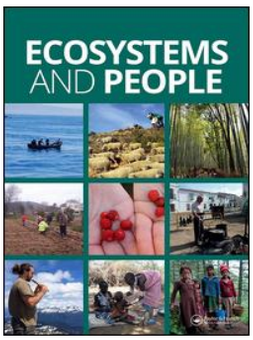

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# Disentangling 'ecosystem services' and 'nature's contributions to people'

Andrew N. Kadykalo [a], María D. López-Rodriguez [b,c], Jacob Ainscough [d], Nils Droste [e], Hyeonju Ryu [f], Giovanni Ávila-Flores [g], Solen Le Clec'h [h,i], Marcia C. Muñoz [j,k], Lovisa Nilsson [e], Sakshi Rana [l], Priyanka Sarkar [m], Katharina J. Sevecke [n] and Zuzana V. Harmáčková [o,p]

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**ABSTRACT**

People depend on functioning ecosystems, which provide benefits that support human existence and wellbeing. The relationship between people and nature has been experienced and conceptualized in multiple ways. Recently, ecosystem services (ES) concepts have permeated science, government policies, multi-national environmental agreements, and science–policy interfaces. In 2017, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) introduced a new and closely related concept – Nature's Contributions to People (NCP). The introduction of NCP has sparked some lively discussion and confusion about the distinguishing characteristics between ES and NCP. In order to clarify their conceptual relation, we identify eleven specific claims about novel elements from the latest NCP literature and analyze how far ES research has already contributed to these corresponding conceptual claims in the existing ES literature. We find a mixed-picture, where on six specific conceptual claims (culture, social sciences and humanities, indigenous and local knowledge, negative contributions of nature, generalizing perspective, non-instrumental values and valuation) NCP does not differ greatly from past ES research, but we also find five conceptual claims (diverse worldviews, context-specific perspective, relational values, fuzzy and fluid reporting categories and groups, inclusive language and framing) where NCP provides novel conceptualizations of people and nature relations.

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## 1. Introduction

All societies are vitally dependent on natural or semi-natural ecosystems ('nature'), which provide them with benefits that support human existence and well-being (Millennium Ecosystem Assessment [MA] 2005; The Economics of Ecosystems and Biodiversity Project [TEEB] 2010; United Nations Environment Programme 2012, p. 4; Díaz et al. 2015a). The relationship between people and nature has been experienced and conceptualized in multiple ways throughout human history (Mace 2014), and considerable heterogeneity still exists between cultures. In the current western-scientific discourse, it is increasingly viewed through the concept of 'ecosystem services' (Costanza et al. 2017). Regardless of what they are called, 'ecosystem services' (ES) or its synonyms (i.e. ecological goods and services, environmental services, nature's services) have been used to characterize a rather broad range of contributions to human wellbeing directly or indirectly through the conditions and processes of natural or semi-natural ecosystem-functioning.

More recently, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) introduced Nature's Benefits to People in 2015 (Díaz et al. 2015a, 2015b). In 2017 the term was changed to Nature's Contributions to People (NCP), defined as 'all the positive contributions, losses or detriments, that people obtain from nature' to capture both *beneficial* and *harmful* effects of nature on people's quality of life (Pascual et al. 2017, p. 9). NCP were introduced as a supra-concept to ES, as ES were seen by IPBES (Díaz et al. 2015a, 2018a) and other scholars (e.g. Turnhout et al. 2012, 2013) as too narrow to capture a broad range of

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worldviews, knowledge systems, and stakeholders. Engaging a wide diversity of knowledge systems (e.g. natural and social sciences, engineering, local and indigenous) and stakeholders (e.g. indigenous people, businesses, farmers, local and rural communities, fishers) is considered necessary to address the objectives of IPBES in developing a holistic understanding of the full range of information and knowledge on people and nature relationships. This undertaking is essential in determining the most practical, effective, and innovative key messages and recommendations (e.g. management and policy options) for audiences (governments and stakeholders), ultimately tasked with their uptake and implementation. Díaz et al. (2018a, p. 270) further refine the NCP definition as 'the contributions, both positive and negative, of living nature (diversity of organisms, ecosystems and their associated ecological and evolutionary processes) to people's quality of life'. On a general level, the NCP definition entails two important re-framings compared to ES: (i) from 'services' to 'contributions', and (ii) from 'well-being' to 'quality of life'. While these may come with different connotations, they are built on similar grounds. Díaz et al. (2018a) acknowledge that ostensibly 'the notion of NCP does not appear to differ much from the original MA definition of ecosystem services' (pg. 271).

### 1.1. Contemporary NCP-ES debate

The introduction of the NCP concept has sparked some lively discussions and confusion among the ES research and practice community (for individual arguments, see: Braat 2018; de Groot et al. 2018; Kenter 2018; Maes et al. 2018; Faith 2018a, 2018b; Peterson et al. 2018a, 2018b) (for perspectives on the discussion or NCP uptake, see: 'The global body for biodiversity science and policy must heal rifts' 2018; Baveye et al. 2018; Costanza et al. 2018; Ecosystem Services Partnership 2018; IISD 2018; Jones 2018; Keller et al. 2018; Masood 2018; Monroy 2018). According to Díaz et al. (2015a), Díaz et al. (2015b), Pascual et al. (2017), Díaz et al. (2018a), Díaz et al. (2018b), and IPBES (2018a), NCP encompasses and also builds upon the ES concept in multiple ways. Here we briefly summarize the 'state-of-the-art' debate in the literature focusing on the distinguishing characteristics between ES and NCP, as presented from differing perspectives.

In the NCP conceptual framework, culture permeates through and across all three (regulating, material, nonmaterial) broad NCP groups. This is in contrast to the ES framework, in which cultural ecosystem services (CES) – criticized for being undervalued and difficult to define and operationalize (Chan et al. 2012a, 2012b; Satz et al. 2013) – are confined to an isolated category – as it is in the MA framework (2005). This claim has largely gone unrefuted in the NCP-ES discussion. However, Maes et al. (2018) note novel and innovative methods in ES-research such as participatory GIS mapping or expert-scoring to assess socio-cultural values which go beyond the realm of just CES. Although, cultural interactions with nature are much more difficult to quantify than regulating or provisioning ES (Maes et al. 2018). Despite unresolved assessment issues in integrating culture, the contributions of nature to culture and the role of culture in defining links between people and nature have been recognized as critical elements within the concept of ES since the MA (2005), if not before.

A critical argument in favour of NCP is that it broadens the conceptual space for social sciences and humanities to be integrated and reflected in people and nature assessments (see also Stenseke and Larigauderie 2017). Braat (2018) disputes this claim by stating that 'of the more than 650 publications in *Ecosystem Services* in the period 2012–2017, more than half address social aspects, and are based on social science methods, specifically in combination with economic and ecological assessments'. Moreover, de Groot et al. (2018) suggest that the NCP authors have underestimated the ES papers and assessment reports produced over the last several decades which have included authors from diverse disciplines. Similarly, Maes et al. (2018) take issue with Díaz et al. (2018a)'s assertion that 'stock-flow' framing (presented as a barrier to social sciences and humanities) is central to the ES concept. Díaz et al. (2018b) concede to several of these assertions, agreeing that there have been important contributions by themselves as well as other authors embracing social sciences and humanities perspectives in ES-research within the last decade (e.g. Chan et al. 2012b; Martín-López et al. 2014; Berbés-Blázquez et al. 2016). However, Díaz et al. (2018b) also cite literature reporting inadequate engagement of social sciences and humanities perspectives within ES literature (i.e. Haase et al. 2014; Chaudhary et al. 2015; Luederitz et al. 2015; Fagerholm et al. 2016; Liquete et al. 2016), as well as persistent discomfort of social sciences and humanities scholars to the ES approach (Satterfield et al. 2013; Satz et al. 2013; Comberti et al. 2015).

According to Díaz et al. (2018a), ES are associated with a western-scientific worldview bias, while NCP embraces and broadens the space for a wider body of worldviews and knowledge. Recent discussions about the NCP concept generally support its contribution in terms of inclusiveness of worldviews (Maes et al. 2018; Peterson et al. 2018a). Yet, the contributions of ES research in communicating diverse values in a variety of cultural contexts to people are perceived to be insufficiently acknowledged in NCP (Braat 2018; Peterson et al. 2018a). This is reinforced by the notion that the existence of the NCP

concept itself is rooted in the core of ES research which has generally aspired for inclusiveness of worldviews to support sustainable people and nature relations (de Groot et al. 2018).

In an effort to better recognize diverse worldviews on people and nature relations, it is claimed that NCP is better suited to embrace indigenous and local knowledge (ILK), which the ES approach has failed to engage. In terms of failing to engage ILK, Braat (2018) refutes the entirety of this claim, explaining that there are a ' … small but increasing number of publications on Indigenous Knowledge'. The response to Díaz et al. (2018a) by de Groot et al. (2018) also emphasizes that many indigenous people and countless local knowledge holders have contributed to the ES community. However, according to Díaz et al. (2018b), out of more than 20,000 ES papers in Scopus (1972–2018), less than 3% explicitly consider ILK with an even fewer percentage (~0.2%) approaching ES research from the perspective of indigenous and local worldviews. Others have agreed with Díaz et al. (2018a) that the evidence of uptake of indigenous knowledge in ES assessments is insufficient, suggesting that ' … additional action is needed to include their [indigenous] perspectives in defining the relations between nature and people' (Maes et al. 2018, p. 3). When it comes to local knowledge however, especially within the European Union, Maes et al. (2018) assert that the ES approach is not failing to engage perspectives from local practitioners and is in fact delivering most of its success stories at the local level.

The NCP concept intends to explicitly consider all contributions of nature, perceived as either positive or negative by stakeholders. In the definition of NCP (Díaz et al. 2018a), the separation between positive and negative contributions is considered critical. Yet in the formulation of NCP, the recognition of negative contributions is presented as innovative without any explicit explanation and reference to ecosystem disservices (outcomes of ecosystem functioning that negatively affect human well-being) (Braat 2018).

NCP can also be distinguished from ES in the classification of 'reporting categories' (i.e. differences in category classification schemes). The NCP concept includes a *generalizing perspective* featuring universal indicators (reporting categories) that can be applied in any context. On the other hand, ES research has developed beyond the MA (2005), diversifying in terms of integrating various value concepts into ES research (Jacobs et al. 2016) and in terms of standardizing indicators and measurements through for example, the Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin 2017). NCP further expands the people and nature conceptual framework beyond the *generalizing perspective* by including a *context-specific perspective* that recognizes unique local or cultural worldviews have their individual applicability to certain socio-ecological settings and these views may not transfer universally. Peterson et al. (2018a) note the valuable contribution of the *context-specific perspective* in emphasizing the importance of cultural context in shaping human perception of nature and good quality of life but also note that it does leave out crucial aspects of people and nature relations identified as frontiers by ES research (e.g. coproduction of ES and NCP; feedbacks between ecosystems; the role of infrastructure, technology, temporal and spatial scales). The inclusion of a *context-specific perspective* beyond a *generalizing perspective* has been presented as an innovation and opens up the potential for hybridization between the two perspectives (IPBES 2018a, p. 7). According to Díaz et al. (2018a, p. 271), including a wide range of perspectives between these two extremes allows for recognizing the diversity of views on people and nature relations and is not meant as a dichotomy but as a spectrum.

ES and nature valuation, broadly construed, have been criticized over a limited scope and over-emphasis in distinguishing only two value dimensions: intrinsic and instrumental values, prone to anthropocentricism (Jax et al. 2013; Schröter et al. 2014). A focus on instrumental and intrinsic values risks impeding the recognition of value pluralism (Martín-López and Montes 2014; Jacobs et al. 2016). In addition to instrumental and intrinsic values of nature, NCP account for value pluralism and holistic nature valuation by being associated with relational values (Díaz et al. 2015a; Pascual et al. 2017) – a third class of values defined as 'preferences, principles, and virtues associated with relationships' (Chan et al. 2016) between and among people and nature contextualized through experiences and entities constituting a 'good life' (Muraca 2011, 2016). In response, Kenter (2018) argues that NCP still focuses on an instrumental frame of perceiving nature as an instrument to human well-being. An additional rationale for favouring NCP is that it goes beyond the 'stock-and-flow framing of people-nature relationships' (Díaz et al. 2018a, p. 271) of ES, which has been dominated by natural sciences and economics perspectives employing monetary, and biophysical values and valuations (see also Schröter et al. 2014). In rebuttal to this alleged predominant stock-and-flow framing of ES, Maes et al. (2018) assert that 'the science, policy and practice of ecosystem services have progressed much beyond a mere economic and ecological rationale' and claim that methods to assess and express social-cultural values beyond biophysical or monetary metrics have become available.

Where it is claimed that ES has failed to resonate with IPBES stakeholders, NCP is conceived as an inclusive concept (and term) that aims at building a more constructive dialogue between actors with different epistemologies, interests, and values. Such inclusiveness emerges from the need to establish a flexible language that helps to reconnect people to nature and to facilitate a more democratic participation of a wider set of viewpoints and stakeholders in the science–policy interface on people and nature (Díaz et al. 2018a). Maes et al. (2018) welcome NCP as an alternative concept for addressing linguistic barriers in cases where ES terms can hinder effective communication processes by evoking different meanings and interpretations among stakeholder groups. However, Kenter (2018) argues that NCP has the same inherent semantic limitations of the ES concept (and term). According to Kenter (2018) in order for NCP to be genuinely inclusive, a term would be needed that places people's plural values of nature central, in place of either services or contributions.

It is apparent that most of the contemporary ES-NCP debate has emerged from three sources, echoing Keller et al. (2018). First, the NCP concept has yet to be extensively validated by further research and practice in the same way ES has. Second, a part of the discussion may be generated by the fact that the recent outline of the NCP concept (i.e. Pascual et al. 2017; Díaz et al. 2018a) has been too brief, and has not sufficiently formalized and clarified the differences with the ES concept. Third, the NCP concept has been presented with little operational guidance on the application or assessments of NCP beyond rather common indicators. This has resulted in the question: Is the concept of Nature's Contributions to People significantly different from ES? (i.e. is NCP another synonym of ES, nature's services, and ecological/ecosystem goods and services *or* is it a new concept?)

### 1.2. Objective

Thus, on the basis of a literature review, this paper aims to:

(1) Contribute to this discussion and clarify some of the confusion between NCP and ES by systematically comparing the aspects of the NCP concept that are claimed to be novel with relevant aspects of ES research and practice; and
(2) Identify new research and action areas (conceptual claims raised by NCP) in which future efforts would be needed to provide an operational framework.

Such a comparison will help organize the current discussion around clearly defined perspectives, and, in addition, help pinpoint the differences between both concepts. Far from being committed to either ES or NCP, we aim to contribute a clearer mapping of the links and relations between the NCP and ES concepts.

## 2. Methods

In order to answer whether the concept of NCP is substantially new compared to what has been accomplished in ES, we first performed a conventional qualitative content analysis (Hsieh and Shannon 2005) of the NCP conceptual literature (i.e. Díaz et al. 2015b, 2018a; Pascual et al. 2017; IPBES 2018a; Díaz et al. 2018b) to identify and clarify *claims which distinguish NCP from ES* (Figure 1: Phase 1; Table 1; Appendix A). We then reviewed the use of NCP in seven IPBES regional and thematic assessments and the peer-reviewed literature and performed a summative content analysis (Hsieh and Shannon 2005) to test our prediction that NCP has yet to be extensively validated in research and practice (Figure 1: Phase 2; Appendix B). Our prediction was clearly supported (see Appendix B): there is currently no more than an anecdotal evidence basis to evaluate claims presented in the NCP conceptual framework. Our subsequent analyses were therefore constrained to comparing what is being claimed in NCP versus what has been accomplished in ES. Consequently, we checked the validity of the claims distinguishing NCP from ES by a three-step literature review on the existing body of peer-reviewed ES literature (Figure 1: Phase 3.1–3.3) as follows: first, we carried specific keyword-based searches of the ES literature related to each claim from the NCP literature (Figure 1: Phase 3.1). Second, we quantitatively estimated the amount of peer-reviewed ES literature related to individual NCP claims through counting the citations retrieved from respective literature searches (hereafter denoted as 'study hits' retrieved from a particular search string) (Figure 1: Phase 3.2). Finally, we qualitatively reviewed the titles and abstracts of the study hits from literature searches to summarize whether NCP claims appear novel or not (Figure 1: Phase 3.3). Individual phases are detailed in the following sections.

### 2.1. Identification of claims which distinguish NCP from ES

To identify *claims which distinguish NCP from ES*, the NCP conceptual literature (i.e. Díaz et al. 2015b, 2018a; Pascual et al. 2017; IPBES 2018a; Díaz et al. 2018b) was read and scanned multiple times to identify claims derived from citations


Figure 1. Methodological overview of the different phases and steps performed in this review.

(i.e. descriptions) of the novelty of the NCP concept, e.g. ' … the NCP approach recognizes the central and pervasive role that culture plays in defining all links between people and nature' (Díaz et al. 2018a, p. 270). Subsequently, an inductive (emergent) coding process (Thomas 2006) was applied to the citations (i.e. claims). As a result, a list of potential claims (e.g. NCP concept recognizes the central and pervasive role of culture) were identified. Similar claims were then grouped into broader themes, denoted as *conceptual claims* and given codes expressed as short titles (e.g. culture). The NCP conceptual literature was then iteratively re-read and sorted under these conceptual claims. Four separate co-authors of this study read and coded the data to ensure inter-coder reliability. We identify eleven specific conceptual claims in which NCP are theoretically distinguished from ES (Table 1). Literal citations from which we derived the conceptual claims distinguishing NCP from ES can be found in Appendix A.

### 2.2. Assessment of NCP uptake in research and practice

To test our prediction that NCP has yet to be extensively validated in research and practice, the use and uptake of NCP were reviewed deductively by a summative content analysis (Hsieh and Shannon 2005) in seven IPBES thematic and regional assessments (IPBES 2016a, 2016b, 2018b, 2018c, 2018d, 2018e, 2018f) and the peer-

**Table 1.** Eleven comparative conceptual claims in which NCP are distinguished from ES, as formulated by descriptions, and characterizations in Díaz et al. (2015b); Pascual et al. (2017), Díaz et al. (2018a), Díaz et al. (2018b), and IPBES (2018a).

| Conceptual Claims (Themes) | Claims which distinguish NCP from ES (Codes) | Literature Search String and Keywords for the Second Topic Field |
|---|---|---|
| Culture | **NCP**: central, mediate, and pervasive to NCP; mapped through and across three broad NCP groups (Regulating NCP, Non-material NCP, Material NCP) (Díaz et al. 2018a, p. 270–21, Supplementary Material; Díaz et al. 2018b; IPBES 2018, p. 7, 9)<br>**ES**: restricted to a discrete and isolated cultural ecosystem services category (Díaz et al. 2018a, p. 271; IPBES 2018, p. 9) | "cultural" OR "culture" |
| Social Science and Humanities (SSH) | **NCP**: more consistent with contemporary research in SSH and broadens the space for and embraces the wider body of knowledge held by SSH (Díaz et al. 2018b; IPBES 2018, p. 2, 6)<br>**ES**: largely failed to engage a range of perspectives from SSH and proceeded largely without benefitting from insights and tools in SSH (Díaz et al. 2018a, p. 271) | "anthropol*" OR "humanit*" OR "integrated valu*" OR "interdisciplin*" OR "social-ecolog*" OR "socialecolog*" OR "social pref*" OR "social science*" OR "socio-cultural" OR "sociocultur*" OR "socio-ecological" OR "socioecolog*" OR "transdisciplin*" |
| Indigenous and Local Knowledge | **NCP**: elevates, embraces, emphasizes and operationalizes the wider body of knowledge held by indigenous and local knowledge systems and its role in understanding NCP (Díaz et al. 2015b, p. 1–2; Pascual et al. 2017, p. 9; Díaz et al. 2018a, p. 270; Díaz et al. 2018b; IPBES 2018, p. 6)<br>**ES**: has a limited and narrow scope and space for indigenous and local knowledge systems (shoe-horns local or indigenous views) (Pascual et al. 2017, p. 9; Díaz et al. 2018b; IPBES 2018, p. 6) | "elder" OR "elders" OR "farmer* knowledge" OR "first nation" OR "first nations" OR "fisher* knowledge" OR "indigenous communit*" OR "indigenous knowledge" OR "local knowledge" OR "mother earth" OR "traditional ecological knowledge" OR "traditional knowledge" |
| Negative Contributions of Nature | **NCP**: makes it possible to account for all contributions of living nature which affect people's quality of life, including those which may be considered negative (i.e. perceived as detrimental or harmful by different social actors or by the same actors in different circumstances depending on cultural, socioeconomic, temporal or spatial context) such as infectious diseases from mosquitoes, malaria, dengue, (Pascual et al. 2017, p. 9; Díaz et al. 2018a, p. 270, Supplementary Material; IPBES 2018, p. 3, 8)<br>**ES**: It is not clear how NCP positions itself relative to ES, yet theoretically the concepts seem similar in terms of recognizing negative effects on human well-being. No references to "ecosystem disservices" were made. | "ecosystem disservice*" OR "ecosystem dis-service*" OR "negative contribution*" |
| Non-Instrumental Values and Valuation | **NCP**: provides greater opportunities to incorporate diverse non-instrumental (e.g. spiritual, non-material, non-monetary, non-biophysical) and pluralistic values/valuation; less likely to be subsumed within a narrow economic (e.g. market-based) approach (Díaz et al. 2015b, p. 2; Pascual et al. 2017, p. 14; Díaz et al. 2018a, p. 271; IPBES 2018, p. 3, 6)<br>**ES**: are generally associated with (an excessive focus on) unidimensional and instrumental values (e.g. economic, biophysical) and a predominantly stock-and-flow framing of people-nature relationships (Díaz et al. 2018a, p. 271; Díaz et al. 2018b; IPBES 2018, p. 3) | "non-monetary" OR "socio-cultur*" OR "sociocultur*" OR "socioecolog*" OR "socio-ecolog*" OR "socialecolog*" OR "social-ecolog*" |
| Generalizing Perspective | **NCP**: a lens through which to view NCP; fundamentally analytical in purpose; seeks a universally applicable set of categories of flow from nature to people; typical of the natural science and economics; 18 reporting categories within the generalizing perspective are distinguished and organized in three partially overlapping broad groups: regulating, material, and nonmaterial NCP (Díaz et al. 2018a, p. 271, Supplementary Material)<br>**ES**: are a key component of the NCP, and the twin sisters of the generalizing NCP perspective (IPBES 2018, p. 7) | Comparative Quantitative Review with CICES version 5.1 (Haines-Young and Potschin 2017) |
| Context-Specific Perspective | **NCP**: an innovation in the concept of NCP (a second lens though which to view NCP) is the context-specific perspective as well as the potential hybridization between the generalizing and context-specific perspectives; tends to resist the scientific goal of attaining a universally applicable schema (universally applicable categories are largely not meaningful); may present NCP as bundles from distinct lived experiences; explicitly provides space for the cosmologies of indigenous peoples and local communities (Díaz et al. 2018a, p. 271–272, Supplementary Material; Díaz et al. 2018b; IPBES 2018, p. 7)<br>**ES**: the context-specific perspective has tended not to be included in the concept of ES (IPBES 2018, p. 7) | "context-specific" OR "place based" OR "place-based" |
| Diverse Worldviews | **NCP**: relates to, respects, recognizes, and embraces diverse worldviews on human-nature relations (Pascual et al. 2017, p. 9–10; Díaz et al. 2018a, p. 271; IPBES 2018, p. 2, 6)<br>**ES**: concepts usually do not capture diverse worldviews on human-nature relations (IPBES 2018, p. 2) | "world view*" OR "worldview*" OR "world-view*" |

(*Continued*)

Table 1. (Continued).

| Conceptual Claims (Themes) | Claims which distinguish NCP from ES (Codes) | Literature Search String and Keywords for the Second Topic Field |
|---|---|---|
| Relational Values | **NCP**: are associated with and can consider and incorporate relational values when linking NCP and wellbeing (Díaz et al. 2015b, p. 2; Pascual et al. 2017, p. 11–12; Díaz et al. 2018b)<br>**ES**: have limited ability to capture relational values due to modest and narrow engagement of social sciences and humanities and an excessive focus on instrumental values (Díaz et al. 2018b) | "cultural identit*" OR "inspiration" OR "personal identit*" OR "place identit*" OR "relational value*" OR "social identit*" OR "social cohesion" |
| Fuzzy and Fluid Reporting Categories and Groups | **NCP**: allow for a more fluid connection across groups; categories have fuzzy limits; some of the 18 NCP reporting categories straddle more than one of the broad groups: material, non-material, regulating; there are gradual transitions, rather than sharp distinctions; NCP reporting categories can be reported as part of a bundle or as transitional between two reporting categories (Pascual et al. 2017, p. 12; Díaz et al. 2018a, Supplementary Material; IPBES 2018, p. 8, 11)<br>**ES**: the groups/categories of ES have tended to be treated as discrete (IPBES 2018, p. 8) | Comparative Narrative Review with main ES classification systems (Costanza et al. 1997; Millennium Ecosystem Assessment [MA] 2005; The Economics of Ecosystems and Biodiversity Project [TEEB] 2010; Haines-Young and Potschin 2017). |
| Inclusive Language and Framing | **NCP**: an inclusive term and framing that has been well received; more palatable, understandable, and neutral; has faced little resistance; has received mainstream attention (IPBES 2018, p. 12, 14–15)<br>**ES**: tend to be associated with some kind of financial value or commodification by the general public (i.e. predominantly stock-and-flow framing); has faced resistance leading to alienation and discomfort in a range of perspectives (e.g. social sciences, local practitioners, indigenous peoples) on people-nature relationships; has received little mainstream attention (Díaz et al. 2018a, p. 271; Díaz et al. 2018b; IPBES 2018, p. 12, 14) | "boundary object*" OR "common language" OR "communicat* tool" OR "dialogue" OR "effective communicat*" OR "jargon" OR "language" OR "narrative*" OR "terminolog*" OR "vocabulary" |

reviewed literature. The keywords 'NCP' *AND* 'nature's contributions to people' were used in searches in the IPBES assessments and the peer-reviewed literature. The peer-reviewed literature was searched using ISI Web of Science from November 2018-April 2019 with an unrestricted search time span. Given the comparatively small amount of empirical research on NCP (see Appendix B for an assessment of NCP uptake in research and practice) and its only recent conceptualization (e.g. Díaz et al. 2015b, 2018a; Pascual et al. 2017; IPBES 2018a), we focus the rest of our analysis on a retrospective literature review relating NCP conceptual claims (Table 1) to their existing prevalence in the peer-reviewed ES literature.

### 2.3. Literature review

To assess all conceptual claims which distinguish NCP from ES in Table 1 (except for 'Generalizing Perspective' and 'Fuzzy and Fluid Reporting Categories and Groups'), a rapid evidence literature review (Khangura et al. 2012) of peer-reviewed ES research was performed to assess the prevalence of ES research addressing each NCP conceptual claim (as identified in Phase 1, Table 1). This literature review was performed in three steps: a literature search and then a quantitative analysis and qualitative analysis based on literature search results (Phase 3.1–3.3). Preliminary literature searches indicated a literature review would not be suitable for assessing the prevalence of *generalizing perspective* and *fuzzy and fluid reporting categories and groups* conceptual claims in ES literature since these points relate to conceptual operationalizations and not research.

The *generalizing perspective* is operationalized in 18 categories that are being used in the context of IPBES assessments (cf. Díaz et al. 2018a). These are meant as an analytically rigorous, science-based set of differentiable measurement variables within a self-consistent system with general applicability (Díaz et al. 2018a). Similar classification systems can be found in ES frameworks. For example, one of the most commonly applied classification systems in ES research and practice, the Common International Classification of Ecosystem Services (CICES) is meant to provide a standardized way of measuring and accounting for ES (Haines-Young and Potschin 2017). The 18 IPBES categories align quite closely with CICES: there is even a column that relates CICES version 5.1 classification with particular IPBES categories. We therefore make use of CICES version 5.1 classification and quantify the overlap with IPBES categories.

For *fuzzy and fluid reporting categories and groups* we present a narrative review comparing NCP to the main ES classification systems used worldwide (Costanza et al. 1997; MA 2005; TEEB 2010; Haines-Young and Potschin 2017).

For the remaining conceptual claims, we used the number of study hits as the prevalence of NCP

conceptual claims in past ES literature and the returned study hits were subsequently assessed and summarized narratively.

### 2.3.1. Literature search

| | |
|---|---|
| TOPIC 1: | ('ecosystem service*' OR 'ecological good*' OR 'ecological service*') |
| | *AND* |
| TOPIC 2: | (keywords for the eleven specified NCP conceptual claims; Table 1) |

Literature searches were conducted in ISI Web of Science – Core Collection from June to November 2018. Searches were performed using a combined search string with two topic fields:
The first field included keywords (search terms) for ES literature. The second topic field included indicator keywords for the eleven specified conceptual claims presented in Table 1. The list of keywords was devised and iteratively developed directly from the eleven conceptual claims and the qualitative raw data (i.e. claims; citations) which underpin the conceptual claims. Keywords were collectively decided upon by all authors and were selected to be as specific as possible to, in principle, capture the conceptual claim in the literature on the basis of title and abstract and provide a reasonably accurate representation of the coverage of conceptual claims in the ES literature. We avoided keywords that were deemed to provide results that were too large, broad, and diffuse to analyze based on title and abstract given time and funding constraints. In doing so, we recognize we have not systematically captured all the available literature for the conceptual claims of interest. Rather, it is almost certainly likely that we underestimate the amount of available literature. An asterisk symbol (*) was used on keyword search terms which might be referred to in the plural or with alternate endings (i.e. ecosystem service or ecosystem services). The date range criteria for literature searches were open-ended (i.e. no limits on the range of publication years).

### 2.3.2 Quantitative analysis

We quantified the (i) the number of study hits retrieved from each literature search for each NCP conceptual claim, and this number was then expressed as (ii) the proportion (expressed as a percentage) of the total ES-literature over the same time period. For example, a search for ('ecosystem service*' OR 'ecological good*' OR 'ecological service*') *AND* ('culture' OR 'cultural') produced 1,936 study hits from 1991–2018 and over the same publication year range (1991–2018) there were 23,325 total ES studies published (i.e. the same search as the first – with the removal of the (TOPIC 2) keywords *and* limited by publication years from results in the original search). These quantifications are only crude estimates since they do not represent the actual available literature in returned searches (i.e. many of the search terms employed and the corresponding results may not address the conceptual claim in question). To provide a more accurate quantitative estimate of NCP conceptual claim coverage in peer-reviewed ES literature we screened all titles and abstracts of unique studies returned in search results for *relevance*. *Relevance* was determined based on whether the studies identified by the search were (i) primary empirical studies of ecosystem services (i.e. assessments, valuations, and case studies were *included* while reviews, narratives, opinions, perspectives, and methodologies were *excluded*) and whether they (ii) focused on the NCP conceptual claim in question. Only studies which appeared *relevant* on the basis of these criteria were then presented as a final quantitative estimate used to inform our qualitative analysis whether the NCP conceptual claim is significantly different and substantially new from ES. *Relevance* is somewhat subjective as it is based on author appraisal. For this reason, each search result for each conceptual claim was appraised by more than two authors to ensure inter-coder reliability of relevant literature estimates.

### 2.3.3. Qualitative analysis

To assess each NCP conceptual claim, a qualitative analysis was performed in a three-step process. First, on the basis of the *relevant* proportion of empirical ES literature, NCP conceptual claims were classified into one of the two classes of **novelty**: *familiar* (within the ES literature) or *novel* (to the NCP conceptual framework). The decision rule (significance level) for novelty was arbitrarily set to a proportion (expressed as a percentage) of 50%. Thus, conceptual claims with a majority of *relevant* literature returned in search results were concluded to be *familiar*, not significantly different, and not substantially new in comparison to the historical peer-reviewed ES literature, and vice versa. Second, NCP conceptual claims were classified into one of the three ordinal classes of **status**: *Not Addressed* (whereby no keywords turned up relevant ES literature to address the NCP conceptual claim), *Emerging* (based on evidentiary support of relevant ES literature), or *Well-Embedded* (based on established ES conceptual frameworks and classification schemes). Third, NCP conceptual claims were classified into one of the three ordinal classes of **trend**: *Unknown, Maintained* (whereby the amount of relevant ES literature on the NCP conceptual claim is approximately steady from year to year), or *Increasing* (whereby the amount of ES literature on the NCP conceptual claim shows an exponentially increasing trend in recent years). None of the literature searches indicated decreasing trends.

## 3. Results

In total, we reviewed 4,718 unique studies that were published between the years 1991 and 2018. Overall, there is a strong increasing trend in the amount of literature in recent years with 2018, 2017, and 2016 comprising 19%, 18%, and 16% of the data, respectively. This dataset covered 124 countries (USA: 31%, England: 15%, Germany: 13%, accounting for the top 3), 1,155 source titles (*Ecosystem Services*: 7%, *Ecology and Society*: 5%, *Ecological Economics*: 3%, accounting for the top 3), and 106 Web of Science Categories (Environmental Sciences: 43%, Ecology: 43%, Environmental Studies: 33%, accounting for the top 3).

Based on our review comparing the distinguishing aspects between the NCP and ES concepts within the existing ES literature we have found six specific *familiar* conceptual claims of the NCP concept which may have overlooked valuable contributions by the ES-research community. However, we have also found five specific *novel* conceptual claims where NCP moves beyond what is currently done in ES research (Figure 2).

### 3.1 Culture

**While ES studies have been dominated by cultural ecosystem services-framing, NCP may be overlooking the rare ES literature where culture has been integrated across ES by incorporating socio-cultural dimensions [*familiar, emerging, increasing*, Figure 2].**

The role of culture in ES assessments or valuations has been dominated by recognizing CES, benefits, or values in (traditional) isolated categories; however, rare cases of the integration of culture between and across ES have been published. Literature searches for ES papers produced 1,936 study hits from 1992–2018, 8.3% of the total ES literature published over the same period. Out of the 1,936 studies, 831 did not assess the role of culture in ES assessments or valuations and were subsequently removed. Of the remaining 1105 studies, 1047 (95%) of these recognized CES or benefits in isolation – applying common classifications and categorizations of CES (e.g. aesthetic, cultural heritage, eco-tourism, recreation, sense of place, spiritual, etc.) – most commonly in assessments of protected areas and urban green spaces. However, in 3% (58 of the 1105 remaining studies), authors did assess the role of culture as permeating through and across ES categorizations or classifications. For example, accounting for differences in cultural dimensions was found to have a significant influence on value estimates of recreation services in marine and coastal ecosystems (Hynes et al. 2018) and the rating and weighting of ES by different groups of people with differing land-use preferences (Schmidt et al. 2017).

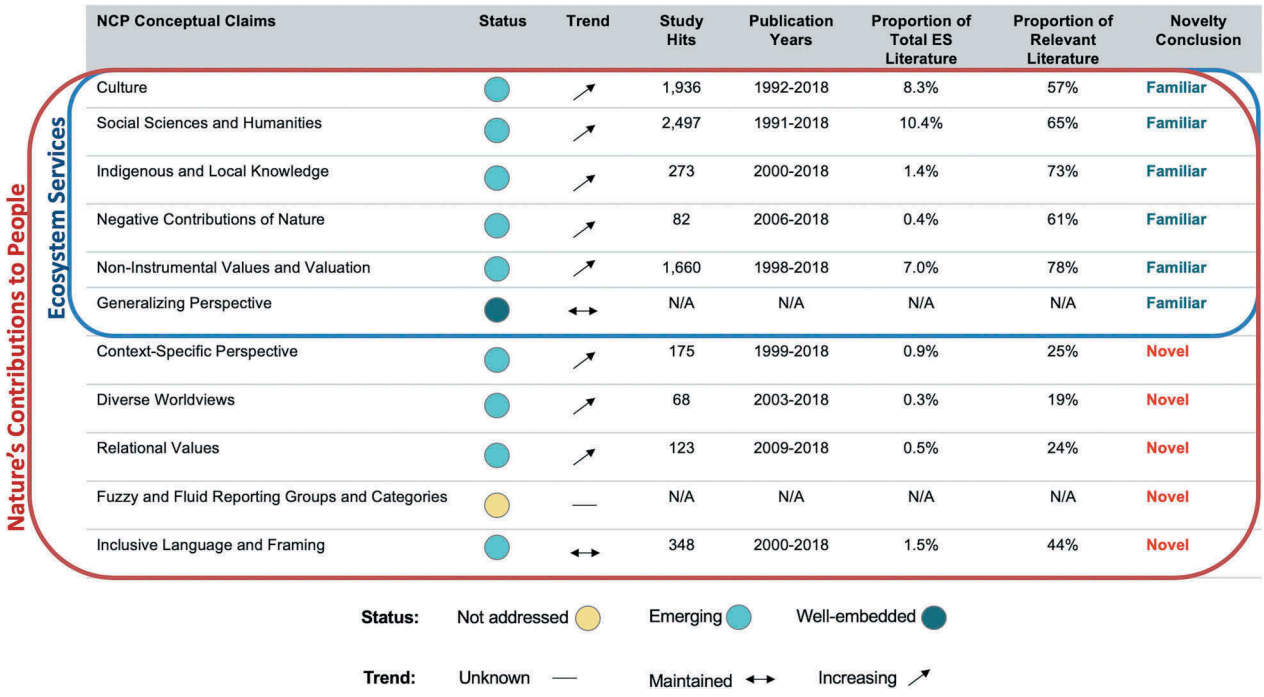


Figure 2. Summary of NCP conceptual claims within the existing ES literature. The status and trend of the NCP conceptual claims, study hits, publication years returned for the given search, proportion of total ES literature (study hits/total ES literature of the publication years returned for the given search), proportion of relevant literature (relevant unique study hits/total unique study hits), and novelty conclusion are presented. Conceptual claims concluded as familiar within ES literature are denoted and boxed blue and those concluded as novel to the NCP conceptual framework are denoted and boxed in red. As conceived by Díaz et al. (2018a), NCP is represented as an extension of ES.

These rare studies reflect more inclusive definitions of culture by incorporating research on socio-cultural dimensions and values as identified by Maes et al. (2018).

### 3.2. Social sciences and humanities

**The plurality and flexibility claimed by the NCP concept to engage the social sciences and humanities seems to have made notable progress within ES research and practice [*familiar, emerging, increasing*, Figure 2].**

A wide range of social sciences and humanities disciplines are engaged throughout much of the ES literature, demonstrating insights and tools from diverse research-fields embraced under the ES-framework and this engagement is only increasing. The literature search produced 2,497 study hits from 1991–2018, 10.4% of the total ES literature published over the same period. Of the 2,497 study hits, 1,632 (65%) were ES assessment studies. Reviewing the remaining 1,632 studies revealed that a large portion (65%) embraced social sciences and humanities perspectives, mostly in combination with economic and/or ecological assessments; congruent with results in Droste et al. (2018). Much of this literature is recent (appearing within approximately the last 4–5 years), suggesting that social sciences and humanities studies are increasing in ES research. Social sciences and humanities research is reflected in ES studies through many examples, namely: participatory mapping and modeling, transdisciplinary approach, payments for ES schemes and program; conservation and sustainable use of biodiversity and ES; and nature-based solutions. These results support the assertions of Maes et al. (2018) and Braat (2018) that there is a growing level of involvement of social sciences and humanities researchers engaging with the ES concept.

### 3.3. Indigenous and local knowledge

**Representation of indigenous and local knowledge in ES literature is present, yet peripheral [*familiar, emerging, increasing*, Figure 2].**

Literature searches for ILK within the ES literature produced 273 study hits from 2000–2018, 1.4% of the total ES literature published over the same period. The same second topic field search terms combined with instead of ES terms, 'sociology' OR 'social science*' – arguably an academic discipline with a greater emphasis on ILK – produced 305 study hits, 0.5% of the literature in that field published over the same period. Literature screening based on reading of the abstracts of all 273 ES articles retrieved revealed that the large majority, 200 (73%), did indeed embrace ILK with a rather equal distribution – 137 articles reflecting local knowledge and 122 reflecting indigenous knowledge. It does appear true that most of this literature (75%) is recent (appearing within approximately the last 5 years) and therefore suggests ILK is increasing in ES research. ILK knowledge is reflected in ES research through many examples of participatory mapping and modelling, ethno-medicinal and ethno-ecological studies, and payments for ES schemes and programs. For example, an ES lens has helped identify ILK on: the nutritional, medicinal, and soil fertility benefits of termites, which are often framed as pests (Sileshi et al. 2009); the highly diverse perceptions on how invasive beavers impact ecosystems and landowners wellbeing (Santo et al. 2017); and sacred freshwater swamps which are valued for their regulating and provisioning ES (Hegde et al. 2017).

### 3.4. Negative contributions of nature

**While the consideration of ecosystem disservices is marginal compared to the studies focused on ES, the consideration of negative contributions of nature is not unique to NCP [*familiar, emerging, increasing*, Figure 2].**

Even though the consideration of ecosystem disservices (EDS) is still marginal compared to the studies focused on ES, negative effects of ecosystems are increasingly recognized in ES literature. Literature searches for ES papers covering EDS and negative contributions produced 82 unique studies, from 2006 to 2018 (0.4% of the total ES literature produced over the same period), with 71 (87%) of these studies being published after 2012. Literature screening based on reading of the abstracts of all 82 ES articles retrieved revealed that most of the studies already assess EDS (61%) (e.g. greenhouse gases from agroecosystems, invasive pests, crop pests, global pathogens, nuisance algae, seed predation). Other studies mention the concept in research papers, as an important aspect of ES framework or as future research perspectives (13%), or in review papers (14%). Finally, some studies discuss the EDS concept and/or try overcoming some of the challenges the concept faces (12%).

### 3.5. Non-instrumental values and valuation

**Instrumental framing based on biophysical and economic approaches dominate ES literature, but socio-economic and non-monetary approaches are emerging [*familiar, emerging, increasing*, Figure 2].**

Literature searches for non-instrumental (non-monetary and non-biophysical) ES literature produced 1,660 study hits (7% of the total ES literature over the same period, 1998 to 2018), with 84% of studies published after 2012, and where 78% of these studies are assessments or valuations using non-monetary and non-biophysical approaches. While stock-and-flow framing terms may appear more

than socio-ecological and non-monetary framing terms in the ES literature (e.g. 'monetary' = 609 hits, 'non-monetary' = 86 hits) a somewhat recent review of the indicators used in ES assessments by Seppelt et al. (2011) found that non-instrumental values (coarse and arbitrary categorical indicators of classifications; e.g. rankings by experts, policymakers, the general public) (49%) were more common than biophysical (26%), and monetary values (24%). This suggests that there may not be common standardized categorical indicators, classifications, or terms which have emerged next to non-monetary and non-biophysical values.

### 3.6. Generalizing perspective

**The overlap between the NCP generalizing perspective with ES classifications, especially CICES, is quite large, providing no great addition beyond what has been done in terms of ES research and classification [*familiar, well-embedded, maintained*, Figure 2].**

In Table 2 we provide an overview of how many times the IPBES categories are mentioned in CICES. Only the IPBES category 'Regulation of ocean acidification' has no corresponding indicator within CICES. Conversely, CICES classifies abiotic ES which have no corresponding categories in IPBES. While there is no perfect congruence between IPBES and CICES, the overlap is quite large. We thus conclude that the *generalizing perspective* of the NCP framework provides no great addition beyond what has already been done in terms of classification in ES research, in particular with regard to the work of CICES.

Table 2. An overview of the occurrences (counts) of IPBES codes which occur within CICES v. 5.1 categories (Source: author's elaboration based on CICES).

| IPBES codes | Description of IPBES codes | Sum of counts |
|---|---|---|
| 1 | Habitat creation and maintenance | 3 |
| 2 | Pollination and dispersal of seeds and other propagules | 2 |
| 3 | Regulation of air quality | 3 |
| 4 | Regulation of climate | 1 |
| 5 | Regulation of ocean acidification | 0 |
| 6 | Regulation of freshwater quantity, location and timing | 11 |
| 7 | Regulation of freshwater and coastal water quality | 2 |
| 8 | Formation, protection and decontamination of soils and sediments | 4 |
| 9 | Regulation of hazards and extreme events | 4 |
| 10 | Regulation of organisms detrimental to humans | 3 |
| 11 | Energy | 4 |
| 12 | Food and feed | 2 |
| 13 | Materials and assistance | 6 |
| 14 | Medicinal, biochemical and genetic resources | 8 |
| 15 | Learning and inspiration | 3 |
| 16 | Physical and psychological experiences | 3 |
| 17 | Supporting identities | 4 |
| 18 | Maintenance of options | 3 |

### 3.7. Context-specific perspective

**The context-specific perspective entails that unique local or cultural worldviews may hold meaning in their own socio-cultural and ecological environment and are not necessarily universal, contrasting the formal ES framework [*novel, emerging, increasing*, Figure 2].**

In the ES literature, an increasing trend in context-specific perspectives is observable as the literature search yielded 175 results (0.9% of the overall ES literature over the same period from 1999–2018, and 50 entries for 2018 which makes it quite a recent topic), 'context-specific' alone yielded 83 of these results. Of the 175 articles, approximately only 25% are empirical studies, and only very few (0.13%) are non-western-scientific (i.e. cosmological, lived experiences) cases.

### 3.8. Diverse worldviews

**While the presence or absence of worldviews in ES literature might be hard to detect, it is likely ES frameworks embrace mostly western-scientific worldviews, something NCP is clearly hoping to expand [*novel, emerging, increasing*, Figure 2].**

While differing worldviews can be difficult to define and articulate, there is some evidence that ES literature embraces diverse worldviews and knowledge systems – especially in recent years, despite traditionally being dominated by western-scientific worldviews. A search for the diversity of worldviews in ES literature resulted in 68 study hits from 2003–2018, 0.3% of the total ES literature published over the same period. Of the 68 study hits, 63 (93%) were published after 2010, indicating an increased interest in connecting worldviews and ES in recent years. However, only 13 (19%) studies assessed non-western scientific worldviews, included in ES research through rare examples of conservation spatial planning, tradeoff analysis, expert-based assessments, stakeholder preferences, holistic valuation, and co-production of ES.

### 3.9. Relational values

**NCP could accommodate a variety of value types beyond instrumental (and intrinsic) values, creating spaces for exploring relational values of nature which have been scarcely covered in ES literature [*novel, emerging, increasing*, Figure 2].**

A search with the second topic field string 'relational value*' within ES literature retrieved only six studies, which suggests that the concept of relational values has gathered little attention in ES studies, or more likely, that is a rather new concept to the ES field demonstrated by a very recent Special Issue of *Current Opinion in Environmental Sustainability* (35,

2018). However, a search adding examples of relational values suggested by IPBES (2018a) such as social identities, social cohesion, and inspiration do appear in ES literature resulting in 123 study hits between 2009 and 2018 (0.5% of the total ES literature produced over this period), half of which were published in the last 3 years. However, only a comparatively few of these studies (24%) were ES assessments focused on relational values; studies exploring for example, social cohesion, place attachments, ecosystem service bundles, (socio-cultural) values, and personal and collective identities.

### 3.10. Fuzzy and fluid reporting categories and groups

**ES literature tends to embrace discrete and rigid categorizations, and thus fluid connections across NCP categories and groups may be novel [*novel, not addressed, unknown*, Figure 2].**

ES classification systems appear to embrace discrete, rigid, and strict boundaries between ES groups and categories exclusively; possibly out of necessity to meet research objectives (i.e. valuation). ES classification systems and ES definitions have been a topic of constant debate for more than 10 years (see La Notte et al. 2017). The failure to properly distinguish ES can lead to double counting and inaccurate valuation of these services and thus has encouraged discrete and rigid ES categorizations and classifications. However, multiple ES classifications and categorizations have been developed to address different aims; the ES community has settled that not a single, consistent ES system is sufficient, 'but rather a pluralism of typologies that will each be useful for different purposes' (Costanza 2008, p. 351). There is an inherent tradeoff in ES classifications between having discrete categorizations to facilitate decision-making of a discrete number of actions versus more accurately reflecting lived realities – something with which the ES field has struggled. In the case of NCP, the primary focus may not be valuation, but rather, to be inclusive in terms of knowledge, worldviews, interests and values (Pascual et al. 2017; Díaz et al. 2018a). By keeping intentionally overlapping groups within one single classification, NCP has attempted to tactfully embrace the plurality of interpretations, which ES has tried to achieve through multiple classifications. However, it may be the case that embracing such fuzzy categorizations is unnecessary if objectives require discrete categorizations.

### 3.11. Inclusive language and framing

**Acknowledging that ES presents several limitations that may diminish its ability for communicating across disciplinary and societal worlds, NCP could represent a powerful communication tool to facilitate dialogue and understanding between a wide range of stakeholders in order to co-produce knowledge for people and nature relations where the ES framework has been limited in acting as common language or a 'boundary object' [*novel, emerging, maintained*, Figure 2].**

Whereas the literature reveals that ES has potential to act as a common language or 'boundary object', arguments against such a role of ES have been increasing over time. Literature searches for ES papers on inclusive language and framing produced 348 study hits from 2000–2018, 1.5% of the total ES literature produced over the same period. Literature screening based on the reading of the abstracts of the retrieved articles revealed only 153 (44%) addressing the ES concept based on its ability to function as a communication tool for bridging actors with a plurality of perspectives and epistemologies. Within such literature, several studies (9 of the total) have emphasized both benefits and challenges of ES framework as a common language or 'boundary object' for communication and collaboration across groups (e.g. Granek et al. 2010; Reyers et al. 2010). In the last few years a growing number of studies (37 of the total) have questioned the function of ES framework as an effective communication tool due to the absence of standardized terminologies and definitions (see La Notte et al. 2017) and the plurality of interpretations that have mainly been attached to its economic origin (see Kusmanoff et al. 2017). The identified literature also revealed that considerable efforts have been made to overcome linguistic barriers in ES research. Such efforts have been concentrated on two important brands of research: (i) studies focused on developing approaches to harmonize and share conceptual vocabulary (29 of the total) (e.g. Munns et al. 2015), and (ii) studies based on the combination of deliberative and innovative approaches (i.e. narratives, images and arts-led dialogue) to facilitate that a wide range of stakeholder contributions to 'people and nature' information and knowledge (53 of the total) (e.g. Salisu Barau et al. 2016).

## 4. Discussion

Our review supports the assertion of Braat (2018), de Groot et al. (2018), Maes et al. (2018) and others that many areas claimed as novel to NCP do exist within the ES field. Comparing the claimed novel aspects of the NCP concept with the existing ES literature we found six specific conceptual claims (culture, social sciences and humanities, ILK, negative contributions of nature, generalizing perspective, non-instrumental values and valuation) where NCP does not differ greatly from past ES research (Figure 2). In these cases, ES has been more integrative than acknowledged by the NCP literature (i.e. conceptual development of NCP may have

overlooked valuable contributions by the ES-research community). Therefore, it is probably unjustified to make broad-sweeping statements about the types of knowledge systems, worldviews, or stakeholders captured by ES research. Many of the conceptual claims which have been reasonably well covered by existing ES research are still being debated, investigated, and formulated – and have been in this state for quite some time. Therefore, a clearer mapping of the relation between NCP and ES may open up synergistic opportunities in operationalizing these conceptual claims for the advancement of future people and nature research, regardless of which conceptual framework is adopted.

ES literature has for some considerable time recognized the interconnectedness and co-production of culture and ES (Chan et al. 2012a, 2012b), though there have been real and imagined challenges to integrating and operationalizing cultural values into ES frameworks (see Fish et al. 2016) addressed in a Special Issue of *Ecosystem Services* (21, 2016). The papers in this special issue adopt a conceptual framework based on the UK National Ecosystem Assessment which identifies the interaction between: environmental spaces and cultural practices, generating material benefits and non-material benefits in terms of identities, experience, and capabilities (Kenter 2016). While evidence of recognizing culture as relational and nonlinear in ES frameworks is scarce, the relationship is still being investigated and formulated. Looking towards operationalizing NCP, defining and articulating the permeating relationship of culture across ES or NCP is required in integrated assessments of ES and NCP.

We have found a wide plurality of conceptualizations which exist under the rubric of 'ES', allowing for the engagement of a range of knowledge systems (e.g. social sciences and humanities disciplines). But we also demonstrated an under-representation of diverse worldviews and knowledge systems which may be inherent to all peer-reviewed research. If diverse worldviews and knowledge systems (e.g. ILK) are underrepresented in ES research, this could reflect a broader research-community-wide trend of under-representation and the call for a more inclusive approach to people and nature research as put forward in Díaz et al. (2018a), may be warranted and should be amplified. Diverse knowledge systems should most certainly be further embraced in the ES research domain as well as all others. There are well-documented epistemological challenges and differences of knowledge generation, validation, and governance when working across worldviews and knowledge systems (Löfmarck and Lidskog 2017; Obermeister 2017) which will need to be considered in providing operational guidance for ES or NCP assessments.

Negative contributions within the ES framework, under the concept of ecosystem disservices, have been acknowledged and have been increasingly considered in the scientific literature (McCauley 2006; Rasmussen et al. 2017; Vaz et al. 2017). For example, ecosystem disservices have been acknowledged as a way to better account for ecosystem complexity (McCauley 2006; Lyytimäki 2014) that support more efficient measures to promote human well-being by avoiding inappropriate targets (Shackleton et al. 2016). Yet, ecosystem disservices are still debated within the ES community (Saunders and Luck 2016) because of the lack of consensual definition and typology (Shackleton et al. 2016) and the dichotomy perspective that it offers on social-ecological complexity (Saunders and Luck 2016). It seems that despite the obvious need for studies that address these challenges, the NCP concept does not explicitly propose an immediate alternative; while studies focusing on the ES framework propose ways toward an integration of ecosystem disservices (Vaz et al. 2017).

Overall, we show that many of these conceptual claims which are familiar within ES are evolving drastically, come from recent literature, and are not inherent to the ES framing as originally conceived in for example, the MA (2005) and TEEB (2010). This suggests that the NCP framework formalizes some recent conceptual and methodological frontiers in ES research, rather than perhaps introducing them. Similarly, the fact that some of the concepts in the NCP contribution are gaining momentum in the ES literature could also explain how and why NCP emerged. This may suggest a response to this momentum by the 'people and nature' community is needed to continue to expand and develop the ES approach.

On the other hand, we find five specific conceptual claims (diverse worldviews, context-specific perspective, relational values, fuzzy and fluid reporting categories and groups, inclusive language and framing) where NCP is clearly distinguished from ES and may provide novel conceptualizations and a more comprehensive perspective on the relationships between people and nature (Figure 2). These conceptual claims may be well orientated to strengthen the science–policy interface in the framework of IPBES by capturing a broader range of worldviews, knowledge systems, and stakeholders to develop a holistic understanding of the full, plural range of information and knowledge on people and nature relationships. This inclusiveness will in theory help IPBES in determining the most practical, effective, and innovative key messages and recommendations (e.g. management and policy options) for audiences (governments and stakeholders).

The *generalizing perspective* of NCP has been (more than) well covered by ES (as exemplified by CICES) but the *context-specific perspective* introduced by NCP seems to be an important addition by broadening the types of acceptable knowledge generation

beyond western-science. However, to conduct corresponding research may require some additional effort to operationalize the idea of context-specific understandings of people and nature relations and translate them into a science–policy language, ideally including experts from relevant fields. For example, the context-specific perspective implies a puzzling enigma: context-specific worldviews or cosmologies have their own concept of how and what the world is and how humans fit in (Berkes 2017). Thus, context-specific worldviews or cosmologies may not seek to recognize, explain, systematize, or evaluate phenomena in a way that other worldviews do, such as a western-scientific worldview. Yet, IPBES aims at recognizing these context-specific perspectives within a framework of scientific support for policymaking – which requires transdisciplinary translation of context-specific worldviews into the language of an international science–policy interface. So, while in general, context-specific perspectives do not seem to ignite any protest, they are limited by traditional (western) research landscapes where scientific information and knowledge are generated and shared.

Instrumental framings of people and nature relations based on biophysical and economic values may have been dominant in ES research, but non-monetary and socio-ecological approaches can be seen in more recent work. Yet, overall, relational values have attracted little attention in the ES literature. Regardless of which framework or perspective (ES or NCP), relational values may be gaining traction as a foundational aspect to understanding people and nature relations (see the Special Issue of *Current Opinion in Environmental Sustainability* (35, 2018) specific to relational values). Overall, the notion of NCP presenting a spectrum of intrinsic, instrumental, and relational values may help explore a wider range of value types than the ES concept has covered thus far. An unequivocal framing of relational values may contribute to better understanding ethical principles which foster environmental stewardship that both ES and NCP aim to promote (Schulz and Martin-Ortega 2018).

The terminology and framing of ES present several limitations that may diminish its ability for communicating across disciplinary and societal worlds, although it has been recognized as a potential boundary object (e.g. Steger et al. 2018; Ainscough et al. 2019). However, limitations of ES can be attributed to the economic background of the ES concept (Kusmanoff et al. 2017), the complex terms interpreted as scientific jargon (Reyers et al. 2015), the inconsistency across terminology and definitions (La Notte et al. 2017), and the overly limited and rigid standardization of ES types (Baveye et al. 2018; Steger et al. 2018). Language used in public discourse is a powerful tool to engage people in sustainability issues (e.g. Kusmanoff et al. 2017) and new flexible approaches can be useful to overcome the mentioned linguistic barriers (e.g. Steger et al. 2018). Whether NCP can provide terminology and concepts to reconnect people to nature, and avenues to facilitate open effective dialogue between a wide range of stakeholders in order to co-produce knowledge remains to be seen (see Akpo et al. 2014). There are some arguments to support the idea that NCP can represent a powerful communication tool given its recognized inclusive and flexible conceptual definition inspired by reconnecting people to nature (Abson et al. 2017; Steger et al. 2018). There are also others that oppose because 'NCP still semantically expresses an instrumental, anthropocentric slant, emphasizing nature as an instrument to human well-being' (Kenter 2018). To progress the scientific debate, future empirical studies are needed to analyze the role of NCP as a common language and framing or 'boundary object' for bridging disciplinary perspectives and social worlds.

### 4.1 Limitations

The approach taken in this review presents several limitations. The presence of NCP conceptual claims in the ES literature may be hard to detect based on titles, keywords, and abstracts considering that a substantial portion of the literature might incorporate and reflect different conceptual claims but fail to label it as such. Therefore, this presents a bias towards information contained within abstracts and coarse search categories such as title and keywords. A coarse-scale approach was taken to review the conceptual relation between NCP and ES rapidly – in the hopes of minimizing immediate confusion within IPBES and the broader people and nature science–policy community, we did not cover grey-literature, nor did we use more than one database in our searches. However, for the purposes of a general state-of-the-art review, we believe the vast majority of relevant data can be found in the academic literature. Moreover, given the body of literature, we were interested in is so vast, it would be inconceivable and not worthwhile to comprehensively and systematically search across multiple databases and grey literature in an attempt to capture all the relevant literature. Keyword selection may also be biased by preconceived notions of authors, and the quantity of selected keywords – which likely correlates with the overall number of results. However, given our rapid review of the literature and un-systematic keyword selection, it is almost certainly likely that we underestimate the amount of ES literature that has already integrated NCP conceptual claims. Each search for each conceptual claim was repeated more than once and estimates of the relevance of the literature returned in searches were appraised by more than two authors, generating confidence that these general patterns are

authentic and repeatable. Lastly, the decision rule of what conceptual claim was deemed familiar or novel within the ES literature was arbitrarily set at 50% of relevant literature returned in searches – a crude, yet insightful, estimate that does not account for the 'natural' variation of literature returned for different search strings or conceptual points.

### 4.2. Conclusions

The introduction of the NCP concept emerged out of necessity to incorporate a wider and more diverse set of knowledge systems, worldviews, and stakeholders to strengthen the science–policy interface on people and nature by increasing inclusivity and plurality. Yet, the NCP introduction has also sparked lively discussions and confusion (over how NCP relates to ES) among experts, policy-makers, and stakeholders; the very people and institutions IPBES and 'people and nature' researchers aim to engage. We, therefore, intended to systematically compare aspects of the NCP concept that are claimed to be novel with relevant aspects of existing ES research and practice to clarify the conceptual relation between NCP and ES. By analyzing NCP conceptual claims of novelty and clarifying the ES-NCP relations in more detail we hope to contribute to a more factual debate, clarify confusion, and to reduce tensions. Unnecessary division and argument within the science–policy community only undermines and jeopardizes derailing the commendable progress made by IPBES and others at the science–policy interface in regards to the conservation and sustainable use of biodiversity (Peterson et al. 2018a).

To answer whether the concept of Nature's Contributions to People is significantly different from ES we would conclude that it is, partly. While recognizing the substantial coverage of people and nature interactions and relations by current ES research, we would conclude that there are dimensions – conceptual claims raised by NCP – which go beyond what is already integrated in ES research. ES research has already acknowledged and integrated the important role of culture and multiple conceptualizations of values, but NCP broadens this scope by putting a stronger emphasis on the importance of context-specific worldviews beyond a standardized and generalizable assessment typology. In other words, NCP is theoretically pushing existing trends in ES research to newer and broader boundaries. These are relatively recent ideas, potentially still under development and thus somewhat lacking rigorous operationalizations. Future efforts should therefore focus on these new research and action areas (conceptual claims raised by NCP). In general, framing NCP as a 'paradigm shift' is probably unwarranted given that many aspects claimed as novel to NCP are captured in ES literature and lack evidence to application in research and practice – rather we therefore join Peterson et al. (2018a) in a call to value the complementarity of ES and NCP with a particular emphasis on developing operational guidance for people and nature assessments regardless of which conceptual framework or moniker is adopted.

### 4.3. Recommendations

We therefore recommend next steps regarding the further conceptual framework development of IPBES, NCP, and ES. Ideas such as context-specific NCP and knowledge co-production with ILK holders need to be implemented and thus a solid methodological development of how these innovative features can be applied in research may serve the community well: IPBES and others in the people and nature science–policy interface should provide further practical operational guidance for NCP assessments (e.g. empirical case-studies, analysis methods, tools, step-by-step guidance for multiple disciples and practitioners) that go well beyond the rather common reporting categories in the NCP conceptual framework (in Díaz et al. 2018a; IPBES 2018a). In fact, recent evidence indicates that a real lack of relevant data and methodologies presents a major obstacle to the uptake and implementation of NCP concepts (Keller et al. 2018) and our review also support this. Specifically, the review here calls for a) further discussion and guidance of the NCP concept with regard to operationalizations at the future IPBES plenaries and beyond, b) careful consideration, transparency, and description in forthcoming IPBES and peer-reviewed assessments noting where NCP are distinguished from or a compliment to ES, and c) more empirical research effort addressing how NCP are reported and assessed in practice to evaluate and demonstrate the benefit and additionality of NCP to the people and nature science–policy interface.

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