

## ***Interactive comment on “Ecosystem function and services provided by the deep sea” by A. R. Thurber et al.***

### **Anonymous Referee #3**

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#### General comment

This paper aims to “review current knowledge on the functions and services provided by the deep sea, providing a foundation of knowledge for effective management, while identifying the traits that differentiate deep-sea habitats from other global biomes” The first reviewer already pointed some of the major issues concerning this review; I agree with most of his/her criticism and will not duplicate these issues in my comment although I must reinforce that in my opinion this is not a complete nor a balanced review of the functions and services provided by the deep-sea. Most importantly, while trying to complement the excellent work by Armstrong et al. (2012) the authors bring unneeded confusion to the field of ecosystem services.

As for “providing a foundation of knowledge for effective management” the chapter on

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threats (5.2 Interrelatedness and threats to ecosystem services and functions” with only 20 lines provided in this review is strikingly insufficient; and the same applies to the brief discussion on “Current challenges in function and service evaluation” which lags much behind the chapter “Valuation of deep-sea ecosystem goods and services” in Armstrong’s paper.

Finally, the issue of “identifying the traits that differentiate deep-sea habitats from other global biomes” is not specifically discussed at any point in the paper; the fact that most of the deep sea lies in Areas Beyond National Jurisdiction” which is an important difference from other biomes and of utmost relevance for management/stewardship issues is not addressed.

#### Other comments

1. The terminology has to be clear! Different terms are used interchangeably and this has a confusing effect (in the text and especially in some of the figures). The Common International Classification of Ecosystem Services (CICES) notes the importance of making a clear distinction between final ecosystem services (which retain a connection to the underlying ecosystem functions, processes and structures that generate them) and goods and benefits (final outputs from ecosystems that have been turned into products or experiences that are no longer functionally connected to the systems from which they were derived) and recommends adequate definitions; CICES defines a model of “how the environment relates socio-economic systems, and in particular how the flows (=ecosystem services) take place between them”. Since the Millennium Assessment much has been debated on ecosystem services and I recommend a more thorough knowledge of more recent approaches such as The Economics of Ecosystems & Biodiversity (TEEB), System of Environmental-Economic Accounting: Central Framework (SEEA 2012) and CICES. After defining supporting services in the introduction, in chapter 2 these are now supporting functions. In the different sub-chapters under “2 Supporting functions and regulating services” what are the supporting functions and what are the regulating services is not clear. P18207-8 Under “Fisheries”

the authors mix provisioning services like animals harvested for nutrition and animals harvested for raw materials (e.g. coral for jewelry) The lack of clarity in the terminology used in the submitted paper is particularly confusing in tables and figures: Table 1: Species diversity is presented as a supporting function (in the text the same as supporting service) and simultaneously a provisioning service, species diversity should be approached more specifically (e.g. animal biomass for nutrition and genetic materials for pharmaceuticals are provisioning services, bioremediation by microorganisms is a regulating service); climate regulation is simultaneously a supporting function and a regulating service; fishing is shown as a provisioning ecosystem service but in fact the service should be described as “biomass of wild animals (fish, shellfish, etc) harvested by commercial and/or subsistence fisheries”; the classification of large area, high pressure, cold remote environment, waves and currents as provisioning services is confusing because these are abiotic components of the structure or processes of the ecosystem and not final ecosystem services; oxygen production is an ecosystem process, should not be under “examples of goods”. Figure 3 (looks more like a Table): the first column is a mix of biotic and abiotic goods, different types of services and other unspecified categories/activities/threats (military?, communication cables?). All these should be clearly categorized and organized. Figure 5 Why is paleoclimate classified as a provisioning service? (In Table 1 paleoclimate archives are defined as an “example of goods” for cultural services

2. Who are the intended recipients of this paper? The level of scientific detail decreases from chapter 2 to chapter 3 and then to chapter 4; the language is not uniform throughout the paper, sometimes more scientific sometimes more adequate to outreach.

3. More specific comments P18194 Abstract “Each of these processes occur on a very small scale”; “many functions occur on the scale of microns to meters and time scales up to years” The emphasis of these statements on the small scale of processes/functions collide with the scales shown in figure 4. P18199 “It is now well

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acknowledged that the deep sea has a relatively high diversity (Hessler and Sanders, 1967; Grassle and Maciolek, 1992; Rex and Etter, 2010), although this can vary dramatically depending on the habitat being investigated (Levin et al., 2001)” the most recent paper on marine biodiversity (Appeltans et al. 2012) provides rather low estimates on the total number of marine species contrarily to the opinion of most deep-sea researchers –do you have a comment on that? P18206 “Methane seep and hydrothermal vent communities provide an outlier of intense secondary production in the deep sea” - firstly because they provide an outlier of intense primary production P18207 “However, owing to the pervasive nature of the function of the deep sea, and the threats to it, an important additional link is needed between each of these scientists and the stakeholders of the deep sea, which is the global population” – this sounds like “bla bla” talk; what can be done in order to increase public awareness on the relevance of the deep sea and make them feel really like stakeholders? Figure 4 A: How did the authors estimate the spatial extent of each of the main deep-sea habitats? References and/or methodology should be indicated.

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