



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Navigating pluralism: understanding perceptions of the ecosystem services concept

Citation for published version:

Ainscough, J, De Vries Lentsch, A, Metzger, M, Schröter, M, Delbaere, B, de Groot, R & Staes, J 2019, 'Navigating pluralism: understanding perceptions of the ecosystem services concept', *Ecosystem Services*.
<https://doi.org/10.1016/j.ecoser.2019.01.004>

Digital Object Identifier (DOI):

[10.1016/j.ecoser.2019.01.004](https://doi.org/10.1016/j.ecoser.2019.01.004)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Ecosystem Services

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



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

3 **Authors:** Jacob Ainscough^{1,2*}, Jacob.ainscough@ed.ac.uk; Aster de Vries Lentsch¹,
4 aster.devrieslentsch@ed.ac.uk; Marc Metzger¹, marc.metzger@ed.ac.uk; Mark
5 Rounsevell^{1,3}, mark.rounsevell@kit.edu; Matthias Schröter^{4,5}, matthias.schroeter@ufz.de;
6 Ben Delbaere⁶, info@delbaereconsulting.com; Rudolf de Groot⁷, dolf.degroot@wur.nl; Jan
7 Staes⁸, jan.staes@uantwerpen.be

8 9 **Affiliations:**

10 ¹School of Geosciences, The University of Edinburgh, Drummond Street, EH8 9XP, Edinburgh, United Kingdom

11 ²Laurence Mee Centre for Society and the Sea, Scottish Association of Marine Science (SAMS), Oban, PA37
12 1QA, United Kingdom

13 ³Institute of Meteorology and Climate Research, Atmospheric Environmental Research, Karlsruhe Institute of
14 Technology, Kreuzeckbahnstraße 19, 82467 Garmisch-Partenkirchen, Germany

15 ⁴UFZ – Helmholtz Centre for Environmental Research, Department of Ecosystem Services, Department of
16 Computational Landscape Ecology, Permoserstr. 15, 04318 Leipzig, Germany

17 ⁵German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Deutscher Platz 5e, 04103
18 Leipzig, Germany

19 ⁶Delbaere Consulting, Udenhout, the Netherlands

20 ⁷Environmental Systems Analysis group, Wageningen University & Research, P.O. box 47, 6700 AA,
21 Wageningen, the Netherlands

22 ⁸Ecosystem Management Research Group (ECOBIE), Department of Biology, University of Antwerp,
23 Universiteitsplein 1, BE-2610 Wilrijk, Belgium

24

25 *Correspondence to:

26 Jacob Ainscough, Jacob.ainscough@ed.ac.uk. + 44 7702243523. Laurence Mee Centre for Society and the Sea,
27 Scottish Association of Marine Science (SAMS), Oban, PA37 1QA, United Kingdom

28

29 Keywords: ecosystem services, boundary object, guided pluralism, sustainability, science-
30 policy interface

31

32 Abstract word count: 200

33 Manuscript word count (excluding title page, tables, references): 8225

34

35 **Abstract**

36 Being open to multiple interpretations allows the ecosystem services concept to operate as
37 a boundary object, facilitating communication and cooperation between different user
38 groups. Yet there is a risk the resultant pluralism limits the capacity of ecosystem services
39 assessments to directly inform decision and policy making, and that the concept could be
40 used to support environmentally or socially harmful activities. Here, we report results from
41 a large mixed methods survey conducted among academics, policymakers and practitioners
42 working in the field of ecosystem services across Europe. We use these results to explore
43 the trade-off that exists between the role of ecosystem services as a boundary object and
44 the needs of policy and decision makers of more standardisation. We conclude this can be
45 done by working towards the standardisation of ecosystem service assessments within
46 specific jurisdictions, whilst maintaining forums for debate, collaboration, and critical
47 reflection within the broader ecosystem services community. We also aim to deduce guiding
48 principles to ensure the ecosystem services concept is not used to support detrimental
49 activities. The consideration of shared and cultural values, the expansion of inter- and
50 transdisciplinary work and the integration of the concept of sustainability are identified as
51 valuable guiding principles to this end.

52

53

54

55

56

57

58

59 **1. Introduction**

60 **1.1. A broadly operational concept despite a lack of unity**

61 A number of wide scale assessments have taken place to assess the status and trends of the
62 world's ecosystem services – including the Millennium Ecosystem Assessment (MA, 2005),
63 The Economics of Ecosystems and Biodiversity (TEEB, 2010), and the assessments of the
64 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES,
65 2018a, 2018b, 2018c, 2018d). Advances have been made towards operationalizing the
66 concept in practice (Beaumont et al., 2017; Dick et al., 2018; Jax et al., 2018), and the
67 concept is starting to be integrated into both national and international policy (Bezák et al.,
68 2017; Bouwma et al., 2018; Matzdorf and Meyer, 2014). Dick et al. (2018, p. 563) declared
69 that the ecosystem services concept is 'broadly operational', despite on-going debates
70 within the ecosystem services community regarding conceptual frameworks, assessment
71 and valuation methodologies, and even core terminology (Braat, 2018; Costanza et al.,
72 2017; Díaz et al., 2018; Fanny et al., 2014). This lack of conceptual and methodological unity
73 has previously been identified as a concern (Nahlik et al., 2012), although Dick et al. (2018)
74 suggest the concept appears to be compatible in practice with a range of approaches
75 founded in different philosophical traditions.

76

77 **1.2. The acceptance of plurality within the field of ecosystem services**

78 Accepting that the ecosystem services concept is open to multiple interpretations is seen by
79 some as a strength, as it allows it to operate as a boundary object (Abson et al., 2014;
80 Schröter et al., 2014; Schröter and van Oudenhoven, 2016). Boundary objects are concepts
81 that are amorphous enough to be adapted to different contexts and worldviews, but are

82 robust enough to act as a channel of communication between these different positions (Star
83 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. This decrease in usefulness was largely due to conflicting interpretations of how the
93 concept should be used in specific management or policy decisions. Saarela and Rinne
94 (2016) develop the idea that artefacts (scenarios, simulation models, indicators etc.)
95 produced using the ecosystem services concept, rather than the concept itself, may act as
96 boundary objects. These artefacts are still open to multiple interpretations but are not
97 neutral objects, as they are tied to the social and institutional context, with their embedded
98 power relations, in which they are made (Saarela and Rinne, 2016). This can limit their
99 capacity to operate as boundary objects, as they are only able to connect actors with pre-
100 existing shared cultural values and preferences (Turnhout, 2009).

101

102 These discussions reveal a tension in the role of ecosystem services as a boundary object.
103 On the one hand, it is most effective as a broad concept that can accommodate a large
104 range of perspectives and worldviews. However, this function decreases in the context of
105 specific policy and decision-making. Undertaking ecosystem services assessments for policy

106 requires the development of standardised classification systems, conceptual frameworks
107 and related methodologies. This process may lead to certain worldviews being crowded out,
108 and others foregrounded. If ecosystem service assessments are to become a mainstream
109 approach for evidencing environmental policy and decisions, then such standardised
110 practices will become institutionalised, potentially curtailing debate over the value laden
111 choices taken to create them. This dynamic is referred to by Steger et al. (2018) as the
112 creation of 'infrastructure'. Infrastructure are 'the tools, work practices, terms, and
113 technologies that become embedded in and support a community of practice' (Steger et al.,
114 2018, p. 144). The tension between ecosystem services as a broad, open boundary object
115 and as an institutionalised concept with precise terminology and associated practices is a
116 key theme of this paper.

117

118 There is evidence that the concept of ecosystem services is beginning to enter into national
119 policy and legislation, but not yet in a manner that includes the explicit use of ecosystem
120 services assessments and valuations (Bezák et al., 2017; Bouwma et al., 2018; Kistenkas and
121 Bouwma, 2018; Leone et al., 2016; McKinley et al., 2018). Within the research community,
122 continued disunity can be seen in ongoing debates over core frameworks and terminology
123 since the introduction of the concept of 'Natures Contribution to People' (Braat, 2018; Díaz
124 et al., 2018; Kenter, 2018; Maes et al., 2018; Pascual et al., 2017). Peterson et al. (2018)
125 make the case here for an acceptance of pluralism to avoid a potentially harmful
126 polarisation within the ecosystem services community. Hermelingmeier and Nicholas (2017)
127 similarly embrace the range of perspectives that still exist around the ecosystem services
128 concept, making the case for 'guided pluralism'.

129

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) to develop a framework
137 for coping with the heterogeneous practices within the field of ecological economics.
138 However the idea has not been explicitly developed in the ecosystem services literature.
139 Hermelingmeier and Nicholas (2017) only suggest the need for open dialogue over values
140 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.
152

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

156

157 **1.3. Aims**

158 To analyse the work on ecosystem services as a boundary object, and the applicability of the
159 notion of guided pluralism, it is important to understand different views within the
160 ecosystem service community. This study hence aims to understand the way the ecosystem
161 services concept is viewed by researchers, policymakers and practitioners. Firstly, we are
162 interested in perceptions of strengths and weaknesses in the concept, and the different
163 ways that people see the concept being used to inform decision-making. From here we ask
164 if the ecosystem services concept can be seen as a boundary object, and what the
165 limitations are to this in the context of policy and decision-making. Secondly, we seek to
166 identify guiding principles for the ecosystem services concept, by synthesizing views from
167 different user groups. Finally, this paper is also intended to underpin the Antwerp
168 Declaration, which was developed during the conference hosted by the Ecosystem Services
169 Partnership (ESP) in Antwerp in 2016. The declaration is an attempt to account for the
170 critiques and concerns viewed by participants and reflect a need and desire to further
171 develop the ecosystem services concept.

172

173 **2. Methods**

174 **2.1. Survey design**

175 We distributed a digital mixed methods survey among 350 early registrants to the European
176 Ecosystem Services Conference 2016¹ (EESC), which presented a good sampling pool for all
177 three target groups: academics, including junior researchers, who seek to gain knowledge
178 and understanding; policymakers, who develop and implement governance strategies and
179 instruments; and practitioners, who broadly spoken support policy development and/or
180 make environmental management decisions. The conference – which attracted 700
181 delegates – was organised by three large research projects (OPERAs², OpenNESS³,
182 ECOPLAN⁴), the University of Antwerp, and the Ecosystem Services Partnership⁵, one of the
183 largest international networks focused on ecosystem services, and so brought together a
184 wide range of people from across the field. We engaged with early registrants to be able to
185 present and discuss the outcomes at the conference. The survey was distributed through
186 the conference organisers' official e-mail list.

187

188 The survey was divided into four categories to capture different aspects of people's views of
189 the ecosystem services concept: its underlying purpose (P); visions (V) for its future
190 evolution (named goals in the survey); perceived myths (M) that misrepresent the concept;
191 and frustrations (F, named grumbles in the survey) to capture any irritations with the
192 ecosystem services concept not captured in the other categories.

193

¹ www.esconference2016.eu

² www.operas-project.eu

³ www.openness-project.eu

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

⁵ www.es-partnership.org

194 Each category featured one closed question, and two or more open-ended questions,
 195 allowing participants to enter as little or as much text as they needed to express their ideas
 196 and opinions. Participants were asked to complete at least one category, and at the end of
 197 their first round of questions were given the opportunity to complete additional ones. Table
 198 1 summarises the questions, which were phrased in generic terms to allow respondents the
 199 opportunity to give unrestricted open answers. The full questionnaire is included as
 200 Supplementary Material 1.

201

202 Table 1. Summary of the survey questions for the four survey categories: Purpose (P),
 203 Visions (V), Myths (M), Frustrations (F). One question on supposed differences of opinion
 204 (A1) was asked to all respondents at the end of the survey. The questions were either on a
 205 5-point Likert scale (Likert), multiple-choice multiple answers (MCMA) or open-ended
 206 (open). MCMA statements are included in Figure 2. The full survey is available as
 207 Supplementary Material 1.

208

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	Open

	framework?	
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

209

210

211

2.2. Quantitative analysis

212

Attributes, i.e. characteristics of participants or cases (Bazeley and Jackson, 2013), were

213

included in the survey design as open questions to prevent restricting participants in their

214

answers. Based on the qualitative entries we constructed attribute labels for gender,

215

discipline, and years of experience (Table 2). For 'Field of Study' we captured unclear

216

answers with the 'Other discipline' category. Participants were also asked whether they

217

were an academic researcher, junior researcher or student, practitioner, policymaker or

218

'other'.

219

220

Each category of the survey (Purpose, Visions, Myths, and Frustrations) had one multiple-

221

choice section for which we compiled separate bar charts to help identify themes and

222

support for the qualitative analysis of the open questions.

223

224

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, Science Policy Nexus, Inter/Transdisciplinary, Other discipline

225

226

2.3. Qualitative analysis

227 A general inductive approach (Thomas, 2006) to thematic content analysis was used to
228 examine patterns in the responses to the open survey questions (Table 2) in a replicable and
229 systematic manner (Bryman, 2016). The general inductive approach provides an easily used
230 and systematic set of procedures for analysing qualitative data that can produce reliable
231 and valid analysis of underlying structure in the raw data (Thomas, 2006). Rather than
232 making prior assumptions about the survey responses in a predefined coding frame, an
233 inductive approach was followed because we had no comprehensive predetermined
234 expectations of the patterns, similar to Asah et al. (2014) and Maraja et al. (2016). The
235 intended outcome of the inductive coding process was to create a small number of
236 summary categories that in the evaluator's view capture key aspects of the themes
237 identified in the raw data and are assessed to be the most important themes given the
238 study's objectives (Thomas, 2006).

239

240 We followed the five stages of analysis described by Thomas (2006) using the Nvivo
241 qualitative data analysis software (QSR International, 2016). The full set of responses was
242 read carefully (1) and specific text segments were identified that related to the topic of the
243 survey category (2). These segments were labelled to create a set of initial themes (3),
244 which were refined to reduce overlap and redundancy (4) in an iterative process both within
245 the categories and across the whole survey, allowing responses to be coded for multiple
246 themes. Themes that were rarely mentioned were grouped as 'other'. The final stage
247 consisted of creating a model that incorporates the most important themes into a limited
248 set (5). Thomas (2006) explains that inductive coding that results in too many major themes
249 – he suggests more than eight – can be viewed as incomplete and encourages the evaluator
250 to make hard decisions about which themes are most important.

251

252 Given likely overlap in responses between the different survey categories we anticipated
253 that the final step would identify a number of cross-cutting themes. The choice of these
254 cross-cutting themes was supported by the results of the quantitative analysis and looked
255 for both consensus and divergence in views among the respondent categories. The cross-
256 cutting themes are illustrated with quotes and cross-references were made to the survey
257 questions that provided answers in support of the cross-cutting theme.

258

259 **2.4. Corroborating our findings and building towards a unified message**

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

273

274 **3. Results**

275 **3.1. Survey response and respondent attributes**

276 The response rate was 34%, n=121, comprising academic researchers (50%); junior
277 researchers (24%); practitioners (15%); policymakers (7%), and 4% who did not fit these
278 categories. The gender balance was 41% male, 51% female, and 8% not stated, and most
279 people reported their experience in the field of ecosystem services to be under or around
280 10 years.

281

282 Table 3. Definitions of each participant category.

Category	Definition
Academic researcher	Research staff at a University or research institute
Junior researcher	Researcher at an academic institution, either at PhD or post-doc stage
Practitioner	Individuals responsible for implementation or making environmental management decisions “on the ground”. This can include support of the creation of public policy (civil service) or overseeing its implementation (government agencies or third sector)
Policymaker	Individuals working for national or supranational government with statutory responsibility for creating public policy
Other	Those that did not identify as any of these categories

283

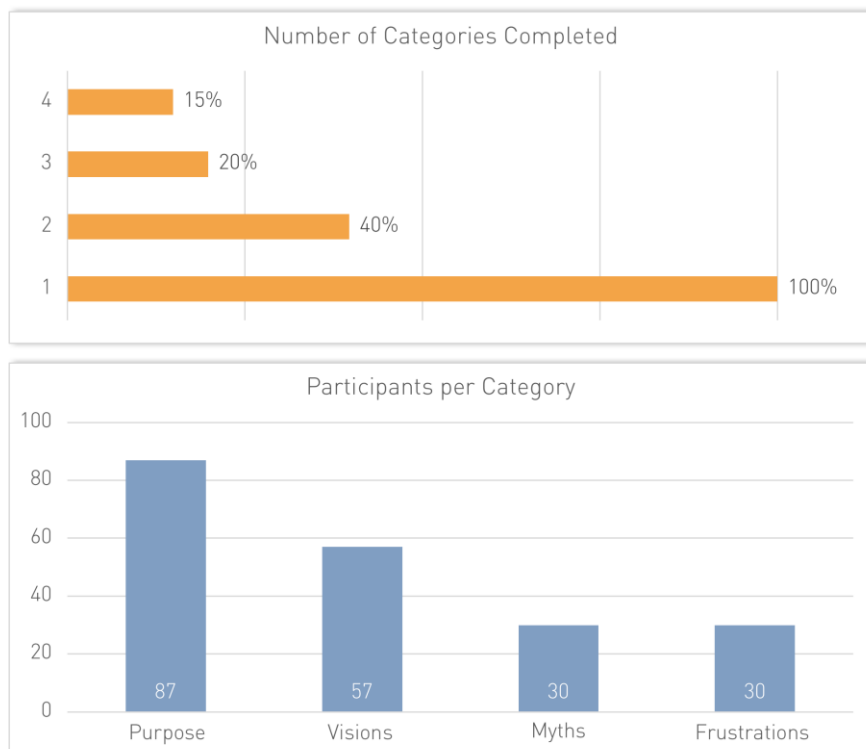
284

285 Table 3 contains our interpretation of the participant categories. However, these definitions
286 were not included in the original survey and we recognize that some individuals could fit in
287 more than one category (e.g. a researcher in an NGO). This is especially true given the
288 contemporary shift from ‘government’ to ‘governance’ and towards a post-normal science
289 approach to research for policy making. We took responses to mean that respondents
290 identified most with this group and saw this as their primary role. The category of
291 ‘practitioner’ is also open to interpretation and this role may change depending on the way
292 in which the ecosystem services concept is used. From the data collected we were not able
293 to determine the precise role of individuals who identified as practitioners.

294

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

CATEGORIES



299

300 Figure 1. Number of survey categories completed by participants and number of
301 respondents per category.

302

303 3.2. Multiple choice responses

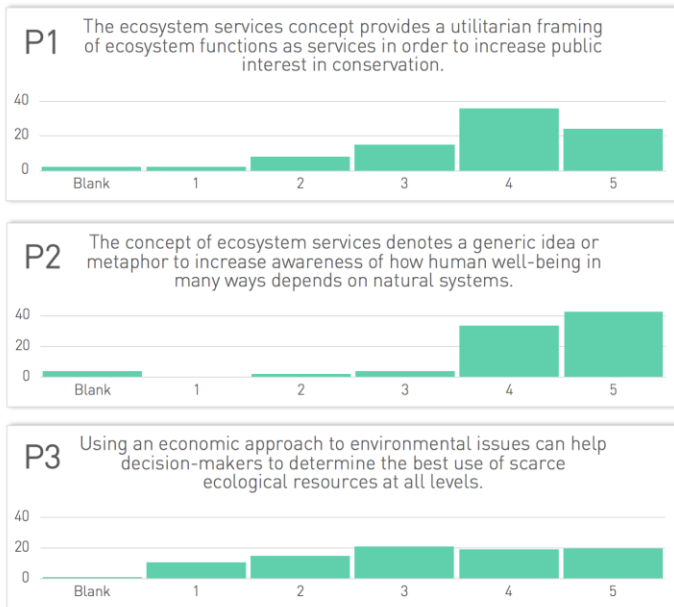
304 Figure 2 presents an overview of the Likert scale and multiple-choice responses for
305 questions P1, P2, P3, V1, M5 and F5. There was strong agreement that the ecosystem
306 services concept could increase societal interest in conservation (P1) and raise awareness of
307 human reliance on natural systems (P2), but opinion was divided as to whether an economic
308 approach could support better decision-making (P3). There was a shared vision that the

309 ecosystem services concept would achieve a paradigm shift in environmental protection
310 (V1C). Three myths frequently encountered were that the ecosystem services concept: does
311 not consider the intrinsic values of nature (M5B); is a capitalist paradigm about making
312 money (M5A); and implicitly accepts that human benefits are the only things that should be
313 protected (M5D). The most dominant frustrations with ecosystem services were: challenges
314 to communicating non-economic research due to misconceptions that economic valuation is
315 at the core of the concept (F5C); that it has become such a buzzword that the concept
316 becomes increasingly vague (F5E); and that the terminology is too complicated and
317 academic to use with non-expert audiences (F5A).

318

PURPOSE

N = 87



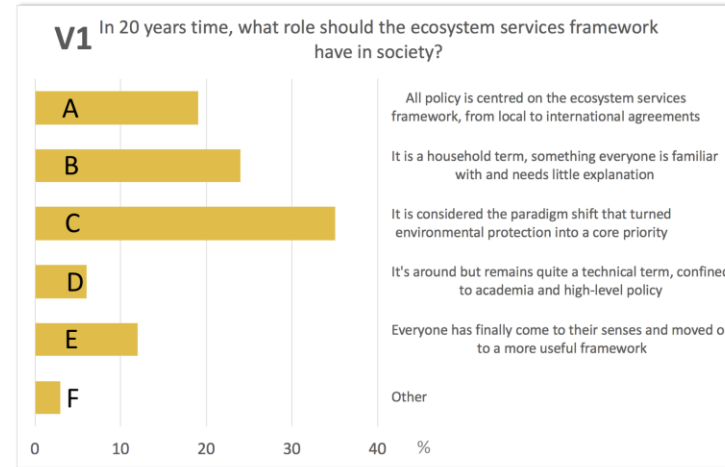
MYTHS

N = 30



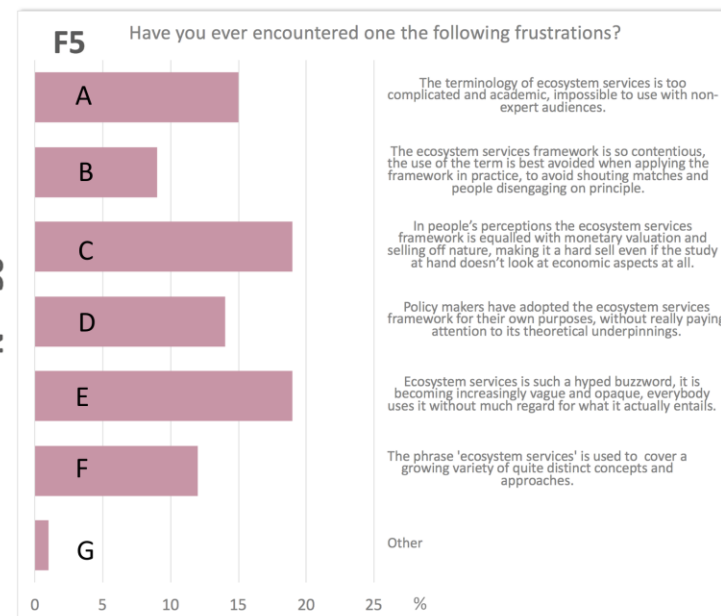
VISIONS

N = 57



FRUSTRATIONS

N = 30



319

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

321 3.3. Cross-cutting themes

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

328

329 3.3.1. Cross-cutting theme 1: Purpose of the concept

330 The core purpose of the ecosystem services concept was viewed by most respondents as an
331 ‘awareness raising’ metaphor of the many ways human well-being depends on natural
332 systems. This was evident in responses to P1 and P2 (Figure 2) and confirmed by the open-
333 ended answers to P4. This can be exemplified by the below quote:

334 *“The ecosystem service framework is useful to quantify the multifunctionality of ecosystems*
335 *and to demonstrate how human health and wellbeing depend on the multiple functions and*
336 *services of ecosystems. It is a concept that can be used to increase awareness among*
337 *ecosystem users and to support conservation.”* – Academic Researcher response to P4.

338

339 Three primary themes emerged from responses to P4 regarding what respondents felt to be
340 at the heart of the ecosystem services concept, ‘awareness raising’, ‘scientific approach’,
341 and ‘decision-making aid’. ‘Awareness raising’ was the most common theme, particularly
342 amongst academics (see Table. 4). The ‘decision-making aid’ code captured answers that
343 emphasised how the ecosystem services concept supports natural resource management
344 and allocation, or explicitly referred to decision-making. Entries coded as ‘scientific
345 approach’ highlighted the ecosystem services concept as a cognitive exercise, aimed at
346 better understanding of socio-ecological systems. ‘Decision-making aid’ and ‘scientific

347 approach' appeared a similar number of times. Four more codes for P4 were derived for
 348 responses that combined elements of the three main codes (see Table 4.).

349

350 Table 4. Summary of the responses under the 'Purpose' theme of the survey.

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

351

352

353 3.3.2. Cross-cutting theme 2: Concerns with the use of economic valuation

354 Although frequently mentioned and occasionally criticised (V2, V3), economic valuation was
 355 – overall – not perceived to be inherently problematic, but its potential misuse was a
 356 concern for many. Respondents disagreed whether an economic approach would help
 357 decision-making (Figure 2; P3). Participants were concerned that misuse of the ecosystem
 358 services concept could lead to poor decision-making, rushed and under-resourced
 359 assessments used to further a political agenda, and a bias towards industry interests (P5,
 360 V2). Several respondents warned against considering the ecosystem services concept as a
 361 panacea or cure-all for any environmental or resource management challenge regardless of
 362 the appropriate scale, methods and application of the framework (V2). There were also
 363 concerns about the framework potentially backfiring by providing a rationale for

364 environmental degradation rather than conservation (P5) as illustrated by the following
365 quote:

366 *“The misconception that it is all about utilitarian and monetary values. This is untrue, even*
367 *to the contrary. However, this has been repeated so often, and some instances in fact do*
368 *misuse the concept that way still. Kind of a self-fulfilled myth almost.”* – Academic
369 Researcher response to M1.
370

371 Thematic content analysis revealed that these frustrations stem from a polarised academic
372 debate, and to a lesser extent from opposition with conservationists. This polarisation and
373 confusion is potentially stirred up by media and high-profile publications that are feeding
374 the debate on which dominant worldviews and ideologies are being served by the
375 ecosystem services concept. Meanwhile, new ecosystem services terminology and
376 underlying conceptual frameworks are continuously developed, with different ideas about
377 the role of economic valuation (M3). There was considerable frustration about false
378 perceptions that economic valuation is central to the ecosystem services concept, which
379 was expressed exhaustively as a common misunderstanding (M1), but also as a frustration
380 (F1) as illustrated by the following quote:

381 *“That ecosystem services is all about 'valuing nature' - it's an approach that should be used*
382 *very intelligently to frame environmental management challenges through a more socially*
383 *relevant and integrated lens. Valuation is just one tool in the ecosystem services basket.”* –
384 Policymaker response to M1.
385

386 *3.3.3. Cross-cutting theme 3: The importance of understanding social and cultural* 387 *values in policy and decision-making*

388 Although economic valuation was not seen as problematic – as explained above – many
389 respondents were concerned about the lack of non-economic valuation methods (V2), and
390 the more limited interest and ability to include non-economic valuation in decision-making
391 (V2). This bias can lead to poor decision-making (P5), and the explicit incorporation of social

392 and cultural values into decision-making was expressed as an important step in the future
393 development of the ecosystem services concept (V3). This would prevent misuse of the
394 framework (P5) and help overcome a range of shortcomings currently identified (F3) –
395 including a lack of social science compared to ecological and environmental sciences and
396 economics. Embracing social and cultural values was seen as important communication
397 pathway to both wider society and decision makers (V3, F2, F4), countering potential
398 misunderstandings and inappropriate use of monetary definitions of value (M4), and a key
399 requirement to realizing the transformative potential of the framework (V3, F4). The
400 following quote is one of many emphasising the importance of social and cultural values:

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

405 *3.3.4. Cross-cutting theme 4: The need to further expand inter- and transdisciplinary*
406 *approaches to ecosystem services assessments*

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

416

417 There was recognition that the ecosystem services concept has been a catalyst for
418 promoting collaboration across disciplines (P4), but that expanding collaboration further is
419 essential to stimulate dialogue and generate common understanding that is necessary to
420 achieve societal impact (V3, F4). Framing the challenges around issue-based research will
421 encourage transdisciplinary collaboration between disciplinary experts, business
422 stakeholders and public body representatives (V3, F4). The involvement of knowledge
423 brokers and the media is critical in supporting collaboration and in communicating
424 outcomes (F4). The following quote is one of many calling for interdisciplinary research:
425 *“Ultimately, it is critical for a more interdisciplinary approach to the scientific research*
426 *agenda to enrich the research and facilitate better policy translation and a reduction in the*
427 *emergence of perverse policies.”* – Respondent from ‘other’ category in response to V2.
428

429 *3.3.5. Cross-cutting theme 5: Ecosystem services in policy and decision-making*

430 As identified above the ecosystem services concept can assume different roles in decision or
431 policy making contexts. It may be used directly as a ‘decision-making aid’ through the
432 instrumental mode of knowledge use (Mckenzie et al., 2014; Weiss, 1979) or as an
433 ‘awareness raising’ tool akin to the conceptual mode of knowledge use (Dunlop, 2014;
434 Weiss, 1979). Although less directly related to policy and decision-making, using the
435 ecosystem services concept in the context of a purely ‘scientific approach’ may also
436 influence decisions again through the conceptual mode by contributing to societies wider
437 understanding of the dependence of humans on natural systems.

438

439 A number of ways to increase the uptake of ecosystem services in policy and decision
440 making were identified that span both instrumental and conceptual knowledge use. A clear
441 need for practical learning emerged (V2, F1, F3, F4), and case study research was identified

442 as a way to progress the implementation of the framework to support land management
443 decision-making (V3, F4). To this end, several steps for further development of the
444 ecosystem services concept were identified (V3, F4): develop and share targeted
445 information, packaged and communicated appropriately to selected audiences; engage
446 stakeholders and the public; and include more socio-cultural values and closer work with
447 social scientists.

448

449 There were many frustrations related to the user-friendliness of the ecosystem services
450 concept (F1, F2) as a decision-making aid. Irritations about the academic nature or the
451 terminology (F5A, Figure 2), has already been mentioned, but the content analysis revealed
452 frustration around the lack of standardisation (F2), insufficient suitable and accessible
453 methods (F3), and a lack of data (V2, F3). Those identifying primarily as practitioners also
454 signalled being overwhelmed by the variety of categorisations and tools available, and the
455 background information required for their appropriate application (F3); suggesting these
456 may have been policy practitioners. The following quotes illustrate the frustration with the
457 user-friendliness of the ecosystem services framework:

458

459 *“The language – and therefore the concept – suffers from its technocratic, utilitarian image.”*
460 – Academic researcher in response to V2.

461

462 *“It is frustrating how many parties seem obsessed with re-classifying ecosystem services on a*
463 *continual basis - this is often unnecessary and unhelpful when seeking to implement a*
464 *joined-up approach across different interest groups.”* – Policymaker response to F1.

465

466 **3.4. The Antwerp Declaration**

467 The ‘early findings’ document, included in the EESC delegate pack (see Supplementary
468 Material 3), formed the basis for the participatory exercises during the conference, which

469 received input from approximately 100 individuals. These participatory events largely
470 confirmed the cross-cutting themes summarised in section 3.3, although greater emphasis
471 was placed on the importance to focus the ecosystem services concept on the principles of
472 sustainability. The discussion also provided guidance about how to translate the findings to
473 a short Declaration that forms a call for action that was signed (on a voluntary basis) by the
474 conference delegates. The resulting Declaration (Figure 3) was presented at the closing
475 plenary and has been signed by 331 people on the website www.antwerpdeclaration.com
476 following the conference (last count 17 August 2018).
477

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



478

479 Figure 3. The Antwerp Declaration – www.antwerpdeclaration.com

480 **4. Discussion**

481 The EESC represented a rare opportunity to collect the views of a varied group of

482 researchers, practitioners and policymakers engaged with the ecosystem services concept.

483 We recognise our result reflects a primarily Eurocentric perspective. However, the survey
484 received many responses and the events held at the conference were well attended,
485 allowing us to collect insights from a diverse group.

486

487 **4.1. The role of the ecosystem services concept in the science-policy interface**

488 Responses to our survey demonstrate the tension between the different roles that the
489 ecosystem services concept can play at the science-policy interface. Many participants
490 expressed the view that the concept was a useful awareness raising tool and could be used
491 to integrate different perspectives and approaches in environmental management (Cross-
492 cutting theme 1). That is, to function as a boundary object. Many academics in our study did
493 not identify scientific inquiry as the primary role of the ecosystem services concept, instead
494 emphasising the awareness raising role that it plays. This could indicate a perception among
495 academics of ecosystem services as a way to communicate research findings to a broader
496 audience, rather than as a tool for scientific inquiry (Barnaud and Antona, 2014; Crouzat et
497 al., 2017).

498

499 There were also concerns around the lack of standardisation and the user-friendliness of the
500 concept for decision makers (Cross-cutting theme 5). Indeed, many practitioners and
501 policymakers did not see the core purpose of the ecosystem services concept as
502 contributing directly to decision-making at present (Table 4). This is consistent with recent
503 literature suggesting that, despite a number of projects and toolkits aimed at integrating
504 ecosystem services into decision-making, assessments rarely play an instrumental role in
505 influencing decisions (Dick et al., 2018; Martinez-Harms et al., 2015; Ruckelshaus et al.,
506 2013; Saarikoski et al., 2018).

507

508 Standardisation was the most frequently cited remediation for the issue of user-friendliness,
509 amongst all groups (F2). Efforts are being made to standardise the categorisation of
510 ecosystem services (primarily through the Common International Classification of Ecosystem
511 Services (CICES⁶)), and several calls and attempts to standardise conceptual frameworks and
512 assessment/valuation approaches have appeared in the literature (Boerema et al., 2017;
513 Boyd and Banzhaf, 2007; Seppelt et al., 2012, 2011). However, standardisation involves the
514 curtailment of some of the conceptual and methodological diversity that exists within the
515 ecosystem services community. This could potentially hamper inter- and transdisciplinary
516 dialogue and communication supported by our respondents (Cross-cutting theme 4).
517 Standardisation correlates to the creation of 'infrastructure', and we follow Steger et al.
518 (2018) in suggesting that such a move would limit the capacity of ecosystem services to
519 function as boundary objects. This supports the conclusion of Galler et al. (2016) that
520 ecosystem services may function most effectively as a boundary object prior to the point
521 where it is used to inform specific policy or management decisions.

522

523 This does not imply that the concept plays no role in policymaking; others have identified
524 conceptual learning, consistent with the boundary role of ecosystem services, as a
525 promising impact pathway of ecosystem services assessments and research (Beaumont et
526 al., 2017; Carmen et al., 2018; Dick et al., 2018; Ruckelshaus et al., 2013).

527

⁶ www.cices.eu

528 There is then a potential conflict between those who see ecosystem services as a tool for
529 raising awareness and discussion, and those who wish to see it standardised and used in
530 decision-making. We argue that this can be reconciled by accepting that the concept is
531 capable of playing both roles at once. Whilst the creation of standardised infrastructure
532 should be supported, it is also necessary to maintain a more pluralistic notion of the
533 concept within academic and policy debates (Figure 4).

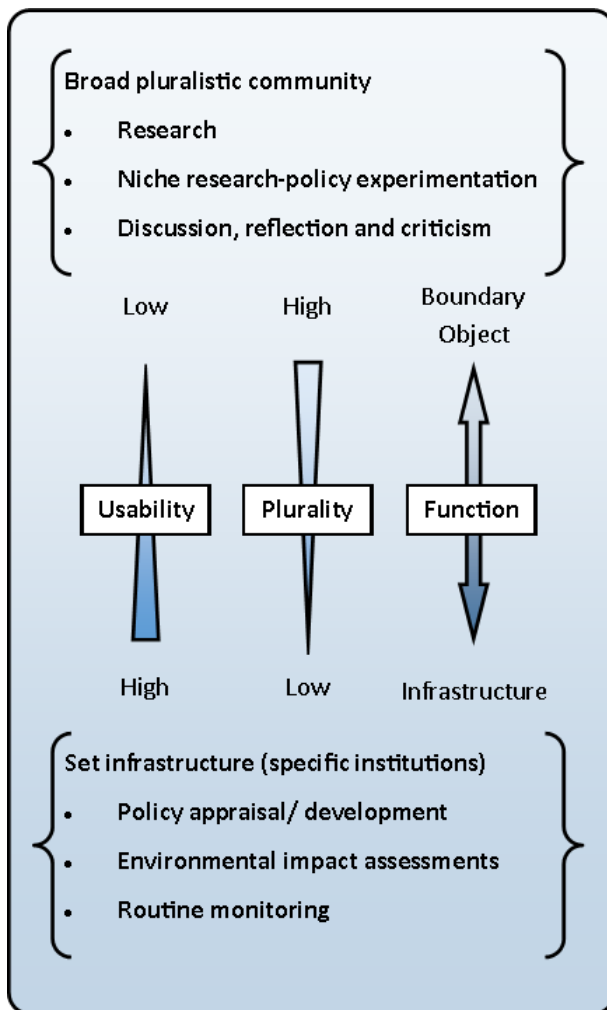
534

535 The creation of infrastructure will reflect and embody the norms of the context in which it is
536 developed (Saarela and Rinne, 2016; Turnhout, 2009). This can be a necessary trade-off to
537 improve usability and uptake of the concept directly in decision and policymaking. However,
538 it can become problematic for two reasons: 1) if the knowledge, views or values of a
539 particular group or groups within this context are excluded, for instance, the development
540 of accounting schemes for ecosystem services might focus on instrumental values (Hein et
541 al., 2015), and could be problematic for the inclusion of relational values that people might
542 hold with respect to nature (Pascual et al., 2017). Or 2) if such infrastructure is transplanted
543 to a cultural context that is significantly different from where it was created (as may be the
544 case in transnational environmental governance settings). This problem was recently
545 pointed out by Díaz et al. (2018), emphasising the need for context-specific perspectives
546 when assessing the relations between humans and nature. Polasky et al. (2015) similarly
547 make the point that ecosystem service assessment standards should be tailored to specific
548 use contexts.

549

550 Experimentation with the ecosystem services concept in different policy contexts is
551 increasing, and it is possible that we will see a continued construction of infrastructure

552 within different administrative jurisdictions (at a sub-national, national, and international
553 scale) (Bezák et al., 2017; Bouwma et al., 2018; Mauerhofer, 2018; Mauerhofer and Laza,
554 2018; McKinley et al., 2018). As this happens, retaining a highly pluralistic notion of the
555 concept that exists above any contextually specific infrastructure has two distinct
556 advantages over full standardisation. Firstly, it maintains space for worldviews that are
557 excluded through the construction of infrastructure, allowing ecosystem services to still
558 function as a boundary object that enhance debate and awareness raising over the
559 relationship between nature and human well-being. Secondly, it allows space for more
560 critical, dissenting voices and academic disciplines to highlight constantly the way that the
561 creation of infrastructure can obfuscate and normalise political choices made during its
562 creation. Critical geographers, for instance, are well positioned to offer such critique, as
563 their discipline is well versed in exploring the power relations around the social construction
564 and mobilisation of emerging and 'taken for granted' concepts and practices (Kull et al.,
565 2015; Turnhout et al., 2016).



567 Figure 4. Trade-offs between the function of ecosystem services as a boundary object and as
 568 set infrastructure capable of informing policy and decision-making, in terms of usability and
 569 plurality.
 570

571 **4.2. Valuation of ecosystem services: integrating cultural and social values as a guiding**
 572 **principle**

573 Values, and valuation, are useful vehicles to explore the dynamic between ecosystem
 574 services in the broad, pluralistic sense (where it is most effective as a boundary object), and
 575 ecosystem services as set infrastructure. Our results show a clear desire for social and
 576 cultural values to be better captured in ecosystem services assessments (Cross-cutting
 577 theme 3). This was reaffirmed through input to the Antwerp Declaration, where the need to
 578 'reclaim' the notion of value was raised. This desire resulted from the dual perception that

579 1) integrating a plurality of values is essential to ensure that ecosystem services
580 assessments lead to inclusive decision-making, and 2) a perception exists that only a limited
581 definition of value is captured within the ecosystem services concept.

582

583 The concept of ecosystem services has stimulated much debate about the notion of value,
584 and how best to measure it; bringing together scholars from a wide range of disciplines
585 (Chan et al., 2016, 2012; Edwards et al., 2016; Fanny et al., 2014; Fish et al., 2016; Jacobs et
586 al., 2018, 2016; Jax et al., 2013; Kenter et al., 2016b, 2015; Ranger et al., 2016; Sagoff,
587 2011). Here we see ecosystem services work as an effective boundary object, and many
588 methodologies now exist for integrating different types of values into ecosystem service
589 assessments (Iniesta-Arandia et al., 2014; Jacobs et al., 2016; Kenter, 2016; Kenter et al.,
590 2016b, 2016a; Ranger et al., 2016). Such methodologies are now established as a part of the
591 plethora of existing ecosystem services approaches and practices. Operationalizing these
592 methods in real world decision-making was a core priority that emerged from our survey
593 (Cross-cutting theme 3).

594

595 However, no method is capable of capturing all types of value (Jacobs et al., 2018), and it is
596 not necessarily the case that the use of a variety of methods will become standard practice
597 within policy and decision-making. In the UK for example, the importance of shared and
598 cultural values was recognised in the UK National Ecosystem Assessment (UK NEA, 2014).
599 However, the Treasury 'Green Book' which dictates valuation methods for public body
600 decision-making in the UK relies exclusively on methods derived from neoclassical
601 economics (Treasury, 2011). The centrality of marginal utility value theory in neoclassical
602 economics makes it difficult to meaningfully account for shared and cultural values. As the

603 ecosystem services concept becomes embedded in set infrastructure there is a risk that
604 evaluation methods will foreground incumbent individualist notions of value at the expense
605 of methods accommodating of social and cultural values.

606

607 Narrow economic valuation of ecosystem services was criticised by some respondents to
608 our survey but was largely not seen as inherently problematic (Cross-cutting theme 2);
609 matching findings from previous studies (Fisher and Brown, 2015; Hermelingmeier and
610 Nicholas, 2017). Concerns were raised however regarding the potential for ecosystem
611 services studies to be misused to further specific political agendas or support
612 environmentally destructive activities. This may be the case if infrastructure is created in the
613 context of highly extraction-driven, capitalistic norms. Maintaining a pluralistic notion of the
614 ecosystem services concept will ensure that space remains for critical reflection on
615 assessment and valuation approaches within different institutional settings. Within this
616 context, the desire to ensure that social and cultural values are captured offers a potential
617 guiding principle for the ecosystem services community.

618

619 **4.3. Expanding inter- and transdisciplinary approaches**

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

627

628 The ecosystem services concept arose at the interface of ecological and economic science,
629 however is now engaged with by, and functions as a boundary object between, a large
630 range of disciplines (Chaudhary et al., 2015). Yet physical, economic and social geographers
631 are just a few groups to have been identified as having useful, but underutilised insights
632 (Barnaud and Antona, 2014; Dempsey and Robertson, 2012; Potschin and Haines-Young,
633 2011). Even large scale efforts at interdisciplinary working, such as the Intergovernmental
634 Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), are to some degree
635 dominated by natural scientists (Timpte et al., 2018) and within IPBES the need for a
636 stronger engagement of social science and humanities was particularly emphasised (Díaz et
637 al., 2018).

638

639 Our result suggest the lack of engagement from some disciplines may be due to the way the
640 concept is perceived. Although respondents to our survey did not see economic valuation as
641 central to the ecosystem services concept (P4), the perception that the two are closely
642 interlinked was commonly encountered by participants. This view was encountered
643 primarily from other scientists and, to a lesser extent, conservationists (Cross-cutting theme
644 2). One respondent suggested that many groups and scientists simply refuse to engage with
645 ecosystem services (P2) due to its image as a technocratic and utilitarian approach. This
646 finding matches others who have noted the tendency to conflate 'ecosystem services' with
647 'payments for ecosystem services' (PES) schemes, and the potential for such confusion to
648 deter some from engaging with the concept (Schröter et al., 2014; Schröter and van
649 Oudenhoven, 2016).

650

651 The perception that the concept of ecosystem services is equivalent to putting a price on
652 nature limits its capacity to function as a boundary object. Increasing integration of other
653 disciplines into ecosystem services research may be assisted by improving communication
654 to overcome myths about the concept (see section 5.1.3: Economic valuation), and by
655 demonstrating the contributions that different disciplines can make through the expansion
656 and publication of case study research.

657

658 As infrastructure is created to embed ecosystem services assessments in specific
659 governance institutions, it will be impossible and potentially unnecessary to maintain the
660 disciplinary heterogeneity that exists within the wider community. However, ecosystem
661 service assessments still require skilled interdisciplinary teams, particularly if they are to
662 capture social and cultural values as well as the biophysical elements of ecosystem services.
663 Assessment approaches also legitimise some knowledge claims at the expense of others. In
664 the context of transdisciplinary assessments it is therefore important to co-develop the
665 design of the research between knowledge holders and to be open about methodological
666 and data-related choices. This consideration requires the deployment of trained social
667 scientists to develop suitable processes for knowledge co-production (see, e.g. (Hauck et al.,
668 2015). Equipping public bodies with the necessary skills requires significant investment as
669 environmental impact assessments and policy appraisals are currently not necessarily
670 conducted by teams of researchers with interdisciplinary skills (Rozas-Vásquez et al., 2018;
671 Turnpenny et al., 2014; Wawrzyczek et al., 2018). It is in this context that it becomes crucial
672 to retain a diverse, reflexive community of practice outside of any specific attempt to
673 institutionalise the concept; as discussed above.

674

675 The importance of inter- and transdisciplinary research and assessment approaches
676 identified in our survey also gains strong support within the ecosystem services literature
677 (Ainscough et al., 2018; Albert et al., 2017; Carmen et al., 2018; Costanza et al., 2017; Steger
678 et al., 2018). This acts as a guiding principle in the broad sense that it rejects narrow
679 disciplinary approaches to ecosystem service assessment and valuation, supporting the
680 norm of collaborative working and respect for different knowledge types.

681

682 **4.4. Integrating sustainability and ecosystem services**

683 A need to focus on the principles of sustainability was emphasised during events at the
684 conference and became a core element of the Antwerp Declaration. Sustainability is usually
685 understood as equitably meeting the needs of current generations without reducing the
686 capacity of future generations to meet their needs (WCED, 1987). As sustainability is not
687 necessarily implied by the ecosystem services concept, many authors have sought to
688 synthesize the two concepts to ensure that the ecosystem services concept is applied in a
689 manner consistent with the principles of sustainability (e.g. Bennett et al., 2015; Ekins et al.,
690 2003; Jacobs et al., 2013; Schröter et al., 2017). Key points made in this literature are, first,
691 that the biophysical processes underpinning ecosystem services (and inherent limits in
692 their ability to survive under different levels of stressors) should not be lost behind the
693 'stock' metaphor of ecosystem services. Second, stakeholder preferences and values should
694 form part of ecosystem service assessments, to ensure people's needs are equitably
695 accounted for.

696

697 Jacobs et al. (2013) stress the need to refocus ecosystem services research around a 'strong'
698 notion of sustainability. These authors suggest the majority of ecosystem services research

699 focuses on the efficient use of ecosystem services, but not the inherent limits and
700 boundaries of the reproductive capacities of underlying natural capital. Jacobs et al. (2013)
701 also emphasise the centrality of fairness and equity to the sustainability concept and
702 suggest that distributional effects should be central to any ecosystem services analysis.

703

704 Schröter et al. (2017) discuss ecosystem services as a descriptive and normative scientific
705 concept, whose application may conflict with the principles of sustainability. They claim that
706 'if the ecosystem service concept is understood as contributing to sustainability, ecosystem
707 services need to be conceptualised through sustainability strategies rather than assessing all
708 forms of natural resource use in aggregated, snap-shot assessments' (Schröter et al., 2017,
709 p. 41). Cavender-Bares et al. (2015) seek to synthesise economic, ecological and systems
710 theory to integrate ecosystem services and sustainability. Principally, they suggest
711 accounting for the ecological mechanisms underpinning services in the way assessments are
712 carried out, particularly the inherent biophysical limits of these processes. By integrating
713 preferences and values of different stakeholders, coupled with a systems dynamics
714 approach, ecosystem services assessments could consider how the whole system might
715 develop over time (Cavender-Bares et al., 2015). Similarly, Bennett and Chaplin-Kramer
716 (2016) point to the development of a socio-ecological systems perspective as a step forward
717 in integrating sustainable use to the ecosystem services research agenda (although it is not
718 clear that this is an 'advancement' as much as a return to the roots of ecosystem services
719 science, given its origins in systems ecology (Costanza et al., 2017; Odum, 1971)). Despite all
720 these calls, sustainability issues of ecological thresholds and fairness are still often ignored
721 in ecosystem services research and practice (Dendoncker et al., 2018).

722

723 Focusing on principles of sustainability, coupled with consideration of social and cultural
724 values of ecosystem services, was seen as key to ensuring the concept was not misused or
725 used to justify environmentally degrading activities (Cross-cutting theme 2). Here we
726 reiterate, with the support of respondents who contributed to the development of the
727 Antwerp Declaration, the call to adopt the normative and analytic content of the concept of
728 sustainability in discussion and application of the ecosystem services concept. We add that
729 as the ecosystem services concept is embedded as infrastructure in planning and decision-
730 making in different contexts, the need for this to be coupled with the principles of
731 sustainability becomes greater.

732

733 In terms of the main types of pluralism we have discussed, the notion of sustainability
734 provides limits to the epistemological and methodological approaches within ecosystem
735 services research, whilst also placing it within a broader normative framing. It is therefore a
736 useful concept to guide the discussion and practice around the ecosystem services concept.
737 This has ramifications for the types of epistemological, theoretical and methodological
738 approaches to ecosystem services research and practice compatible with sustainability.

739

740 A heavy focus on human values, or biophysical processes, whilst not precluded by a
741 commitment to sustainability, should also be treated with caution. Methodologies that seek
742 purely to understand how humans value their environment will not capture ecological
743 dynamics and limits. Similarly, approaches focused purely on the biophysical underpinning
744 of ecosystem services may miss the important distributional impacts of changes between
745 different user groups. At the broad level of research and policy-science innovations, this is
746 not problematic as studies may seek to answer certain questions or develop new methods.

747 However, as infrastructure is created, it is important that neither values, nor biophysical
748 dynamics are neglected. This reinforces the need to ensure that inter- and transdisciplinary
749 practices are carried forward as the concept is institutionalised.

750

751 The three guiding principles that emerged from this survey are mutually reinforcing; a
752 consideration of social and cultural values, inter- and transdisciplinary approaches and a
753 commitment to the principles of sustainability. Such principles can accommodate a broad
754 range of theoretical, epistemological and methodological approaches, whilst guarding
755 against an 'anything goes' approach to the application of the ecosystem services framework.

756

757 **4.5. Limitations and future research**

758 User group identifications in our survey broad and not defined during the data collection;
759 leading to potentially different interpretations between participants. Participants were also
760 not able to identify as multiple user groups, which may not reflect the way that these roles
761 can overlap. We also received fewer responses from those identifying as policy makers or
762 practitioners than those identifying as academics. We were therefore not able to explore in
763 detail the variety of different roles connected to varying uses of the ecosystem services
764 concept outlined above. In order to gain a more nuanced understanding of how the
765 ecosystem services concept is perceived by different user groups, further research will be
766 needed with a more targeted sampling approach.

767

768 Future work may also build upon the distinction between set infrastructure and a broad,
769 pluralistic ecosystem services community. These two strands are undoubtedly already in
770 existence and we do not suggest that critical debate is waning within the ecosystem services

771 community. Yet the ecosystem services concept is likely to become increasingly embedded
772 in policy and decision-making institutions moving forward. As this happens, there may be a
773 need for a more substantive elaboration of the necessary structures to ensure that the
774 critical, pluralistic perspective on ecosystem services is maintained and crucially kept in
775 dialogue with the construction of contextually specific infrastructure.

776

777 Part of this process may be cross jurisdictions reviews of the way that ecosystem services is
778 being embedded at sub-national, national, and international level. Studies of individual
779 jurisdictions and some comparisons are beginning to emerge, but not yet in a systematised
780 way (Bezák et al., 2017; Leone et al., 2016; Mauerhofer and Laza, 2018; McKinley et al.,
781 2018). We suggest that such studies would benefit from considering the guiding principles
782 laid out in this paper. These principles formed the basis of the collaboratively developed
783 Antwerp Declaration and are supported by other literature as outlined above. We suggest
784 that these may constitute potentially useful frames to reflexively assess the
785 institutionalisation of the ecosystem service concept.

786

787 **5. Concluding remarks**

788 There are advantages and disadvantages to the ecosystem services concept being a
789 boundary objects or set infrastructure, and likely these roles represent poles on a spectrum
790 rather than a binary split. We find these two notions useful lenses for understanding the
791 role of the ecosystem services concept at the science-policy interface, and for framing the
792 views of different user groups. As the concept is further institutionalised in governance
793 institutions, it is important to remain cognizant of the trade-off that exists between these

794 two roles and to not lose sight of the political choices necessary for the creation of set
795 infrastructure.

796

797 The structured pre-conference survey and the participatory process of developing the
798 Antwerp declaration have helped to identify different major purposes of the ecosystem
799 service concept, including its function as awareness raising tool, scientific approach, and
800 decision-making aid. The integration of the principles of sustainability and the inclusion of
801 social and cultural values were seen as major research frontiers.

802

803 Although our findings are based on large number of responses of relevant stakeholders (n=
804 121), they are biased towards the European research community, and the segmentation of
805 policy and practitioner stakeholders could not be clearly defined. Nevertheless, they
806 emphasised research needs that have been identified and discussed in the literature for
807 some time thus affirming and supporting existing arguments, whilst providing and guidance
808 to support application of the ecosystem services concept. We suggest that surveys of the
809 wider community to understand the ecosystem services concept provide a valuable
810 approach to encourage nuanced discussion and reflexivity and prevent polarisation of the
811 debate.

812

813 **Acknowledgements**

814 We thank our three anonymous reviewers for their constructive feedback which helped to
815 greatly strengthen the manuscript.

816

817 We also thank our survey participants as well as all collaborators on the Antwerp
818 Declaration at the EESC 2016. We thank Sander Jacobs and Alexander van Oudenhoven for
819 their feedback and contributions to the Declaration process. We thank Vanessa Burton for
820 proofreading and logistical support to the writing team. This study was funded by the
821 European Commission Seventh Framework Programme under Grant Agreements No. FP7-
822 ENV-2012-308393-2 (OPERAs) and 308428 (OpenNESS) and supported by the Ecosystem
823 Services Partnership, the University of Antwerp, and ECOPLAN – Planning for Ecosystem
824 Services (Research Foundation Flanders Grant No. 120014).

825

826 Jacob Ainscough was supported by a NERC doctoral training partnership grant
827 (NE/L002558/1).

828

829 **Conflicts of interest**

830 None

831

832

833

834

835

836

837

838

839

840

841

842 **References**

- 843 Abson, D.J., Wehrden, H. Von, Baumgärtner, S., Fischer, J., Hanspach, J., Härdtle, W.,
844 Heinrichs, H., Klein, A.M., Lang, D.J., Martens, P., Walmsley, D., 2014. Ecosystem
845 services as a boundary object for sustainability. *Ecol. Econ.* 103, 29–37.
- 846 Ainscough, J., Wilson, M., Kenter, J.O., 2018. Ecosystem services as a post-normal field of
847 science. *Ecosyst. Serv.* 31, 93–101.
- 848 Albert, C., Neßhöver, C., Schröter, M., Wittmer, H., Bonn, A., Burkhard, B., Dauber, J.,
849 Döring, R., Fürst, C., Grunewald, K., Haase, D., Hansjürgens, B., Hauck, J., Hinzmann, M.,
850 Koellner, T., Plieninger, T., Rabe, S.-E., Ring, I., Spangenberg, J.H., Stachow, U.,
851 Wüstemann, H., Görg, C., 2017. Towards a National Ecosystem Assessment in
852 Germany: A plea for a comprehensive approach. *GAIA - Ecol. Perspect. Sci. Soc.* 26, 27–
853 33.
- 854 Asah, S.T., Guerry, A.D., Blahna, D.J., Lawler, J.J., 2014. Perception, acquisition and use of
855 ecosystem services: Human behavior, and ecosystem management and policy
856 implications. *Ecosyst. Serv.* 10, 180–186.
- 857 Barnaud, C., Antona, M., 2014. Deconstructing ecosystem services: Uncertainties and
858 controversies around a socially constructed concept. *Geoforum* 56, 113–123.
- 859 Baumgärtner, S., Becker, C., Frank, K., Müller, B., Quaas, M., 2008. Relating the philosophy
860 and practice of ecological economics: The role of concepts, models, and case studies in
861 inter- and transdisciplinary sustainability research. *Ecol. Econ.* 67, 384–393.
- 862 Bazeley, P., Jackson, K., 2013. *Qualitative Data Analysis with Nvivo, Second Edi.* ed. SAGE.
- 863 Beaumont, N.J., Mongruel, R., Hooper, T., 2017. Practical application of the Ecosystem
864 Service Approach (ESA): lessons learned and recommendations for the future. *Int. J.*
865 *Biodivers. Sci. Ecosyst. Serv. Manag.* 13, 68–78.

866 Bennett, E.M., Chaplin-Kramer, R., 2016. Science for the sustainable use of ecosystem
867 services. *F1000Research* 5, 1–13.

868 Bennett, E.M., Cramer, W., Begossi, A., Egoh, B.N., Cundill, G., Di, S., Geijzendorffer, I.R.,
869 Krug, C.B., Lavorel, S., Lazos, E., Lebel, L., Marti, B., Meyfroidt, P., Mooney, H.A., Nel,
870 J.L., Pascual, U., Payet, K., Roebeling, P., Seppelt, R., Solan, M., Tschakert, P.,
871 Tschamntke, T., Li, B.L.T., Verburg, P.H., Viglizzo, E.F., White, P.C.L., 2015. Linking
872 biodiversity, ecosystem services, and human well-being: three challenges for designing
873 research for sustainability. *Curr. Opin. Environ. Sustain.* 14, 76–85.

874 Bezák, P., Mederly, P., Izakovičová, Z., Špulerová, J., Schleyer, C., 2017. Divergence and
875 conflicts in landscape planning across spatial scales in Slovakia: An opportunity for an
876 ecosystem services-based approach? *Int. J. Biodivers. Sci. Ecosyst. Serv. Manag.* 13,
877 119–135.

878 Boerema, A., Rebelo, A.J., Bodi, M.B., Esler, K.J., Meire, P., 2017. Are ecosystem services
879 adequately quantified? *J. Appl. Ecol.* 54, 358–370.

880 Bouwma, I., Schleyer, C., Primmer, E., Winkler, K.J., Berry, P., Young, J., Carmen, E.,
881 Špulerová, J., Bezák, P., Preda, E., Vadineanu, A., 2018. Adoption of the ecosystem
882 services concept in EU policies. *Ecosyst. Serv.* 29, 213–222.

883 Boyd, J., Banzhaf, S., 2007. What are ecosystem services? The need for standardized
884 environmental accounting units. *Ecol. Econ.* 63, 616–626.

885 Braat, L.C., 2018. Five reasons why the Science publication “Assessing nature’s contributions
886 to people” (Diaz et al. 2018) would not have been accepted in *Ecosystem Services*.
887 *Ecosyst. Serv.* 30, A1–A2.

888 Bryman, A., 2016. *Social Research Methods*, 5th Editio. ed. Oxford University Press.

889 Carmen, E., Watt, A., Carvalho, L., Dick, J., Fazey, I., Garcia-Blanco, G., Grizzetti, B., Hauck, J.,

890 Izakovicova, Z., Kopperoinen, L., Liqueste, C., Odee, D., Steingröver, E., Young, J., 2018.
891 Knowledge needs for the operationalisation of the concept of ecosystem services.
892 *Ecosyst. Serv.* 29, 441–451.

893 Cavender-Bares, J., Polasky, S., King, E., Balvanera, P., 2015. A sustainability framework for
894 assessing trade-offs in ecosystem services. *Ecol. Soc.* 20.

895 Chan, K.M.A., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E.,
896 Gould, R., Hannahs, N., Jax, K., Klain, S., Luck, G.W., Martín-López, B., Muraca, B.,
897 Norton, B., Ott, K., Pascual, U., Satterfield, T., Tadaki, M., Taggart, J., Turner, N., 2016.
898 Opinion: Why protect nature? Rethinking values and the environment. *Proc. Natl.*
899 *Acad. Sci.* 113, 1462–1465.

900 Chan, K.M.A., Satterfield, T., Goldstein, J., 2012. Rethinking ecosystem services to better
901 address and navigate cultural values. *Ecol. Econ.* 74, 8–18.

902 Chaudhary, S., McGregor, A., Houston, D., Chettri, N., 2015. The evolution of ecosystem
903 services: A time series and discourse-centered analysis. *Environ. Sci. Policy* 54, 25–34.

904 Costanza, R., de Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., Farber, S.,
905 Grasso, M., 2017. Twenty years of ecosystem services: How far have we come and how
906 far do we still need to go? *Ecosyst. Serv.* 28, 1–16.

907 Crouzat, E., Arpin, I., Brunet, L., Colloff, M.J., Turkelboom, F., Lavorel, S., 2017. Researchers
908 must be aware of their roles at the interface of ecosystem services science and policy.
909 *Ambio* 47, 97–105.

910 Dempsey, J., Robertson, M.M., 2012. Ecosystem services: Tensions, impurities, and points of
911 engagement within neoliberalism. *Prog. Hum. Geogr.* 36, 758–779.

912 Dendoncker, N., Turkelboom, F., Boeraeve, F., Boerema, A., Broekx, S., Fontaine, C.,
913 Demeyer, R., De Vreese, R., Devillet, G., Keune, H., Janssens, L., Liekens, I., Lord-Tarte,

914 E., Popa, F., Simoens, I., Smeets, N., Ulenaers, P., Van Herzele, A., Van Tichelen, K.,
915 Jacobs, S., 2018. Integrating Ecosystem Services values for sustainability? Evidence
916 from the Belgium Ecosystem Services community of practice. *Ecosyst. Serv.* 31, 68–76.

917 Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan,
918 K.M.A., Baste, I.A., Brauman, K.A., Polasky, S., Church, A., Lonsdale, M., Larigauderie,
919 A., Leadley, P.W., van Oudenhoven, A.P.E., van der Plaat, F., Schröter, M., Lavorel, S.,
920 Aumeeruddy-Thomas, Y., Bukvareva, E., Davies, K., Demissew, S., Erpul, G., Failler, P.,
921 Guerra, C.A., Hewitt, C.L., Keune, H., Lindley, S., Shirayama, Y., 2018. Assessing nature's
922 contributions to people. *Science (80-.)*. 359, 270–272.

923 Dick, J., Turkelboom, F., Woods, H., Iniesta-Arandia, I., Primmer, E., Saarela, S.R., Bezák, P.,
924 Mederly, P., Leone, M., Verheyden, W., Kelemen, E., Hauck, J., Andrews, C., Antunes,
925 P., Aszalós, R., Baró, F., Barton, D.N., Berry, P., Bugter, R., Carvalho, L., Czúcz, B.,
926 Dunford, R., Garcia Blanco, G., Geamănă, N., Giucă, R., Grizzetti, B., Izakovičová, Z.,
927 Kertész, M., Kopperoinen, L., Langemeyer, J., Montenegro Lapola, D., Liqueste, C.,
928 Luque, S., Martínez Pastur, G., Martin-Lopez, B., Mukhopadhyay, R., Niemela, J., Odee,
929 D., Peri, P.L., Pinho, P., Patrício-Roberto, G.B., Preda, E., Priess, J., Röckmann, C.,
930 Santos, R., Silaghi, D., Smith, R., Vădineanu, A., van der Wal, J.T., Arany, I., Badea, O.,
931 Bela, G., Boros, E., Bucur, M., Blumentrath, S., Calvache, M., Carmen, E., Clemente, P.,
932 Fernandes, J., Ferraz, D., Fongar, C., García-Llorente, M., Gómez-Baggethun, E.,
933 Gundersen, V., Haavardsholm, O., Kalóczkai, Á., Khalalwe, T., Kiss, G., Köhler, B.,
934 Lazányi, O., Lellei-Kovács, E., Lichungu, R., Lindhjem, H., Magare, C., Mustajoki, J.,
935 Ndege, C., Nowell, M., Nuss Girona, S., Ochieng, J., Often, A., Palomo, I., Pataki, G.,
936 Reinvang, R., Rusch, G., Saarikoski, H., Smith, A., Soy Massoni, E., Stange, E., Vågnes
937 Traaholt, N., Vári, Á., Verweij, P., Vikström, S., Yli-Pelkonen, V., Zulian, G., 2018.

938 Stakeholders' perspectives on the operationalisation of the ecosystem service concept:
939 Results from 27 case studies. *Ecosyst. Serv.* 29, 552–565.

940 Dunlop, C.A., 2014. The possible experts: How epistemic communities negotiate barriers to
941 knowledge use in ecosystem services policy. *Environ. Plan. C Gov. Policy* 32, 208–228.

942 Edwards, D.M., Collins, T.M., Goto, R., 2016. An arts-led dialogue to elicit shared, plural and
943 cultural values of ecosystems. *Ecosyst. Serv.* 21, 319–328.

944 Ekins, P., Simon, S., Deutsch, L., Folke, C., De Groot, R., 2003. A framework for the practical
945 application of the concepts of critical natural capital and strong sustainability. *Ecol.*
946 *Econ.* 44, 165–185.

947 Fanny, B., Nicolas, D., Sander, J., Erik, G.B., Marc, D., 2014. How (not) to perform ecosystem
948 service valuations: pricing gorillas in the mist. *Biodivers. Conserv.* 24, 187–197.

949 Fish, R., Church, A., Willis, C., Winter, M., Tratalos, J.A., Haines-Young, R., Potschin, M.,
950 2016. Making space for cultural ecosystem services: Insights from a study of the UK
951 nature improvement initiative. *Ecosyst. Serv.* 21, 329–343.

952 Fisher, J.A., Brown, K., 2015. Ecosystem services concepts and approaches in conservation:
953 Just a rhetorical tool? *Ecol. Econ.* 117, 261–269.

954 Galler, C., Albert, C., von Haaren, C., 2016. From regional environmental planning to
955 implementation: Paths and challenges of integrating ecosystem services. *Ecosyst. Serv.*
956 18, 118–129.

957 Hauck, J., Stein, C., Schiffer, E., Vandewalle, M., 2015. Seeing the forest and the trees:
958 Facilitating participatory network planning in environmental governance. *Glob.*
959 *Environ. Chang.* 35, 400–410.

960 Hein, L., Obst, C., Edens, B., Remme, R.P., 2015. Progress and challenges in the development
961 of ecosystem accounting as a tool to analyse ecosystem capital. *Curr. Opin. Environ.*

962 Sustain. 14, 86–92.

963 Hermelingmeier, V., Nicholas, K.A., 2017. Identifying five different perspectives on the
964 ecosystem services concept using Q Methodology. *Ecol. Econ.* 136, 255–265.

965 Iniesta-Arandia, I., García-Llorente, M., Aguilera, P.A., Montes, C., Martín-López, B., 2014.
966 Socio-cultural valuation of ecosystem services: uncovering the links between values,
967 drivers of change, and human well-being. *Ecol. Econ.* 108, 36–48.

968 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2018a.
969 The regional assessment report on biodiversity and ecosystem services for the
970 Americas. IPBES Secretariat, Bonn, Germany.

971 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2018b.
972 The regional assessment report on biodiversity and ecosystem services for Asia and the
973 Pacific. IPBES Secretariat, Bonn, Germany.

974 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2018c.
975 The regional assessment report on biodiversity and ecosystem services for Europe and
976 Central Asia. IPBES Secretariat, Bonn, Germany.

977 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2018d.
978 The regional assessment report on biodiversity and ecosystem services for Africa. IPBES
979 Secretariat, Bonn, Germany.

980 Jacobs, S., Dendoncker, N., Martín-López, B., Barton, D.N., Gomez-Baggethun, E., Boeraeve,
981 F., McGrath, F.L., Vierikko, K., Geneletti, D., Sevecke, K.J., Pipart, N., Primmer, E.,
982 Mederly, P., Schmidt, S., Aragão, A., Baral, H., Bark, R.H., Briceno, T., Brogna, D., Cabral,
983 P., De Vreese, R., Liqueste, C., Mueller, H., Peh, K.S.H., Phelan, A., Rincón, A.R., Rogers,
984 S.H., Turkelboom, F., Van Reeth, W., van Zanten, B.T., Wam, H.K., Washbourn, C.L.,
985 2016. A new valuation school: Integrating diverse values of nature in resource and land

986 use decisions. *Ecosyst. Serv.* 1, 213–220.

987 Jacobs, S., Martín-López, B., Barton, D.N., Dunford, R., Harrison, P.A., Kelemen, E.,
988 Saarikoski, H., Termansen, M., García-Llorente, M., Gómez-Baggethun, E., Kopperoinen,
989 L., Luque, S., Palomo, I., Priess, J.A., Rusch, G.M., Tenerelli, P., Turkelboom, F.,
990 Demeyer, R., Hauck, J., Keune, H., Smith, R., 2018. The means determine the end –
991 Pursuing integrated valuation in practice. *Ecosyst. Serv.* 29, 515–528.

992 Jacobs, S., Nicolas, D., Keune, H., 2013. No root, no fruit- sustainability and ecosystem
993 services, in: Jacobs, S., Nicolas, D., Keune, H. (Eds.), *Ecosystem Services - Global Issues,*
994 *Local Practices.* Elsevier Inc., London, pp. 19–28.

995 Jacobs, S., Spanhove, T., De Smet, L., Van Daele, T., Van Reeth, W., Van Gossum, P., Stevens,
996 M., Schneiders, A., Panis, J., Demolder, H., Michels, H., Thoonen, M., Simoens, I.,
997 Peymen, J., 2015. The ecosystem service assessment challenge: Reflections from
998 Flanders-REA. *Ecol. Indic.* 61, 715–727.

999 Jadhav, A., Anderson, S., Dyer, M.J.B., Sutton, P.C., 2017. Revisiting ecosystem services:
1000 Assessment and valuation as starting points for environmental politics. *Sustain.* 9.

1001 Jax, K., Barton, D.N., Chan, K.M.A., de Groot, R., Doyle, U., Eser, U., Görg, C., Gómez-
1002 Baggethun, E., Griewald, Y., Haber, W., Haines-Young, R., Heink, U., Jahn, T., Joosten,
1003 H., Kerschbaumer, L., Korn, H., Luck, G.W., Matzdorf, B., Muraca, B., Neßhöver, C.,
1004 Norton, B., Ott, K., Potschin, M., Rauschmayer, F., von Haaren, C., Wichmann, S., 2013.
1005 *Ecosystem services and ethics.* *Ecol. Econ.* 93, 260–268.

1006 Jax, K., Furman, E., Saarikoski, H., Barton, D.N., Delbaere, B., Dick, J., Duke, G., Görg, C.,
1007 Gómez-Baggethun, E., Harrison, P.A., Maes, J., Pérez-Soba, M., Saarela, S.-R.,
1008 Turkelboom, F., van Dijk, J., Watt, A.D., 2018. Handling a messy world: Lessons learned
1009 when trying to make the ecosystem services concept operational. *Ecosyst. Serv.* 29,

1010 415–427.

1011 Kenter, J.O., 2018. IPBES: don't throw out the baby whilst keeping the bathwater; Put
1012 people's values central, not nature's contributions. *Ecosyst. Serv.* 33, 40–43.

1013 Kenter, J.O., 2016. Editorial: Shared, plural and cultural values. *Ecosyst. Serv.* 21, 175–183.

1014 Kenter, J.O., Jobstvogt, N., Watson, V., Irvine, K.N., Christie, M., Bryce, R., 2016a. The impact
1015 of information, value-deliberation and group-based decision-making on values for
1016 ecosystem services: Integrating deliberative monetary valuation and storytelling.
1017 *Ecosyst. Serv.* 21, 270–290.

1018 Kenter, J.O., O'Brien, L., Hockley, N., Ravenscroft, N., Fazey, I.R., Irvine, K.N., Reed, M.,
1019 Christie, M., Brady, E., Bryce, R., Church, A., Cooper, N., Davies, A., Evely, A., Everard,
1020 M., Fish, R., Fisher, J.A., Jobstvogt, N., Molloy, C., Orchard-Webb, J., Ranger, S., Ryan,
1021 M., Watson, V., Williams, S., 2015. What are shared and social values of ecosystems?
1022 *Ecol. Econ.* 111, 86–99.

1023 Kenter, J.O., Reed, M.S., Irvine, K.N., O'Brien, E., Bryce, R., Christie, M., Cooper, N., Hockley,
1024 N., Fazey, I.R., Orchard-Webb, J., Ravenscroft, N., Raymond, C., Tett, P., Watson, V.,
1025 2016b. Shared values and deliberative valuation: Future directions. *Ecosyst. Serv.* 21,
1026 358–371.

1027 Kistenkas, F.H., Bouwma, I.M., 2018. Barriers for the ecosystem services concept in
1028 European water and nature conservation law. *Ecosyst. Serv.* 29, 223–227.

1029 Kull, C.A., Arnauld de Sartre, X., Castro-Larranaga, M., 2015. The political ecology of
1030 ecosystem services. *Geoforum* 61, 122–134.

1031 Leone, M., Grizzetti, B., Liqueste, C., Antunes, P., Carvalho, L., Geam, N., 2016. Ecosystem
1032 services for water policy: Insights across Europe. *Environ. Sci. Policy* 66, 179–190.

1033 MA, 2005. Ecosystem and human well-being: Synthesis report. Island Press, Washington,

1034 D.C.

1035 Maes, J., Burkhard, B., Geneletti, D., 2018. Ecosystem services are inclusive and deliver
1036 multiple values. A comment on the concept of nature's contributions to people. *One*
1037 *Ecosyst.* 3, e24720.

1038 Maraja, R., Barkmann, J., Tschardtke, T., 2016. Perceptions of cultural ecosystem services
1039 from urban green. *Ecosyst. Serv.* 17, 33–39.

1040 Martinez-Harms, M.J., Bryan, B.A., Balvanera, P., Law, E.A., Rhodes, J.R., Possingham, H.P.,
1041 Wilson, K.A., 2015. Making decisions for managing ecosystem services. *Biol. Conserv.*
1042 184, 229–238.

1043 Matzdorf, B., Meyer, C., 2014. The relevance of the ecosystem services framework for
1044 developed countries' environmental policies: A comparative case study of the US and
1045 EU. *Land use policy* 38, 509–521.

1046 Mauerhofer, V., 2018. The law, ecosystem services and ecosystem functions: An in-depth
1047 overview of coverage and interrelation. *Ecosyst. Serv.* 29, 190–198.

1048 Mauerhofer, V., Laza, I., 2018. How do ecosystem services perform in enforceable law?
1049 Potentials and pitfalls within regional and national integration. *Ecosyst. Serv.* 29, 260–
1050 270.

1051 Mckenzie, E., Posner, S., Tillmann, P., Bernhardt, J., Howard, K., Rosenthal, A., 2014.
1052 Understanding the use of ecosystem service knowledge in decision making: Lessons
1053 from international experiences of spatial planning. *Environ. Plan. C Gov. Policy* 32, 320–
1054 340.

1055 McKinley, E., Ballinger, R.C., Beaumont, N.J., 2018. Saltmarshes, ecosystem services, and an
1056 evolving policy landscape: A case study of Wales, UK. *Mar. Policy* 91, 1–10.

1057 Nahlik, A.M., Kentula, M.E., Fennessy, M.S., Landers, D.H., 2012. Where is the consensus? A

1058 proposed foundation for moving ecosystem service concepts into practice. *Ecol. Econ.*
1059 77, 27–35.

1060 Odum, H.T., 1971. *Environment, Power and Society*. Wiley-Blackwell, New Jersey, US.

1061 Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., Watson, R.T., Başak
1062 Dessane, E., Islar, M., Kelemen, E., Maris, V., Quaas, M., Subramanian, S.M., Wittmer,
1063 H., Adlan, A., Ahn, S.E., Al-Hafedh, Y.S., Amankwah, E., Asah, S.T., Berry, P., Bilgin, A.,
1064 Breslow, S.J., Bullock, C., Cáceres, D., Daly-Hassen, H., Figueroa, E., Golden, C.D.,
1065 Gómez-Baggethun, E., González-Jiménez, D., Houdet, J., Keune, H., Kumar, R., Ma, K.,
1066 May, P.H., Mead, A., O’Farrell, P., Pandit, R., Pengue, W., Pichis-Madruga, R., Popa, F.,
1067 Preston, S., Pacheco-Balanza, D., Saarikoski, H., Strassburg, B.B., van den Belt, M.,
1068 Verma, M., Wickson, F., Yagi, N., 2017. Valuing nature’s contributions to people: the
1069 IPBES approach. *Curr. Opin. Environ. Sustain.* 26–27, 7–16.

1070 Peterson, G.D., Harmáčková, Z. V., Meacham, M., Queiroz, C., Jiménez-Aceituno, A., Kuiper,
1071 J.J., Malmborg, K., Sitas, N., Bennett, E.M., 2018. Welcoming different perspectives in
1072 IPBES: “Nature’s contributions to people” and “Ecosystem services.” *Ecol. Soc.* 23, 39.

1073 Polasky, S., Tallis, H., Reyers, B., 2015. Setting the bar: Standards for ecosystem services.
1074 *Proc. Natl. Acad. Sci.* 112, 7356–7361.

1075 Potschin, M.B., Haines-Young, R.H., 2011. Ecosystem services: Exploring a geographical
1076 perspective. *Prog. Phys. Geogr.* 35, 575–594.

1077 QSR International, 2016. *Nvivo*. Melbourne, Australia.

1078 Ranger, S., Bryce, R., Richardson, P., Kenter, J.O., 2016. Forming shared values in marine
1079 conservation management: a deliberative multi-criteria approach to include
1080 community voices. *Ecosyst. Serv.* 21, 344–357.

1081 Rozas-Vásquez, D., Fürst, C., Geneletti, D., Almendra, O., 2018. Integration of ecosystem

1082 services in strategic environmental assessment across spatial planning scales. *Land use*
1083 *policy* 71, 303–310.

1084 Ruckelshaus, M., McKenzie, E., Tallis, H., Guerry, A., Daily, G.C., Kareiva, P., Polasky, S.,
1085 Ricketts, T., Bhagabati, N., Wood, S.A., Bernhardt, J., 2013. Notes from the field:
1086 Lessons learned from using ecosystem service approaches to inform real-world
1087 decisions. *Ecol. Econ.* 115, 11–21.

1088 Saarela, S.R., Rinne, J., 2016. Knowledge brokering and boundary work for ecosystem
1089 service indicators. An urban case study in Finland. *Ecol. Indic.* 61, 49–62.

1090 Saarikoski, H., Primmer, E., Saarela, S.R., Antunes, P., Aszalós, R., Baró, F., Berry, P., Blanko,
1091 G.G., Gómez-Baggethun, E., Carvalho, L., Dick, J., Dunford, R., Hanzu, M., Harrison, P.A.,
1092 Izakovicova, Z., Kertész, M., Kopperoinen, L., Köhler, B., Langemeyer, J., Lapola, D.,
1093 Liqueste, C., Luque, S., Mederly, P., Niemelä, J., Palomo, I., Pastur, G.M., Peri, P.L.,
1094 Preda, E., Priess, J.A., Santos, R., Schleyer, C., Turkelboom, F., Vadineanu, A.,
1095 Verheyden, W., Vikström, S., Young, J., 2018. Institutional challenges in putting
1096 ecosystem service knowledge in practice. *Ecosyst. Serv.* 29, 579–598.

1097 Sagoff, M., 2011. The quantification and valuation of ecosystem services. *Ecol. Econ.* 70,
1098 497–502.

1099 Schröter, M., Stumpf, K.H., Loos, J., van Oudenhoven, A.P.E., Böhnke-Henrichs, A., Abson,
1100 D.J., 2017. Refocusing ecosystem services towards sustainability. *Ecosyst. Serv.* 25, 35–
1101 43.

1102 Schröter, M., van der Zanden, E.H., van Oudenhoven, A.P.E., Remme, R.P., Serna-Chavez,
1103 H.M., de Groot, R., Opdam, P., 2014. Ecosystem services as a contested concept: A
1104 synthesis of critique and counter-arguments. *Conserv. Lett.* 7, 514–523.

1105 Schröter, M., van Oudenhoven, A.P.E., 2016. Ecosystem services go beyond money and

1106 markets: Reply to Silvertown. *Trends Ecol. Evol.* 31, 333–334.

1107 Seppelt, R., Dormann, C.F., Eppink, F. V., Lautenbach, S., Schmidt, S., 2011. A quantitative
1108 review of ecosystem service studies: Approaches, shortcomings and the road ahead. *J.*
1109 *Appl. Ecol.* 48, 630–636.

1110 Seppelt, R., Fath, B., Burkhard, B., Fisher, J.L., Grêt-Regamey, A., Lautenbach, S., Pert, P.,
1111 Hotes, S., Spangenberg, J., Verburg, P.H., Van Oudenhoven, A.P.E., 2012. Form follows
1112 function? Proposing a blueprint for ecosystem service assessments based on reviews
1113 and case studies. *Ecol. Indic.* 21, 145–154.

1114 Star, S.L., Griesemer, J.R., 1989. Institutional ecology, “translations” and boundary objects:
1115 Amateurs and professionals in Berkley’s Museum of Vertebrate Zoology, 1907-39. *Soc.*
1116 *Stud. Sci.* 19, 387–420.

1117 Steger, C., Hirsch, S., Evers, C., Branoff, B., Petrova, M., Nielsen-Pincus, M., Wardropper, C.,
1118 van Riper, C.J., 2018. Ecosystem Services as Boundary Objects for Transdisciplinary
1119 Collaboration. *Ecol. Econ.* 143, 153–160.

1120 TEEB, 2010. The economics of ecosystems and biodiversity: Mainstreaming the economics
1121 of nature: A synthesis of the approach, conclusions and recommendations of TEEB,
1122 Environment.

1123 Thomas, D.R., 2006. A general inductive approach for analyzing qualitative evaluation data.
1124 *Am. J. Eval.* 27, 237–246.

1125 Timpte, M., Montana, J., Reuter, K., Borie, M., Apkes, J., 2018. Engaging diverse experts in a
1126 global environmental assessment: participation in the first work programme of IPBES
1127 and opportunities for improvement. *Innovation* 31, S15–S37.

1128 Treasury, H.M., 2011. The Green Book: Appraisal and evaluation in central Government.

1129 Turnhout, E., 2009. The effectiveness of boundary objects: The case of ecological indicators.

1130 Sci. Public Policy 36, 403–412.

1131 Turnhout, E., Dewulf, A., Hulme, M., 2016. What does policy-relevant global environmental
 1132 knowledge do? The cases of climate and biodiversity. *Curr. Opin. Environ. Sustain.* 18,
 1133 65–72.

1134 Turnpenny, J., Russel, D., Jordan, A., 2014. The challenge of embedding an ecosystem
 1135 services approach: Patterns of knowledge utilisation in public policy appraisal. *Environ.*
 1136 *Plan. C Gov. Policy* 32, 247–262.

1137 UK National Ecosystem Assessment, 2014. UK National Ecosystem Assessment Follow-on
 1138 Work Package 4 – Coastal/marine ecosystem services : Principles and Practice
 1139 Summary.

1140 Wawrzyczek, J., Lindsay, R., Metzger, M.J., Quétier, F., 2018. The ecosystem approach in
 1141 ecological impact assessment: Lessons learned from windfarm developments on
 1142 peatlands in Scotland. *Environ. Impact Assess. Rev.* 72, 157–165.

1143 Weiss, C., 1979. The many meanings of research utilization. *Public Adm. Rev.* 39, 426–431.

1144 World Commission on Environment and Development, 1987. *Our Common Future*. Oxford
 1145 University Press, Oxford.

1146

1147

1148

1149 **Supplementary Material**

1150 SM1 – Full questionnaire

1151 SM2 – Coding Matrix

1152 SM3 – Early findings documents

1153

1154 **Supplementary Material 1**

1155 Full survey circulated among 350 early registrants to the European Ecosystem Services
 1156 Conference 2016.

1157

<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. C) The ecosystem services framework implicitly accepts that happiness and wellbeing can be quantified.

<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>) <ul style="list-style-type: none"> A) The terminology of ecosystem services is too complicated and academic, impossible to use with non-expert audiences. 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. 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. D) Policy makers have adopted the ecosystem services framework for their own purposes, without really paying attention to its theoretical underpinnings. 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. F) The phrase 'ecosystem services' is used to cover a growing variety of quite distinct concepts and approaches. G) Other
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>) <ul style="list-style-type: none"> A) Student/Junior Researcher B) Academic Researcher C) Policy maker D) Practitioner E) Other
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]

1159 **Supplementary Material 2**

1160 Coding matrix of the inductive thematic content analysis. Counts refer to the number of
 1161 times each theme was mentioned by each user group. Any empty responses to open
 1162 questions were removed from the analysis prior to coding.

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

1163

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

1167
1168
1169
1170
1171
1172

Supplementary Material 3

Early findings documents circulated in the delegate pack to the all participants in the European Ecosystem Services Conference 2016.

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.

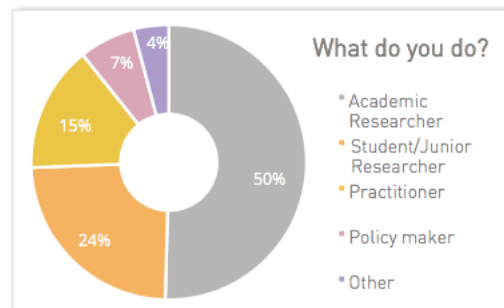
It's an approach that should be used very intelligently to frame environmental management challenges through a more socially relevant and integrated lens. Valuation is just one tool in the ES basket. ”

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

1173

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.

