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Reference:

Pasgaard M., Van Hecken Gert, Ehammer A., Strange N.- Unfolding scientific expertise and security in the changing governance of ecosystem services
Geoforum - ISSN 0016-7185 - 84(2017), p. 354-367
Full text (Publisher's DOI): <https://doi.org/10.1016/J.GEOFORUM.2017.02.001>
To cite this reference: <https://hdl.handle.net/10067/1408060151162165141>

Unfolding scientific expertise and security in the changing governance of Ecosystem Services

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Abstract

Within the past few decades, the idea of global Ecosystem Services (ES) has moved center stage in environmental and sustainability debates. The academic and policy discourse underlying the reasons for Ecosystem Service protection appears to have changed from an ecological focus on habitat restoration to a more economic focus revolving around the well-being of humans. The overall aim of this paper is to unfold the coupling between scientific expertise and security in the changing governance of Ecosystem Services. We employ a ‘securitization’ lens to advance our understanding of the recent turn in the governance of ecosystems, as we reflect upon the role of scientific expertise at the boundary between science and security. Empirically, we analyze how scientific experts as securitizing actors frame the degradation and loss of ES as an existential threat to human security thereby justifying certain measures to reverse these negative trends. In order to trace how the voices of scientific experts shape policies to govern ES we apply bibliometric analysis and an opinion-based survey to first identify *who* produces the scientific knowledge published, and then follow *how* key scientific experts link to policy-making arenas and use security framing. Lastly, we discuss the implications of the shifting discourse surrounding ES, and we reflect upon our own positionality and approach, as we string together our findings in an attempt to contribute to the debate about environmental expertise and governance, and the authority of scientific knowledge.

Key words: expertise; self-reflectivity; bibliometric analysis; Ecosystem Services; IPBES; securitization

1. Introduction: The link between Ecosystem Services, security, and expertise

Environmental crises often take center stage in the global political and academic debates on threats to our planet and human societies (e.g. IPCC, 2014; Latour, 2011; Steffen et al., 2015). It is therefore important to unfold the coupling between the environment, security, and the role of scientific experts in this. In this paper we specifically examine how scientific experts, through their security framing of environmental degradation, shape environmental governance in the case of Ecosystem Services (ES).

The academic and policy discourse on Ecosystem Services (ES) has changed from being predominantly eco-centric to being more anthropocentric and economic, although different discourses are present at the same time (Barnaud and Antona, 2014; Raymond et al., 2013; Sandbrook et al., 2013). Méral (2012) retraces the origins of the ES concept and notes that since the mid-2000s there appears to be a growing trend to include the notion in political agendas, branching out in several directions, including the monetary valuation of ES, its introduction in agricultural and environmental policies, and payments for ecosystem services (PES)¹. Similarly, Coralie et al. (2015) show this move from ecologically-driven approaches to an economic and market lexicon, and specifically show a change in concern from ecological restoration and habitat creation to more economic terminology from mid-2000s. In a critical tone, Spash (2015) notes what he calls a shift in conservation from the protection of Nature for non-instrumental and eco-centric reasons (e.g. duty of care, prevention from harm, and protection of non-humans) to an anthropocentric, instrumental and economic focus, where the role of Nature is exclusively that of value provision in the global economy supporting market governance (see also Lele et al., 2013). The advocates of this shift on the other hand argue that until we can show that nature is essential for economic growth and development the degradation of ecosystems will continue (Juniper, 2014). This also explains why ‘much of the ES literature tacitly or explicitly accepts an economic valuation framework for assessing human well-being’ (Lele et al.,

¹ The terms ‘ecosystem services’ and ‘environmental services’ are often taken as interchangeable despite some differences between them (Barnaud and Antona, 2014).

2013, p. 351). Parallel to this, Roth and Dressler (2012) note a growing commitment to markets as a means of meeting conservation objectives and livelihood *security*; promoting the idea that social well-being, rural livelihoods and economic development must not be at odds with conserving valued species and ecological systems. De Freitas et al. (2015) emphasize that these developments are presented “as a welcome ‘greening’ of capitalism that will resolve *critically urgent environmental crises*” (p. 239-240, emphasis added). Other scholars even go as far as comparing this ecological crisis with war (Latour, 2011, p. 75; Spash, 2015) and several highlight the “*urgen[cy]* for societies to act towards mitigating the effects of multiple environmental and natural resource *crises* and prevent or minimize further *damages*” (Thiel et al., 2015, p. 81, emphasis added). Kremen (2005, p. 477) concludes that ecologists should campaign to convince society of the importance of ecosystem services since “nothing less than our human future is at stake”. With these notions by scientists of “crisis”, “urgency”, “damage” and even the use of war terminology, the changing discourse around ES can be coupled to notions of security and expertise, which are the core topics of the present paper.

Within traditional security studies, however, security was not about the protection of ES, it was about states and survival of the state, and security experts were those who understood state apparatuses and state relations (Buzan et al., 1998; Dalby, 2002; Halfon, 2015; Owen, 2010). Only newer articulations have shifted security expertise from its traditional state-centric realms to other areas, such as human development and environmental protections (Dalby, 2002; Halfon, 2015). Scholarly work has for instance focused on the securitization of broad environmental issues such as climate change (e.g. Trombetta, 2009) and biodiversity conservation through processes of ‘green militarization’ (e.g. Lunstrum, 2014; Massé and Lunstrum, 2016; Verweijen and Marijnen, 2016), revealing how security practices are transformed and risks of dispossession and displacement rise (Fairhead et al., 2012; Duffy, 2016; Neumann, 2004; Peluso and Vandergeest, 2011; Ybarra, 2012). Indeed, the threats that states are asked to mitigate on behalf of their citizens require the assessment of complex trajectories of social, technological and environmental change

72 (Jasanoff, 2005). In that way, *scientific* experts can become *security* experts, since their specifications are an
73 unavoidable part of any discussion on environmental or security politics (Dalby, 2002). Experts provide
74 means to identify what is dangerous and what is not, for instance by deciding whether an alert status
75 should be moved from green to yellow or even red (Berling and Bueger, 2015). This occurs for instance
76 when lead scientists define the boundaries of our planet “within which humanity can operate safely”
77 stating that transgression of these boundaries may be “deleterious or even catastrophic” (Rockstrom et al.,
78 2009, see also Milkoreit et al., 2015, and Castree, 2015). Or when prominent ES scholars propose essential
79 principles to ensure “scientific integrity in environmental interventions”, predicting that *without* these
80 principles, social and ecological benefits may be “undermined” (Naeem et al., 2015). Or, as central to this
81 paper, when comprehensive scientific meta-assessments couples Ecosystem Services (ES) to human well-
82 being, stating that the degradation of natural capital has substantial harmful effects on human livelihoods,
83 security, health, and economy (Costanza et al., 1997; Kremen, 2005; MEA, 2005; Figure 1) taking the planet
84 “to the edge of a massive wave of species extinctions, further threatening our own wellbeing” (MEA, 2005,
85 p.3). Avoiding environmental catastrophe as a result of human activity then requires and justifies
86 “significant changes in policies, institutions, and practices that are not currently underway” (MEA, 2005, p.
87 1; see also Danley and Widmark, 2016). Today it seems like the security threat of ES degradation is widely
88 accepted as a fact in the science community, like an implicit undercurrent we take for granted and no
89 longer need to make explicit, or what Berling (2011) calls a scientific ‘objectivation’ closing down
90 controversy, even if contemporary uses of terms like “environment” and “security” should arguably be
91 continuously challenged (Dalby, 2002).

92

93 [Figure 1]

94

95 Experts and expertise, our second core topic related to ES, have become indispensable to the politics of
96 nations, and indeed to transnational and global politics. The weight of political legitimization rests

97 increasingly on the shoulders of experts, and yet they occupy at best a shadowy place (Jasanoff, 2005).
98 *Scientific* experts are, as already mentioned, increasingly involved in environmental security politics
99 (Halfon, 2015), but their role and the sites of science-security encounters have gone largely unrecognized
100 and are under-researched (Berling, 2011). There is a need to examine the individuals and social and
101 professional groups, rooted in evolving national and transnational societies, who govern in global
102 governance (Kauppi and Madsen, 2014), and specifically, there is a need to actively engage with the moves
103 and practices of science towards practical (security) politics (Buger and Villumsen, 2007). Recent
104 scholarship has increasingly focused on the (discursive) ways in which different involved (expert) actors
105 (such as project consultants, government officials, NGOs, scholars, etc.) increasingly draw upon ‘green
106 economy’ ideas and accompanying ecological crisis narratives to justify and further the “marketization” or
107 “financialisation” of ES (Büscher, 2012, 2014; Fairhead et al., 2012; Robertson, 2012; Sullivan, 2013).
108 However, to our knowledge, the explicit security framing that accompanies these processes in the context
109 of ES governance has remained largely unexplored, as has the role of scientific experts (see however Lund,
110 2015, on the professionalization of participatory forestry and its un-democratic and social consequences; or
111 Büscher 2014 on the construction and ‘epistemic circulation’ of value in conservation and development
112 projects). While adopting the language of value and economic impacts offers obvious advantages in
113 advancing the argument that ES are currently undervalued (Costanza et al., 1997), it is important to
114 acknowledge that ‘ES does not spring from a simple narrative of marketization’ (Dempsey and Robertson,
115 2002, p.759). Knowledge around ecosystems services is composed of normative beliefs, cause-and-effect
116 claims, agreed methodological standards and socially-necessary abstractions, as well as policy aspirations
117 (Haas, 1992; Dunlop, 2014; Robertson, 2012). This makes it all-the-more important to scrutinize the
118 multiple ways in which evidence and discourses inform policy-making, and the different discursive
119 strategies that ‘experts’ might deploy to negotiate the knowledge-policy interface (Dunlop, 2014, p.208;
120 Robertson, 2011; Van Hecken et al., 2015b). In this paper, we respond to these calls by examining how
121 scientific experts are linked to environmental governance and security with the case of ES, and we discuss

122 the consequences for society and nature. In order to explore how interpretative frames and related
123 interests unfold through the coupling between ES, security, and expertise, we identify key scientific experts
124 in ES through the use of bibliometric analysis and an opinion-based survey, and we follow some of their
125 voices to ES governance and interrogate their security framings.

126

127 While previous critical scholarship has already engaged with the socio-political consequences of a world
128 reduced to a collection of quantifiable ecosystem services (Robertson, 2012; Dempsey and Robertson,
129 2012; Sullivan, 2013; McAfee, 1999; Büscher et al., 2014), or have dealt with ways to govern emergencies
130 and attend to security affects as geographers (Adey et al., 2015; Anderson, 2015), we attempt to examine
131 environmental expertise at the boundary between science and security from the ‘inside’ by studying
132 experts through their own knowledge forms and approaches (see Mosse, 2011), which we are familiar with
133 as environmental scientists ourselves. Hence, we, the authors of this paper, *practice* scientific expertise and
134 *speak* security concerning environmental governance (e.g. Pasgaard, 2013; Strange et al., 2011; Van Hecken
135 and Bastiaensen, 2010a), while proposing to simultaneously *examine* this area of expertise. Therefore, this
136 paper contains explicit and honest self-reflections about our positionality and the approaches we apply
137 (Section 5.2).

138

139 The paper is organized as follows. We take our point of departure in the coupling between ES, security and
140 expertise. In Section 2 we outline our theoretical background inspired by boundary-work, political ecology,
141 “securitization” theory, and reflexive thinking. In Section 3 we describe our empirical frame, which in a
142 novel and unique way combines bibliometric analysis with a survey approach in order to quantitatively
143 identify experts by their attribution. We present our analysis in Section 4, before we round up with a
144 discussion in Section 5 including our self-reflections.

145

2. Theoretical frame: Expertise at the boundary between science and security (politics)

To better grasp the linkages between the governance of ES, security, and scientific expertise, we employ a broad theoretical frame drawing first on Thomas Gieryn's conception of the boundaries between science and non-science, which we relate to the coupling between science and policy (as governance of ES) from a political ecology lens. We then turn to "securitization" and expertise as processes, which can inform an analysis of the discourses and actors at the boundary between science and governance of ES. Here, we explicitly focus on the scientific expert as a potential securitizing actor. Lastly, we include some notions about reflexivity in research, which we will direct at our own positions and practices.

2.1 The contested boundaries of science

According to Thomas Gieryn (1983) the boundaries of science are ambiguous, flexible, historically changing, contextually variable, internally inconsistent, and sometimes disputed. Construction of a boundary between science and non-science is however useful, according to Gieryn, for several reasons, including scientists' pursuit of career opportunities, for acquisition of intellectual authority, for denial of "pseudo-scientists", and for the protection of the autonomy of scientific research from political interference. However, instead of such an ideologically clear boundary around science, where scholars are being seen as only 'speaking truth to power', a more cynical interpretation sees scientific advisers as following their own interests, and sees politicians as asking for advice only to support and legitimize their pre-formed political decisions (Hoppe, 2005). As such, science and politics have long collaborated to co-produce dominant understandings of nature. Behind the public face of environmental science, nation-states are continually at work, setting baseline conditions for whose knowledge counts and when knowledge is sufficient for action (Jasanoff, 2010; Hajer, 1995; Scott, 1998). This also leads us to acknowledge that 'truths' about the environment are inevitably 'shaped by the relationship between the subject and object of research, such that different actors, like scientists or others, may construct the same environment in very different ways

169 (Blaikie, 1999). Indeed, understandings of nature and society are open to multiple – often contested –
170 framings, i.e. different ways of understanding or representing specific problems and corresponding sets of
171 solutions (Leach et al., 2010). The broad and interdisciplinary field of political ecology provides useful
172 frameworks to critically analyse how environmental knowledge is produced, represented and contested
173 (Bryant, 1998; Peet and Watts, 1996). In particular, some of the political ecologists influenced by Foucault's
174 conceptualizations of power, knowledge and discourse (e.g. Blaikie, 1999; Escobar, 1996) provide crucial
175 insights into how knowledge and power interrelate and mediate political-ecological outcomes (Bryant,
176 1998). They demonstrate that social–ecological conflicts are both struggles over meaning and battles over
177 material practices (ibid). These insights have spurred political ecologists to turn to discourse, or the analysis
178 of particular narratives promoted by and interlocked with governance processes (Adger et al., 2001; Hajer,
179 1995; Leach et al., 2010). The emphasis on narratives as particular ways of framing problems and solutions
180 is held to promote a shift from descriptive to more critical and reflexive modes of explanation that 'help
181 illuminate how knowledge claims derived from particular instances and sites are spread and consolidated
182 by enrolling other actors and institutions into knowledge/power networks' (Leach et al., 2010:74).

183

184 While science is indeed politics, research does not necessarily or easily translate into policy practice on the
185 ground (Bueger and Villumsen, 2007). According to Jasanoff (2005), science operates within a thick web of
186 social constraints, and it is important to understand who has the right to define how, when, by whom, and
187 to what extent science will be integrated into the solution of public problems, and *who*, indeed, will frame
188 those problems in the first place. Inevitably, she says, there are boundary conflicts over where the role of
189 science ends and that of politics or policy begins. These boundary issues are visibly illustrated in our
190 analysis of the evolving discourse, expertise and governance of ES (Section 3), the security dimensions of
191 which we now turn to.

192

193 *2.2 Securitization and scientific expertise*

194 According to security scholars of the so-called “Copenhagen School”, security does not have a fixed
195 meaning – security issues are socially constructed in a process called “securitization”. A socially relevant
196 *securitizing actor* uses certain *speech acts* – a particular discourse or narrative – to proclaim something an
197 *existential threat* for a *valued referent object*, for instance a state or human welfare and economy. If this
198 securitizing move is accepted by a relevant *audience*, such as the public or politicians, the securitizing actor
199 may initiate and apply *extraordinary measures* which lie beyond the normal political realm and implies the
200 use of force in order to tackle the threat. The issue in question then moves from being non-politicized or
201 politicized to be a *securitized issue* (e.g. Buzan et al., 1998; Waever, 2011). Scholars studying such
202 securitization processes in various contexts point out that security framing has implications; it can bring
203 about exclusionary and stigmatizing effects, it may lead to selective policies or mismanagement, and it
204 limits an open democratic debate (e.g. Balzacq, 2011; Elbe, 2006; Trombetta, 2008). Importantly, the
205 problematic side effects of applying a security mindset should always be weighed against the possible
206 advantages; for instance, securitization can have tactical attractions as a way to obtain sufficient attention
207 to environmental problems (Buzan et al., 1998).

208 Having briefly unfolded how *security* is conceptualized in our analysis of ES, the notion of *expertise* remains
209 to be unpacked. An expert can be understood as a person who holds a certain type of knowledge, or who
210 achieves an authoritative position through claims of knowledge (Berling and Bueger, 2015; Jasanoff, 2005).
211 Expert status can be produced by *acquisition* of certain skills or through *attribution*; the latter meaning
212 someone being recognized as an expert by an audience (Berling and Bueger, 2015). In the latter view,
213 expertise is not possessed, but designates authoritative knowledge (Halfon, 2015), similar to the notion of
214 “power”, which can be viewed as only meaningful when perceived as legitimate by others (see Haugaard,
215 2003; Sikor and Lund, 2009). Importantly, expertise mediates between different forms of knowledge and
216 occupies a boundary position by navigating positions and relations, and by translating between different
217 domains, such as between science and politics (Berling and Bueger, 2015, p. 9). According to Jasanoff

218 (2005), scientists are expected to function as experts, that is, as persons possessing analytic skills grounded
219 in practice and experience, rather than as truth-tellers with unmediated access to ascertainable facts. In
220 other words, what is increasingly expected from experts in decision-making processes is to manage
221 heterogeneous bodies of knowledge and offer balanced *opinions*. In the face of uncertainty, the central
222 question is no longer which scientific assessments are *right*, but *whose* recommendations the public should
223 accept as credible and authoritative. With the shift from science (as 'speaking truth to power') to expertise,
224 and from knowledge to judgment, (scientific) experts have become indispensable to the politics of nations,
225 and indeed to transnational and global politics, including security politics. The weight of political
226 legitimation rests increasingly on the shoulders of such experts, and yet they occupy at best a shadowy
227 place in the evolving discourse of democratic theory, says Jasanoff (2005). In relation to Gieryn's boundary
228 work, scientists attempt to construct a boundary around themselves contrasting them favourably to non-
229 scientific activities in order to protect their professional autonomy and protect the assumption that science
230 carries its own intellectual authority. In turn, "different concepts and arguments are socially constructed
231 and legitimated through complex processes that have produced new forms of expertise" (Aguilar-Stoen,
232 2015, 40-41), and these processes in the end determine how problems and solutions are framed,
233 constructed and circulated (Büscher, 2014). This paves the way to govern the environment by the
234 management of 'risks' through the 'modulation of control' in a 'society of control', usually through
235 practices of 'rendering technical' (Li, 2007a, b) or by securitizing the environment to 'render it governable'
236 (Büscher, 2014; Nel, 2015). Thus, as noted in the definition of expertise above, scientific knowledge must
237 be widely accepted in society as a preferred truth in descriptions of natural and social reality to maintain its
238 authority (Gieryn, 1983) and describe solutions. How some scientific experts on ES portray themselves,
239 construct boundaries to other scientists and non-scientists, and propose solutions to counter ES
240 destructions, is exemplified in our analysis, and this boundary work is strongly coupled to (self-)reflectivity
241 of research positions and practice.

242

243 2.3 (Self-)reflectivity at the boundary between science and security

244

245 Being an expert at the boundary between science and security can be an “uneasy position of the academic”
246 opening up for important reflexive questions about expert practices and the production of scientific
247 knowledge (Berling and Bueger, 2015). Adding to the unease, academics are in a constant situation of
248 ‘science in the making’, where many decisions have to be made without a full understanding and
249 predictability of causal effects (Barnaud and Antona, 2014, p. 115). The “awkward tension” between the
250 maintenance of professional modes of thought and identities, and the world with which these have to
251 engage, makes professional subjectivity and even self-ethnography increasingly relevant with studies of
252 experts through their own knowledge forms and modes of sociality (Mosse, 2011).

253

254 While *social* scientists oftentimes direct their critical gaze towards other scientific experts and technicians
255 operating in the *natural* sciences (Kauppi, 2014, see also Section 5.2), natural scientists can be accused of
256 the same (e.g. Naeem et al., 2015; see Pasgaard, 2013). Thus, ideological self-descriptions constructed by
257 scientists to monopolize professional authority and resources in the hands of some scientists by excluding
258 others as “pseudoscientists” is not limited to demarcations of science from non-science. One epistemic
259 group of scientists can draw a boundary to exclude another group also claiming to be scientific thereby
260 making ideological demarcations of disciplines, specialties or theoretical orientations *within* science
261 (Gieryn, 1983). As such, methods of science do reflect back on themselves, making science the unwilling
262 target of its own methodological skepticism (Jasanoff, 2010), but this skepticism occurs mostly between
263 disciplines within science instead of within scientific disciplines. Hence, it is ever more justified to
264 investigate the status of science in society by pointing the finger at *ourselves* as researchers, by calling for
265 practical reflexivity on the part of the scientist (Berling, 2011) and encouraging reflections about underlying
266 predispositions, beliefs, and understandings that frame and guide scientific inquiries (Greene, 2007;

267 Pasgaard et al., 2017). One way to do this is to foster reflexive empirical work on researchers' own
268 practices, including how researchers' sayings and doings play out in concrete situations and contribute to
269 the securitization of issues (Buger and Villumsen, 2007). Such practical reflexivity is needed to equip us with
270 tools to capture relations between academia and policy, and to address dilemmas and challenges in
271 concrete everyday situations (Berling and Bueger, this issue). Specifically, research approach and design,
272 and researchers' positionality and stance within it, is a process which requires sensitivity, reflexivity,
273 application and ongoing dialogue between the researcher and social actors (Prowse, 2010). The issue and
274 appropriateness of value-driven science is of particular relevance and highly contested within areas such as
275 ecosystem protection, and scholars themselves wish to initiate reflection and debate in the science
276 community concerning their own role in growing the middle ground between science and politics, as they
277 conduct science within that "hybrid space" (Milkoreit et al., 2015, p. 87; Pasgaard et al., 2017). In this study,
278 we go beyond wishing and beyond reflexivity as merely a tool of critique (Berling and Bueger, this issue),
279 and expose ourselves as awkward, but willing, targets of our own sensitive self-reflections.
280
281 In sum, our reflexive analysis of expertise and the changing governance of ES at the boundary between
282 science and security lean on securitization and expertise as key parts of our theoretical frame. At the center
283 of this frame stand the scientific experts on ES, and the following section outlines how we operationalize
284 and examine their expertise, policy linkages and security framing.

285

286 3 Empirical approach: Operationalizing (security) expertise in Ecosystem Services

287

288 3.1 Examining (security) expertise in Ecosystem Services

289

290 Exploring the politics of expertise is not about what experts *know*, but rather what they *do*, meaning their
291 systems for producing knowledge and the *practices* that they are able to institutionalize (Halfon, 2015). As
292 mentioned earlier, expert status is produced through *attribution*, meaning that an expert needs to be
293 *recognized* as an expert (Berling and Bueger, 2015). We operationalize this concept of expertise attribution
294 quantitatively through bibliometric analysis and a qualitative opinion-based survey. We apply these
295 methods as briefly explained below (see also Supplementary Materials) in order to identify key scientific ES
296 experts and then trace their practices to policy arenas and expose their security framings.

297

298 For the bibliometric analysis we use article citations as our proxy to identify key scientific experts within ES
299 research. In more detail, our citation proxy is operationalized as the top ten *most cited* scientific articles
300 each year over more than a decade (2005-2015) using the search terms ‘ecosystem service*’ or
301 ‘environmental service*’ in Scopus (extracted on 5th January 2016). For these most cited articles (110 in
302 total) we list all first, second, second-last and last authors (335 in total), since those are perceived most
303 important, i.e. the last author is oftentimes the head of the laboratory or research team. Authors who did
304 not publish any of the 110 articles as first author were eliminated from the list. The citations were then
305 added and the authors were ranked accordingly (Table 1). To supplement and compare this list of key
306 experts derived from bibliometrics, we conducted an anonymous online survey among academics,
307 practitioners and policy-makers within the fields of ES, and asked them to identify key experts (Table 2).
308 The survey respondents were identified and contacted based on their engagement in recent publications²

² Corresponding authors that recently (2012 till present) published on “ecosystem services” or “environmental services”. We extracted 3655 unique email addresses from Scopus on November 9th, 2015.

309 and events³ related to ES. Based on the bibliometric analysis and the survey, we then explored the
310 backgrounds and affiliations of four selected key experts, their links to policy design and execution, and
311 importantly, the use of security framings in their work. Moreover, the survey approach itself gave rise to
312 interesting comments from the invited respondents, some of which are included in our summarizing
313 reflections (Section 5.2).

314

315 3.2 Methodological considerations

316

317 As we employ a bibliometric approach with a focus on highly cited articles we use publication performance
318 indicators as novel measures of expert attribution. Here, we measure authors' scientific weight to label
319 them as experts, rather than any other criteria (e.g. research grants, keynote talks, public outreach,
320 networks – such criteria might be used by media or government). With this approach we run the risk of
321 including publications by authors who are well-cited because other scholars *criticize* their work, possibly
322 *questioning* their status as experts. This bias is balanced by comparison with the key experts identified in
323 the opinion-based survey. With the bibliometric approach, we also run the risk of overlooking influential
324 and politically-engaged researchers with relatively older, few, or less-cited scientific publications, as they
325 fall out of our bibliometric radar, which is designed by people and biased in these regards. However, we
326 explicitly aim to trace voices of experts operating at the boundaries between *science* and security, and we
327 understand expertise as *attribution* (Berling and Bueger, 2015). Therefore we identify scientific experts
328 based on their/our own commonly used valuation metric (namely highly-cited publications) in combination
329 with subjective opinions collected through the online survey. Cynically speaking, we are less concerned
330 with identifying *the* top scientific experts on ES, since such a list will differ with slight changes in the setup
331 and timing of the bibliometric analysis and the survey. Although interesting discussions can be connected
332 to the credibility of creating “a top list”, we are more concerned with *the way* our identified experts (highly

³ For instance the “Ecosystem Services Partnership conference 2015” and “A Community on Ecosystem Services Linking Science, Practice and Decision Making (ACES 2014 conference)”

333 cited and recognized by an audience) link to policy and frame ES. In other words, exactly *who* features on
334 our expert list is less relevant in this study, as opposed to exemplifying *how they practice* their expertise on
335 ES. Finally, we note that our empirical approach is further discussed as part of our reflections (Section 5.2).

336 4 Analysis: Expertise, security and governance of Ecosystem Services

337

338 Having sketched out in our Introduction the shift in the broader ES discourse from a mainly ecological focus
339 towards a more dominant economic focus, we here direct our analysis at the security framings and the role
340 of scientific experts. We first examine the changing discourse and governance of ES from a securitization
341 lens by presenting speech acts by securitizing actors, in this case the scientific experts, who point to
342 valuable referent objects and call for certain measures to reverse the proposed destructive trajectories of
343 ES. Two governance platforms, namely PES and Intergovernmental Science-Policy Platform on Biodiversity
344 and Ecosystem Services (IPBES), are used as further examples to connect ES, security, and expertise. We
345 then identify key experts, follow the practices of four selected key experts to ES policies, and exemplify
346 their security framings. To supplement these analyses and examples, an anecdote from a recent conference
347 on ES provides a more personal illustration of the heated discursive struggles among experts about the
348 governance of, and science in, ES.

349

350 4.1 Security framings of Ecosystem Services and governance implications

351

352 Gomez-Baggethun et al. (2010) and Norgaard (2010) note that the rationale behind the use of the ES
353 concept was mainly pedagogic, aiming to demonstrate how the disappearance of biodiversity directly
354 affects ecosystem functions that underpin *critical services for human well-being*. In other words; by using a
355 security language that reflects dominant political and economic views as a tool to communicate ecosystem
356 functioning, the concept or metaphor of ES was applied in search for short term policy actions to halt ES
357 loss, as traditional narratives of conservation largely failed to influence economic decision making (ibid; see
358 also Barnaud and Antona, 2014; Bonie and Hulme, 2015; Vadrot, 2014). While examples of security
359 framings in relation to ES are plentiful to the point that the security threat of ES degradation today is a
360 widely accepted fact (see Introduction), we emphasize here two publications, both issued in 2005, which

361 seem to have played a key role in the changing discourse on ES, namely Wunder (2005) and the Millennium
362 Ecosystem Assessment on Ecosystems and Human Well-being (MEA, 2005). It is around this time topics
363 linked with ES and market-based instruments became significant concerns (see Introduction and
364 bibliometric results in Supplementary Information). We bring attention to these two influential
365 publications, since they both reflect and have further ignited a turn from a more ecologically-driven
366 discourse to a more economically-driven one (see also Méral, 2012; Spash, 2015; and Van Hecken et al.,
367 2015a, who among others point out the importance of these publications). Importantly, as evident from
368 the brief analysis below, both Wunder (2005) and the MEA (2005) use a security framing of ecosystem
369 destruction or environmental crisis to legitimize and justify the type of governance they suggest.

370

371 The economist Sven Wunder (2005) “demystif[ies] PES for non-economists” arguing that it is part of a new
372 conservation paradigm and that “PES best suits intermediate and/or projected *threat* scenarios” (p. 1,
373 emphasis added). Wunder clearly notes that “[a]s wilderness and natural habitats shrink, environmental
374 services (ES) previously provided free by Mother Nature are becoming increasingly *threatened*. This
375 *emerging scarcity* makes them potentially subject to trade” (p. 1, emphasis added). According to Google
376 Scholar, Wunder’s paper has been cited more than 1,400 times (as of April 2016), and Sven Wunder also
377 features on both our lists of key experts as identified by the bibliometric analysis and survey, respectively
378 (see Tables 1-3). The other key publication, the MEA (2005), is authored by over a thousand experts from
379 different scientific disciplines, and the publication applies “the judgment of [these] experts to existing
380 knowledge to provide scientifically credible answers to policy-relevant questions (p. v)” by synthesizing
381 information from the scientific literature and relevant peer-reviewed datasets and models. The MEA
382 explicitly couples ES and human well-being, noting that “[e]veryone in the world depends completely on
383 Earth’s ecosystems and the services they provide”⁴. According to the MEA, these ecosystem services are
384 specifically linked to the security constituent of human well-being in terms of personal safety, secure

⁴ Categorized in the MEA (2005) as *provisioning, regulating, cultural, and supporting* services.

385 resource access and security from disasters (p. vi, see Figure 1 portraying these security dimensions at the
386 top of the graphics). The MEA states in a non-controversial and fact-based manner that “the *harmful effects*
387 of the degradation of ecosystem services on livelihoods, health, and local and national economies are
388 *substantial* (p. 6, emphasis added)”. Economic and financial interventions, including greater use of marked-
389 based approaches and transfer of subsidies to payments for non-marketed ES, are suggested in the MEA as
390 powerful instruments to regulate the use of ecosystem goods and services. Indeed, the MEA has
391 contributed much to putting ES on the political agenda (e.g. Gomez-Baggethun et al., 2010; Vadrot, 2014).
392 According to Google Scholar, the MEA is cited more than 11,000 times (as of April 2016).

393

394 From a securitization lens, we show above and in Table 3 how some socially relevant securitizing actors
395 (selected scientific experts) attempt to proclaim that the destruction of ES is an existential threat to a
396 valued referent object (all humans; livelihoods, health, economies). The securitizing actors in question
397 suggest applying certain measures (such as monetary valuation of ES, or implementing market-based
398 approaches) in order to tackle the threat (e.g. Costanza et al.’s (1997) attempt to capture the entire value
399 of the Earth; and Wunder’s (2005) or Engel et al.’s (2008) plea to set up payment mechanisms for securing
400 the provision of ES). Examples of such measures are further illustrated by PES and IPBES below. If the
401 attempted securitization of the issue in question (namely ES) is accepted by a relevant audience and fully
402 securitized, it is moved from being non-politicized or politicized (centered on ecological restoration,
403 biodiversity and species protection), to be a securitized issue with the possibility to apply extraordinary
404 measures. Whether ES can be considered fully securitized and whether the governance turn towards
405 marketization can be perceived as “extraordinary” is indeed interesting, and will be further explored in
406 Section 4.2. But first we direct our attention to scientific expertise.

407

408 From an expertise perspective, the speech acts or particular narratives exemplified above attempts to shift
409 not just the discourse, but also the realm of problematization and thus the realm of policy expertise, away

410 from the “traditional” nature conservation experts with roots in biological/ecological science *towards*
411 environmental economists. This requires the adoption of a new range of socially-necessary abstractions of
412 nature that allow for the translation of parts of nature into calculable (exchange) values for capitalist
413 circulation (Robertson, 2012). Just to clarify; the “traditional” experts do not suddenly disappear, rather
414 they might take up another role in the policy process, as they become the deliverers of necessary data to
415 inform the stock-flow ES models in order to ‘get the science right’ (Naeem et al., 2015), when particular
416 policy models are proposed. For instance, economic concerns about “additionality” (protecting *more* ES
417 than a projected baseline or business-as-usual) raise the need to predict what the world would have been
418 like without environmental protection, and this need inevitably promotes a strong role for economic
419 experts, as well as requires the imposition of technical standards related to for instance carbon credits
420 (measured as “tonnes of CO₂ equivalent”) (e.g. Fairhead et al., 2012; Robertson, 2011). This process of
421 “rendering technical” (Li, 2007a, b) and the use of “calculative devices” (Latour, 1987) results in a specific
422 approach to environmental problems, where experts are empowered to design policy initiatives that direct
423 government action (Spash, 2015). Wunder (2005) himself also notes that with PES replacing previous
424 integrated conservation and development projects “a whole *different skill set would be required*, such as
425 land-use and *service monitoring*, facilitating negotiation, and *financial intermediation* (p. 2, emphasis
426 added)”. This framing implies the involvement of a whole new set of (intermediary) actors, playing a crucial
427 role in the ‘management’ of the complexities of, for example, the monitoring of carbon sequestration, and
428 the design of PES schemes (Fairhead et al., 2012). Indeed, such meso-level actors largely shape how
429 conservation policies trickle from global level down and *vice versa* when outcomes and knowledge are
430 translated from local levels back to global decision makers (Pasgaard, 2015).

431
432 Concerns are raised that in practice, the economic discourse enables the empowerment of economic logic
433 in public policy including a presumption *against* direct regulation, legal restrictions, planning, public
434 participation, and any form of government intervention that does not support private property rights or

435 work through market-based approaches (Lewis, 2011; Spash, 2015). While the focus on monetary valuation
436 and payment schemes has contributed to attract political support for conservation, it has also contributed
437 to a growing number of attempts to commodify ES and to reproduce the use of a market logic to tackle
438 environmental problems (Gomez-Baggethun et al., 2010). Other policy effects partly justified by the
439 attempted securitization of ES are emphasized in the discussion below of PES and the IPBES as proposed
440 measures to counteract the threat of ES destruction.

441

442 *4.2 Security framing and expert influence in Ecosystem Services: The cases of PES and IPBES*

443

444 In order to illustrate the security and expertise dimensions of ES, we look into Payments for Ecosystem
445 Services (PES) as a new governance tool to protect or restore ecosystems considered valuable, and we
446 focus on the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) as a
447 site producing expert knowledge for global policies (see also Jasanoff, 2010 on IPCC).

448

449 In line with the changing discourse on ES noted in the Introduction, PES have become an extremely popular
450 governance tool in the last 10 years, both in academic and policy circles (Wunder, 2015; McElwee, 2012).
451 Applying the securitization vocabulary and exemplified with the influential works by Wunder (2005) and
452 MEA (2005), PES can be perceived as a measure to combat ecosystem destruction as an existential threat
453 to a valued referent object (in this case mainly human well-being, see Figure 1). In that way, PES is partly
454 justified by a security framing imposed by scientific experts as securitizing actors (see Table 3). In other
455 words, the main argument for creating a PES mechanism is that ecosystems provide people with valuable
456 and potentially marketable ‘services’ or positive externalities (Van Hecken and Bastiaensen, 2010b); the
457 emerging scarcity of which makes them potentially subject to trade (Wunder, 2005).

458

459 According to critical scholars, the PES approach might appear innovative and appealing, and an attractive
460 narrative about the causes and possible market solutions to the problem of the so-called under-provision of
461 ES. These scholars argue that despite the apparent attractiveness of PES, it could eventually do more harm
462 than good, especially if it promotes the market as a superior solution which can and should replace
463 ‘ineffective local or state governance’ (Muradian et al., 2013; Van Hecken and Bastiaensen, 2010a). Harm
464 could also be done when such market mechanisms are exported to developing countries and non-market
465 societies where this economic logic is non-existent, or culturally discouraged by the existing institutional
466 structures (Gomez-Baggethun et al., 2010; Muradian et al., 2010). According to some critics, the
467 problematic nature of PES is not that it is a market per se, but that it is a powerful intervention
468 masquerading as a market. Such market-style or neoliberal conservation can powerfully re-shape nature–
469 society relations, in some instances by portraying communities (or individuals) as willing ‘service providers’
470 in market transactions, while the bottom-up considerations of empowerment or rights are obscured (Milne
471 and Adams, 2012; Büscher, 2012). Such potential violation of rights bears notions of ‘extraordinariness’
472 according to the securitization vocabulary, as it implies use of force. Also, broadly speaking, the resolution
473 of “market failures” through payments tends to be seen as a technical matter, while in practice, PES is part
474 of broader structures of power (Muradian et al., 2013; Büscher, 2014). This point resonates well with the
475 view of ‘rendering’ complex matters of nature and development ‘technical’ (Li, 2007a,b).

476
477 Interestingly, among its proponents, the role of a certain type of science and expertise in PES has not gone
478 unnoticed. A large group of prominent PES scholars, featuring Sven Wunder as last author and Shahid
479 Naeem (director of Science at the Earth Institute Center for Environmental Sustainability and co-chair of the
480 MEA, 2005) as lead author, recently published an article in *Science* about “Getting the science right when
481 paying for nature’s services” (Naeem et al., 2015). This article has a “focus on the natural science [as
482 opposed to social science] because of growing concerns over scientific weaknesses” (p. 1206). The authors
483 claim that the success of PES initiatives is reliant upon *scientific* knowledge on issues such as the methods

484 for verifying delivery of services, the establishment of a relationship between natural resource practices
485 and the generation of a service, and trade-offs with other beneficial non-target services. Without tools for
486 identifying the *best* and most *affordable* metrics, the authors argue that PES proponents may struggle to
487 collect *scientifically meaningful, cost-effective baseline* data and implement *effective* monitoring programs.
488 To counteract the perceived limited scientific evidence and lack of empirical data on effectiveness, four
489 *natural-science* principles are deemed essential, according to Naeem and his colleagues, in order to ensure
490 *scientific integrity* in environmental interventions. These principles concern baseline data, monitoring of
491 key environmental factors and services, recognizing that ecosystems are dynamic, and inclusion of metrics;
492 specifically on risks such as climate change or invasive species. If any of these basic principles are not
493 considered, the authors claim that the ability of PES mechanisms to generate ecological and social benefits
494 may be undermined. Besides the security undercurrent, these statements can be viewed as an attempt to
495 monopolize professional authority in the hands of one particular group of (natural) scientists, portraying
496 others as (social) "pseudoscientists" (see Gieryn, 1983).

497
498 The IPBES is an expert institution expected to transform the governance of biodiversity and ecosystem
499 services. The organization was established in 2012 and brings together 124 governments and more than
500 1,000 international experts with the explicit objective of addressing the degradation of biodiversity and ES
501 to improve human well-being (Montana and Borie, 2015). According to Vohland and Nadim (2015) the
502 design of IPBES is partly a response to a call emerging in the mid-2000s for a more sustained and systematic
503 approach that would actively support policy. Beck et al. (2014) notes that the platform was set up as a
504 permanent intergovernmental science-policy organization in order to build on and further the work of the
505 MEA (see also Bonie and Hulme, 2015; Vadrot, 2014). The conceptual framework of IPBES determines how
506 the *problem* (loss of biodiversity and ecosystem function) is understood and *how to ameliorate* it (Vohland
507 and Nadim, 2015), which in securitization vocabulary corresponds to the existential threat (as framed in the
508 MEA) and the justification of certain measures, which are perceived by some as extraordinary (see below).

509

510 According to Vohland and Nadim (2015), the conceptualizations by IPBES distribute causation, agency and
511 efficacy quite unevenly: nature is passive and only changed through human intervention; biodiversity loss is
512 a problem of excessive pressures (rather than business as usual); and quantification is presented as the
513 precondition for any remedial action. Adhering to this order, the authors suggest, denies many concrete
514 experiences of biodiversity loss and destruction as well as other conceptions of diversity, nature, human
515 intervention or evolution. As such, IPBES has been feared by some countries insofar as it could impinge on
516 national sovereignty and prescribe a certain type of biodiversity governance as a tool for Western states to
517 legitimize access to biological diversity at the expense of benefit sharing (Vadrot, 2014). Moreover, some
518 scholars caution that IPBES might be used as a proxy to pursue agendas that are cursory or even
519 detrimental, or that the work pursued in its name might cause hurt and damage elsewhere (Vohland and
520 Nadim, 2015). In this light, IPBES can be perceived as an extraordinary measure due to concerns about
521 additional pressures on sovereignty and resource access. In the establishment of IPBES, the use of the ES
522 concept was, and probably still is, highly contested and controversial (Bonie and Hulme, 2015; Vadrot,
523 2014).

524

525 Jasanoff (2010) argues that efforts to understand natural and social processes at increasingly complex
526 levels are producing new, boundary-crossing scientific representations. Global institutions have arisen to
527 produce expert knowledge for global policy: Though 'intergovernmental' in name, they are not answerable
528 to particular national traditions or institutions of policy legitimization. Instead, claims about the environment
529 and its sustainability produced by such novel bodies inevitably function as sites of contestation among
530 competing models of knowledge-making and governance (Jasanoff, 2010). Others believe that an
531 international, *neutral* body, such as the IPBES, would be an ideal coordinator for regular review and
532 assessment of *science* guidelines for PES (Naeem et al., 2015), and that the *credibility* of IPBES will be
533 shown if assessment processes are *not impacted by political or economic interests* (Vohland and Nadim,

2015). In effect, IPBES is part of a development of an “authority of truth” with regards to stabilization and reinforcement of internal and external demarcation lines (Vadrot, 2014), for instance as it essentializes and makes explicit (with colour-coded diagrams) the distinction between science and indigenous and local knowledge (Bonie and Hulme, 2015, see also analysis by Robertson, 2012, of classification and categorization in the measuring and abstraction of ES). Thus, paradoxically, attempts to demarcate science from non-science are evident in a platform, where the boundaries between science, security, politics, and economics are fluid and contested at the very least.

541

Returning again to the securitization process coined by Buzan et al. (1998), it is explicitly noted that the existential threat has to be argued and gain enough resonance to legitimize emergency measures “that would have been *impossible* had the discourse *not* taken the form of existential threats, point of no return, and necessity” (p. 25, emphasis added). Arguably, we have no way of knowing whether IPBES (or PES) would have been established or function differently *without* a security framing provided by for instance the MEA (2005) and by the experts we identify in the following.

548

549

550 4.3 Tracing key scientific experts to policy debates

551

According to Thiel et al. (2015), an increasing number of academics are now aspiring to take part in guiding purposeful institutional change. Or at least they should (Castree, 2015; Cornell et al., 2013). With the use of bibliometric analysis and an opinion-based survey, we have identified a list of key scientific experts (Tables 1 and 2). From our lists of key experts, we have selected four specific experts to follow in more detail. We trace their backgrounds and affiliations, activities and links to policy, as well as giving examples of their security framing of ES (Table 3). We have chosen these four experts since they provide good examples of how ES and urgency thinking has been used for particular policy proposals and practices (S. Wunder and S.

559 Pagiola): some in a more conceptual way (R. Costanza), while still offering a more balanced view by
560 recognizing integrated social-ecological systems, and how we should avoid panacea policy solutions
561 through more adaptive governance ideas (C. Folke). Other experts would indeed have been equally
562 interesting to follow, but we bring forward the science-policy relations of these four experts to illustrate
563 the web of scientific expertise and security in the changing governance of ES.

564 [Tables 1-3]

565

566 Table 3 shows some common characteristics and arguments across our four selected experts. For instance,
567 they have a similar disciplinary background as (environmental or ecological) economists; they co-author
568 publications (e.g. Wunder-Pagiola, Constanza-Folke, and Wunder-Folke); they are active in policy platforms
569 and policy advising (e.g. MEA and PES, CIFOR and World Bank); they all couple ES with (human) security;
570 and the majority of them see the creation of economic incentives as a necessary solution to the
571 degradation of ES⁵. Arguably, since we selected these experts (among others in Tables 1 and 2) to further
572 examine these exact traits and linkages these findings come as no surprise, but do illustrate the linkages
573 between science and security in the changing governance of ES in more detail.

574

575 4.4 An echo of the ongoing struggles between experts

576

577 We round up our analysis with a recent participant observation from a conference, namely the 27th
578 International Congress for Conservation Biology (ICCB) in Montpellier, France, in August 2015, where more
579 than a thousand scientists and experts with an interest in biodiversity conservation and ES met. Here,
580 Professor Clive Spash, Chair of Public Policy and Governance at the WU Vienna University of Economics and
581 Business, Austria, received a *standing ovation* at a plenary debate on the future of conservation. He
582 questioned the usefulness of market-based instruments in conservation and stated that “conservation is
583 already lost when it enters the world of corporate finance, economic trade-offs and the commensuration of
584 all values”. He continued: “The current neoliberal capitalist development model assumes limitless
585 economic growth, and that market failures can be corrected by pricing Nature [...] This system is neither
586 economically, socially nor ecologically sustainable. Allying with corporations is nothing more than
587 supporting the old ideology of economic growth, neoliberalism and technocracy”. In his recent academic
588 writings, Spash (2015) notes that economists take preference satisfaction as being linked to welfare (being

⁵ See however Constanza et al.(2014, p. 152), who “emphasize that valuation of eco-services (in whatever units) is not the same as commodification or privatization [...] conventional markets are often not the best institutional frameworks to manage them.”.

589 better-off), and welfare enhancement is taken as the moral good. Science is irrelevant for economic value,
590 Spash claims, and what counts are the preferences of the individual: If people do not care then nature does
591 not matter. On the contrary, ecologists and biologists often employ different justifications for why
592 something should be conserved (or not), he says. The difference according to Spash is “that *experts* are
593 meant to employ *scientific* argument and judgement rather than their own preferences, while, at least in
594 theory, economists appeal to the public and their preferences” (Spash, 2015, p. 3, emphasis added). Thus,
595 similar to Naeem et al. (2015) (see Textbox 1), this rhetoric can be said to construct an ideological self-
596 description and monopolize authority, but this time it is in favour of ecologists/biologists, while the
597 economists are portrayed as ‘pseudoscientists’ (cf. Gieryn, 1983).

598

599 **5 Discussion**

600

601 *5.1 Ecosystem services at the boundary between science and security*

602

603 Nature lies in the political realm and issues about natural entities have become some of the hottest topics
604 of public controversy - it is as if nature and geopolitics have been conflated (Latour, 2011). The
605 marketization of nature and conservation action is said to depoliticize powerful interventions that attempt
606 to change relationships between people and nature (Milne and Adams, 2012; see also Van Hecken et al.,
607 2015a). New forms of value, new kinds of equivalence, new practices of calculation, new relations between
608 human and the non-human, and new distinctions between what is real and its representation are created.
609 This ‘politics of calculation’ favors certain kinds of expertise to improve the perceived defects of nature and
610 repair the ills of society (Mitchell, 2002), as with carbon forestry interventions justified by reference to
611 claims to sustain the life of populations of humans and non-humans (see also Nel, 2015).

612

613 At the boundary between environmental science and security, scientific experts increasingly have a
614 proactive role in making their work part of a political discourse, and show a willingness to blur the lines
615 between science and institutional change (see Castree, 2015; Milkoreit et al., 2015; Thiel et al., 2015).
616 Indeed experts *construct* – they do not simply *find* – the knowledge base on which they rest their hybrid
617 judgments (Jasanoff, 2005). Ish-Shalom (2015) argues that “once the environment is perceived as a security
618 issue, *people with relevant knowledge* can be enacted and attributed as having expertise (p. 229, emphasis
619 added)”. We advance this notion as our study suggests that the attempted securitization of the
620 environment has been part of setting the stage for *new* kinds of nature conservation experts, namely
621 (environmental) economists, who have effectively entered this arena with market-based solutions and
622 green neoliberalism (see Roth and Dressler, 2012; Wunder, 2005; Table 3). As with other issues being
623 securitized and transformed from a (non-)politicized to a securitized issue (see for instance Elbe, 2006), this

624 securitization attempt can serve positively to strengthen international initiatives by raising awareness and
625 resources, for instance concerning the interdependencies of ES providers and beneficiaries, opening ways
626 for negotiated agreements or collective action (see Barnaud and Antona, 2014). But it also risks pushing
627 responses away from civil society towards private organizations and investors with the power to override
628 local rights (Lewis, 2011; Milne and Adams, 2012). Arguably, while the appropriation of land and resources
629 have long and well-known histories of resource alienation by state and non-state actors in the name of the
630 environment, novel forms of valuation and commodification of nature are constructed through new
631 discursive framings, introducing an extraordinary new range of actors and alliances, and imposing diverse
632 implications and consequences for people and nature (Fairhead et al., 2012). We add to this debate that
633 such novel forms of market-based or neoliberal governance, and the general economization of protection
634 of ES as effectuated in PES-like policies, are partly legitimized and intensified by a security framing by
635 scientific experts (see Table 3). We question whether the motivation and intentions behind the
636 securitization of ES is always grounded in a “genuine” concern for the nature-human balance, or whether it,
637 for some, is based on a blind belief in market mechanisms, or even a strategic move to position a certain
638 kind of expert(ise) at the forefront of environmental protection with access to funds and political influence
639 (see de Sardan, 2005; see Goldman, 2005). Either way, motives perceived as more “genuine” or justified,
640 for instance conservation concerns by traditional ecologists/biologists (Spash, 2015), might rely on strategic
641 positioning and lead to injustices (Fairhead et al., 2012). Revealing such underlying motives requires honest
642 and sensitive self-reflections on the part of the scientists. We attempt to make a move in this direction
643 before concluding.

644

645 5.2 *Self-reflections: expert positions, disciplinary arrogance and types of knowledge*

646

647 We, the authors of this paper, are all academically raised as natural or social scientists (within fields of
648 biology, geography and forestry). With these backgrounds, we face a sort of internal dilemma or unease

649 when critically examining scientific expertise in ES, and simultaneously acting as scientific experts on these
650 same issues, albeit with a critical stance (e.g. Dallimer and Strange, 2015; Pasgaard, 2015; Van Hecken and
651 Bastiaensen, 2010b). By *examining* while *practicing* scientific expertise, we deal with very different research
652 questions and problems at the same time, which requires different methodological approaches and
653 theoretical frames (Greene, 2007; Prowse, 2010), which might display philosophical and ontological
654 inconsistencies. We do however not see this "pragmatic eclecticism" of our work, a concept borrowed from
655 Berling and Bueger (2015), as problematic or disqualifying as such. Rather, it reflects our personal progress
656 and span as researchers. Constantly progressing, questioning and putting things in new perspectives is
657 what science (and expertise) is about - or at least should be about in our minds. On a less romantic note,
658 this "eclecticism" on our side also reflects how we strategically adapt to the current trends and flows in
659 academia in order to keep up our publication output, since we also need to tap into the changing streams
660 of funding to maintain our professions and paychecks (see de Sardan, 2005; Goldman, 2005; Hoppe, 2005).
661
662 Besides exposing these personal positions and motives, our novel methodological approach to studying
663 expertise gives rise to other practical reflections. With the bibliometric analysis, we use a *quantitative*
664 method of a natural science character to examine a social concept like (scientific) expertise. A brief
665 excursion into the micro-cosmos of our own expert-making and knowledge-production processes reveals,
666 to no surprise, that the internal allocation of tasks among us mirrored our individual skills and interests:
667 The 'political ecologist(s)' conceptualized the study and wrote the main text, while the 'technical
668 geographer' and the 'ecological economist' were mainly responsible for the quantitative data collection and
669 analyses. During our process, we tried to pull the paper in our own favored directions. In the end though,
670 and with our combined efforts, our study does use a technical scientific approach with quantitative
671 indicators to expose and question scientific expertise. On top of that, the majority of us are natural
672 scientists by training as we confess above. It all sounds contradictory, and this particular setup also gave
673 rise to critical reflexive questions in the early phase of this project by one of the guest editors of the special

674 issue: (How) could we use such methods for that purpose? We answer with a slightly provocative related
675 question: Are some methods more legitimate to examine the boundaries of science and security? Is it only
676 social or political scientists who are allowed to study and criticize the practices of the “hard” sciences with
677 their ethnographic or other “soft” methods (as done in Science and Technology Studies and which we also
678 apply by analyzing how experts frame ES and by our participatory observations)? Mirroring the comment by
679 the guest editor, many natural scientists consider qualitative indicators and retrospective methods ‘weak’
680 compared to measurable quantifiable indicators and counterfactual methodologies, for instance in
681 assessing the social impacts of environmental protection projects (Pasgaard, 2013). This attitude or even
682 arrogance became very clear in our opinion-based survey to identify key experts. Several invited survey
683 respondents replied back in person with concerns about the “subjectivity” and “bias” of the survey; many
684 feeling uneasy pointing out experts, and suggesting that we examined publications instead (as we actually
685 do). One of the top experts identified in our survey was early to reply with a personal email outlining these
686 brief directions in order for us to properly identify the key experts in ES scholarship: “Go on Web of Science
687 or Scopus, type in “ecosystem services” in the topic search, then sort results by author” (personal
688 communication, November 11, 2015). Attached was a paper authored by the expert about the authorship
689 structure of ES literature, clearly indicating *how* we should identify experts and that this was already *done*
690 (by the expert). Moreover, several respondents issued concerns about the purpose and confidentiality of
691 the survey being unsure if they could trust this sharing of “such kind of information” (about who they
692 consider ES experts).

693

694 As our last reflection, we discuss authority of knowledge. The PES and IPBES cases show a favouring of
695 certain kinds of knowledge over others, in turn arranging the object to be governed and reproducing
696 specific modes of regulation (see Vadrot, 2014). According to Milkoreit et al. (2015) it is a problematic
697 assumption that scientists who acknowledge subjectivity automatically practice “advocacy” if they engage
698 in a policy process. For these authors, this boundary-blurring tendency to conflate *scientific* knowledge and

699 facts with value or interest-laden *opinions* poses a *serious threat* to the *authority of science* as a foundation
700 for policy-making and to the social contract between science, society and politics. While these concerns are
701 very real and experienced by many scholars, we argue that this “blurring” cannot be undone, if it was ever
702 “un-blurred” (see Hoppe, 2005; Jasanoff, 2010). It is important to recognize differences, and these
703 differences should indeed be respected, but not to the extent that blurred boundaries are a threat “to the
704 authority of science [...] as a truth-seeking enterprise” (Milkoreit et al., 2015, p. 93). Rather, we should
705 acknowledge and expose differences through self-reflections and diminish divides through collaboration. As
706 Milkoreit et al. (2015) themselves rightly state, we should “consider more explicitly the normative
707 implications of [our] scientific approach (p. 89)”, and specifically, each of us has to become aware of
708 different cultures of science, paradigms and competing claims, instrumentations, research protocols and
709 designs (Latour, 2011; see also Greene, 2007).

710

711 5.3 Concluding remarks

712

713 With this study we contribute to the emerging self-reflective discourse in security studies (Berling and
714 Bueger, 2015; Kurowska and Tallis, 2013), in human geography broadly speaking (Castree, 2015; Hulme,
715 2015; Pasgaard et al., 2017; Saito-Jensen and Jensen, 2010), and across academic practices (Berling and
716 Bueger, this issue). By exposing the securitization processes which can harm the functioning of deliberative
717 and reasoned democracy (Ish-Shalom, 2015), and by examining key scientific experts as securitizing actors,
718 we contribute to a wider understanding of the discourses that legitimize and bring authority to new (neo-
719 liberal) forms of environmental governance and practice. The examples of the PES and the IPBES indicate
720 that there is a need and an opportunity to reflect on the very purpose and underlying rationale of global
721 expert-driven policy schemes and organizations (see also Beck et al., 2014). Echoing Hoppe (2005) we find a
722 need to rethink the role of scientific expertise in policymaking, and a need to better guide experts and
723 policymakers in their day-to-day boundary work (Berling and Bueger, this issue). Specifically, since the

724 appropriation of nature for green ends often operates through novel legal and market mechanisms, we
725 face new methodological and analytical challenges, as well as new dilemmas for action (Fairhead et al.,
726 2012). As our concluding remark, and in line with Ish-Shalom (2015), we stress the need to transparently
727 reflect on our own sensitivities, experiences and biases, as we attempt to do in this study. Along with
728 individual responsibility and judgement, self-reflexivity and transparency should be a constitutive and
729 definitional feature of academic expertise and practice, allowing us to understand the biases and social
730 settings that form our standpoints as we expose and disclose ourselves (ibid.). However, as made clear in
731 this study, demand for public visibility, openness and efforts to embrace transparency bring their own
732 dilemmas, even eroding professional trust (Mosse, 2011).

733

734 9,996 words (including footnotes, but excluding bibliography, abstract, tables, and figure captions)

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