) to improve its messages.
163	8	18	9			<p>It says: ” i.e., it changes when the stakeholder characteristics of its focusing scale changes.” This sentence is confusing (e.g. does it refer just to spatio- temporal scale?) and it needs re-writing.</p>	Marcela Brugnach (MB)	The sentence has been revised.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
164	8	18	10			“Different stakeholders dispersed over the assessment region have different interests according to their lives, which are tightly connected to specific scales.” This is not only a matter of interests, but also of values, beliefs, or more general of ways of knowing reality and of framing issues and problems, determining what is important and not.	Marcela Brugnach (MB)	The sentence has been revised.
165	8	18	11			“This plurality of recognition is the cause of potential conflict of interests and at the same time the source of resilience in the assessment process (Sabatier et al. 2005; Reid et al. 2006; Cash et al. 2006; Berks 2007)”. This sentence is a little confusing. While I agree that plurality of recognition (which may generate ambiguity in problem definitions and solution) may lead to conflict, it can also lead to creativity and innovation. I also agree that it can be the source of resilience, but it is not clear from the above text how this can become a source of resilience <i>in</i> the assessment process. What is resilience in an assessment process?	Marcela Brugnach (MB)	The sentence has been removed.
166	8	18	12			Add “especially as regards engagement of the private sector (Hochkirch et al. 2014 Nature), ” after “of interest”.	Thomas Brooks (TB)	This has been added.
167	8	18	13			Berkes, not Berks	Marcela Brugnach (MB)	Corrected.
168		18	15			“Among the reasons of past failures in assessments is the exclusion of stakeholders from the assessment process, because of ignorance, prioritizing efficiency to equity, and intuitive exclusion.” This sentence needs clarification. What is meant by <i>because of ignorance, prioritizing efficiency to equity, and intuitive exclusion</i> ?	Marcela Brugnach (MB)	This sentence has been revised and the confusing part removed.
169		18	16	18	20	“Furthermore, it makes the excluded people distrust assessment process and perceive it as unfair, hindering communication that is essential to resolve conflicts, and leading to the failure of the project (...). I think, this statement be further elaborated: what project? Including people is not a guarantee of resolving conflicts? On the other hand, excluding people may not necessary lead to conflict. Why is it necessary that stakeholders are included?	Marcela Brugnach (MB)	This sentence has been removed. We have revised the paragraph to explain why it is important to include multiple stakeholders to increase plurality of viewpoints and knowledge and to ensure buy in of the assessment results.
170		18	17			What does <i>manpower</i> refer to in this context?	Marcela Brugnach	The sentence has been revised and “manpower” has been replaced by “human

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
							(MB)	resources”.
171	8	18	Section 8.3.1.2			I think an example of participatory modelling in a Box would be good here. It'd be interesting to think about what is meant by "participatory" at different scales, specifically at the IPBES scale as I think that's potentially more challenging (and less done) than doing it at a local scale.	EJ Milner-Gulland (EJMG)	We have added a couple of references on participatory methods (Palacios-Agundez et al. 2013; Carvalho-Ribeiro et al. 2010;) and refer the reader to Chapter 3.
172		18	34			Please, review the term credible information in light on previous comment # 31.	Marcela Brugnach (MB)	This sentence has been revised, and there is no longer mention to “credible information”.
173		18	36			I would also add individual and social learning.	Marcela Brugnach (MB)	It has been added.
174		18	37			The reference Lucas et al. 2010 is missing from reference list.	Marcela Brugnach (MB)	The reference has been added.
175	8	18	37	18	37	The reference Lucas et al. 2010 is not in the reference list.	Audrey Coreau (AC)	See comment 192.
176	8	18	43	18	44	As the AofA “best practices” explains clearly, that is only one of several ways, and one with some real dangers as well as real opportunities. Giving only one example is dangerous in this (and most other) case, because it leaves readers thinking the illustration is THE way to move forward, rather than A way.	Jake Rice (JCR)	The text has been revised to make clear this is only one of several ways. A reference to the Assessment of Assessments of UN has been added.
177	8	19	Section 8.3.2.1			this section is not so good - it seems to be a bit misplaced because it's about actual modelling, not about engaging stakeholders, It's also a bit too general and focussed on explaining the problem, rather than giving ideas about how to move forward.	EJ Milner-Gulland (EJMG)	This seems to be a misunderstanding of the section structure. We nevertheless edited the whole section to make it clear this text is about presenting a rationale for the need to connect scenarios to model parameters.
178	8	19	Section 8.3.2	21		overall I think it's important to separate out (and put in the preceding sections) discussion of issues around developing models that include both social and ecological processes. Here in this section, it would be more appropriate to focus on issues about involving stakeholders of various sorts in model building, validation and scenario specification. More examples are needed in these sections as well (in boxes).	EJ Milner-Gulland (EJMG)	We think that it is difficult to separate aspects about engagement of stakeholders from discussing how to better incorporate the stakeholders potential choices in the models. Furthermore, the previous section, section 8.3.1 already focuses on stakeholder engagement. Related to comment 169.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
179	8	19	10	20	30	There is no policy level analysis of what current policies around biodiversity at either global or regional levels. For example, how do the goals identified in the Aichi targets link to FAO policies on sustainable fisheries and farming? How can you make a statement about linking policy & scenarios without understanding the policy framework? Or the statement “A key issue is how to manage tradeoffs”. This is not even an issue at the policy level despite frequent discussion of it in the scientific literature.	Piers Dunstan (PD)	We added a paragraph on the beginning of the section touching on some key policy issues.
180	8	19	11	20	30	In WG 3 of the IPCC 5 th assessment report, the “Behaviour” cross-cut looked fairly far into exactly this issue - that is; the mitigation of emissions is not just an issue of developing better technologies. Success depends crucially on the societal behaviours underlying current practices, the types of behavioural changes necessary to reduce emissions (whether it is adopting the better technologies or just changing practices) and the policy incentives that facilitate or impeded behavioural change. And yes – the scenario chapter was well connected to the behavioural cross-cut team. I’m surprised the authors here seem unaware of the progress and conclusions of those efforts, given how relevant they are to the IPBES initiative/	Jake Rice (JCR)	This paragraph has been removed. But we do cite multiple references related to IPCC scenario development (e.g. section 3.2.2).
181	8	19	16	19	26	This is indeed important to improve the link between ecological and socio-economical parameters in models. However, scenarios are also very useful to do so, this may be discussed here.	Audrey Coreau (AC)	Scenarios are now discussed in the first paragraph of this section.
182	8	19	16			What is meant by “ <i>advanced social system</i> “ in the question: An overarching question is how to include advanced social systems in modeling to respond to policy relevant information?	Marcela Brugnach (MB)	We now used the term “modelling dynamic social systems”.
183	8	19	28	19	34	I would be very skeptic if a complex social process is reduced to parameter. Another source of uncertainty associated with processes representation that is worth mentioning.	Marcela Brugnach (MB)	That is what modellers often do: to simplify the representations of complex systems through proxies and processes analysis. But often, the representation of social systems is much more complex, e.g. see IAM literature.
184	8	19	40	19	45	Discussion on how to cross-link modelling communities from the natural and social sciences could be developed with empirical literature. In particular, what “linguistic, epistemological, technical and other hurdles” exist and how	Jasper Montana (JP)	We believe these details fit better into Chapters 3 and 7. We also now provide a brief discussion of the types of uncertainties, including linguistic uncertainty in section

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						might they be overcome in practical terms? This important section could be developed to match the breadth and detail of sections dealing with the technical aspects of linking between models in previous chapters.		8.2.3.
185	8	20	1		9	How about giving an example of when this has been done, and the issues that were involved? one example would be the use of Management Strategy Evaluation in fisheries, e.g. the work of Cathy Dichmont and Beth Fulton	EJ Milner-Gulland (EJMG)	We rephrased the paragraph to improve the style and provide an example from conservation of a protected area under the MAB program of UNESCO.
186	8	20	1	20	10	The dialogue proposed only includes scientific knowledge. Part of the advantage of including stakeholders is knowledge diversity. From this text it seems that stakeholders are only receivers of scientific knowledge. Please review this in light of comment # 31	Marcela Brugnach (MB)	Related to comment 169.
187	8	20	1	20	8	This section on linking policy needs with models and scenarios could be significantly developed with empirical literature. How have policy needs been identified and incorporated in the past? What has worked? What has not worked? How can we (or can we not?) define policy needs for diverse policy contexts? In particular, the references to "solutions brought by science" should be revised, as they suggest adherence to a linear model of science and policy. As above, significant development to match the breadth of technical sections, and identification and analysis of practical recommendations for linking policy needs would be valuable.	Jasper Montana (JP)	The idea of scenario development as an iterative cycle in continuous improvement is now a key component of the chapter (new Figure 8.1).
188	8	20	32	21	13	The link between scenarios and action is a little more complex: You can have backcasting scenarios that have no political influence, and you can build very efficient exploratory scenarios that really make stakeholders change their mind and their actions.	Audrey Coreau (AC)	We agree, which is why we write "Exploratory scenarios ... do not always provide clear actions", implying that sometimes they can. Similarly, we state "Normative scenarios are more likely" to do so, meaning that they don't always. In any case, the typology of scenarios has been discussed and agreed upon at the 3rd author meeting. The final draft of our chapter will reflect this revised typology, which distinguishes between exploratory and policy intervention scenarios.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
189	8	21				Communicating uncertainties. This section repeats also content of the section above on uncertainty propagation (8.2.2.2). I think it is somehow confusing having them separated, or if so, the content of each section must be better discriminated.	Marcela Brugnach (MB)	Sections 8.2.2 and 8.3.3.2 were merged and incorporated into a new Section 8.2.3.
190	8	21	21			I would also add here, the challenging issue of integrating different types of knowledge into models (i.e., indigenous knowledge).		We added: " It is clear that research is needed on developing robust methods to elicit local and indigenous knowledge that are, in many situations, key to the development of models and scenarios. There are some lessons to be learned from climate science and efforts to include traditional ecological knowledge in mitigation and adaptation strategies (Dewulf et al. 2005; Smith & Sharp 2012; Brugnach et al. 2014)." See also 179.
191	8	21	3	21	7	Absolutely; but that was the early projection work based on getting the physics right. The later WG3 behavioural crosscut work is much more relevant to the needs here,	Jake Rice (JCR)	Here, we mention how the IPCC scenarios have elements that of policy intervention and target-seeking scenarios ("normative"). This includes behavioral elements of the SSP scenarios. This will be further expanded in the final draft.
192	8	21	15	21	29	No reasonable person can be against the points made here. They all are reasonable, and most at least sometimes important. But I would think a list like this is the starting point for an expert group to commence work on the "how to do it", rather than a concluding list, still back a the "what to do" stage. I don't see a lot that is news on this list.	Jake Rice (JCR)	We agree that this list is the starting point for successful IPBES assessments. As such assessments are just starting, we believe this list is appropriate in this section.
193	8	21	15	21	29	This section on building a framework for collaboration makes important recommendations for IPBES. Given their central importance to the ongoing work of the Platform, it is necessary that they are well explained and developed in the text of the chapter. In particular, the recommendation that IPBES should "Overcome disciplinary barriers in modeling, data collection, selection and management" needs more substantive and evidence-based discussion in the text (see comment 21), as does the recommendation that IPBES should "Establish a permanent dialogue between modelers	Jasper Montana (JP)	These recommendations are built towards much of the chapter, and we do not think we need to add even further references here.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						and decision-makers to address issues such as common understanding of concepts, transdisciplinarity, and Infrastructure for resource and knowledge sharing” (see comment 22). If such substantiating literature does not exist, clearly identifying knowledge gaps would clarify important areas for knowledge generation.		
194	8	21	15	21	30	What about Key policy needs, biodiversity outcomes (as opposed to outputs) identified by IGOs, regional organizations and national governments? There also needs to be reference to the development of objectives for	Piers Dunstan (PD)	See comment 199.
195	8	21	34	25	3	in general, section 8.3.3. is too superficial, lacking depth of analysis, examples of best practice, weighing up of the trade-offs involved in modelling decisions, and thinking about the best ways forward for the future. Also I think the materials on uncertainty in the modelling process itself should be in sections above, and this section should be about how best to communicate uncertainty. That will also bound the scope so that it is more achievable to write about.	EJ Milner-Gulland (EJMG)	The two sections have now been merged. Unfortunately, they may still be perceived as superficial given space limitations and the breadth of models and scenarios.
196	8	21	42	22	3	We also need to involve stakeholders at an early stage in identifying uncertainties - that will make the job of communicating uncertainty much easier	EJ Milner-Gulland (EJMG)	This is now mentioned.
197	834					This section describes important motivations for earlier discussions in the chapters. It might be used upfront as a way to provide more structure to the chapter.	Florian V. Eppink (FE)	We tend to disagree.
198	834					This section describes important motivations for earlier discussions in the chapters. It might be used upfront as a way to provide more structure to the chapter.	Florian V. Eppink (FE)	Repeats 219.
199	8	22		24	15	A lot of 8.2.2 overlaps with 8.3.3.2. Not only is the overlap unfortunate when I expect they are working to a tight page limit, so it comes at the expense of better coverage of some other topics (many pointed out above), but the treatment of uncertainty and communication in the two sections is to an unhelpful extent inconsistent between them. 8.3.3.2 is much better, and if the multiple treatments of uncertainty are unavoidable, 8.2.2 should be matched better to 8.3.3.2	Jake Rice (JCR)	See comment 217
200	8	22	5		12	A boxed example would be good here?	EJ Milner-Gulland (EJMG)	Box 8.5 of an example of the importance of communicating uncertainty in a science-policy interface has been added.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
201	8	22	17			It should be "...should permit an increase in the confidence..."	William Cheung (WC)	Corrected.
202	8	22	19			Using a table to summarize the topography of uncertainties and approaches to address them may be helpful for the readers.	William Cheung (WC)	To be added to Ch. 1.
203	8	22	Section 8.3.3.2			It seems like this section is misplaced and should be earlier in the chapter, as it's so fundamental (it's not just about communicating uncertainty but about understanding it).	EJ Milner-Gulland (EJMG)	See comment 217. Sections 8.2.2 and 8.3.3.2 are merged and incorporated into a new Section 8.2.3.
204		22	31		44	Are these techniques recommended techniques?	Florian V. Eppink (FE)	No, they are examples of possible techniques that are not commonly used.
205	8	23	1		5	An example and reference needed here, and something about the strengths and weakness of using local ecological knowledge more generally (not just indigenous peoples)	EJ Milner-Gulland (EJMG)	Done, based on climate science experiences in mitigation and adaptation.
206	8	23	7	23	19	This section on dealing with assumptions could do with substantiating literature, or clarification of source (i.e. shared practical experience by authors?).	Jasper Montana (JP)	The paragraph has been moved to another section and improved with more details.
207	8	23	8		19	Again this is all true but a bit superficial - can we have some analysis of different approaches that are available, and some examples?	EJ Milner-Gulland (EJMG)	Related to comment 230
208	8	23	21	23	33	This section should be removed. It contains a number of unsupported assertions such as "When data series are incomplete, it is possible to generate artificial data and then perform a statistical analysis of the output of the model." Such a method, while useful for testing statistical methods cannot be a substitute for actual data.	Piers Dunstan (PD)	Sections 8.2.2 and 8.3.3.2 were merged and incorporated into a new Section 8.2.3.
209	8	23	17			Should be "a way" not "away"	William Cheung (WC)	Corrected.
210	8	23	22		32	Again this is a bit superficial. Explain the difference between a consistency and a sensitivity analysis. There isn't any section so far on best practice in sensitivity analysis. As I said above, a typology of uncertainties would be good.	EJ Milner-Gulland (EJMG)	See comment 232.
211	8	24	1		2	Add examples, best practice...	EJ Milner-Gulland (EJMG)	We have added a paragraph on visualization for improving communication. And a couple of references as examples.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
212	8	24	19			It would be good if this section can suggest some concrete proposals to address this challenge.	William Cheung (WC)	Research focused on better understanding the cognitive and the psychological processes involved when a person interprets information containing uncertainties is suggested.
213	8	24	20		27	Discuss the tradeoffs in using different types of models, in terms of both understanding and exposition?	EJ Milner-Gulland (EJMG)	Earlier in the chapter, the use of different types of models was suggested, hence this point is mentioned here again.
214	8	24	30		38	So what should IPBES people do about this? I think this question should be asked throughout the chapter (and particularly in these sections, which tend to be very general).	EJ Milner-Gulland (EJMG)	Research focused on better understanding the cognitive and the psychological processes involved when a person interprets information containing uncertainties is recommended.
215	8	24	32	24	34	That is not a valid general conclusion on at least three levels. To begin with, an “the average” citizen does understand the concept of probabilities quite well, if presented to them in meaningful contexts. I haven’t time to dig out literature this team should have found, but the psychology and political science literatures are filled with publications and counter-publications on this issue. Depending on the intent of the communicator, one can do an excellent or a poor job of communicating probabilities to “average citizens”. Second it is true that in communication of probabilities can be fraught with “biases and mis-interpretations, but so can communicating <i>any kind of summary information</i> again largely depending on the motivation and experience of the communicators (any politician and partisan advocate develops such skills early in their careers). In the hands of good communicators probabilities are probably LESS susceptible to bias and misinterpretation than many alternative types of conclusions. And finally, notwithstanding all the usual neo-liberal sentiments we all express, the target audience of IPBES are no truly the “average citizen”. We are trying to inform policy makers and get support from communities that are already engaged in dialogue about biodiversity and ecosystem services. They are a subsample of the entire citizenry that is probably more familiar with the concepts than the average for humanity, There is indeed an important task in raising awareness of a wider populace, but the scenario modelling is not the place	Jake Rice (JCR)	We agree that the context matters when it comes to interpreting probabilities. Therefore, we now write: "Research focused on better understanding both the cognitive and the psychological processes involved when a person interprets information containing uncertainties, particularly in cases which involve appraising risks which are given in probabilistic terms, either numerically or linguistically, could be extremely useful. Based on this research, IPBES could set standards for communication through Task Force on Capacity Building."

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						to state.		
216	8	24	37			That is NOT misunderstanding probabilities. It is applying an asymmetric risk tolerance to a correct understanding of probabilities. And civil society is fully entitled to have an asymmetric risk tolerance for negative vs positive outcomes, even if it can be exploited by unscrupulous partisans (just like symmetric ones can be) This has been pointed out many times since Kahneman's work more than 30 years ago, but people seem to still use this misrepresentation of the findings.	Jake Rice (JCR)	This is addressed in comment 159 of 2nd review.
217	8	25	Section 8.3.4.1			Can you end this subsection by relating this specifically to IPBES?	EJ Milner-Gulland (EJMG)	This is addressed in section 8.3.4.3
218	8	25	5	26	29	The links between science and policy have been studied by scholars since at least 40 years. Findings are clear about the complexity and non linearity of the science policy interface (van den Hove, Latour, Callon, Koetz, etc.). It is not only science to policy (l. 44) but also policy to science. IpBES can be a boundary institution only if it takes into account this complexity. Maybe reflexivity and epistemology of science could also be a possible way to improve the impact of IpBES.	Audrey Coreau (AC)	This has been revised, eg. we now state: "This is a two-way process, and there is a variety of science -policy "interfaces"
219	8	25	5	26	30	This section needs to pay more attention to ideas around "Honest Brokers" (Pielke 2007;The Honest Broker: Making Sense of Science in Policy and Politics). There is no clear articulation of how models can be used in a policy process. IPBES has a number of clear stakeholders (eg CBD) who have clearly articulated policy around biodiversity. How will models practically be used within those frameworks to both inform implementation and change? IPBES is already a boundary organization – the question for this chapter is how can models inform that?	Piers Dunstan (PD)	This is beyond the scope of this section.
220	8	25	5			Section: Linking output to policy. I found a bit of disconnect in this section with regard to the rest of the manuscript. Up to this section, the chapter takes a rather classical position with respect to models, where models are considered in their predictive capacities, and claims the importance and limitations models may have to inform	Marcela Brugnach (MB)	We have overall revised section 3 to make it about improving scenarios, including changing the title and revising the last subsection. We think that the concept of scenarios as boundary objects is appropriate here.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						<p>decision and policy making processes. But in this section there is an abrupt conceptual jump and models are considered boundary objects. While, I fully agree with conceiving models as boundary objects, the transition in the text is not smooth.</p> <p>Conceiving models as boundary objects is a governance issue and it requires paying attention to how processes are organized (both modeling processes and policy and decision making), to the networks of actors involved, to the supporting institutions, etc. And the text, as it is now, falls short in explaining these concepts.</p> <p>Another conceptual problem I have, is that when I read the section on boundary objects, my first reaction is that the difficult problem of science- policy interaction, and the existing gaps between the modeler-scientist and policy communities seems to be pushed aside: <i>Now is the boundary institution that will solve it.</i> But boundary objects or institutions are not magic bullets. In this text the questions of how these boundary objects or institutions will improve the communication among different actors and communities and how they will serve to improve the use of models to support decision and policy making remain unanswered.</p> <p>Addressing some of the challenges presented here will require not only IPBES to change its role, or become a boundary institution, as suggested in the text. But also will imply a new role for scientists and modelers and policy makers. And I think that this is the discussion that yet needs to be included.</p>		
221	8	25	19	26	15	<p>Review original citation and meaning of “boundary object” (e.g. Star and Greisner 1989, also referenced in Cash et al. 2003 from first order draft). Not all “maps, models, scenarios and assessments” <i>are</i> boundary objects, but through their production and use can <i>become</i> boundary objects. Also consider revision of boundary object abbreviation to ‘BO’ for English language readers. In subsequent paragraphs, use of ‘boundary object’ should be revised based on a review of its meaning in social and political science literature, as above.</p>	Jasper Montana (JP)	The paper cited is too theoretical for the goals of this section.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						(Star S.L., Griesemer J.R. (1989) Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. Social Studies of Science 19, 387-420.)		
222	8	25	23		35	It's great to have the ABS example for legitimacy - could you give relevant examples for saliency and credibility too?	EJ Milner-Gulland (EJMG)	We now provide one example for each.
223	8	25	26	25	28	Most of this section is pretty good, but that is a complete mis-representation of the reasons why ABS was such a difficult issue for CBD (and will be for IPBES)/ The ABS issue is just one of countless manifestations of the issue of socio-economic inequity on scales from local to global. Engaging Indigenous Peoples was the <i>right</i> thing to do for many reasons, and I am in no way arguing against their presence But it did not accelerate a solution to any of the issues involved in ABS, and should not be presented as if their presence will simplify such issues. It would just as easily be argued their presence will made some things more complex. The problem was never that with the voices of Indigenous Peoples not in the room, there was a perspective that was missing in the equity debates. The perspective was always there and central to the WEOG dialogue with other Parties to the Convention. And the power-sharing and wealth-sharing compromises were made among Parties.	Jake Rice (JCR)	Addressed in comment 160 of 2nd review.
224	8	25	37	25	45	This is a good description of the problem, but one that has been described many times before. I am missing the suggestions from the expert group for how to address it effectively	Jake Rice (JCR)	We have added a recommendation on how to choose stakeholders and scales.
225	8	25	44		45	Again - relate this to IPBES's specific issues/remit	EJ Milner-Gulland (EJMG)	See comment 249.
226	8	26	6			"Best performed institutionally" - what does this mean? as opposed to what?	EJ Milner-Gulland (EJMG)	Clarified.
227	8	26	10	26	15	The lack of including the major UN Intergovernmental Organizations in this list is a serious oversight. Much of the most policy relevant work on science-policy interactions has been done or consolidated by the major IGOs, certainly at global and regional scales and often at least informing	Jake Rice (JCR)	Done, and with acronyms removed.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
						smaller scales (just like IPBES will work). The IGOs have achieved at least as much (and I would argue more from my own experience) that the NGOs that do get a categorical listing.		
228	8	26	11	26	13	IUCN (http://www.iucn.org) and its six specialist Commissions (http://www.iucn.org/about/union/commissions/) should be added to this list: it has served as a science-policy interface for biodiversity and ecosystem services since 1948. The S.A.P.I.E.N.S. special issue on the IUCN Commissions (http://sapiens.revues.org/1248) is a useful citation here, too.	Thomas Brooks (TB)	Added
229	8	26	17	26	29	This final paragraph, as it is without references, and makes bold suggestions for the ongoing collaborative activities of IPBES appears speculative and it is unclear how it relates to rest of the assessment.	Jasper Montana (JP)	We have removed this paragraph.
230	8.3.4.3	26		26		It seems that very little will actually be done to mainstream model outputs into policy and practice of various stakeholders. I would like to more details on how can IPBES can engage different stakeholders (e.g. industry groups) on both model design & model outputs so the outputs are actually relevant to their own policy, planning and decision-making processes	Joel Houdet (JH)	This is beyond the scope of this chapter.
231	8	26	25	26	30	And this perpetuated the error/oversight above. It is exactly the major IGOs – UNESCO and its components like IOC, UNEP, FAO, etc – that have vast experience in doing the down scaling from informing global policy-making of overarching frameworks, to regional realizations of those frameworks at less heterogeneous (ecologically, socio-economically and culturally) units, and then facilitating the further downscaling of the regional realizations to national and sub-national scales. They have vastly more experience at this complex scaling issue than most of the “NGOs, international research centers, or universities”.	Jake Rice (JCR)	We have removed this paragraph.
232	8	26	29			A good last thought	EJ Milner-Gulland (EJMG)	Thank you.
233	8	Reference list				Is not completed. For example Tittensor et al. 2014 is missing	UNEP-WCMC	Corrected.

Nr	Chapter	From page	From line	Till page	Till line	Comment	Reviewer Initials	What was done with the comment
234						Refer inter-model comparison in relation to Chapter 4 and benchmarking in relation to Chapter 6 in the section on validation.	Ourselves	Done. We have added clear statements on the need for multi-model comparisons and we gave examples.