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Navigating pluralism : understanding perceptions of the ecosystem services concept

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1 Navigating pluralism: understanding perceptions of the 2 ecosystem services concept

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30 policy interface

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123 **Abstract**
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125 36 Being open to multiple interpretations allows the ecosystem services concept to operate as
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128 37 a boundary object, facilitating communication and cooperation between different user
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130 38 groups. Yet, there is a risk that the resultant pluralism limits the capacity of ecosystem
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132 39 services assessments to directly inform decision and policy making, and that the concept
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134 40 could be used to support environmentally or socially harmful activities. Here, we report
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136 41 results from a large mixed methods survey conducted among academics, policymakers and
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138 42 practitioners working in the field of ecosystem services across Europe. We use these results
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140 43 to explore the trade-off that exists between the role of ecosystem services as a boundary
141
142 44 object and the needs of policy and decision makers of more standardised practices. We
143
144 45 conclude that this can be done by working towards the standardisation of ecosystem service
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146 46 assessments within specific jurisdictions, whilst maintaining forums for debate,
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148 47 collaboration, research and critical reflection within the broader ecosystem services
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150 48 community. We also aim to deduce guiding principles to ensure the ecosystem services
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152 49 concept is not used to support possible detrimental activities. The consideration of shared
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154 50 and cultural values, and integration of the concept of sustainability are identified as valuable
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156 51 guiding principles to this end.
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183 **59 1. Introduction**
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186 **60 1.1. A broadly operational concept despite a lack of unity**
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188 **61** A number of wide scale assessments have taken place to assess the status and trends of the
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190 **62** world's ecosystem services – including the Millennium Ecosystem Assessment (MA, 2005),
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192 **63** The Economics of Ecosystems and Biodiversity (TEEB, 2010), and the assessments of the
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194 **64** Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES,
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196 **65** 2018a, 2018b, 2018c, 2018d). Advances have been made towards operationalizing the
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198 **66** concept in practice (Beaumont et al., 2017; Dick et al., 2018; Jax et al., 2018), and the
199
200 **67** concept is starting to be integrated into both national and international policy (Bezák et al.,
201
202 **68** 2017; Bouwma et al., 2018; Matzdorf and Meyer, 2014). Dick et al. (2018, p. 563) declared
203
204 **69** that the ecosystem services concept is 'broadly operational', despite on-going debates
205
206 **70** within the ecosystem services community regarding conceptual frameworks, assessment
207
208 **71** and valuation methodologies and even core terminology (Braat, 2018; Costanza et al., 2017;
209
210 **72** Díaz et al., 2018; Fanny et al., 2014). This lack of conceptual and methodological unity has
211
212 **73** previously been identified as a concern within the ecosystem services community (Nahlik et
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214 **74** al., 2012), although Dick et al. (2018) suggest the concept appears to be compatible in
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216 **75** practice with a range of approaches founded in different philosophical traditions.
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224 **77 1.2. The acceptance of plurality within the field of ecosystem services**
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226 **78** Accepting that the ecosystem services concept is open to multiple interpretations is seen by
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228 **79** some as a strength, as it allows it to operate as a boundary object between different
229
230 **80** worldviews (Abson et al., 2014; Schröter et al., 2014; Schröter and van Oudenhoven, 2016).
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232 **81** Boundary objects are concepts that are amorphous enough to be adapted to different
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82 contexts and worldviews, but are robust enough to act as a channel of communication
83 between these different positions (Star and Griesemer, 1989).
84
85 The idea of ecosystem services as a boundary object is well developed in the literature
86 (Abson et al., 2014; Galler et al., 2016; Hermelingmeier and Nicholas, 2017; Jadhav et al.,
87 2017; Kull et al., 2015; Schröter et al., 2014; Steger et al., 2018). Saarikoski et al. (2017)
88 found the concept operated as a useful boundary object in some of the 22 European and
89 Latin American case studies they assessed. From their case study in German environmental
90 planning, Galler et al. (2016) conclude that ecosystem services can act as an effective
91 boundary object in the early stages of collaboration, but that its usefulness decreases over
92 time due to conflicting interpretations of how the concept should be used in practice.
93 Saarela and Rinne (2016) develop the idea that artefacts (scenarios, simulation models,
94 indicators etc.) produced using the ecosystem services concept, rather than the concept
95 itself, may act as boundary objects. These artefacts are still open to multiple interpretations
96 but are not neutral objects, as they are tied to the social and institutional context, with their
97 embedded power relations, in which they are made (Saarela and Rinne, 2016). This can limit
98 their capacity to operate as boundary objects, as they are only able to connect actors with
99 pre-existing shared cultural values and preferences (Turnhout, 2009).
100
101 These discussions reveal a tension in the role of ecosystem services as a boundary object.
102 On the one hand, it is most effective as a broad concept that can accommodate a large
103 range of perspectives and worldviews. However, this function decreases in the context of
104 specific policy and decision-making. Undertaking ecosystem services assessments for policy
105 requires the development of standardised classification systems, conceptual frameworks

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303 106 and related methodologies; inevitably leading to certain worldviews being crowded out, and
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305 107 others foregrounded. If ecosystem service assessments are to become a mainstream
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307 108 approach for evidencing environmental policy and decisions, then such standardised
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309 109 practices will become institutionalised, potentially curtailing debate over the value laden
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311 110 choices taken to create them. This dynamic is referred to by Steger et al. (2018) as the
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313 111 creation of 'infrastructure'. Infrastructure are 'the tools, work practices, terms, and
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315 112 technologies that become embedded in and support a community of practice' (Steger et al.,
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317 113 2018, p. 144). The tension between ecosystem services as a broad, open boundary object
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319 114 and as an institutionalised concept with precise terminology and associated practices, is a
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321 115 key theme of this paper.
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328 117 Within policy and decision-making, there is evidence that the concept of ecosystem services
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330 118 is beginning to enter into national policy and legislation, but usually in a manner that does
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332 119 not include the explicit use ecosystem services assessments and valuations (Bezák et al.,
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334 120 2017; Bouwma et al., 2018; Kistenkas and Bouwma, 2018; Leone et al., 2016; McKinley et
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336 121 al., 2018). Within the research community, continued disunity can be seen in ongoing
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338 122 debates over core frameworks and terminology since the introduction of the concept of
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340 123 'Natures Contribution to People' (Braat, 2018; Díaz et al., 2018; Kenter, 2018; Maes et al.,
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342 124 2018; Pascual et al., 2017). Peterson et al. (2018) make the case here for an acceptance of
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344 125 pluralism to avoid a potentially harmful polarisation within the ecosystem services
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346 126 community. Hermelingmeier and Nicholas (2017) similarly embrace the range of
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348 127 perspectives that still exist around the ecosystem services concept, making the case for
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350 128 'guided pluralism'.
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130 The continued heterogeneity of interpretations and understandings of the ecosystem
131 services concept requires an exploration of how far such a pluralistic outlook should be
132 extended. Accepting pluralism does not mean that any work carried out either in research
133 or policymaking using the language of ecosystem services is accepted as part of the overall
134 canon, regardless of the theoretical basis, methodological approach or normative framing.
135 The term 'guided' pluralism used by Hermelingmeier and Nicholas (2017) captures this idea.
136 This term originates from the attempt of Baumgärtner et al. (2008)'s to develop a
137 framework for coping with the heterogeneous practices within the field of ecological
138 economics, however the idea has not been explicitly developed in the ecosystem services
139 literature. Hermelingmeier and Nicholas (2017) only suggest the need for open dialogue
140 over values and assumptions to establish common ground for research.
141
142 Baumgärtner et al. (2008) seek to harmonise the epistemological and methodological
143 diversity of their field that interweaves descriptive and positive science with values and
144 normative judgement. In applying the concept of guided pluralism to the field of ecosystem
145 services, we carry forward this differentiation of epistemological and methodological
146 diversity, and the view that this naturally arises from different philosophical and normative
147 positions. We add the consideration of theoretical diversity, with theory being an
148 intermediate stage, informed by particular epistemologies and informing methodologies.
149 The second theme of this paper is an attempt to identify guiding principles with which to
150 navigate this diversity, as to achieve a 'guided' pluralism within ecosystem services research
151 and practice.

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423 153 The two notions of boundary object and guided pluralism are complementary. Boundary
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425 154 objects accept pluralism, while the notion of guided pluralism allows space to discuss
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428 155 principles with which applications of the ecosystem services concept can be directed.
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432 157 **1.3. Aims**

434 158 To analyse the work on ecosystem services as a boundary object, and the applicability of the
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436 159 notion of guided pluralism, it is important to understand different views within the
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439 160 ecosystem service community. This study hence aims to understand the way the ecosystem
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441 161 services concept is viewed by different user groups. Firstly, we are interested in perceptions
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443 162 of strengths and weaknesses in the concept, and the different ways that people see the
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446 163 concept being used to inform decision-making. From here we ask if the ecosystem services
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448 164 concept can be seen as a boundary object, and what the limitations are to this in the
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450 165 context of policy and decision-making. Secondly, we seek to identify guiding principles for
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452 166 the ecosystem services concept, by synthesizing views from different user groups.
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457 168 **2. Methods**

459 169 **2.1. Survey design**

461 170 We distributed a digital mixed methods survey among 350 early registrants to the European
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463 171 Ecosystem Services Conference 2016¹ (EESC), which presented a good sampling pool for all
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465 172 three target groups: researchers seeking to gain knowledge and understanding;
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468 173 policymakers formulating public strategies; and practitioners making or supporting
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470 174 environmental management decisions. The conference – which attracted 700 delegates –
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475 ¹ www.esconference2016.eu
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483 175 was organised by three large research projects (OPERAs², OpenNESS³, ECOPLAN⁴), the
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485 176 University of Antwerp, and the Ecosystem Services Partnership⁵, one of the largest
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488 177 international networks focused on ecosystem services, and so brought together a wide
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490 178 range of people from across the field. We engaged with early registrants to be able to
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492 179 present and discuss the outcomes at the conference. The survey was distributed through
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494 180 the conference organisers' official e-mail list.
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499 182 The survey was divided into four categories to capture different aspects of people's views of
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501 183 the ecosystem services concept: its underlying purpose (P); visions (V) for its future
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503 184 evolution (named goals in the survey); perceived myths (M) that misrepresent the concept;
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505 185 and frustrations (F, named Grumbles in the survey) to capture any irritations with the
506
507 186 ecosystem services concept not captured in the other categories.
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512 188 Each category featured one closed question, and two or more open-ended questions,
513
514 189 allowing participants to enter as little or as much text as they needed to express their ideas
515
516 190 and opinions. Participants were asked to complete at least one category, and at the end of
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518 191 their first round of questions were given the opportunity to complete additional ones. Table
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520 192 1 summarises the questions, which were phrased in generic terms to allow respondents the
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522 193 opportunity to give unrestricted open answers. The full questionnaire is included as
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524 194 Supplementary Material 1.
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531 ² www.operas-project.eu

532 ³ www.openness-project.eu

533 ⁴ www.uantwerpen.be/en/research-groups/ecoplan/

534 ⁵ www.es-partnership.org
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Table 1. Summary of the survey questions for the four survey categories: Purpose (P), Visions (V), Myths (M), Frustrations (F). One question on supposed differences of opinion (A1) was asked to all respondents at the end of the survey. The questions were either on a 5-point Likert scale (Likert), multiple-choice multiple answers (MCMA) or open-ended (open). MCMA statements are included in Figure 2. The full survey is available as Supplementary Material 1.

ID	Question	Type
P1	The ecosystem services concept provides a utilitarian framing of ecosystem functions as services to increase public interest in conservation.	Likert
P2	The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of how human well-being in many ways depends on natural systems.	Likert
P3	Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels.	Likert
P4	Can you put down in your own words what you think is at the heart of the ecosystem services framework?	Open
P5	What would be the worst misuse of the ecosystem services framework?	Open
P6	Beyond basic research ethics and good practice, what values and principles or ideas should guide the practical applications of the ecosystem services framework?	Open
V1	In 20 years' time, what role should the ecosystem services framework have in society?	MCMA
V2	What are the main challenges for the widespread use of the ecosystem services framework?	Open
V3	What do you think are key steps to undertake in the future development of the ecosystem services framework?	Open
M1	Can you describe a common myth or misunderstanding you frequently encounter in your work?	Open
M2	Who holds these erroneous views?	Open
M3	What to your mind is the source of confusion that gave rise to these myths?	Open
M4	How would you debunk the myth?	Open
M5	Have you ever encountered one of the following claims regarding ecosystem services in your work?	MCMA
F1	What do you find most frustrating about working with the ecosystem services framework?	Open
F2	What would be the best way to resolve your frustration?	Open
F3	What to your mind is the biggest theoretical, moral or practical shortcoming of the ecosystem services framework?	Open
F4	How could that shortcoming be remedied?	Open
F5	Have you ever encountered one of the following frustrations?	MCMA
A1	In the field of ecosystem services, where do you think the biggest differences of opinion lie?	Open

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2.2. Quantitative analysis

Attributes, i.e. characteristics of participants or cases (Bazeley and Jackson, 2013), were included in the survey design as open questions to prevent restricting participants in their

208 answers. Based on the qualitative entries we constructed attribute labels for gender,
 209 discipline, and years of experience (Table 2). For 'Field of Study' we captured unclear
 210 answers with the 'Other discipline' category. Participants were also asked whether they
 211 were an academic researcher, junior researcher or student, practitioner, policymaker or
 212 'other'.

213
 214 Each category of the survey (Purpose, Visions, Myths, and Frustrations) had one multiple-
 215 choice section for which we compiled separate bar charts to help identify themes and
 216 support for the qualitative analysis of the open questions.

217
 218 Table 2. Retrofitted attribute labels describing survey participants

Open-ended	Retrofitted Attribute labels
Gender	Female, Male
Years of experience	<5; 5-9; 10-19; >20
Discipline	Natural/Physical Sciences, Social Sciences, Economics, SciencePolicy Nexus, Inter/Transdisciplinary, Other discipline

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 220 **2.3. Qualitative analysis**

221 A general inductive approach (Thomas, 2006) to thematic content analysis was used to
 222 examine patterns in the responses to the open survey questions (Table 2) in a replicable and
 223 systematic manner (Bryman, 2016). The general inductive approach provides an easily used
 224 and systematic set of procedures for analysing qualitative data that can produce reliable
 225 and valid analysis of underlying structure in the raw data (Thomas, 2006). Rather than
 226 making prior assumptions about the survey responses in a predefined coding frame, an
 227 inductive approach was followed because we had no comprehensive predetermined

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663 228 expectations of the patterns, similar to Asah et al. (2014) and Maraja et al. (2016). The
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665 229 intended outcome of the inductive coding process was to create a small number of
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667 230 summary categories that in the evaluator's view capture key aspects of the themes
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669 231 identified in the raw data and are assessed to be the most important themes given the
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671 232 study's objectives (Thomas, 2006).
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676 234 We followed the five stage of analysis described by Thomas (2006) carried out using the
677
678 235 Nvivo qualitative data analysis software (QSR International, 2016). The full set of responses
679
680 236 were read carefully (1) and specific text segments were identified that related to the topic
681
682 237 of the survey category (2). These segments were labelled to create a set of initial themes
683
684 238 (3), which were refined to reduce overlap and redundancy (4) in an iterative process both
685
686 239 within the categories and across the whole survey, allowing responses to be coded for
687
688 240 multiple themes. Themes that were rarely mentioned were grouped as 'other'. The final
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690 241 stage consists of creating a model that incorporates the most important themes into a
691
692 242 limited set. Thomas (2006) explains that inductive coding that results in too many major
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694 243 themes – he suggests more than eight – can be viewed as incomplete and encourages the
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696 244 evaluator to make hard decisions about which themes are most important.
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703 246 Given likely overlap in responses between the different survey categories we anticipated
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705 247 that the final step would identify a number of cross-cutting themes. The choice of these
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707 248 cross-cutting themes was supported by the results of the quantitative analysis and looked
708
709 249 for both consensus and divergence in views among the respondent categories. The cross-
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711 250 cutting themes are illustrated with quotes and cross-references were made to the survey
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713 251 questions that provided answers in support of the cross-cutting theme.
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2.4. Corroborating our findings and building towards a unified message

Key findings from the analysis were presented at EESC 2016 to corroborate our findings through discussions with conference attendees, and to collaboratively shape a charter (named the Antwerp Declaration) that could capture and communicate a set of recommendations based on our findings and discussions. An early findings document was compiled and distributed among conference participants in the delegate packs. This formed the basis for informed discussions and events during the conference where participants could engage with the Antwerp Declaration process: a parallel session on the second day of the conference presenting and discussing many of the themes relevant to the Declaration; a Quote of the Day booth where participants could vote and share their opinion on proposed bits of text for the Declaration; and a workshop held on the third day specifically addressing different aspects of the Declaration. Input gathered through these events was then taken forward by a writing team. At the end of the conference the final Declaration was presented in plenary and a website was opened for signing the Declaration.

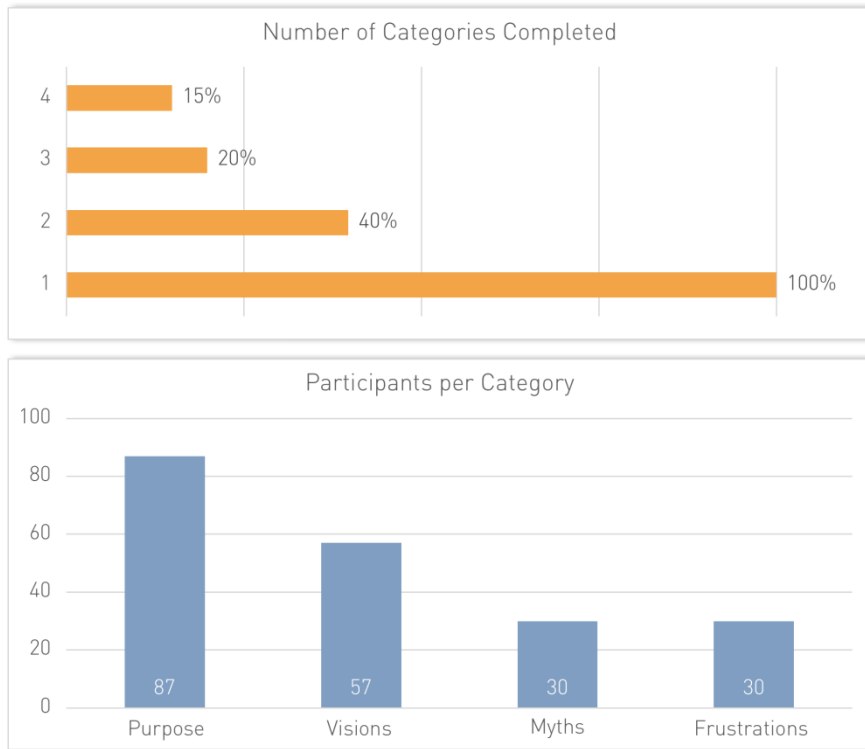
3. Results

3.1. Survey response and respondent attributes

The response rate was 34%, n=121, comprising academic researchers (50%); junior researchers (24%); practitioners (15%); policymakers (7%), and 4% who did not fit these categories. The gender balance was 41% male, 51% female, and 8% not stated, and most people reported their experience in the field of ecosystem services to be under or around 10 years.

CATEGORIES

276 All participants were obliged to complete the questions for at least one category, and many
277 chose to complete multiple (Figure 1). Participants were free to choose which category they
278 completed, but the distribution among themes suggests most people followed the
279 categories in order of listing (Figure 1), although this may also reflect their interests.



280
281 Figure 1. Number of survey categories completed by participants and number of
282 respondents per category.

3.2. Multiple choice responses

285 Figure 2 presents an overview of the Likert scale and multiple-choice responses for
286 questions P1, P2, P3, V1, M5 and F5. There was strong agreement that the ecosystem
287 services concept could increase societal interest in conservation (P1) and raise awareness of
288 human reliance on natural systems (P2), but opinion was divided as to whether an economic
289 approach could support better decision-making (P3). There was a shared vision that the
290 ecosystem services concept would achieve a paradigm shift in environmental protection

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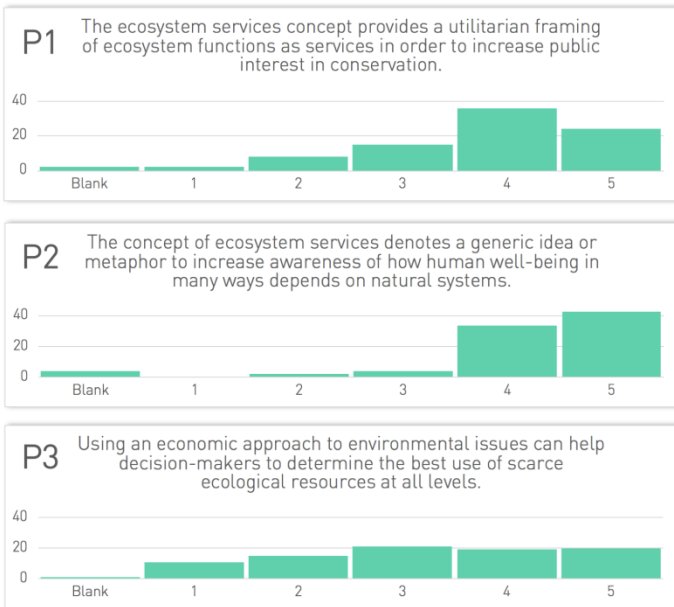
291 (V1C). Three myths frequently encountered were that the ecosystem services concept: does
292 not consider the intrinsic values of nature (M5B); is a capitalist paradigm about making
293 money (M5A); implicitly accepts that human benefits are the only things that should be
294 protected (M5D). The most dominant frustrations with ecosystem services were: challenges
295 to communicate non-economic research due to misconceptions that economic valuation is
296 at the core of the concept (F5C); that it has become such a buzzword that the concept
297 becomes increasingly vague (F5E); and that the terminology is too complicated and
298 academic to use with non-expert audiences (F5A).

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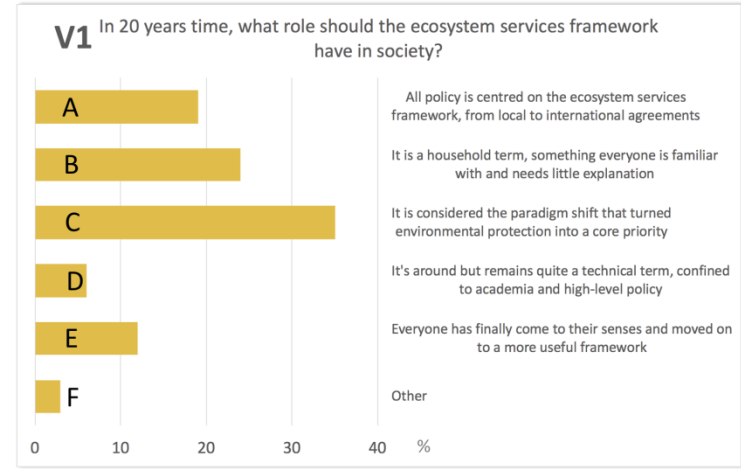
PURPOSE

N = 87



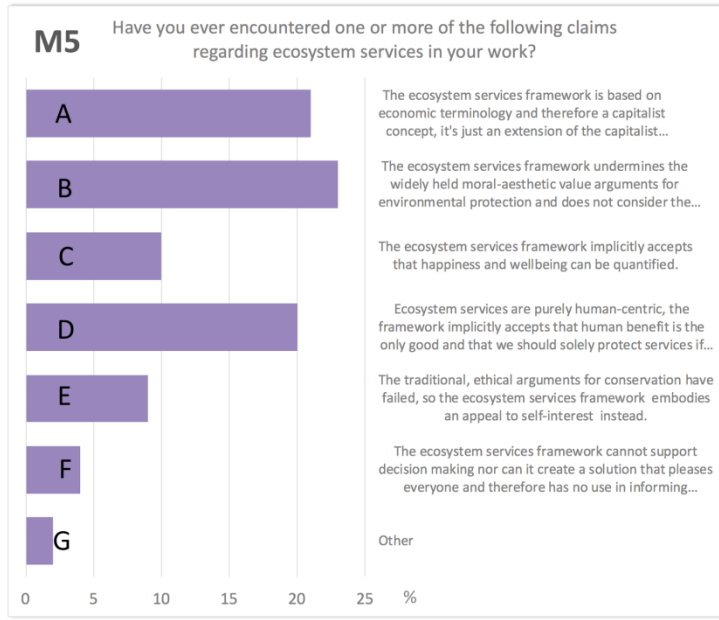
VISIONS

N = 57



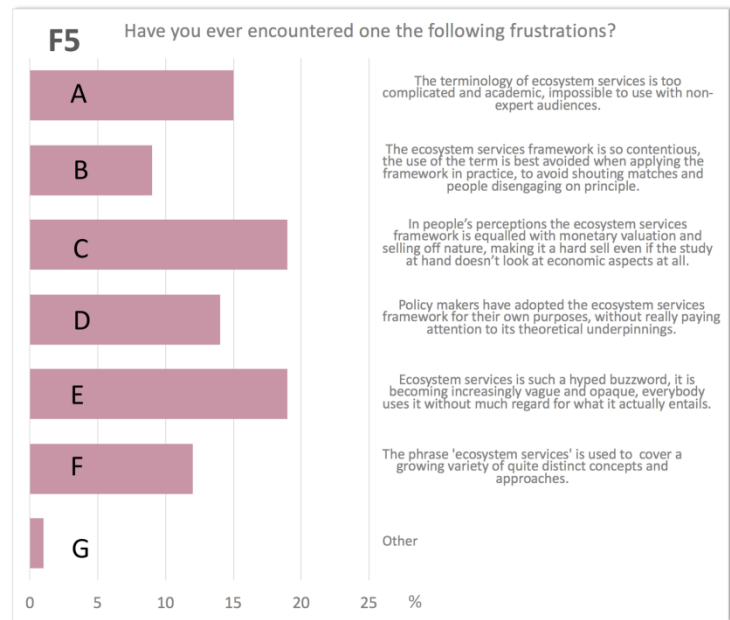
MYTHS

N = 30



FRUSTRATIONS

N = 30



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301 Figure 2. Responses to the closed questions in the survey.

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302 **3.3. Cross-cutting themes**

303 Thematic content analysis helped structure the richness of the open question responses.
304 Supplementary Material 2 provides an overview of the identified themes per question.
305 Identical or highly related themes emerged for different questions and different survey
306 categories. Results were therefore further synthesised to five cross-cutting themes, which
307 are described below. The descriptions are based on the open-ended survey responses and
308 identified themes, which are referenced, and illustrated by direct quotes.

309
310 **3.3.1. Cross-cutting theme 1: Purpose of the concept**

311 The core purpose of the ecosystem services concept is viewed by most respondents as a
312 metaphor that raises awareness of the many ways human well-being depends on natural
313 systems. This was evident in responses to P1 and P2 (Figure 2), and confirmed by the open-
314 ended answers to P4. The latter reveals more complex and diverse views, which could be
315 structured in a simplex diagram around four themes: awareness raising; decision-making;
316 science; and a holistic approach encompassing these three themes (Figure 3). Each
317 respondent was illustratively plotted in the diagram based on an interpretation of their
318 response to P4. Most respondents can be placed in the 'Awareness Raising' corner of the
319 simplex diagram based on responses such as the following two quotes.

320 *"The ecosystem service framework is useful to quantify the multifunctionality of ecosystems*
321 *and to demonstrate how human health and wellbeing depend on the multiple functions and*
322 *services of ecosystems. It is a concept that can be used to increase awareness among*
323 *ecosystem users and to support conservation."* – Academic Researcher response to P4.

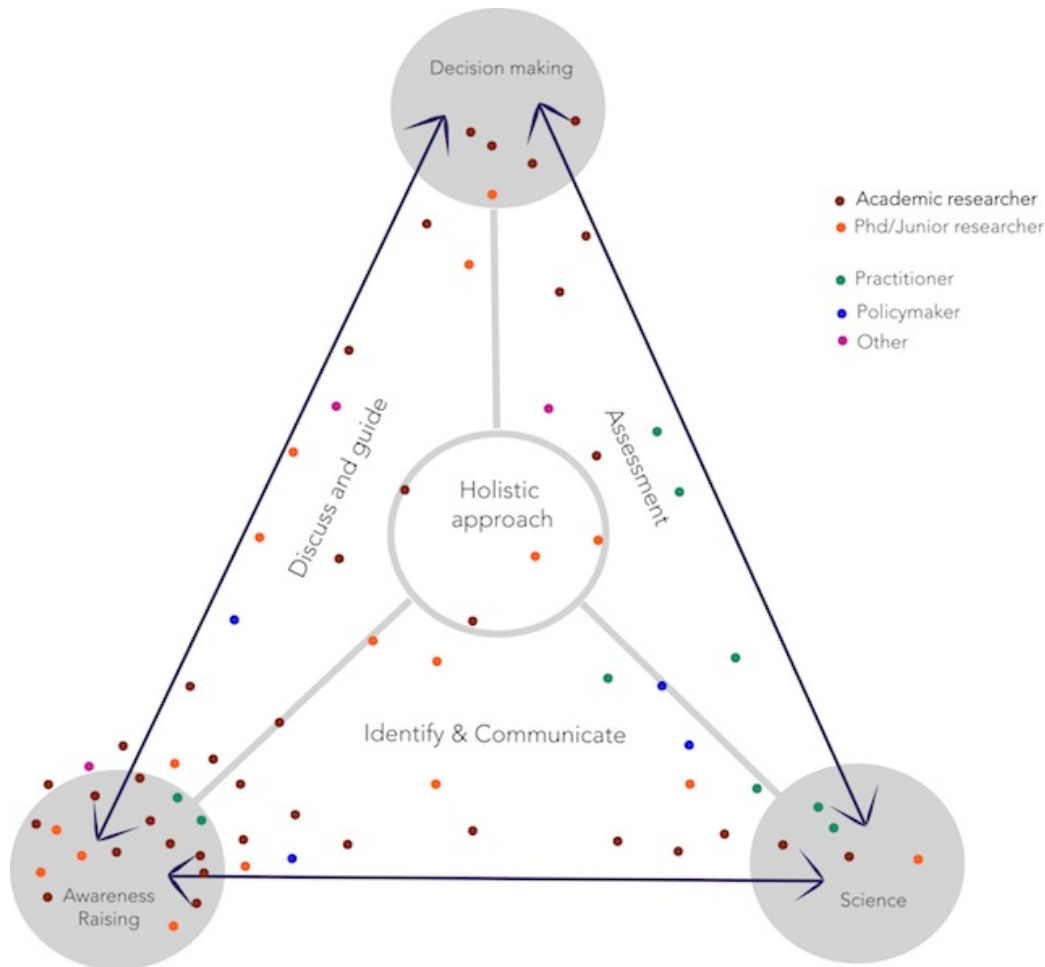
324
325 *"The integrative transdisciplinary character of the approach is very suitable to raise*
326 *awareness, support and integrate different valuation and quantification methods (social,*
327 *ecological, economic) that all are needed to support sustainable resource management and*
328 *decision making."* – Academic Researcher response to P4.

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330 The 'Decision-making' corner is populated by answers that emphasised how the ecosystem
331 services concept supports natural resource management and allocation, or explicitly
332 referred to decision-making. Note that all respondents falling in this part of the diagram are
333 researchers while practitioners making or supporting land management decisions were
334 absent.

335
336 Entries in the 'Science' corner highlighted the ecosystem services concept as a cognitive
337 exercise, aimed at better understanding of socio-ecological systems.

338



339
340 Figure 3. Simplex diagram illustrating different views about the main purpose of the
341 ecosystem services concept expressed by 87 respondents in response to survey question P4.
342 Each dot represents one respondent and is labelled for different respondent types.
343

1062
1063
1064 344 Between the corners of the diagram, conceptual axes summarise entries and positions that
1065
1066 345 combine elements from different corners. 'Assessment' connects the 'Decision-making' and
1067
1068 346 'Science' spheres, and entries were plotted here if they referred to understanding and
1069
1070 347 managing ecosystem services, or specifically talked about assessment. The 'Identify and
1071
1072 348 Communicate' axis between 'Science' and 'Awareness raising' is populated by entries which
1073
1074 349 related to communicating with stakeholders and demonstrating the links between human
1075
1076 350 and natural systems to a variety of audiences. Lastly, the 'Discuss and Guide' axis that
1077
1078 351 connects 'Awareness Raising' and 'Decision-Making' features entries concerning guiding
1079
1080 352 policy and influencing politicians, veering towards the action research domain. The centre of
1081
1082 353 the diagram highlights the holistic approach of the ecosystem services concept. This was
1083
1084 354 emphasised – to greater or lesser degree – in many answers and conceptually bridges the
1085
1086 355 three corners of the triangle.

1091 356

1094 357 *3.3.2. Cross-cutting theme 2: Economic valuation*

1096 358 Although frequently mentioned and occasionally criticised (V2, V3), economic valuation was
1097
1098 359 – overall – not perceived to be inherently problematic, but its potential misuse was a
1099
1100 360 concern for many. However, respondents disagreed whether an economic approach would
1101
1102 361 help decision-making (Figure 2; P3). Participants were concerned that misuse of the
1103
1104 362 ecosystem services concept could lead to poor decision-making, rushed and under-
1105
1106 363 resourced assessments used to further a political agenda, and a bias towards industry
1107
1108 364 interests (P5, V2). Several respondents warned against considering the ecosystem services
1109
1110 365 concept as a panacea or cure-all for any environmental or resource management challenge
1111
1112 366 regardless of the appropriate scale, methods and application of the framework (V2). There
1113
1114 367 were also concerns about the framework potentially backfiring by providing a rationale for
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1124 368 environmental degradation rather than conservation (P5) as illustrated by the following
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1127 369 quote:
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1131 371 *“The misconception that it is all about utilitarian and monetary values. This is untrue, even*
1132 372 *to the contrary. However, this has been repeated so often, and some instances in fact do*
1133 373 *misuse the concept that way still. Kind of a self-fulfilled myth almost.” – Academic*
1134 374 *Researcher response to M1.*
1135 375
1136
1137 376 Thematic content analysis revealed that these frustrations stem from: a polarised academic
1138
1139
1140 377 debate, and to a lesser extent from opposition with conservationists with further confusion
1141
1142 378 stemming from media and high-profile publications; ecosystem services terminology and
1143
1144 379 underlying conceptual framework; dominant worldviews and ideologies (M3). There was
1145
1146
1147 380 also considerable frustration about false perceptions that economic valuation is central to
1148
1149 381 the ecosystem services concept, which was expressed exhaustively as a common
1150
1151 382 misunderstanding (M1), but also as a frustration (F1) as illustrated by the following quote:
1152
1153 383 *“That ecosystem services is all about 'valuing nature' - it's an approach that should be used*
1154 384 *very intelligently to frame environmental management challenges through a more socially*
1155 385 *relevant and integrated lens. Valuation is just one tool in the ecosystem services basket.” –*
1156 386 *Policymaker response to M1.*
1157 387
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1160 388 3.3.3. *Cross-cutting theme 3: Social and cultural values*

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1162 389 Although economic valuation was not seen as problematic – as explained above – many
1163
1164 390 respondents were concerned about the lack of non-economic valuation methods (V2), and
1165
1166
1167 391 the more limited interest and ability to include non-economic valuation in decision-making
1168
1169 392 (V2). This bias can lead to poor decision-making (P5), and the explicit incorporation of social
1170
1171 393 and cultural values into decision-making was expressed as an important step in the future
1172
1173 394 development of the ecosystem services concept (V3). This would prevent misuse of the
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1175
1176 395 framework (P5) and help overcome a range of shortcomings currently identified (F3) –
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396 including a bias towards economic valuation approaches and a lack of social science
397 compared to ecological and environmental sciences and economics. Embracing social and
398 cultural values was seen as important communication pathway to both wider society and
399 decision makers (V3, F2, F4), countering potential misunderstandings and inappropriate use
400 of monetary definitions of value (M4), and a key requirement to realizing the transformative
401 potential of the framework (V3, F4). The following quote is one of many emphasising the
402 importance of social and cultural values:

403 *“Incorporate the cultural (and spiritual) value of nature more which brings back the*
404 *connection to nature and why we care about nature.”* – Junior researcher or student in
405 response to V3.
406

3.3.4. *Cross-cutting theme 4: Inter- and transdisciplinarity*

408 Many respondents hope the ecosystem services concept would be considered a paradigm
409 shift in environmental protection within the next 20 years (35% of responses; V1C Figure 2).
410 Despite this apparent enthusiasm, a broad range of challenges impeding the widespread use
411 of the ecosystem services concept were raised (V2) including: the lack of training and
412 awareness of the concept among policymakers and practitioners; a lack of demonstrable
413 policy impact and evidence of halting environmental degradation; institutional barriers and
414 ‘silos’ in research and governmental bodies; and the technocratic and/or utilitarian
415 terminology. These challenges were mirrored in frustrations about the bias and limitations
416 in methods and decision-making processes (F3).

417
418 There was recognition that the ecosystem services concept has been a catalyst for
419 promoting collaboration across disciplines (P4), but that expanding collaboration is essential
420 to stimulate dialogue and generate common understanding that is necessary to achieve

1242
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1244 421 societal impact (V3, F4). Framing the challenges around issue-based research will encourage
1245
1246 422 transdisciplinary collaboration between disciplinary experts, business stakeholders and
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1249 423 public body representatives (V3, F4). The involvement of knowledge brokers and the media
1250
1251 424 is critical in supporting collaboration and in communicating outcomes (F4). The following
1252
1253 425 quote is one of many calling for interdisciplinary research:

1255 426 *“Ultimately, it is critical for a more interdisciplinary approach to the scientific research*
1256 427 *agenda to enrich the research and facilitate better policy translation and a reduction in the*
1258 428 *emergence of perverse policies.”* – Respondent from ‘other’ category in response to V2.
1259 429

1261 430 3.3.5. Cross-cutting theme 5: Ecosystem services in practice

1262
1263 431 From the policy and practitioner side, a clear need for practical learning emerged (V2, F1,
1264
1265
1266 432 F3, F4), and case study research was mentioned frequently as a way to progress the
1267
1268 433 implementation of the framework to support land management decision-making (V3, F4).
1269
1270 434 Several key steps for further development of the ecosystem services concept were
1271
1272 435 identified (V3, F4): develop and share targeted information, packaged and communicated
1273
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1275 436 appropriately to selected audiences; engage stakeholders and public; bring business and
1276
1277 437 researchers together to encourage innovation and creation of new flexible business models
1278
1279 438 that integrate ecosystem services; include more socio-cultural values and by extension
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1281 439 social scientists; and strengthen the integration of ecosystem services into all policy sectors,
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1284 440 in dialogue with researchers and practitioners.

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1286 441
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1288 442 There were many frustrations related to the user-friendliness of the ecosystem services
1289
1290 443 concept (F1, F2). Irritations about the academic nature or the terminology (F5A, Figure 2),
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1292
1293 444 has already been mentioned in this respect, but the content analysis revealed frustration
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1295 445 around the lack of standardisation (F2), insufficient suitable and accessible methods (F3),
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1304 446 and a lack of data (V2, F3). Practitioners also signalled being overwhelmed by the variety of
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1306 447 categorisations and tools available, and the background information required for their
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1309 448 appropriate application (F3). Challenges remain to move the ecosystem services concept
1310
1311 449 into the mainstream of natural resource management, with many calls to increase the user-
1312
1313 450 friendliness of planning and decision support tools to support their application beyond
1314
1315
1316 451 current users and to better share the large amount of knowledge and learning that is
1317
1318 452 generated by case study research (V3, F2, F4). The following quotes illustrate the frustration
1319
1320 453 with the user-friendliness of the ecosystem services framework:
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1322 454
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1325 455 *“The language – and therefore the concept – suffers from its technocratic, utilitarian image.”*
1326 456 *– Academic researcher in response to V2.*
1327 457

1328
1329 458 *“It is frustrating how many parties seem obsessed with re-classifying ecosystem services on a*
1330 459 *continual basis - this is often unnecessary and unhelpful when seeking to implement a*
1331 460 *joined-up approach across different interest groups.” – Policymaker response to F1.*
1332
1333 461

1334 1335 462 **3.4. The Antwerp Declaration** 1336

1337 463 The ‘early findings’ document, included in the EESC delegate pack (see Supplementary
1338
1339 464 Material 3), formed the basis for the participatory exercises during the conference, which
1340
1341 465 received input from approximately 100 individuals. These participatory events largely
1342
1343 466 confirmed the cross-cutting themes summarised in section 3.3, although greater emphasis
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1345 467 was placed on the importance to focus the ecosystem services concept on the principles of
1346
1347 468 sustainability. The discussion also provided guidance about how to translate the findings to
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1349 469 a short Declaration that forms a call for action that was signed (on a voluntary basis) by the
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1351 470 conference delegates. The resulting Declaration (Figure 4) was presented at the closing
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471 plenary and has been signed by 331 people on the website www.antwerpdeclaration.com
472 following the conference (last count 17 August 2018).

473

The Antwerp Declaration



Following a decade of ever more research activity the ecosystem services framework has major political and scientific momentum. We must now deliver societal impact.

In this declaration we – the signatories – call for action to realise the transformative potential of the ecosystem services framework. We need to refocus on principles of sustainability, reclaim the notion of value and expand collaborations.

Refocus on principles of sustainability

Ecosystem services gained prominence as a framework that acknowledges nature's fundamental role in supporting human wellbeing. There has been considerable progress in quantifying, valuing, and mapping ecosystem services. Yet, there is a risk that these methods are applied without consideration of equality and social justice. To ensure the fair distribution of nature's benefits we need to refocus the ecosystem services framework on the principles of sustainability. By explicitly including sustainability principles in ecosystem services assessments we can bring into focus trade-offs between conflicting interests, guide just decisions and avoid misuse of the concept.

Reclaim the notion of value

How we understand our relationship with nature sits at the heart of the ecosystem services framework. To do justice to all the ways nature matters to us as humans we need to include diverse values into our assessments. By embracing a multitude of perspectives, voices and values we can move away from understanding nature's importance in a purely monetary way. Finding innovative approaches that include multiple values is challenging, but enables us to make better decisions. Collaborative projects with many different stakeholders should therefore be the starting point of any ecosystem assessment.

Expand collaborations

The ecosystem services framework has been a catalyst for promoting collaboration across disciplinary boundaries. Expanding collaboration is essential to stimulate dialogue and generate common understanding that is necessary to achieve societal impact. Framing the challenges around issue-based research will encourage collaboration between disciplinary experts, business stakeholders and local government representatives. The involvement of knowledge brokers and the media is critical in supporting collaboration and in communicating outcomes.

For Impact we need to

- make the most of the large amount of knowledge and learning that is generated by case study research
- develop and share targeted information, packaged and communicated appropriately to selected audiences
- increase the user-friendliness of frameworks and tools to support their application beyond current users
- bring business and researchers together to encourage innovation and creation of new flexible business models that integrate ecosystem services
- strengthen the integration of ecosystem services into all policy sectors in dialogue with researchers and practitioners

Sign the Declaration today:
www.antwerpdeclaration.com



474
475 Figure 4. The Antwerp Declaration – www.antwerpdeclaration.com

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476 **4. Discussion**

477 The EESC represented a rare opportunity to collect the views of a varied group of
478 researchers, practitioners and policymakers engaged with the ecosystem services concept.
479 We recognise our result reflects a primarily Eurocentric perspective. However, the survey
480 received many responses and the events held at the conference were well attended,
481 allowing us to collect insights from a diverse group.

483 **4.1. The role of the ecosystem services concept in the science-policy interface**

484 Responses to our survey demonstrate the tension between the different roles that the
485 ecosystem services concept can play at the science-policy interface. Many participants
486 expressed the view that the concept was a useful awareness raising tool and could be used
487 to integrate different perspectives and approaches in environmental management (Cross-
488 cutting theme 1). That is, to function as a boundary object. Many academics in our study did
489 not identify scientific inquiry as the primary role of the ecosystem services concept, instead
490 clustering to a much greater extent in the 'Awareness Raising' corner. This could indicate a
491 perception among academics of ecosystem services as an advocacy tool, rather than a
492 primarily scientific concept (Barnaud and Antona, 2014; Crouzat et al., 2017).

493
494 There were also concerns around the lack of standardisation and the user-friendliness of the
495 concept for decision makers (Cross-cutting theme 5). Indeed, many practitioners and
496 policymakers did not see the core purpose of the ecosystem services concept as
497 contributing directly to decision-making (Figure 3). This is consistent with recent literature
498 suggesting that, despite a number of projects and toolkits aimed at integrating ecosystem
499 services into decision-making, assessments rarely play an instrumental role in influencing

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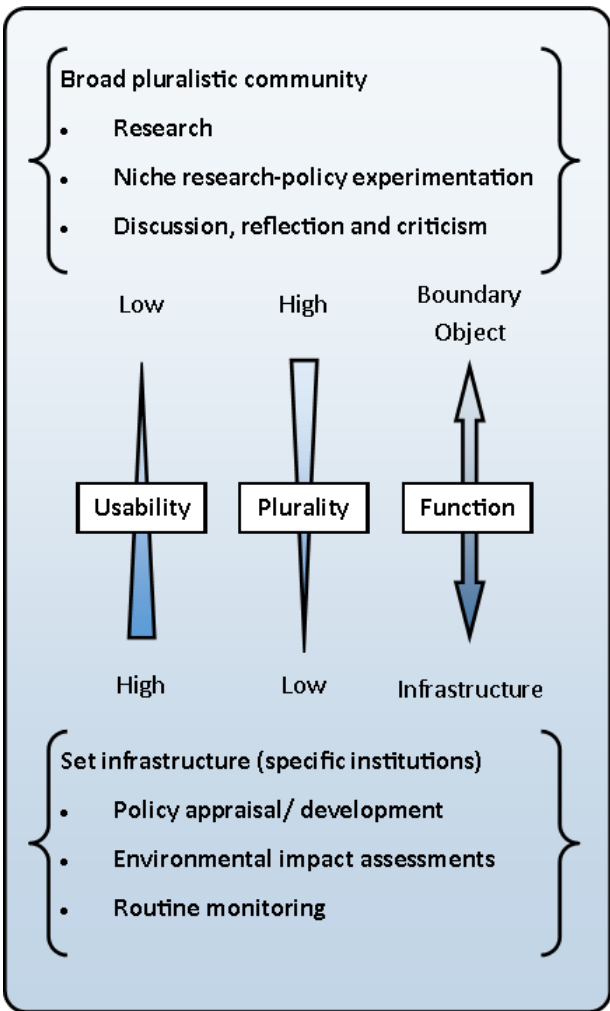
500 decisions (Dick et al., 2018; Martinez-Harms et al., 2015; Ruckelshaus et al., 2013; Saarikoski
501 et al., 2018).
502
503 Standardisation was the most frequently cited remediation for the issue of user-friendliness,
504 amongst both practitioners and academics (F2). Efforts are being made to standardise the
505 categorisation of ecosystem services (primarily through the Common International
506 Classification of Ecosystem Services (CICES⁶)), and several calls and attempts to standardise
507 conceptual frameworks and assessment/valuation approaches have appeared in the
508 literature (Boerema et al., 2017; Boyd and Banzhaf, 2007; Seppelt et al., 2012, 2011).
509 However, standardisation involves the curtailment of some of the conceptual and
510 methodological diversity that exists within the ecosystem services community, potentially
511 hampering inter- and transdisciplinary dialogue and communication supported by our
512 respondents (Cross-cutting theme 4: Inter- and transdisciplinarity). Standardisation
513 correlates to the creation of 'infrastructure', and we follow Steger et al. (2018) in suggesting
514 that such a move would limit the capacity of ecosystem services to function as boundary
515 objects.
516
517 Decreasing existing ambiguity around the ecosystem services concept, and space for
518 disagreement or multiple interpretation, may limit the ability of ecosystem services to act as
519 a boundary object and facilitate communication and collaboration between different
520 stakeholders, decision makers and local communities. This supports the conclusion of Galler
521 et al. (2016), that ecosystem services may function most effectively as a boundary object

⁶ www.cices.eu

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1544 522 above the level of specific policy or management decisions. This does not imply that the
1545
1546 523 concept plays no role in policymaking; others have identified conceptual learning, consistent
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1549 524 with the boundary role of ecosystem services, as a promising impact pathway of ecosystem
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1551 525 services assessments and research (Beaumont et al., 2017; Carmen et al., 2018; Dick et al.,
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1553 526 2018; Ruckelshaus et al., 2013).
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1555 527
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1557 528 There is a potential conflict between those who see ecosystem services as a tool for raising
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1559 529 awareness and discussion, and those who wish to see it standardised and used in decision-
1560
1561 530 making. We argue that this can be reconciled by accepting that the concept is capable of
1562
1563 531 playing both roles at once, and that whilst the creation of standardised infrastructure should
1564
1565 532 be supported, it is necessary to maintain a more pluralistic notion of the concept within
1566
1567 533 academic and policy debates (Figure 5).
1568
1569 534
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1571 535 The creation of infrastructure will reflect and embody the norms of the context in which it is
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1573 536 developed (Saarela and Rinne, 2016; Turnhout, 2009). This can be a necessary trade-off to
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1575 537 improve usability and uptake of the concept directly in decision and policymaking, however
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1577 538 it can become problematic for two reasons: 1) if the knowledge, views or values of a
1578
1579 539 particular group or groups within this context are excluded; or 2) if such infrastructure is
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1581 540 transplanted to a cultural context that is significantly different from where it was created (as
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1583 541 may be the case in transnational environmental governance settings).
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1585 542
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1587 543 Experimentation with the ecosystem services concept in different policy contexts is
1588
1589 544 increasing, and it is possible that we will see a continued construction of infrastructure
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1591 545 within different administrative jurisdictions (at a sub-national, national, and international
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546 scale) (Bezák et al., 2017; Bouwma et al., 2018; Mauerhofer, 2018; Mauerhofer and Laza,
547 2018; McKinley et al., 2018). As this happens, retaining a highly pluralistic notion of the
548 concept that exists above any contextually specific infrastructure has two distinct
549 advantages over full standardisation of the concept. First, it maintains space for worldviews
550 that are excluded through the construction of infrastructure, allowing ecosystem services to
551 still function as boundary objects that enhance debate and awareness raising over the
552 relationship between nature and human well-being. Secondly, it allows space for more
553 critical, dissenting voices and academic disciplines to highlight constantly the way that the



554 creation of infrastructure can obfuscate and normalise political choices made during its
555 creation (Kull et al., 2015; Turnhout et al., 2016).

556

1662
1663
1664 557 Figure 5. Trade-offs between the function of ecosystem services as a boundary object and as
1665 558 set infrastructure capable of informing policy and decision-making, in terms of usability and
1666 559 plurality.
1667 560
1668
1669

1670 561 **4.2. Valuation of ecosystem services**

1672 562 Values, and valuation, are useful vehicles to explore the dynamics between ecosystem
1673
1674 563 services in the broad, pluralistic sense (where it is most effective as a boundary object), and
1675
1676 564 ecosystem services as set infrastructure. Our results show a clear desire for social and
1677
1678 565 cultural values to be better captured in ecosystem services assessments (Theme 3: Social
1679
1680 566 and cultural values). This was reaffirmed through input to the Antwerp Declaration, where
1681
1682 567 the need to 'reclaim' the notion of value was raised. This desire resulted from the dual
1683
1684 568 perception that 1) integrating a plurality of values is essential to ensure that ecosystem
1685
1686 569 services assessments lead to inclusive decision-making, and 2) a perception exists that only
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1688 570 a limited definition of value is captured within the ecosystem services concept.
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1695 572 The concept of ecosystem services has stimulated much debate about the notion of value,
1696
1697 573 and how best to measure it; bringing together scholars from a wide range of disciplines
1698
1699 574 (Chan et al., 2016, 2012; Edwards et al., 2016; Fanny et al., 2014; Fish et al., 2016; Jacobs et
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1701 575 al., 2018, 2016; Jax et al., 2013; Kenter et al., 2016c, 2015; Ranger et al., 2016; Sagoff, 2011).
1702
1703 576 Here, we see ecosystem services function as an effective boundary object, and many
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1705 577 methodologies now exist for integrating different types of values into ecosystem service
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1707 578 assessments (Iniesta-Arandia et al., 2014; Jacobs et al., 2016; Kenter, 2016; Kenter et al.,
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1709 579 2016c, 2016a; Ranger et al., 2016). Such methodologies are now established as a part of the
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1711 580 plethora of existing ecosystem services approaches and practices. Operationalizing these
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1713 581 methods in real world decision-making was a core priority that emerged from our survey
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1724 582 (Theme 3: Social and cultural values). However, none of these methods are capable of
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1726 583 capturing all types of value (Jacobs et al., 2018), and it is not necessarily the case that such
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1728 584 methods will become standard practice within policy and decision-making. In the UK for
1729
1730 585 example, despite recognition of the importance of shared and cultural values within the UK
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1732 586 National Ecosystem Assessment (UK NEA, 2014), the Treasury 'Green Book' which dictates
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1734 587 suitable valuation methods for public body decision-making in the UK relies exclusively on
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1736 588 methods derived from neoclassical economics (Treasury, 2011). As much as an economic
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1738 589 figure might be open to boundary work (Jadhav et al., 2017), it cannot be removed by the
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1740 590 institutional context that created it and cannot be neutral; this is totemic of the broader
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1742 591 issue of creating infrastructure for ecosystem service assessment and valuation.
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1744 592
1745
1746 593 Narrow economic valuation of ecosystem services was criticised by some respondents to
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1748 594 our survey, however it was largely not seen to be inherently problematic (Theme 2:
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1750 595 Economic valuation); matching findings from previous studies (Fisher and Brown, 2015;
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1752 596 Hermelingmeier and Nicholas, 2017). Concerns were raised however regarding the potential
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1754 597 for ecosystem services studies to be misused to further specific political agendas or support
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1756 598 environmentally destructive activities, as may be the case if infrastructure is created in the
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1758 599 context of highly extraction-driven, capitalistic norms. Maintaining a pluralistic notion of the
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1760 600 ecosystem services concept will ensure that space remains for the critical reflection of the
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1762 601 use of the concept within different institutional settings. Within this context, the desire to
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1764 602 ensure that social and cultural values are captured offers a potential guiding principle.
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1768 604 Epistemologically, meaningful knowledge can be generated both about how others see and
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1770 605 value the world, and about how collectives of individuals do at different scales, moving
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606 beyond the notion that value is held only by individuals. There is a growing body of theory
607 on how shared and cultural values are formed and created, and how these relate to other
608 value types (Kenter et al., 2016b, 2016c; Raymond et al., 2014). Using the notion of shared
609 and cultural values as a guiding principle of the ecosystem services community, it is
610 necessary to engage with this theory to adopt methods consistent with this. This has
611 implications for neoclassic approaches to economic valuation, due to the inadequacy of the
612 theory of marginal utility value to meaningfully engage with the concept of shared values.
613 Neoclassical approaches are prevalent in ecosystem services values, both at the research
614 and experimental policy assessment level, and in settings where the valuation of some
615 services is institutionalised. However, such hegemony of neoclassic economics means that
616 rejecting valuation based on marginal utility theory entirely might significantly reduce the
617 space for ecosystem services with national and international policymaking.

618

4.3. Inter- and transdisciplinary approaches

619 Increased collaboration, both between academic disciplines and between academia and
620 wider society, was identified as a key area for the development of ecosystem services
621 research and practice. The expansion of inter- and transdisciplinary work was a clear desire
622 of the respondents (Theme 4: Inter- and transdisciplinarity), and matches aspirations in the
623 literature (Carmen et al., 2018; Jacobs et al., 2015). The inclusion of more social scientists
624 within ecosystem services assessments was particularly stressed as a necessary step to
625 increase the integration of social and cultural values (Theme 5: Ecosystem service in
626 practice).

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1842
1843
1844 629 The ecosystem services concept arose at the interface of ecological and economic science,
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1846 630 however is now engaged with and functions as a boundary object between a large range of
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1849 631 disciplines (Chaudhary et al., 2015). Yet physical, economic and social geographers are just a
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1851 632 few groups to have been identified as having useful, but underutilised insights (Barnaud and
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1853 633 Antona, 2014; Dempsey and Robertson, 2012; Potschin and Haines-Young, 2011). Even large
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1855 634 scale efforts at interdisciplinary working, such as the Intergovernmental Science-Policy
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1857 635 Platform on Biodiversity and Ecosystem Services (IPBES), are dominated by natural scientists
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1859 636 (Timpote et al., 2018) and within IPBES the need for a stronger engagement of social science
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1861 637 and humanities was particularly emphasised (Díaz et al., 2018).
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1863 638
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1865 639 Our results, suggesting the lack of engagement from some disciplines, may be due to the
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1867 640 way the concept is perceived. Although respondents to our survey did not see economic
1868
1869 641 valuation as central to the ecosystem services concept (P4), the perception that the two are
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1871 642 closely interlinked was commonly encountered by participants; primarily being held by
1872
1873 643 other scientists and, to a lesser extent, conservationists (Theme 2: Economic valuation). One
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1875 644 respondent suggested that many groups and scientists simply refuse to engage with
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1877 645 ecosystem services (P2), due to its image as a technocratic and utilitarian approach. This
1878
1879 646 finding matches others who have noted the tendency to conflate 'ecosystem services' with
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1881 647 'payments for ecosystem services' (PES) schemes, and the potential for such confusion to
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1883 648 deter some from engaging with the concept (Schröter et al., 2014; Schröter and van
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1885 649 Oudenhoven, 2016).
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1887 650
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1889 651 The perception that the concept of ecosystem services is equivalent to putting a price on
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1891 652 nature limits its capacity to function as a boundary object, as some may regard it as
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653 antithetical to their way of viewing the human-nature relationship. We suggest that future
654 collaborations may be assisted by addressing false perceptions of the ecosystem services
655 concept, particularly regarding the centrality of economic valuation. Increasing integration
656 of other disciplines into ecosystem services research may be assisted by improving
657 communication to overcome myths about the concept (see section 5.1.3: Economic
658 valuation), and by demonstrating the contributions that different disciplines can make
659 through the expansion and publication of case study research.

660
661 As infrastructure is created to embed ecosystem services assessments with specific
662 governance institutions, it will be impossible and potentially unnecessary to maintain the
663 disciplinary heterogeneity that exists within the community. However, ecosystem service
664 assessments still require skilled interdisciplinary teams, particularly if they are to capture
665 social and cultural values as well as the biophysical elements of ecosystem services.

666 Assessment approaches also legitimise some knowledge claims at the expense of others,
667 meaning that in the context of transdisciplinary assessments it is important to co-develop
668 the design of the research between knowledge holders and to be open about
669 methodological and data-related choices. This consideration requires the deployment of
670 trained social scientists to develop suitable processes for knowledge co-production.

671 Equipping public bodies with the necessary skills therefore requires significant investment,
672 as currently environmental impact assessments and policy appraisals are not necessarily
673 conducted by teams of researchers with interdisciplinary skills (Rozas-Vásquez et al., 2018;
674 Turnpenny et al., 2014; Wawrzyczek et al., 2018).

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676 It is in this context that it becomes crucial to retain a diverse, pluralistic community of
677 practice outside of any specific attempt to institutionalise the concept. Such a community
678 can play at least two vital roles: 1) continuing to bring different groups together in inter- and
679 transdisciplinary research projects to better understand the relationship between nature
680 and human well-being; 2) to critically appraise the construction of infrastructure within
681 particular institutional contexts, specifically in relation to which knowledge or groups are
682 excluded from the process. Critical geographers are uniquely positioned to offer such
683 critique, as their discipline is well versed in exploring the power relations around the social
684 construction and mobilisation of emerging and 'taken for granted' concepts and practices
685 (Kull et al., 2015; Turnhout et al., 2016).

686
687 Inter- and transdisciplinary research and assessment approaches are strongly supported
688 within the ecosystem services community (Ainscough et al., 2018; Albert et al., 2017;
689 Carmen et al., 2018; Costanza et al., 2017; Steger et al., 2018). This acts as a guiding
690 principle in the broad sense that it rejects narrow disciplinary approaches to ecosystem
691 service assessment and valuation. This brings the norm of collaborative working and respect
692 for different knowledge types. However, whilst important, this commitment does not offer
693 a guide to the breadth of pluralism within the ecosystem services community per se; as it is
694 more an acceptance that plurality itself is a positive thing.

695
696 **4.4. Sustainability and ecosystem services**

697 A need to focus on the principles of sustainability was emphasised during events at the
698 conference and became a core element of the Antwerp Declaration. Sustainability is usually
699 understood as equitably meeting the needs of current generations without reducing the

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700 capacity of future generations to meet their needs (WCED, 1987). As sustainability is not
701 necessarily implied by the ecosystem services concept, many authors have sought to
702 synthesize the two concepts to ensure that the ecosystem services concept is applied in a
703 manner that is consistent with the principles of sustainability. This literature makes two key
704 points. First, that the biophysical processes underpinning ecosystem services (and inherent
705 limits in their ability to survive under different levels of stressors) should not be lost behind
706 the 'stock' metaphor of ecosystem services. Secondly, stakeholder preferences and values
707 should form part of ecosystem service assessments, to ensure people's needs are equitably
708 accounted for.
709
710 Jacobs et al. (2013) stressed the need to refocus ecosystem services research around a
711 'strong' notion of sustainability; suggesting that the majority of ecosystem services research
712 focuses on the efficient use of ecosystem services, but not the inherent limits and
713 boundaries of the reproductive capacities of underlying natural capital. These authors
714 suggest that there is high uncertainty around the capacity of natural capital to be
715 maintained which should factor into the assessment of ecosystem services and any related
716 scenario modelling or policy analysis. These authors also emphasise the centrality of fairness
717 and equity to the sustainability concept and suggest that distributional effects should be
718 central to any ecosystem services analysis.
719
720 Schröter et al. (2017) discuss ecosystem services as a descriptive and normative scientific
721 concept, whose application may conflict with the principles of sustainability. They claim that
722 'if the ecosystem service concept is understood as contributing to sustainability, ecosystem
723 services need to be conceptualised through sustainability strategies rather than assessing all

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2084 724 forms of natural resource use in aggregated, snap-shot assessments' (Schröter et al., 2017,
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2086 725 p. 41). Cavender-Bares et al. (2015) seek to synthesise economic, ecological and systems
2087
2088 726 theory to integrate ecosystem services and sustainability. Principally, they suggest
2089
2090 727 accounting for the ecological mechanisms underpinning services in the way assessments are
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2092 728 carried out, particularly the inherent biophysical limits of these processes. By integrating
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2094 729 preferences and values of different stakeholders, coupled with a systems dynamics
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2096 730 approach, ecosystem services assessments could consider how the whole system might
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2098 731 develop over time (Cavender-Bares et al., 2015). Similarly, Bennett and Chaplin-Kramer
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2100 732 (2016) point to the development of a socio-ecological systems perspective as a step forward
2101
2102 733 in integrating sustainable use to the ecosystem services research agenda (although it is not
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2104 734 clear that this is an 'advancement' as much as a return to the roots of ecosystem services
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2106 735 science, given its origins in systems ecology (Costanza et al., 2017; Odum, 1971). Despite all
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2108 736 these calls, sustainability issues of ecological thresholds and fairness are still often ignored
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2110 737 in ecosystem services research and practice (Dendoncker et al., 2018).
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2118 739 Focusing on principles of sustainability, coupled with consideration of social and cultural
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2120 740 values of ecosystem services, was seen as key to ensuring the concept was not misused or
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2122 741 used to justify environmentally degrading activities (Theme 2: Economic valuation). Here we
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2124 742 reiterate, with the support of respondents who contributed to the development of the
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2126 743 Antwerp Declaration, the call to adopt the normative and analytic content of the concept of
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2128 744 sustainability in discussion and application of the ecosystem services concept. We add the
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2130 745 caveat that, as the ecosystem services concept is embedded as infrastructure in planning
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2132 746 and decision-making in different contexts, the need for this to be coupled with the
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2134 747 principles of sustainability becomes greater.
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2147 749 In terms of the main types of pluralism we have discussed, the notion of sustainability
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2149 750 provides limits to the epistemological and methodological approaches within ecosystem
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2151 751 services research, whilst also placing it within a broader normative framing. It is therefore a
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2153 752 useful concept to guide the discussion and practice around the ecosystem services concept.
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2155 753 This obviously has ramifications for the types of epistemological, theoretical and
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2157 754 methodological approaches to ecosystem services research and practice compatible with
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2159 755 sustainability.
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2165 757 A heavy focus on human values, or biophysical processes, whilst not precluded by a
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2167 758 commitment to sustainability, should also be treated with caution. Methodologies that seek
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2169 759 purely to understand how humans value their environment will not capture ecological
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2171 760 dynamics and limits. Similarly, approaches focused purely on the biophysical underpinning
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2173 761 of ecosystem services may miss the important distributional impacts of changes between
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2175 762 different user groups. At the broad level of research and policy-science innovations, this is
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2177 763 not problematic as studies may seek to answer certain questions or develop new methods.
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2179 764 However, as infrastructure is created, it is important that neither values, nor biophysical
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2181 765 dynamics are neglected. This reinforces the need to ensure that inter- and transdisciplinary
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2183 766 practices are carried forward as the concept is institutionalised.
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2190 768 **5. Concluding remarks**
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2192 769 There are advantages and disadvantages to the ecosystem services concept being a
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2194 770 boundary objects or set infrastructure, and likely these roles represent poles on a spectrum
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2196 771 rather than a binary split. We find these two notions useful lenses for understanding the
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2204 772 role of the ecosystem services concept at the science-policy interface, and for framing the
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2206 773 views of different user groups. As the concept is further institutionalised in governance
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2208 774 institutions, it is important to remain cognizant of the trade-off that exists between these
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2210 775 two roles and to not lose sight of the political choices necessary for the creation of set
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2212 776 infrastructure.
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2214 777 The integration of the principles of sustainability, and the inclusion of social and cultural
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2216 778 values have been prevailing in the literature for some time. We suggest that these can
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2218 779 operate as guiding principles to the application of the ecosystem services concept, however
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2220 780 do not suggest this is an exhaustive list. The work of guiding the multitude of interpretations
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2222 781 and applications of the ecosystem services concept is an ongoing reflexive task of the wider
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2224 782 community, and we suggest that surveys such as ours can provide useful data for such a
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2226 783 process.
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3045 **1107** **Supplementary Material**
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3049 **1109** SM2 – Coding Matrix
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1130 **Supplementary Material 1**

1131 Full survey circulated among 350 early registrants to the European Ecosystem Services
1132 Conference 2016.

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<p>Q1. What would you like to talk about? (<i>Multiple-choice, single choice, mandatory</i>)</p> <ul style="list-style-type: none"> A) Values B) Goals C) Myths D) Grumbles
<p>Purpose (Values in the original survey)</p>
<p>What do you think is at the heart of the Ecosystem services framework? [...] Please indicate how closely each of the following statements resembles your own thinking:</p> <p>P1) The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation. (<i>5-point Likert scale</i>)</p> <p>P2) The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of how human well-being in many ways depends on natural systems. (<i>5-point Likert scale</i>)</p> <p>P3) Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels. (<i>5-point Likert scale</i>)</p> <p>P4) Now that you've gone through the literature statements, can you put down in your own words what you think is at the heart of the ecosystem services framework? (<i>Open-ended</i>)</p> <p>P5) What, to your mind, would be the worst misuse of the ecosystem services framework? (<i>Open-ended</i>)</p> <p>P6) Beyond basic research ethics and good practice, what values and principles or ideas should guide the practical applications of the ecosystem services framework? (<i>Open-ended</i>)</p>
<p>Visions (Goals in the original survey)</p>
<p>V1) In 20 years time, what role should the ecosystem services framework have in society? (<i>Multiple-choice, tick all that apply</i>)</p> <ul style="list-style-type: none"> A) All policy is centred on the ecosystem services framework, from local to international agreements B) It is a household term, something everyone is familiar with and needs little explanation C) It is considered the paradigm shift that turned environmental protection into a core priority D) It's around but remains quite a technical term, confined to academia and high-level policy E) Everyone has finally come to their senses and moved on to a more useful framework F) Other (please describe below) <p>V2) What are the main challenges for the widespread use of the ecosystem services framework (<i>Open-ended</i>)</p> <p>V3) What do you think are key steps to undertake in the future development of the ecosystem services framework? (<i>Open-ended</i>)</p>
<p>Myths</p>
<p>M1) Can you describe a common myth or misunderstanding you frequently encounter in your work? (<i>Open-ended</i>)</p> <p>M2) Who holds these erroneous views? (<i>Open-ended</i>)</p> <p>M3) And what to your mind is the source of confusion that gave rise to these myths? (<i>Open-ended</i>)</p> <p>M4) How would you debunk the myth? (<i>Open-ended</i>)</p> <p>M5) Have you ever encountered one of the following claims regarding ecosystem services in your work? (<i>Multiple-choice, tick all that apply</i>)</p> <ul style="list-style-type: none"> A) The ecosystem services framework is based on economic terminology and therefore a capitalist concept, it's just an extension of the capitalist paradigm and all about making money B) The ecosystem services framework undermines the widely held moral-aesthetic value arguments for environmental protection and does not consider the intrinsic value of nature.

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<p>C) The ecosystem services framework implicitly accepts that happiness and wellbeing can be quantified.</p> <p>D) Ecosystem services are purely human-centric, the framework implicitly accepts that human benefit is the only good and that we should solely protect services if they benefit humans.</p> <p>E) The traditional, ethical arguments for conservation have failed, so the ecosystem services framework embodies an appeal to self-interest instead.</p> <p>F) The ecosystem services framework cannot support decision-making nor can it create a solution that pleases everyone and therefore has no use in informing environmental policy.</p> <p>G) Other (please describe below)</p>
Frustrations (Grumbles in the original survey)
F1) What do you find most frustrating about working with the ecosystem services framework? (<i>Open-ended</i>)
F2) What would be the best way to resolve your grumble? (<i>Open-ended</i>) What to your mind is the biggest theoretical, moral or practical shortcoming of the ecosystem services framework? (<i>Open-ended</i>)
F3) How could that shortcoming be remedied? (<i>Open-ended</i>)
F4) Have you ever encountered one of the following frustrations? (<i>Multiple-choice, tick all that apply</i>)
<p>A) The terminology of ecosystem services is too complicated and academic, impossible to use with non-expert audiences.</p> <p>B) The ecosystem services framework is so contentious, the use of the term is best avoided when applying the framework in practice, to avoid shouting matches and people disengaging on principle.</p> <p>C) In people's perceptions the ecosystem services framework is equalled with monetary valuation and selling off nature, making it a hard sell even if the study at hand doesn't look at economic aspects at all.</p> <p>D) Policy makers have adopted the ecosystem services framework for their own purposes, without really paying attention to its theoretical underpinnings.</p> <p>E) Ecosystem services is such a hyped buzzword, it is becoming increasingly vague and opaque, everybody uses it without much regard for what it actually entails.</p> <p>F) The phrase 'ecosystem services' is used to cover a growing variety of quite distinct concepts and approaches.</p> <p>G) Other</p>
Background
A1) In the field of ecosystem services, where do you think the biggest differences of opinion lie? (<i>Open-ended</i>)
A2) What do you do? (<i>Multiple-choice, single option</i>)
<p>A) Student/Junior Researcher</p> <p>B) Academic Researcher</p> <p>C) Policy maker</p> <p>D) Practitioner</p> <p>E) Other</p>
A3) What is your main field of study? (<i>Open-ended</i>)
A4) How long have you been working with the ecosystem services approach? (<i>Open-ended</i>)
A5) What gender do you identify with? (<i>Open-ended</i>)
A6) Schedule permitting, would you be interested in attending a follow-up workshop at the conference, to discuss some of the topics raised here in more detail? (<i>Yes/No</i>)
That was all, thank you so much for taking part and we're looking forward to meeting you in September. Would you like to do another theme? (<i>Yes/No</i>) [If yes, redirects to Q1]

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1135 **Supplementary Material 2**

1136 Coding matrix of the inductive thematic content analysis. Counts refer to the number of
 1137 times each theme was mentioned by each user group.

Theme	Summary of responses coded under theme	Academic Researcher	Student/Junior Researcher	Practitioner	Policy maker	Other	Total
Purpose (Values)							
P4 - Can you put down in your own words what you think is at the heart of the ecosystem services framework?							
Decision-making aid	<i>ES as tool/support for decisionmaking & resource management</i>	7	1	2	1	1	12
Scientific approach	<i>ES as a scientific endeavour, expanding knowledge</i>	4	2	3	1	0	10
Awareness raising	<i>ES to demonstrate value of nature</i>	22	11	4	0	1	38
Holistic approach	<i>ES as an encompassing approach to complexity</i>	3	3	0	1	1	8
Advocacy x Science	<i>Responses combining science and awareness raising, focus on general public</i>	8	4	1	2	0	15
Decision x Activism	<i>Responses combining awareness raising and decision support, focus on policy</i>	4	4	0	2	1	11
Science x Decision	<i>Responses combining science and decision support, technocratic focus</i>	2	0	4	1	0	7
Other		4	1	1	0	0	6
P5 – What would be the worst misuse of the ecosystem services framework?							
Backfiring	<i>ES used to demonstrate that environmental degradation is affordable</i>	3	0	0	0	2	5
Monetary valuation	<i>ES solely used to put a price on nature</i>	28	8	4	2	1	43
Panacea	<i>ES used a cure-all applied without concern for context or applicability</i>	3	0	0	2	0	5
Poor decision making	<i>ES used in flawed decision-making processes</i>	7	2	1	1	1	12
Selling off nature	<i>ES used to commodify nature</i>	8	4	3	1	1	17
Other		6	4	4	0	0	14
Visions (Goals)							
V2 - What are the main challenges for the widespread use of the ecosystem services framework?							
Education & awareness	<i>Addressing lack of knowledge of ES framework and theoretical underpinnings</i>	6	2	2	2	1	13
Impact	<i>Lack of tangible impact (i.e. Halting of environmental degradation)</i>	0	1	0	0	2	3
Institutional barriers	<i>Historic and organisational challenges in academia and governance</i>	3	4	1	0	1	9
Methods, date & tools	<i>Methodological improvements needed and concerns around data gaps/quality</i>	11	4	5	2	1	23
Policy & decision making	<i>Lack of political will and vested interests in decision making</i>	4	2	2	0	2	10
Terminology	<i>Overly technical ES terminology acting as a barrier to widespread use</i>	9	3	0	0	0	12
Un-niching	<i>Need to move ES beyond a scientific margin into policy and public mainstream</i>	3	0	0	0	1	4
Other		1	0	0	1	0	2
V3 - What do you think are key steps to undertake in the future development of the ecosystem services framework?							
Better communication- General	<i>Responses citing better communication</i>	2	2	1	1	0	6
Better communication- Holistic emphasis	<i>Responses citing communication to promote holistic nature of ES framework</i>	0	1	0	1	0	2
Better communication- Stakeholder & public engagement	<i>Responses citing better communication with non-expert audiences</i>	1	1	3	0	0	5
Better decision-making	<i>Improving the decision-making process</i>	1	0	0	0	0	1
Better science- General	<i>Responses citing the need for better science in general (tools, methods, data, theory)</i>	9	2	3	3	0	17
Better science- Accounting	<i>Responses specifically citing need for better accounting for ES</i>	1	0	0	0	0	1
Better science- Include cultural values	<i>Responses focusing on improving inclusion cultural values in ES research/valuations</i>	3	2	0	1	0	6
Better science- Interdisciplinarity	<i>Responses citing need for working more interdisciplinarily in ES</i>	3	0	1	1	0	5
Science-policy	<i>Improvements to the science-policy interface and evidence based decisions</i>	15	5	1	1	0	22

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Theme		Academic Researcher	Student/Junior Researcher	Practitioner	Policy maker	Other	Total
Myths							
M1 - Describe a common misunderstanding or myth around ecosystem services you frequently encounter in your work?							
All about the money	<i>ES revolves around monetary valuation of nature</i>	10	2	3	1	0	16
Other		5	1	3	0	0	9
M2 - Who holds these erroneous views?							
Conservationist	<i>Responses citing conservationists and/or environmentalists as myth believers</i>	4	1	0	1	0	6
Lay people	<i>Responses citing lay people as myth believers</i>	6	1	0	0	0	7
Scientists	<i>Responses citing other disciplines and scientists as myth believers</i>	8	3	1	0	0	12
Polymakers & practitioners	<i>Responses citing policymaker and/or practitioners as myth believers</i>	2	0	2	1	0	5
Other		2	0	2	0	0	4
M3 - What to your mind is the source of confusion that gave rise to the myth you've just described?							
Media & publications	<i>Responses citing certain ES publications or media in general as source of myths</i>	2	1	2	0	0	5
Terminology & concept	<i>Confusion seen as inherent to the language and concept of ES</i>	3	0	1	0	0	4
Worldview & ideology	<i>Responses citing ideological bias and vested worldviews as source of myths</i>	4	1	2	0	0	7
Other		5	1	1	1	0	8
M4 - How would you debunk the myth?							
Communication	<i>Improving communication around ES</i>	8	3	4	0	0	15
Expanding disciplinary	<i>Working across disciplines and audiences</i>	3	0	1	0	0	4
Refine concept	<i>Improve ES framework conceptually</i>	1	1	0	0	0	2
Other		3	0	1	0	0	4
Frustrations (Grumbles)							
F1 - What do you find most frustrating about working with the ecosystem services framework?							
External skepticism	<i>Responses citing negative attitudes to ES framework</i>	3	0	0	0	1	4
Misuses	<i>ES framework being misapplied</i>	2	0	0	0	0	2
User friendliness	<i>Difficulties with terminology and high expertise needed to use ES & tools</i>	7	2	4	2	0	15
Practical implementation	<i>Difficulties with applying ES framework in practice</i>	4	0	1	2	0	7
Science shortcomings	<i>Scientific issues raised - lack of data, accounting methods, conceptual flaws</i>	5	4	2	1	0	12
Silos-Niche	<i>Lack of mainstreaming and inter/cross disciplinary work within ES</i>	4	1	0	0	0	5
F2 - What would be the best way to resolve your grumble?							
Best practice	<i>Spreading best practice guidance and knowledge sharing</i>	0	0	0	1	0	1
Educate	<i>Improving education around ES framework</i>	2	1	0	0	0	3
Interdisciplinarity	<i>Working across disciplines and audiences</i>	3	0	0	1	0	4
More research	<i>Issues can be addressed by further research into challenges</i>	1	1	0	0	0	2
Pick & roll	<i>Picking one ES framework methodology and sticking with it across all ES research</i>	0	0	1	0	0	1
Standardisation	<i>Standardising existing frameworks and methodologies (plural)</i>	3	2	3	1	0	9
Tailor & complement	<i>Tailoring ES framework to local contexts and use in conjunction with other tools</i>	1	0	0	0	1	2
F3 - What to your mind is the biggest theoretical, moral or practical shortcoming of the ecosystem services framework?							
Bias	<i>Problems relating to perceived ideological biases in ES framework</i>	0	1	0	0	0	1
Concept & method deficit	<i>Problems cited relating to the theory, concept and method of ES framework</i>	5	4	2	1	1	13
Decision-making deficit	<i>Issues with use of ES framework in (flawed) decision-making processes</i>	1	0	0	1	0	2
Practical implementation deficit	<i>Lack of practical applications of ES framework</i>	1	0	1	0	0	2
Social science deficit	<i>Lack of inclusion of social sciences in ES research</i>	4	1	1	0	0	6
F4 - How could that shortcoming be remedied?							
Communication	<i>Improved communication can address challenges</i>	3	0	0	1	0	4
Inter/ transdisciplinarity	<i>Improving and increasing work across disciplines and audiences</i>	5	0	1	0	0	6
More research	<i>Additional studies needed</i>	1	1	1	0	1	4
Public/ stakeholder engagement	<i>Better inclusion and outreach to general public and stakeholders</i>	1	1	0	2	0	4
Standardisation	<i>Standardising existing frameworks and methods</i>	2	3	1	0	0	6

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1142 Supplementary Material 3

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1144 Early findings documents circulated in the delegate pack to the all participants in the
1145 European Ecosystem Services Conference 2016.
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The Antwerp Declaration



The Antwerp Declaration will outline a clear message from the conference participants about ecosystem services that is relevant to the wider world. It provides a means of communicating high-level views to a range of potential audiences including decision makers, academics and practitioners. The Declaration embodies a legacy for the conference and a statement of intent from the scientific community.

Survey

To inform the discussions on the conference we sent out an online survey in July to 350 early registrants. The questionnaire gathered views from the participants on the Values, Goals, Myths and Grumbles they encounter in their work with ecosystem services. A big Thank You goes out to the **121 participants** who contributed!

Values

The Values theme asked what participants considered the core of the ecosystem services framework.

“ Ecosystems services are a wide window through which we have to realise that our survival is dependent on the planet's ecology and that we have to start to work hand in hand with it.

At its heart, the ecosystem services framework is still viewed by most as a metaphor that **raises awareness** of the many ways human wellbeing depends on natural systems. Although frequently mentioned and occasionally criticised, economic valuation was on the whole not perceived to be inherently problematic. Its potential misuse on the other hand was a concern for many and resonated strongly with responses in the Myths theme as well.

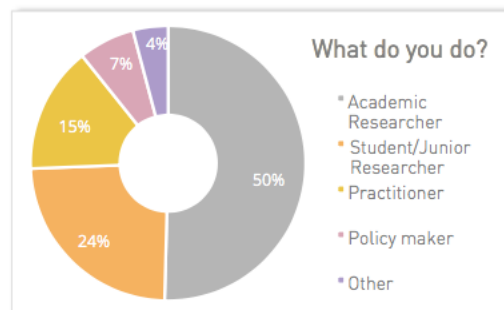
It's an approach that should be used very intelligently to frame environmental management challenges through a more socially relevant and integrated lens. Valuation is just one tool in the ES basket.

However, most of our respondents come from an academic background, which begs the question from policy makers, applied researchers and practitioners:

Q – What are the practical benefits of using the ecosystem services framework on the ground? Does it indeed enable awareness raising and a more socially relevant approach to environmental management?

Goals

The ecosystem services community certainly does not lack ambition: in the Goals section the majority of re-



spondents expressed a hope that in 20 years time the ecosystem services framework will have catalysed a **paradigm shift** that turned environmental protection into a core priority. However, despite this widespread enthusiasm and high-held hopes for the concept, a broad range of challenges was raised.

The language - and therefore the concept - suffers from its technocratic, utilitarian image. It has been used in this way so long that it is impossible to broaden it to embrace real-world problems (and their less tangible but essential values) fully. This is demonstrated by the still awkward and clumsy state of the cultural services debate, and the blunt refusal of many movements - and scientists - to work with it as a central concept. The time has come to face the fact that there are frontiers, and confine this concept to its safe operating space.

We also asked what key steps are necessary for the future development of ecosystem services, and the answers were surprisingly homogenous: better communication, emphasising the holistic nature of the approach, more inclusion of socio-cultural values (and by extension social scientists), improve stakeholder engagement and strengthen the science policy nexus.

Q – Is concentrating on incorporating cultural values through transdisciplinary work and participative projects with many different stakeholders the most transformative frontier of the ecosystem services framework

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Myths

We asked what myths people most frequently encountered in working with ecosystem services, and there was a very clear answer: it's all about the money. Economic valuation and commodification of nature was the most frequently raised point in this section. Interestingly enough, the reported sources of these myths and their audiences (who subscribe to the reported myths) show that it is mostly **a quarrel between scientists**. 'Other scientists' was the most cited audience to misunderstand ecosystem services, followed by conservationists, lay people, and finally policymakers & practitioners.

The remedies offered resonate with those mentioned in other themes: better communication and working more interdisciplinarily. However the direction of communication suggests an engagement gap between scientists and policymakers & practitioners, those who would arguably be one of the most important target audiences to reach. One respondent raised an interesting point in terms of the potential impact of applying the ecosystem services framework and the limits of scientific evidence:

“ *[It is a myth] that describing a range of (natural) ecosystem services could counterbalance the conflicting interests of industry (and politics).*

Many respondents, especially from the policy and practitioners side called for best practice examples and effective case studies to demonstrate how ecosystem services are used in decision-making processes on the ground and to promote best practice.

Q — How can we encourage case study research of successful applications of ecosystem services that are actually being used in the decision making process?

Grumbles

A lot of the frustrations voiced in the Grumbles section had to do with **user friendliness** in various forms. On the scientific side there were complaints around the lack of standardization in the framework as well as insufficient methods, and a lack of data. Practitioners on the other hand signaled being overwhelmed by the variety of categorisations and tools available, and the background information required for their appropriate application.

Q — Instead of further adaption and refinement of ecosystem services frameworks, efforts should be focused on ensuring the existing frameworks and tools are understood by and accessible to practitioners and policymakers.

Events during the conference

Monday - Introduction

Opening address by Ben Delbaere.

Quote of the Day

From Tuesday to Thursday a statement will be up in a central location for you to discuss, leave comments and vote on. Stickers for voting have been provided: a different colour for each day and white for comments.

Tuesday - G4 Session

11:00-12:30

There will be an opportunity to discuss themes related to the Declaration in the G4 session *"Reflections on the last decade of ecosystem services research: Rights, Wrongs and the Way Forward"*. This session is organised by Alexander van Oudenhoven, Matthias Schröter and Sander Jacobs, and will take place in room K.201.

Wednesday – AD16 Workshop

12:30-16:30 (at the latest)

The main AD16 discussion event will be an interactive workshop style session, taking place over lunch and into the afternoon on Wednesday. We will ply you with food and drink, and set your brilliant minds to work over some of the puzzles thrown up by the survey results and previous discussions. Location TBC.

NOTE: This event runs parallel to the field excursions, and has limited spaces. If you would like to attend please e-mail: aster.devrieslentsch@ed.ac.uk.

Thursday – Drop-In Session

09:00-12:30

We will run a drop-in session in the morning. Pop in to discuss the Declaration progress, share your thoughts on the Quotes or take a seat and to be our armchair critic!

Friday – Official launch

Social Media - #AD16 (Twitter)

CONTACT

If you have any questions about the Antwerp Declaration, please get in touch with Aster via e-mail: aster.devrieslentsch@ed.ac.uk.

All quotes used were taken directly from the survey as illustrative examples of points raised.

