

1 Mainstreaming ecosystem science in spatial planning practice: 2 exploiting a hybrid opportunity space

3 Abstract

4 *This paper develops a framework for improved mainstreaming of ecosystem science in policy and*
5 *decision-making within a spatial planning context. Ecosystem science is advanced as a collective*
6 *umbrella to capture a body of work and approaches rooted in social-ecological systems thinking,*
7 *spawning a distinctive ecosystem terminology: ecosystem approach, ecosystem services, ecosystem*
8 *services framework and natural capital. The interface between spatial planning and ecosystem*
9 *science is explored as a theoretical opportunity space to improve mainstreaming processes adapting*
10 *Rogers’ (2003) diffusion model. We introduce the twin concepts of hooks (linking ecosystem science*
11 *to a key policy or legislative term, duty or priority that relate to a particular user group) and ‘bridges’*
12 *(linking ecosystem science to a term, concept or policy priority that is used and readily understood*
13 *across multiple groups and publics) as translational mechanisms in transdisciplinary mainstreaming*
14 *settings. We argue that ecosystem science can be embedded into the existing work priorities and*
15 *vocabularies of spatial planning practice using these hooks and bridges. The resultant framework for*
16 *mainstreaming is then tested, drawing on research funded as part of the UK National Ecosystem*
17 *Assessment Follow-On programme (2012-2014), within 4 case studies; each reflecting different*
18 *capacities, capabilities, opportunities and barriers. The results reveal the importance of leadership,*
19 *political buy in, willingness to experiment outside established comfort zones and social learning as*
20 *core drivers supporting mainstreaming processes. Whilst there are still significant challenges in*
21 *mainstreaming in spatial planning settings, the identification and use of hooks and bridges*
22 *collectively, enables traction to be gained for further advances; moving beyond the status quo to*
23 *generate additionality and potential behaviour change within different modes of mainstreaming*
24 *practice. This pragmatic approach has global application to help improve the way nature is*
25 *respected and taken account of in planning systems nationally and globally.*

26 **Key Words:** Ecosystem Science; Ecosystem Approach; Spatial Planning; Nature; Ecosystem Services;
27 Environmental Governance; Natural Capital

28 1.Introduction

29 Ecosystem Services (ES) are widely used to identify and assess the value of the natural environment
30 through the quantification and qualification of the multiple societal benefits from finite stocks of
31 Natural Capital (NC) (Bateman et al., 2013; Likens, 1992; Hubacek and Kronenberg, 2013; Raffaelli
32 and White, 2013). They have gained increasing traction as a policy-shaping framework, largely
33 through the Millennium Ecosystem Assessment (MEA) (2003), TEEB (2010) and Ecosystem Services
34 Poverty Alleviation (ESPA) programme which all have exposed significant and ongoing declines in
35 most ES as a consequence of human interventions and actions (see also Constanza et al., 2014;
36 Douglas and James, 2014; Guerry et al., 2015; WWF 2016). This has catalysed significant global, EU
37 and national responses with ES mainstreaming increasingly evident within dedicated national
38 ecosystem assessments (e.g. Schroter et al., 2016; UKNEA, 2011); new environmental markets in the
39 form of payments for ecosystem services programmes (e.g. Reed et al., 2017); multi-criteria

40 assessments to inform strategic policy guidance and priority setting (e.g. Bryan et al., 2011); green
41 accounting methods (e.g. World Bank, 2010) and improved communication on the importance of
42 ecosystems and biodiversity to human well-being (e.g. Luck et al., 2012).

43

44 Mainstreaming can be defined as a process that *“involves taking a specific objective of one issue*
45 *domain and declaring that this objective should be integrated into other issue domains where it is*
46 *not (yet) sufficiently addressed.”* (Karlsson-Vinkhuyzen et al., 2017: 145). For example, there was
47 clear evidence from the UKNEA (2011) that government departments did not explicitly consider ES
48 and their values in policy appraisal processes. Hence mainstreaming implies a process requiring
49 improved translation, acceptance and usage of new idea(s) in line with classic diffusion of innovation
50 theory (Rogers, 2003).

51

52 In contemporary spatial planning practice signs of mainstreaming are evident in developing ES
53 mapping and baseline indicators as part of evidence bases for plans and programmes (Gómez-
54 Baggethun and Barton, 2013; Söderman et al., 2012). However, as Posner et al. (2016) note, there is
55 limited research demonstrating how policy- and decision-makers use such evidence in their decision-
56 making processes. Indeed, tracing the impact of ES and their additionality remains an unexploited
57 research gap (see also Daily and Matson, 2008; Laurans et al., 2013).

58

59 Within this paper we propose the term “ecosystem science” to capture the collective body of work,
60 approaches and tools located within a social-ecological systems perspective. It is an ‘umbrella term’
61 incorporating Natural Capital (NC), Ecosystem Approach (EcA), Ecosystem Services (ES), Ecosystem
62 Services Framework (ESF) and Ecosystem Services approach. These terms are often used
63 interchangeably, uncritically and applied selectively ignoring the inter-relationships, thresholds and
64 dependencies that position nature as a complex social-ecological system (Jones et al., 2016; Spash,
65 2008) although ideally these concepts should help to highlight those interdependencies and
66 complexities. Within ecosystem science we contend that the EcA, with its 12 principles, offers a
67 potential framework for improved sustainable use and management of nature (Waylen et al., 2014).
68 Yet it has become increasingly marginalised and overlooked in favour of NC and ES, and associated
69 market-based instruments and policy tools within a dominant neoliberal narrative of nature
70 (Buscher et al., 2012; Jackson and Palmer, 2015). Waylen et al. (2014) speculate that this may, in
71 part, be due to the intangibility of some EcA principles and the lack of guidance and case studies
72 demonstrating success in policy- and decision-making (see also Posner et al., 2016).

73

74 Furthermore, ecosystem science has only gained partial traction in spatial planning processes and
75 outcomes (UKNEA, 2011; McKenzie et al., 2014), partly due to an artificial separation between the
76 governance for the built and natural environment; each with its own policy and legislative
77 frameworks which arguably creates a wider 'disintegrated development' narrative leading to
78 unnecessary duplication, inefficiency and conflict (Scott et al., 2013). There is, however, a
79 pioneering strand of interdisciplinary research working at the interface between ecosystem science
80 and spatial planning that has tried to exploit their potential synergies (e.g. Douvère, 2008; Scott et
81 al., 2013; Mckenzie et al., 2014; Cowell and Lennon, 2014; Ruckelshaus et al., 2015).

82

83 In this paper we undertake further exploration in order to develop stronger theoretical, policy and
84 practice foundations for mainstreaming robust ecosystem science in spatial planning practice
85 arguing, in particular, that the ECA - SP interface is key for effective ecosystem science knowledge
86 integration across planning and environmental governance domains (Natural Capital Committee,
87 2015; Ruckelshaus et al., 2015; Dennis et al., 2016; Jones et al., 2016). Table 1 exposes this potential
88 through a preliminary mapping exercise of the 12 Malawi principles (EcA) against six spatial planning
89 principles advanced by the UNECE (2008). This reveals significant points of intersection with
90 opportunities to maximise social learning and knowledge exchange across the built and natural
91 environment divides.

92

93 Similarly, when definitions for the EcA and spatial planning are compared, the synergies become
94 apparent. For example, the UN Convention of Biological Diversity's definition of the EcA (CBD, 2010:
95 12) as *"a strategy for the integrated management of land, water and living resources that promotes
96 conservation and sustainable use in an equitable way"*, accords with Allmendinger and Haughton's
97 (2010: 83) definition of SP as *"shaping economic, social, cultural, and ecological dimensions of
98 society through 'place making' with a shift towards more positive, integrated and resource-based
99 contexts"*. Both EcA and SP are rooted in social-ecological systems thinking within an
100 interdisciplinary human-centred perspective crossing environmental, social, economic, political and
101 cultural contexts and sectors (Gomez-Baggethum and Barton, 2013; Jansson, 2013). Both require
102 the adoption of participatory approaches incorporating equity and shared values (e.g. Bryden and
103 Geisler, 2007; Reed et al., 2013). Both involve a change in values and thinking from the negative
104 associations of protection based on policies of control and restraint towards more holistic, proactive
105 and development-led visions and interventions (Scott et al., 2013).

106

107 This convergence of definitions and principles can be taken a step further. Rather than maintaining
 108 separate narratives and audiences for ‘built’ and ‘natural’ environment domains, which have typified
 109 their evolutions to date, there could be added value from exploring mechanisms that facilitate their
 110 integration to support ecosystem science mainstreaming and knowledge transfer (Cowell and
 111 Lennon, 2014; Karlsson-Vinkhuyzen et al., 2017). Indeed, Cowell and Lennon (2014) stress the
 112 importance of using social learning and methodological approaches that better incorporate and
 113 integrate competing theories and ideas rather than producing yet more complexity and competition
 114 through creeping incrementalism. How we might address this challenge becomes the central theme
 115 of this paper.

116

Spatial Planning Principles	Ecosystem Approach Principles
The Governance Principle (e.g. authority, legitimacy, institutions power; decision making) (e.g. Tewdwr Jones et al., 2010; Kidd, 2007),	1 The objectives of management of land, water and living resources are a matter of societal choice. 3 Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems. 9 Management must recognize the change is inevitable.
The Subsidiarity Principle (e.g. delegation to lowest level; shared responsibility; devolution) (e.g. Haughton and Allmendinger, 2014)	2 Management should be decentralized to the lowest appropriate level.
The Participation Principle (e.g. consultation; inclusion; equity; deliberation) (e.g. Albrechts, 2015; Gilliland and Laffoley, 2008)	11 The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices. 12 The ecosystem approach should involve all relevant sectors of society and scientific disciplines.
The Integration Principle (e.g. holistic; multiple scales and sectors; joined up) (e.g. Low, 2002; Mommas and Jansen, 2008)	3 Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems. 5 Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach. 7 The ecosystem approach should be undertaken at the appropriate spatial and temporal scales. 8 Recognizing the varying temporal scales and lag effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term. 10 The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
The Proportionality Principle (e.g. deliverable viability; pragmatism; best available information) (e.g. Nadin, 2007)	4 Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. 9 Management must recognize the change is inevitable.

The Precautionary Principle (e.g. adaptive management; limits; uncertainty; risk) (e.g. Counsell, 1998)	6 Ecosystem must be managed within the limits of their functioning, 8 Recognizing the varying temporal scales and lag effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term. 10 The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity,
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117 *Table 1: The 12 principles of the ecosystem approach (CBD, 2010: 12) mapped against spatial planning principles as defined*
 118 *by UNECE (2008)*

119

120 The research presented in this paper originates from and builds upon workpackage 10 of the United
 121 Kingdom National Ecosystem Assessment Follow-On (UKNEAFO) research programme between
 122 2012-2014 which developed a framework to improve the understanding and mainstreaming of
 123 ecosystem science across different spatial planning settings¹. The paper proceeds by illuminating
 124 the SP: ecosystem science interface as a conduit for mainstreaming processes, adapting Rogers’
 125 (2003) diffusion theory. Within this adaption we introduce the twin concepts of “hooks” and
 126 “bridges” as mechanisms to help ecosystem science infiltrate policy and decision-making contexts,
 127 priorities and vocabularies. Hooks are defined as key policy or legislative terms, duties or priorities
 128 that relate to a particular user group (i.e. spatial planners) into which ecosystem science
 129 mainstreaming efforts can then be positioned. Whereas bridges are defined as terms, concepts or
 130 policy priorities that are used and readily understood across multiple groups and publics, thereby
 131 functioning as integrating mechanisms. We then use four different participant-led narratives of
 132 mainstreaming to show the interplay of hooks and bridges in improving SP practice. The
 133 commonalities and issues raised within these experiences are then discussed with regard to
 134 facilitating wider mainstreaming opportunities and additionality, also paying attention to likely
 135 challenges at both national and global scales (Posner et al., 2016).

136

137 **2.Methodology**

138 The UKNEAFO (2014) was charged with the translation and mainstreaming of the emerging science
 139 from the UKNEA (2011) into policy and decision making processes. To do this a transdisciplinary
 140 research team of academics, policy and practice participants was established championing a co-
 141 production ethic across 10 work packages. This paper draws primarily from intelligence gained
 142 within work package 10 from three deliberative partner workshops in 2012-2014. Our partners

¹ Work Package Report 10: Tools – Applications, Benefits and Linkages for Ecosystem Science (TABLES) The work package was tasked with developing a tools framework for better mainstreaming of ecosystem science in policy and decision making

143 included key players who were actively involved as innovators in trying to mainstream ecosystem
144 science within particular policy and practice settings. This necessarily shaped the case studies
145 selected. Workshop 1 reported on partners' experiences of ecosystem science mainstreaming
146 practice to identify the barriers and opportunities affecting progress. Workshop 2 then devised an
147 analytical framework for tools and techniques as part of ecosystem science mainstreaming. Finally,
148 workshop 3 developed a resource kit to help integrate guidance, tools and case studies as part of an
149 ecosystem science mainstreaming web platform for wider policy and practice impact and
150 dissemination (NEAT tree²).

151

152 The method was rooted in a managed and deliberative process championing social learning,
153 enabling partners to work collectively and openly to share problems from their ongoing initiatives
154 and use joint problem-solving to build both conceptual and practice-led innovation. We are thus
155 reporting on core workshop outcomes, participant-led assessments of ecosystem science
156 mainstreaming from which our purposive case studies were selected as well as our own post project
157 reflexivity³.

158 **3. Building our conceptual framework**

159 Our theoretical focus on mainstreaming is centred on ecosystem science knowledge flows and
160 exchange within policy and decision-making processes. Roger's (2003) contribution on the diffusion
161 of innovation provides a useful theory catalyst for considering how any new
162 innovation/knowledge/idea evolves from initial discovery through to implementation and
163 acceptance involving key stages of knowledge generation, persuasion, decision (adoption/rejection),
164 implementation and confirmation (Figure 1). Given that mainstreaming involves the active diffusion
165 of a specific idea from one domain to another where it has not been sufficiently addressed,
166 attention necessarily needs to be focussed on the ways (mechanisms or tools) the
167 innovation/knowledge is spread; partly through the different communication channels and time but
168 also through the prevailing governance frameworks. However, change is not just confined to users
169 modifying or adapting their behaviour, it also is shaped by the emerging science, nature and
170 progress within the idea/innovation/knowledge itself.

² The NEAT tree <http://neat.ecosystemsknowledge.net/> [accessed 5th July 2017]

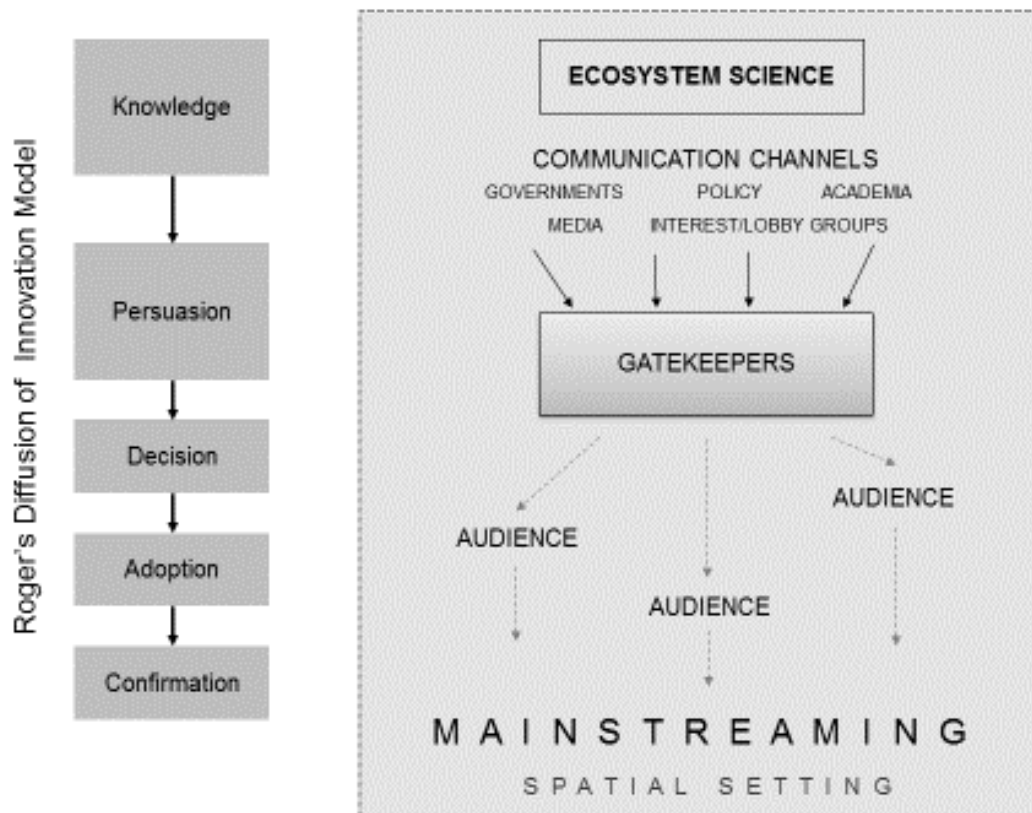
³ This was particularly important for incorporating Rogers 2003 theory of innovation diffusion into the paper to help conceptualise ecosystem science as innovation. We also generated much of our thinking on the SP ECA fusion to help illuminate the synergies across both ecosystem science and spatial planning to aid the mainstreaming process.

171

172 We have applied this thinking to characterise the current state of ecosystem science mainstreaming
173 in Figure 1, which exposes the difficulties in securing sufficient traction with ecosystem science ideas
174 for further diffusion in SP practice. The following persuasion “barriers” were evidenced from
175 workshop 1 and reflect the innovative nature of ecosystem science itself in SP theory and practice
176 (Scott et al., 2013); its technocentric diffusion (Fish and Saratsi, 2015); its complex language and
177 multiple terms (Jordan and Russel, 2014); its requirement for advanced skills to
178 understand/use/access many of the tools available (McKenzie et al., 2014); its lack of exemplars and
179 social learning platforms (Dunlop, 2014; Posner et al., 2016) and its lack of champions and local-
180 scale information (Burke et al., 2015). Crucially, it is the cumulative impact of these barriers that
181 hinder its acceptance and integration within decision-making processes in spatial planning.

182

183 A further barrier identified related to key gatekeepers who control the flow of “acceptable”
184 knowledge based on their values and how well ‘new’ ideas and ways of thinking fit their own
185 narrative and agendas (Scott et al., 2013; Jordan and Russel, 2014). Complicating this picture is the
186 wider stakeholder audience, in a given spatial planning setting, each with their own priorities and
187 capabilities. Thus the consequential policies, plans and agendas that emerge often reflect the
188 pragmatic and politically acceptable with only piecemeal ad-hoc (faint arrows) progress indicating
189 limited mainstreaming successes (Turnberry et al., 2014). The complexity and diversity of the spatial
190 planning context makes it difficult to trigger any meaningful conceptual change (McKenzie et al.,
191 2015).



192

193

194 *Figure 1. The current model of mainstreaming ecosystem science within the Eca. (adapted from Rogers (2003))*

195 In order to breach the “persuasion” stage successfully (Rogers, 2003), mechanisms need to be
 196 identified that enable the necessary ecosystem science traction in a given SP setting thus gaining the
 197 support and involvement of the gatekeepers and other stakeholders. It is important that any
 198 mechanisms should use and work with familiar terms but also allow deliberation and a change in
 199 perspective to move beyond knowledge simply being absorbed into existing systems to actually
 200 influence and change values and behaviours (McKenzie et al., 2014). Communication and diffusion
 201 of ecosystem science through ES jargon and applications to date has largely been in the hands of
 202 natural science experts although there is an increasing move towards more public-led deliberative
 203 exercises (e.g. Fish and Saratsi, 2015). Consequently, we argue that more attention needs to be paid
 204 on identifying and developing mechanisms that appeal to, and engage with, broader SP audiences,
 205 politicians and publics who are not familiar with ecosystem science. It is from this logic that we
 206 advance the twin notions of hooks and bridges as mechanisms to facilitate and engineer diffusion
 207 and change (Figure 2).

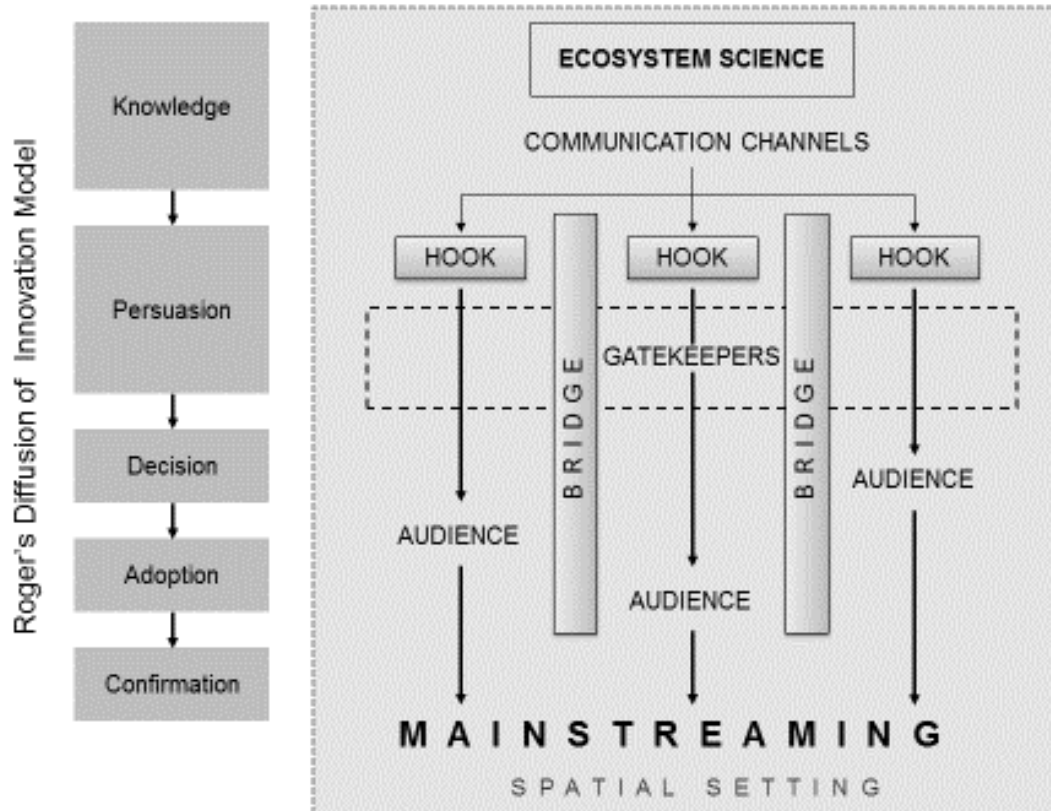
208

209 Hooks are defined as key policy or legislative terms, duties or priorities that relate to a particular
210 user group or professional network that are used in regular practice whereas bridges are defined as
211 terms, concepts or policy priorities that are readily understood and used across multiple groups and
212 publics, functioning as integrating mechanisms enabling more holistic and integrative thinking and
213 actions across different sectors and policy goals. Using the example of ecosystem science, ideally
214 the 12 EcA principles should be realised within any potential bundle of hooks and bridges to enable
215 optimal ecosystem science mainstreaming.

216

217 Figure 2 conceptualises how hooks and bridges when applied in tandem enable ecosystem science to
218 be mainstreamed without the dilution evident in Figure 1. Having secured the necessary initial
219 traction through the identification and usage of relevant hooks and bridges, knowledge/innovation
220 can then flow through the Ecosystem Science and SP interface within the existing governance
221 system(s), engaging gatekeepers and relevant audiences (e.g. public agencies, private and voluntary
222 sectors and publics). The hooks and bridges facilitate the adoption of innovation pragmatically;
223 appropriate to the socio-political context and capabilities of participants with changes in
224 values/rationality occurring through social learning and/or inspired by innovator case studies and
225 individual champions/leaders. This, ideally, creates a virtuous circle leading to further exploration of
226 innovation (applying ecosystem science to inform policy- and decision-making).

227



228

229

230 *Figure 2: Desired model for mainstreaming showing 'persuasion'/acceptability through use of hooks and bridges. Drawing*
 231 *on Rogers (2003)*

232

233 However, different target audiences require different hooks; meaning that the most influential
 234 hooks need to be identified in conjunction with the needs, priorities and remits of that audience at
 235 that particular time in that SP setting (Douglas and James, 2016). Equally important, is ensuring the
 236 selection of bridges that are intelligible as mechanisms to engage multiple audiences and publics to
 237 progress ecosystem science ideas. Thus it is the communication, adaption, use and impact of the
 238 hooks and bridges cumulatively that will determine mainstreaming success. In the next section, we
 239 identify and unpack how specific hook and bridge 'bundles' have been used within four case studies
 240 from the UKNEAFO work in different SP contexts. However, the general process of embedding
 241 ecosystem science through the interface of EcA and SP principles and identifying suitable hooks and
 242 bridges is directly transferable to other countries considering or already working on mainstreaming
 243 ecosystem science within their own built environments (see e.g. Brink and Ketunen, 2016; Posner et
 244 al., 2016; McKenzie et al., 2014).

245

246 Table 2 locates the four case studies in relation to their spatial planning challenge and context.

Case Study	Spatial Planning Challenge (framed by participants)	Approach to Ecosystem Science Mainstreaming
DRAFT North Devon/Torridge Joint Local Plan	How can we recognise the value of ES in a local plan? How can we adapt local policies to maintain/improve benefits from nature?	Used the biosphere reserve concept to frame the ES narrative. Developed an ES policy within the environment chapter of the plan Mapping ES and doing a ES assessment of housing masterplans.
South Downs National Park SDNPA DRAFT Local Plan	How can the EcA be used within a park local plan to improve policy and decision making?	EcA principles rewritten in SDNPA setting. Using framework from Park Management plan and developing an ES policy as one of 4 core policies pervading across all plan areas. Mapping ecosystem services. Green infrastructure workshops and strategy.
Cotswolds Area of Outstanding Natural Beauty (AONB) management plan review	How can we review our AONB management plan mindful of the benefits offered by ES?	Management plan created with an ES framework imported in the action plan. Post adoption consideration of using ES to evaluate the plan and to develop PES schemes for flood management.
Birmingham City Council non statutory Green Living Spaces Plan 2014	What is the value of green infrastructure to the residents and businesses of the city? How can the council embed this information to improve its policies, plans and investment opportunities?	ES assessment of green infrastructure. Created green commission at Cabinet level. Used ES data sets to create demand and supply maps showing areas requiring ES investment. Used as evidence base to support other statutory (Birmingham Local Development plan) and non-statutory plan. Created 7 principles as proxy for EcA.

247 *Table 2 : Spatial challenges of the case studies and approaches to mainstreaming*

248

249 Table 3 identifies the principal hooks and bridges evident within the four case studies detailing their
 250 different approaches to ecosystem mainstreaming. The hooks were identified primarily from
 251 UKNEAFO stakeholder workshops and, given the English SP context, were heavily focussed towards
 252 the National Planning Policy Framework.

253

Case Study	Hook (H) / Bridge (B)
Cotswolds AONB Management Plan	H Natural Environment White Paper B Connectivity B Multiple benefits
North Devon and Torridge Joint Local Plan	H NPPF paragraph 109 H NPPF Duty to cooperate B Multiple benefits and assets B Green infrastructure
Birmingham City Council Green Living Spaces Plan	H NPPF Duty to Cooperate H NPPF paragraph 109 H B Green infrastructure
South Downs National Park Plan	H NPPF paragraph 109 H NPPF Duty to Cooperate B Green infrastructure

254

255 *Table 3: Hooks and Bridges within the NEAFO case studies (detailed case studies in bold)*

256

257 **Hook 1: NPPF Paragraph 109 - Value Ecosystem Services**

258 *“The planning system should contribute to and enhance the natural and local environment by:*

- 259 • *protecting and enhancing valued landscapes, geological conservation interests and soils;*
- 260 • *recognising the wider benefits of ecosystem services;*
- 261 • *minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the*
 262 *Government’s commitment to halt the overall decline in biodiversity, including by establishing coherent*
 263 *ecological networks that are more resilient to current and future pressures”*

264 *(DCLG, 2012: paragraph 109)*

265 Paragraph 109 of the National Planning Policy Framework (NPPF) is significant in English planning
 266 policy as for the first time explicit reference is made to ES. However, the relatively weak wording of
 267 “recognising” imposes limitations as to its influence in policy and decision-making processes. It
 268 does, however, provide an opportunity for using ES as part of an evidence base from which to inform
 269 policy. Thus it has commonly involved identifying, mapping and modelling the amount, spatial
 270 distribution and quality of ES and NC in a given area, identifying opportunities for enhancing
 271 particular services, analysing trade-offs and alternatives and targeting policy interventions (Baker et
 272 al., 2012; Attlee et al., 2015).

273

274 **Hook 2: Duty to Cooperate - NPPF paragraph 158 and Localism Act 2011**

275 The Duty to Cooperate (DTC) is a legal requirement within the NPPF, enshrined within the Localism
 276 Act 2011, requiring all development plans to demonstrate active co-operation on strategic matters
 277 in their process of plan formation. This is tested legally at an examination in public by government-
 278 appointed planning inspectors (HM Government, 2011a; DCLG, 2012). DTC depends on the extent
 279 to which a planning authority has *“engaged constructively, actively and on an ongoing basis to*
 280 *maximise the effectiveness of Local Plan preparation in the context of **strategic cross boundary***
 281 ***matters”*** (HM Government, 2011a; our emphasis). These strategic cross boundary matters dovetail
 282 with the integration principle (Table 1), in theory. However, at the present time, ministerial advice
 283 and national practice policy guidance (NPPG) has exclusively focussed on securing housing need
 284 assessments for plan approvals/rejections.

285

286 Hook 3: Natural Environment White Paper

287 The Natural Environment White Paper (NEWP) entitled *The Natural Choice: Securing the Value of*
288 *Nature* (HM Government, 2011b) is signed up to by all UK government departments, representing a
289 powerful hook. It includes principles towards the improved valuing of nature in policy and decisions,
290 recognising the intrinsic value of nature and the key role the planning system has in protecting
291 biodiversity (although framed largely within a human-environment duality and no-net-loss neoliberal
292 narrative). However it has become evident that the NPPF trumps NEWP in policy and decision
293 making considerations (House of Lords Built Environment Committee, 2016). Still, the NEWP is
294 probably the most important policy document in terms of capturing and promoting ecosystem
295 science thinking.

296 *“We need a more strategic and integrated approach to planning for nature within and across local*
297 *areas [...] We want the planning system to contribute to our objective of no net loss of biodiversity”*
298 (HM Government 2011b:2.37)

299 As part of the approach there is endorsement of ES as a key concept:

300 *“Taking account of all the economic and non-economic benefits we get from these (ecosystem)*
301 *services enables decision-makers to exercise judgement about how we use our environment”*. (HM
302 Government, 2011b: 11).

303

304 Bridge 1: Green Infrastructure (GI)

305 GI is a term that seems to be widely used by built and natural environment professionals and also
306 understood by many publics. GI is explicitly addressed in the Natural Environment White Paper (HM
307 Government, 2011b) and NPPF/National Planning Policy Guidance (NPPG)⁴ and is a term widely used
308 in public policy discourses globally (Mell , 2014). The NPPF recognises the value of GI within the
309 concept of ecological corridors, improved connectivity and the multiple benefits it delivers in
310 (re)development projects. NPPF Annex 2 defines GI as “[...] a *network of multi-functional green*
311 *space, urban and rural, which is capable of delivering a wide range of environmental and quality of*
312 *life benefits for local communities”*. National Planning Guidance has also been recently updated to
313 include specific guidance to help with defining GI scope and extent; *“As a network it includes parks,*
314 *open spaces, playing fields, woodlands, but also street trees, allotments and private gardens”* (NPPG:
315 par 27). The explicit mention of gardens helps it have relevance at the individual household level

⁴ National Planning Practice Guidance <http://planningguidance.communities.gov.uk/> [accessed 1 September 2016]

316 which is important in terms of public engagement and appeal but is a largely neglected dimension in
317 mainstreaming efforts (Dewaelheyns et al., 2016). The NPPG also recommends embedding GI into
318 the development process at an early stage linking it explicitly to ES. *“Green infrastructure provides*
319 *multiple benefits, notably ecosystem services, at a range of scales, derived from natural systems and*
320 *processes, for the individual, for society, the economy and the environment.”* (NPPG: par 27).

321

322 **Bridge 2: Multiple benefits/assets**

323 Multiple benefits language has been used to secure initial public and/or political support for
324 ecosystem science particularly where ecosystem terminology was unfamiliar (Fish and Saratsi, 2015).
325 The term has been used on its own but has also been linked to environmental assets. This helps
326 challenge perceptions of nature as a constraint to development and economic growth with the
327 multiple benefits being presented as financial values to help highlight nature’s value to society
328 (Baker et al., 2012).

329

330 **Bridge 3: Connectivity**

331

332 Connectivity was often encountered when dealing across complex spatial geographies associated
333 with political and administrative boundaries meeting natural boundaries. The idea of connections is
334 important in allowing multiple audiences to understand the flows of ES between one place and
335 another and to understand the interrelationships between these interactions (provider and
336 beneficiary); for example, in water management (flood and drought management). It also enabled
337 an understanding of winner and losers when ES flows of benefits are mapped (Scott et al., 2013).

338

339 **4. Mainstreaming Ecosystem Science in** 340 **Spatial Planning Practice**

341 This section provides a commentary on four UKNEAFO project participant self-assessment narratives
342 illuminating how specific hooks and bridges were used in response to particular
343 opportunities/challenges and how they influenced the mainstreaming process and resulting
344 outcomes in different SP settings. The case study narratives are summarised in Table 4 exposing the
345 most influential EcA (1-12) and SP principles (UNECE, 2008). It is noteworthy how both subsidiarity

346 and precautionary principles were less evident perhaps reflecting the quasi-judicial nature of English
 347 spatial planning practice. It also suggests a wider challenge that there are inherent problems in
 348 trying to capture all 12 EcA principles simultaneously.

SP Principles EcA Principles	Governance 1 3 9	Subsidiarity 2	Participation 11 12	Integration 3 5 7 8 10	Proportionality 4 9	Precautionary 6 8 10
Cotswolds	++	-	+	-	++	0
North Devon	++	-	++	-	++	-
Birmingham	++	+	++	++	++	+
South Downs	++	+	++	++	+	+

349 *Table 4. Case Study summary impact analysis in relation to EcA / SP principles (++ very positive; +*
 350 *positive; 0 not evident; - negative; - - very negative)*

351

352 [Cotswolds AONB Management Plan⁵](#)

353 **Governance and Participation Principles:** The Cotswolds Area of Outstanding Natural Beauty
 354 (AONB) is designated for its high quality landscape. A statutory Conservation Board across seven
 355 local authorities is charged with ensuring that the landscape is conserved, enhanced, better
 356 understood and enjoyed. The Board’s Management Plan is updated every five years and provides a
 357 statutory document which all relevant public agencies must take into account in their decisions and
 358 operations. The Plan is also a crucial communication tool helping to inform land managers,
 359 stakeholders and wider publics about the value of the AONB. It is subjected to formal public
 360 consultation processes.

361

362 Ecosystem science did not feature at all in the initial development and discussions of the plan
 363 review. There were differing levels of knowledge about ES across the members of the Board but the
 364 AONB officers did have a working knowledge. The priority in the plan review process was to address
 365 criticism of the previous management plan for being too complex and too generic and for a failure to
 366 engage partners, public bodies or parish councils sufficiently.

367

⁵ Participant led report adapted from <http://neat.ecosystemsknowledge.net/cotswolds.html> [accessed 6 July 2017]

368 **Proportionality and Integration Principles:** The publication of the Natural Environment White Paper
 369 (hook) helped re-invigorate the ecosystem science discussions within an AONB plan workshop in
 370 2011. The officers shifted from the traditional ‘exploitative’ view of natural resources using the
 371 bridge of the environment as an asset with multiple benefits. A Strategic Environmental Assessment
 372 (SEA) was undertaken to inform the plan making process using ES explicitly. However, the draft plan
 373 presented them as an add-on benefit alongside scenic beauty, cultural heritage, economic
 374 development and GI. At the final stages of plan preparation ES did not feature at all, but pressure
 375 from some board members, drawing on their own experience in the NEAFO research process,
 376 persuaded the Board to retrofit ES into the draft plan. Consequently, the final Cotswolds AONB
 377 Management Plan for 2013-18 presents ES as one of five multiple benefits for society delivered by
 378 good management and conservation measures (Figure 3: provisioning services shown as an
 379 example).

Ecosystem Services	
Provisioning Services	Link to Plan Objective/s
Food (e.g. crops, livestock, fish, game) Cotswold farmers produce food through arable crops, the breeding of store lambs, suckled calves and, increasingly, finished lamb and beef and a limited quantity of dairy products.	CEO2
Water supply The catchments on the Cotswolds provide drinking water for much of the population of south-east England.	CEO3
Fibre (e.g. timber, arable crops, wool) Historically, the Cotswolds has been an important producer of wool and timber, and there are opportunities to develop local markets and innovative uses.	CEO2
Fuel (e.g. renewable energy) The Cotswolds provides good conditions for renewable energy including hydro, solar and biomass and there is considerable scope for further development of this resource, particularly woodfuel.	CEO3
Genetic diversity The “Cotswold Lion” local breed of sheep helps retain important genetic diversity as well as contributing to local distinctiveness.	CEO2 CEO3

380
 381 *Figure 3 Extract of Provisioning Ecosystem services in the Cotswolds AONB linked to Plan Objectives*
 382 *(Source Cotswolds AONB management Plan 2013-2018 (2013:10))*

383
 384 The final plan identified the main ES flowing from the AONB area and links them to individual plan
 385 objectives to show how they will be secured and/or enhanced. This retrospective mapping approach
 386 directly replicated the Exmoor National Park Plan⁶ model which was used as an exemplar within a

⁶ Exmoor National Park Partnership Plan 2012-2017 <http://www.exmoor-nationalpark.gov.uk/?a=260857> [accessed 30 September 2016].

387 UKNEAFO workshop in demonstrating how an ESF could be embedded pragmatically into a
388 management plan setting. This partial mainstreaming provides an initial foundation for further
389 progress as the management plan is reviewed. Also, discussions have taken place over the
390 development of a Payment for Ecosystem Service scheme regarding improved management of the
391 upper catchment of the River Thames within the AONB.

392

393 [North Devon and Torrington \(Draft\) Joint Local Plan⁷](#)

394 **Governance Principle:** The development of the North Devon and Torrington Joint Local Plan (North
395 Devon and Torrington District Councils, 2014) involved a statutory development plan process crossing
396 two local authority areas in a bold joint working endeavour. The lead planning officer was familiar
397 with ecosystem science, having had extensive working relationships with academics and research
398 communities, as well as being a member of the NEAFO research team. However, there were
399 significant internal and external challenges (and thus learning spaces needed) for all planning
400 officers, elected councillors across both authorities as well as their wider publics to understand and
401 accept ecosystem science thinking in the plan.

402

403 **Proportionality and Integration Principles:** The mainstreaming process was framed using ES within a
404 pragmatic understanding of the national and local political discourses dealing with the peripherality,
405 world-class environment assets (UNESCO Biosphere Reserve) and economic challenges of the joint
406 council area. Paragraph 109 of the NPPF was used as a key hook by the lead planning officer as part
407 of the political persuasion process to legitimise ES thinking internally across both planning teams and
408 elected members. This secured resources for mapping the different ES across the area as an
409 evidence baseline for future monitoring and evaluation of plan policies. The outputs were translated
410 into a strategic aim within the draft local plan promoting the environment as an asset intimately tied
411 up with the development of the area and with ES as adaptable outcomes responding to changing
412 needs. This is now under consideration by a government appointed planning inspector.

413 *“Aim 2: A World Class Environment – where important assets are valued and enhanced for future*
414 *generations [...]. (c) land is used efficiently and effectively – optimise how ecosystem services provide*

⁷ Participant led report adapted from <http://neat.ecosystemsknowledge.net/devon.html> [accessed 6 July 2017]

415 *and result in productive living landscapes and townscapes that adapt to our changing needs*". This
416 shaped a more detailed but isolated local plan policy ST14.

417 *"Policy ST14: Enhancing Environmental Assets:*

418 *The quality of northern Devon's natural environment will be protected and enhanced by ensuring*
419 *that development contributes to:*

420 *(a) providing a net gain in northern Devon's biodiversity where possible , through positive*
421 *management of an enhanced and expanded network of designated sites and green infrastructure,*
422 *including retention and enhancement of critical environmental capital; [...]*

423 *(h) conserving and enhancing the robustness of northern Devon's ecosystems and the range of*
424 *ecosystem services they provide;"*

425

426 The ES policy, although innovative, was in addition to the existing suite of environmental policies
427 rather than integrated or aligned to other policies and chapters of the plan. Importantly, there were
428 few cross-references to ecosystem science outside the environmental chapter itself. However, this
429 was seen as a necessary and proportional compromise to the local political and public mindset that
430 was unfamiliar with ecosystem science. This led to the sole use of the ES term in the plan rather
431 than wider ecosystem science terms. At the time of writing (March 2017) the plan is awaiting
432 examination in public and it remains to be seen how accepting the inspector and wider public are of
433 this approach.

434

435 **Participation Principle:** The local plan process was able to build upon a foundation of ecosystem
436 science knowledge from a number of other work streams which recognised the value of
437 environmental assets in the area and their multiple benefits for the local economy. These included
438 participation as a pilot authority in a county-wide biodiversity offsetting programme; involvement in
439 the Ecosystems Knowledge Network⁸; and contribution towards other spatial strategies such as for
440 the UNESCO Biosphere Reserve at Branton Burrows⁹ and the Nature Improvement Area on the
441 culm measures¹⁰. The cumulative impact of these joint endeavours created the necessary social
442 capital to advance ecosystem science into their local plan using the global importance of the natural
443 environment as an asset for growth. The plan had been consulted upon as part of its statutory duty.
444 In general there was support for the approach to ecosystem science diffusion taken by the council as

⁸ Ecosystem Knowledge network <http://ecosystemsknowledge.net/> is a UK based knowledge exchange network to promote improved understanding and use of the ecosystem approach

⁹ <http://www.northdevonbiosphere.org.uk/> Branton Burrows Biosphere Reserve

¹⁰ <http://www.northerndevonnia.org/culm-grassland> Nature Improvement Area Culm Measures Devon accessed 30 September 2016

445 stated in the response to the public consultation document par 343 *“The plan’s ecosystem approach*
446 *is supported”*¹¹. However, issues of scale were raised resulting in a change to the plan to “19.
447 *recognise the importance of protecting ecosystems and ecosystem services at an ecosystem scale”*
448 (p89).

449

450 [Birmingham City Council’s Green Living Spaces Plan \(GLSP\)](#)¹²

451

452 **Governance Principle:** The establishment in 2013 of a Green Commission, a cabinet level body
453 involving experts, influencers and decision-makers with its ambition and vision to make Birmingham
454 a leading global green city was influential in obtaining higher level political support for ecosystem
455 science ideas and initiatives. The multiple benefits (bridge) was embedded into the city’s
456 governance framework through a suite of strategic planning processes and associated documents
457 including the statutory local plan (Birmingham City Council, 2014). Key policy-related hooks were
458 the climate change related national performance indicators against which local authorities had to
459 report in England between 2008 and 2010, the Lawton Review (2010), the Natural Environment
460 White Paper (HM Government 2011b), the UKNEA (2011) report and the NPPF’s paragraph 109. The
461 city council’s (GLSP) initiative has evolved over time with the environmental and sustainability
462 sections of the council driving the organic and pragmatic research and local policy-making process,
463 adjusting to changes/opportunities in national policies and planning frameworks as they presented
464 themselves.

465

466 **Participation Principle** GI was used as a policy bridge to engage stakeholders from different
467 departments across the council as well as external stakeholders around common goals and interests.
468 A key output of that process was the publication of the GLSP (Birmingham City Council, 2013) where
469 its non-statutory status provided much needed flexibility, but with the necessary elected member
470 and officer buy in to inform future policies and decision-making across the council It also was
471 championed as an exemplar for other urban areas nationally and globally (UKNEAFO, 2014). The
472 GLSP process involved the formation of a cross-disciplinary working group involving both internal

¹¹ North Devon and Torridge Local plan Consultation Document Response (2014)
http://consult.torridge.gov.uk/file/3001633_par_343_p87 accessed 8 April 2017

¹² Participant led report adapted from <http://neat.ecosystemsknowledge.net/birmingham2.html> [accessed 6 July 2017]

473 and external members from Climate Science; Water; Biodiversity; Green Infrastructure; Sustainable
474 Transport/Mobility; Planning; Community & Resilience; Business and Public Health, each bringing
475 their evidence bases, policies and delivery plans to the shared table. The bridges of multiple benefits
476 and risk were used to help secure greater buy in across these stakeholder communities. Collectively
477 they were able to agree seven cross cutting key principles¹³, each with associated outcomes/targets
478 that now form the backbone of the GI policy.

479

480 These seven principles have then informed the statutory planning framework for the city; i.e. the
481 Birmingham Local Plan as well as the Sustainable Development Plan Your Green and Healthy City.
482 Direct engagement with community representatives and third sector organisations broadened the
483 democratic nature of the policy which has led to further developments with natural capital involving
484 working with planners, developers and industry consultants on a toolkit (RICS, 2015¹⁴) to help
485 further mainstream nature into planning decision making.

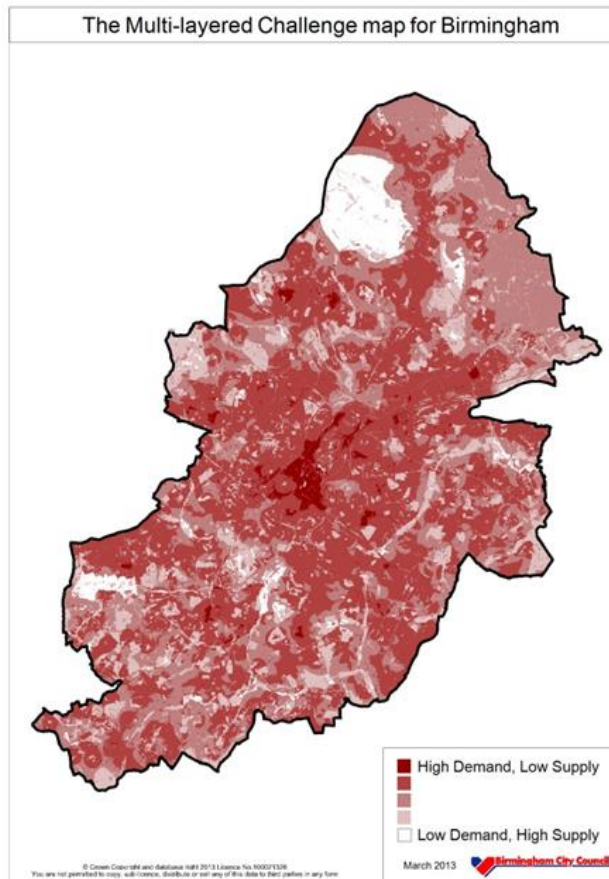
486

487 **Integration and Precautionary Principles:** The NPPF (par 109) hook helped persuade the council to
488 fund a series of research studies applying the ES methodology to six dominant urban issues
489 (aesthetics and mobility, flood risk, urban heat island effect (local climate), educational
490 attainment/provision, recreation and biodiversity) with each displayed as Geographic Information
491 System maps of the city (BUCCANEER, 2010; Scott et al., 2014). These individual maps depicted
492 areas of high and low demand/supply of each ES. The maps were then integrated into a single multi-
493 layered challenge map for Birmingham which could be interrogated at different scales for use by
494 residents, community groups, non-governmental organisations, strategic planners and elected
495 members (Figure 4¹⁵). These maps provide a powerful link between ES and social/environmental
496 justice considerations acting as an evidence base for place-specific policy interventions. In addition,
497 they also provide a baseline for climate change mitigation and adaptation priorities and actions,
498 revealing areas at risk from flooding and urban heat island effect.

¹³ 7 principles; An Adapted City; The City's Blue Network; A Healthy City; The City's Productive Landscapes; The City's Greenways; The City's Ecosystems; and The City's Green Living Spaces

¹⁴ Natural Capital Planning Tool <http://www.rics.org/uk/knowledge/research/research-reports/natural-capital-tool-planning/> accessed 8 April 2017

¹⁵ This map represents a city as depicted by its relationship with its ecosystem. GIS layers of data are combined to create as multiple challenge map. The lighter the tone the greater the benefits being obtained from that local environment. Darker tone shading indicates are areas where the current quality or availability of the local environment, does not meet the full demands of the local population.



499

500 *Figure 4: ES Multi challenge map. Source: Birmingham City Council (2013 [f])*

501

502 [Ecosystem Approach-led: South Downs National Park Authority Local Plan¹⁶](#)

503

504 **Governance Principle:** The South Downs National Park Authority (SDNPA) was created in 2011 and
 505 manages one of the newest UK National Parks. The SDNPA has statutory responsibilities for the
 506 protection of the national park’s natural beauty and special qualities and the promotion of informal
 507 recreation. As a new national park it positioned itself as an innovator and champion in ecosystem
 508 science planning and delivery seeking to mainstream ecosystem science into all its plans and policy
 509 processes. This meant that all staff and board members were actively involved in the mainstreaming
 510 process. The NEA (2011); NEWP (2011) and NPPF (2012) were used as highly influential hooks to
 511 facilitate this. Its first park management plan (SDNPA, 2013) set out the statutory framework for the
 512 protection of the park and its special qualities using the ESF. The park authority also developed and

¹⁶ The participant led report has been provided by Tim Slaney Director of Planning South Downs National Park Authority

513 approved its own papers highlighting the relationship between ES and NC which further
514 consolidated their own particular way of mainstreaming ecosystem science¹⁷.

515

516 The draft local plan (preferred options document¹⁸) builds on the statutory Park Management plan
517 (SDNPA, 2015) providing the legal planning policy framework and area plans for deciding planning
518 applications within the park boundary. It also set out to incorporate EcA at its heart drawing on its
519 fast growing national network of ecosystem science practitioners and experience in the UKNEAFO
520 project.

521

522 **Participation Principle:** Initially there was a targeted strategy of consultation and awareness-raising
523 of ecosystem science amongst its members, partnership board and 15 planning districts through a
524 number of meetings and workshop events. This helped build capacity and support for the statutory
525 management plan to incorporate ecosystem science at its heart. This then was translated to the
526 planning team as part of its local plan process and, to help maximise social learning and knowledge
527 exchange, close relationships were formed with research communities during and after the
528 UKNEAFO work to help facilitate local plan related workshops within which key hooks and bridges
529 were identified. The draft plan was sent out for consultation and the dedicated ES policy SD2 was
530 broadly welcomed and supported within the 52 responses received. However East Hampshire
531 District Council submitted a response that they “*consider that this policy duplicates other policies
532 and makes the policy repetitive and whole document unnecessarily long*”.¹⁹

533

534 **Integration and Proportionality Principles:** The SDNPA translated the 12 EcA principles into the
535 South Downs context in keeping with their statutory objectives and vision (Box 1). This provided a
536 powerful sense of ownership; translating the EcA language to their own setting and priorities and
537 thus creating a useful umbrella within which to position the local plan process as well as helping to
538 inform new ways of internal thinking across the staff.

¹⁷ Committee Paper https://www.southdowns.gov.uk/wp-content/uploads/2015/02/pp_2014Jul24_Agenda-Item-10.pdf (approved) [accessed 1 June 2016]

¹⁸ The preferred options stage is part of the formal stages that all development plans have to go through. When compared with North Devon and Torridge draft local plan this is an earlier phase of plan development as it has yet to go formally to a planning inspector. The usual stages include an options document; preferred options; local plan submission; examination in public; modifications and approved document.

¹⁹ SDNPA (2015) South Downs Local Plan Preferred Options Consultation Responses page 27 <https://consult.southdowns.gov.uk/consult.ti/localplanpo/listresponses> [accessed 8th July 2017]

- 539 1. *Be based upon the public interest both inside and outside the plan area, including in particular, the opportunities*
540 *for recreational activities and learning experiences and conserving the diverse, inspirational landscapes, breath-taking*
541 *views and tranquillity.*
- 542 2. *Delegate decision making to the most appropriate level, particularly for the communities with pride in their*
543 *distinctive towns and villages*
- 544 3. *Identify and assess adjacent effects at different scales, in particular taking into account, views, priority habitat*
545 *connectivity, rare and internationally important species, river and water catchment issues and the associated flooding,*
546 *water quality and supply issues.*
- 547 4. *Understand the economic context and aim to reduce market distortion, particularly to enable farming to enhance*
548 *the environment and continue to embrace new enterprise.*
- 549 5. *Support the enhancement of Natural Capital, historic features and rich cultural heritage so it can be enjoyed by*
550 *future generations*
- 551 6. *Respect known environmental limits using best available evidence but develop flexible policies to respond to*
552 *issues of uncertainty*
- 553 7. *Operate at appropriate spatial and temporal timescales, linking in particular with partnership landscape-scale*
554 *approaches, the National Character Assessment and local data and evidence*
- 555 8. *Manage for the long-term, considering lagged effects*
- 556 9. *Accept and manage change as inherent and inevitable, particularly considering recreation, housing, farming and*
557 *land management as significant aspects of this change*
- 558 10. *Deliver the National Park's two purposes as a priority and whilst doing so, the Authority duty using the Sandford*
559 *Principle in case of conflict between purposes (Partnership Management Plan / Delivery Framework reference)*
- 560 11. *Use a robust evidence base and the sustainable development precautionary principle where the data or evidence*
561 *is not complete*
- 562 12. *Maximise and maintain stakeholder engagement.*

563 *Box 1 SDNPA Ecosystem Approach Principles (SDNPA, 2014)*

564

565 The NPPF (par 109) hook helped justify the involvement of the entire planning team (strategic and
566 development management) in the local plan process with the thought-leadership and enthusiasm of
567 the director of planning. It created a bridge to communicate and work jointly with other section
568 leads in the park (e.g. landscape and park management). This collaborative working also enabled
569 the park to secure resources for mapping ecosystem services (ECOSERV²⁰); using this data as an
570 evidence base to inform subsequent policy development. The cumulative social learning resulted in
571 draft policy (SD2) which sits as one of only four higher-level policies that all other policies in the plan
572 are subservient to.

573

574 *Draft Core Policy SD2: Ecosystems Services SDNP 2015 Local Plan Preferred Options document*

²⁰ ECOSERV <http://ecosystemsknowledge.net/ecoserv-gis> accessed 8th April 2017

575 1. Proposals that deliver sustainable development and comply with other relevant policies will be permitted provided that they do not have
576 an unacceptable adverse impact on the natural environment and its ability to contribute goods and services. Proposals will be expected, as
577 appropriate, to:

- 578 a. provide more and better joined up natural habitats;
- 579 b. conserve water resources;
- 580 c. sustainably manage land and water environments;
- 581 d. improve the National Park's resilience to, and mitigation of, climate change;
- 582 e. increase the ability to store carbon through new planting or other means;
- 583 f. conserve and improve soils;
- 584 g. reduce pollution;
- 585 h. mitigate the risk of flooding;
- 586 i. improve opportunities for peoples' health and wellbeing;
- 587 j. stimulate sustainable economic activity; and
- 588 k. deliver high-quality sustainable design

589

590 Unlike many planning policies for conservation, the positive framing of this policy, with a
591 presumption in favour of development, enables, in theory, some beneficial ES/NC outcomes to be
592 achieved from all planning applications. Crucially, the policy becomes a negotiating tool for
593 planners to have a dialogue about securing positive ES and NC outcomes. It is also important to note
594 how ES language is used explicitly in headline form but then translated into plain English concepts in
595 categories (a-k) which improve accessibility and intelligibility to planning applicants and wider
596 publics thus engaging the public in meaningful ecosystem science dialogues.

597

598 This thinking has also shaped the newly emerging GI framework and roadmap (SDNPA, 2016) which
599 collectively now provides a strong suite of plans and policies all with ecosystem science at their
600 heart.

601

602 **Subsidiarity Principle:** Under the NPPF and Localism Act 2011, the park is carrying out its DTC
603 function to ensure that ES are protected and enhanced. From their interim statement on DTC
604 (SDNPA, 2015: 4.2) the following strategic principles are identified for collaborative work with the
605 surrounding 15 district authorities:

- 606 • *Conserving and enhancing the natural beauty of the area*
- 607 • *Conserving and enhancing the region's biodiversity (including GI issues)*
- 608 • *The delivery of new homes, including affordable homes and pitches for Travellers*
- 609 • *The promotion of sustainable tourism*
- 610 • *Development of the rural economy*
- 611 • *Improving the efficiency of transport networks by enhancing the proportion of travel by sustainable*
612 *modes and promoting policies which reduce the need to travel.*

613

614 The translation of DTC within SDNPA priorities has necessitated the forging of new dialogues and
615 partnerships with the surrounding authorities, forcing their planning staff outside usual DTC
616 priorities associated with housing need to deal with water management, GI and public rights of way.

617 The legal obligation to cooperate under the Localism Act helps the SDNPA engage with other
618 planners providing the initial traction to what are likely to be challenging discussions.

619

620 At the time of writing (April 2017) the local plan is going through a formal consultation process with
621 an impending examination in public for approval in 2017 which will be its ultimate test. In addition
622 there is ongoing collaboration as part of the NEAFO legacy process and new work on NC to
623 undertake ES assessments of major developments to improve ES/NC outcomes.

624

625 **Summary**

626 Together these case studies reveal the combined influence of hooks and bridges in progressing
627 ecosystem science mainstreaming beyond the persuasion barrier in different ways that suit specific
628 contexts set within the political realities. Each case study showed some progress and initial traction
629 in ecosystem science mainstreaming. These processes have and will evolve differently over time and
630 whilst all our case studies are front runners, or champions, acting at an early stage of ecosystem
631 knowledge diffusion, they represent innovators with important lessons to be learnt for future
632 ecosystem science diffusion. It is to this that attention now turns.

633

634

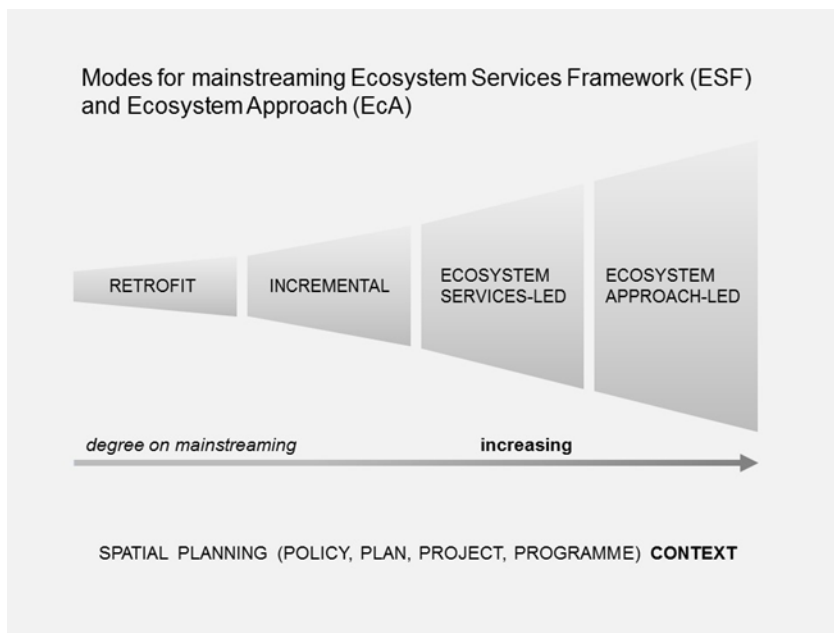
635 **5. Discussion and Conclusions**

636 **Realising ecosystem science mainstreaming in spatial planning practice**

637

638 The diverse approaches to mainstreaming ecosystem science encountered within our four case
639 study narratives reflect different capabilities, vulnerabilities and pragmatism required when trying to
640 introduce new ideas within policy and decision-making processes. This finding is important as it
641 suggests that mainstreaming is an evolutionary and dynamic process which can be conceptualised as
642 different modes of ecosystem science mainstreaming (Figure 5).

643



644

645 *Figure 5 Different modes of mainstreaming ecosystem science as observed in practice. (adapted UK NEAFO 2014:11)*

646

647 The Cotswolds AONB case study conforms to the ‘Retrofit’ mode where ecosystem science is bolted-
 648 on to a management plan retrospectively without influencing the rest of the plan process or
 649 document itself. The lack of knowledge of ES, together with other policy priorities emerging from
 650 critiques of the previous management plan were crucial barriers to further progress. But the linking
 651 of ES to the management plan objectives, allows, in theory, future progress to be made in
 652 subsequent plan reviews.

653

654 The Torridge and North Devon local plan case study conforms to the ‘Incremental’ mode where
 655 ecosystem science largely through ES and critical natural capital were incorporated into the plan
 656 within an overall Aim 2 and as part of a dedicated policy (ST11). Although having a ES evidence base
 657 to inform the policy it currently sits as an extra layer with limited integration across other economic
 658 or social policies in the plan.

659

660 The Birmingham GLSP case study conforms to the ‘Ecosystem Services led’ mode where ES have
 661 been embedded in the process from the outset as evidence bases and subsequently incorporated
 662 into outputs (challenge maps) that can help target interventions. With bespoke ES participation
 663 using the 9 piece jigsaw with stakeholders across Birmingham the plan was able to inform other
 664 plans (e.g. the approved Birmingham Local Plan as part of its impact).

665 The South Downs National park draft local plan conforms to the 'Ecosystem Approach led' stage
666 where the EcA principles and associated ecosystem science concepts were embedded in the process
667 from the start and inform successive stages. Crucially the management plan was championing an
668 ecosystem approach as a statutory framework for delivery within which the local plan process could
669 fit. The wholesale involvement of the planning team in this reflected a cultural buy in to the idea in
670 a way that the previous stages were unable to secure.

671

672 In each case study hooks and bridges provide evidence of getting through the persuasion phase
673 (Rogers, 2003) within ecosystem science mainstreaming (Figure 2). Here hooks and bridges provide
674 important mechanisms using the vocabularies and work priorities of particular target groups to
675 secure traction but with wider potential to embed ecosystem thinking and conceptual/behaviour
676 change. In the SDNPA case there is clear evidence of a culture change within the planning
677 department as they embrace ecosystem thinking in their local plan and suite of documents that
678 drive the national park's core work. Crucially, it is not confined to one champion or sector of the
679 authority. However, each of the four case studies captured a particular stage of mainstreaming at
680 the time of the research. The dynamic nature of ecosystem science mainstreaming diffusion will
681 enable future progression or regression depending on their particular experiences, learning and
682 external drivers of change. Here the role of gatekeepers (influenced by local / national /
683 international changes or challenges) become critical in their future evolutions in terms of restricting,
684 enabling or supporting change of ecosystem science ideals.

685

686 For example, the Birmingham example shows that mainstreaming processes can move negatively in
687 responses to external drivers. Progress has now stalled with the transformational change in
688 governance with the establishment of a Mayor and a new combined authority model which has
689 relegated environmental considerations in favour of an agenda focused on jobs and growth²¹.
690 Within the South Downs and North Devon and Torridge case studies, the government-appointed
691 planning inspectorate has the role to approve or reject both local plans following their examination
692 in public in late 2017/2018. If approved, they will provide the much needed exemplar case studies
693 to help legitimatise and catalyse the diffusion of ecosystem science policies in other local plans
694 (Posner et al., 2016); but equally, the converse applies. Indeed, it is only when other policy makers

²¹ See the prospectus for the WMCA <https://www.wmca.org.uk/media/1383/sep-executive-summary.pdf> where there is a section devoted to "transformational environmental technologies".

695 see how ecosystem science can be validated and approved in policy and planning decisions that the
696 new knowledge / innovation will gain momentum and lead to further mainstreaming activities
697 (Cowell and Lennon, 2014; Rogers, 2003). The example of the Cotswolds AONB using the approved
698 Exmoor National Park plan as a model serves to illustrate this point.

699

700

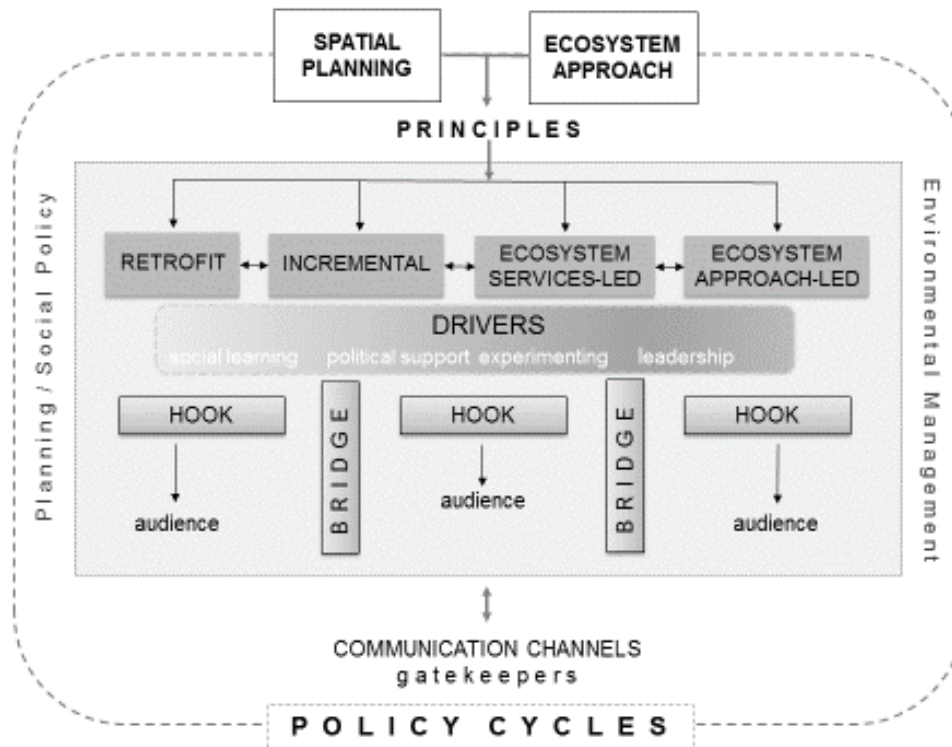
701 Part of the difficulties in mainstreaming ecosystem science lies in the fact that the encompassed
702 concepts largely reside in natural environment policy and practice and only slowly infiltrate SP
703 practice where it has yet to be fully accepted and valued (UKNEA, 2011; Karlsson-Vinkhuyzen et al.,
704 2017). Figure 5 provides a schematic representation of how mainstreaming can be achieved. The
705 initial step necessitates working explicitly at the SP: EcA interface where hooks and bridges are
706 identified within a bundle for ecosystem science mainstreaming. It is important that they map
707 successfully on to all the EcA:SP principles. Our case study narratives have then identified a set of
708 common ingredients that support the operationalisation of hooks and bridges leading to successful
709 mainstreaming outcomes. These are unpacked in the next section; the need for political support;
710 effective leadership; safe social learning spaces; and a willingness to experiment by operating
711 outside usual comfort zones.

712

713 However, there is a danger that simple accommodation or incorporation of ecosystem science terms
714 in existing work practices as bolt-ons could lead to little or no behaviour change, with accusations of
715 “ecosystem-wash” mirroring the greenwash accusations observed in sustainability and
716 environmental valuation discourses (e.g. Spash, 2015). All our case studies hopefully demonstrate
717 that there is more to this than that.

718

719 For example the reframing of EcA principles in SDNPA (Box 1) and Birmingham’s 7 cross cutting GLSP
720 principles (Footnote 8). This translation and adaption of EcA principles within a local context helps
721 engender a sense of ownership and purpose, creating shared values and the conditions where
722 culture and behaviour change can take place. This process parallels findings by McMorran et al.
723 (2014) after crofters had taken ownership of “their” land post Land Reform in Scotland where
724 previously a landowner had control (See also Lienert et al., (2013) paper on water infrastructure
725 planning).



726

727 *Figure 5. Mainstreaming Ecosystem Science in different SP settings: An environmental governance diffusion model*

728

729 Likewise the NPPF hook provides potential mainstreaming opportunities through creative
 730 interpretations of “recognising the value of ES” in paragraph 109. This is evidenced globally where
 731 INVEST and other ES mapping models are now becoming much more influential (Gómez-Baggethun
 732 and Barton, 2013; Söderman et al., 2012). Creative policy development such as evident in SDNPA’s
 733 core policy ST2 also enables ES to become a negotiation tool to help achieve better ES outcomes in
 734 all planning applications. This more progressive use of ES in policy approaches is key to unlocking
 735 important ES gains locally, nationally and globally and indeed has served as a catalyst for further
 736 research work in Birmingham and South Downs plus 6 other local authorities on a natural capital
 737 planning tool²².

738

739 The DTC, equating with strategic regional planning in more global contexts, also provides a potential
 740 opportunity tool to engage in new dialogues and partnerships, creating new social learning and

²² The Natural Capital Planning Tool is now one of 12 GI Innovation projects funded by NERC.

<http://gtr.rcuk.ac.uk/projects?ref=NE%2FN017587%2F1> accessed 8th July 2007

741 knowledge-sharing spaces, addressing a range of strategic planning challenges of local, national and
742 international significance such as flood and drought management (e.g. Reed et al., 2017); green
743 infrastructure creation and improvements (Connop et al., 2016); provision for recreation, and
744 climate change mitigation and adaptation (Jordan and Huitema, 2014). However, in England this is
745 inhibited by the dominance of the economic growth narrative and priority in DTC matters towards
746 joint housing need assessments (Scott, 2016). Here, the new dialogues started by SDNPA with
747 surrounding local authorities, developers and other built environment professionals within their
748 bespoke DTC policy, provides a more progressive exemplar model for strategic planning, that can be
749 applied beyond a protected landscape planning context.

750 Core ingredients for mainstreaming ecosystem science globally

751

752 As depicted in Figure 5, the four case study narratives reveal core ingredients which drive successful
753 ecosystem science mainstreaming processes. These have wider global applicability; the need for
754 political support; effective leadership; safe social learning spaces; and a willingness to experiment by
755 stepping outside usual comfort zones.

756

757 Getting high-level political support early on in a mainstreaming process is a significant but often
758 neglected step as it builds political capital which is essential in subsequent plan validation and
759 legitimatisation; whether for non-statutory (GSLP) or statutory plans (SDNPA and North Devon and
760 Torridge local plan) (Scott et al., 2014; see also City of Vancouver, 2012). Within Birmingham, the
761 establishment of the Green Commission with its vision to make Birmingham a global green city
762 provided a cross-departmental cabinet level body in the Council within which ecosystem science
763 could be championed. In the SDNPA case study, the NPA committee played an important role
764 endorsing the EcA as proposed by staff, combined with a willingness to innovate in their plans and
765 policies as a new National Park Authority.

766

767 Effective leadership enabled people to work outside their usual comfort zones as innovators with
768 ecosystem science. In three cases (SDNPA, Birmingham, North Devon and Torridge), senior policy
769 officers commanded respect internally within their respective policy arenas as well as being
770 proactive in engaging externally with academic research communities (e.g. the NEAFO amongst
771 others) on their own terms. This willingness to engage with research communities is significant in
772 connecting knowledge across research, policy and practice boundaries. Here the co-production of

773 research to support the policy- and plan-making created important social learning space where
774 outcomes had both academic credibility and practical usability (Tress et al., 2005; Cowell and
775 Lennon, 2014; Scott et al., 2014).

776

777 All case studies had collaborative workshop activities both as ongoing internal requirements but
778 also as part of the UKNEAFO exercise which gathered and discussed evidence from different sectors
779 and helped connect people across sectors, disciplines and/or municipal boundaries for the first time
780 with a specific focus around mainstreaming ecosystem science in spatial planning. The workshops
781 as part of the UKNEAFO research itself provided safe social learning spaces, outside existing work
782 patterns and pressures. Policy makers and decision makers engaging in research programmes can
783 play an important role in driving innovation by building social capital and confidence within such
784 knowledge exchange flows as illuminated by Cowell and Lennon (2014) and McKenzie et al (2014).
785 Dialogues with publics and stakeholders can also be a powerful mechanisms for social learning. For
786 example, work by Fish and Saratsi (2015) help illuminate the power of deliberation with public
787 audiences to optimise social learning within an ES format. This was also evident in the SDNPA and
788 Birmingham examples through a range of learning activities and knowledge exchange workshops
789 between planning staff, elected members and wider partners as well as wider statutory public
790 consultation activities. Furthermore, the construction of the SDNPA policy SD2 enables that policy
791 itself to become a hook in its own right from which planners can hold dialogues with developers and
792 householders to try and optimise the ES/NC gains from any development. This Russian doll model of
793 hooks within hooks has real potential to change the way people behave in drafting and justifying
794 planning applications in the SDNP.

795

796 Our case studies and discussions have highlighted innovative thinking and practice but they are still
797 very much pioneers. Indeed, it is fallacious to view our case studies as 'successful'. Their journeys
798 are evolving and will be affected positively and negatively by both internal and external drivers of
799 change as innovators and the extent to which they can overcome the other barriers to ecosystem
800 science; its technocentric nature (Fish and Saratsi, 2015); the need for advanced skills to
801 understand/use/access many of the tools available (McKenzie et al., 2014); the lack of exemplars
802 and social learning platforms (Dunlop, 2014; Posner et al., 2016) and lack of local-scale information
803 (Burke et al., 2015).

804

805 Indeed, as reported the statutory local plans (SDNPA and North Devon and Torridge) are facing
806 examination procedures within the current governance framework that will have major
807 repercussions for the adoption of ecosystem science mainstreaming in English planning whatever
808 the decisions. Furthermore, all our case studies will need to make difficult resource management
809 and planning decisions that require making trade-offs between different SP and/or EcA principles
810 with resulting winners and losers that typify any decision-making processes. Moreover SP practice is
811 an arena where here is an explicit tension between the holistic and integrated and the legalistic
812 (quasi-judicial) which presents real challenges for translating some aspects of EcA thinking into
813 practice (see Inch, 2012) ; the precautionary and subsidiarity principles being cases in point
814 (Albrechts, 2015; Scott et al., 2014; Raudsepp-Hearne et al., 2010). Within the four case studies
815 discussed in some detail in this paper there is a collective appetite to take up this challenge. How
816 that is played out in the political arenas of the future remains to be seen and reported upon.

817

818 Conclusion

819

820 This paper has developed and used a framework to assess and progress mainstreaming ecosystem
821 science within four case studies. Hooks and bridges are key mechanism that enable ecosystem
822 science language and concepts to be transferred into spatial planning practice. This is facilitated by
823 a mapping exercise of SP-EcA principles which revealed significant convergence and thus establishing
824 the hybrid opportunity space for mainstreaming. Mainstreaming itself is a dynamic process
825 constrained by setting, capacities, knowledge and familiarity within a particular spatial planning
826 setting. We have identified key drivers that influence success: the need for political support;
827 effective leadership; safe social learning spaces; and a willingness to experiment by stepping outside
828 usual comfort zones. Thus when hooks and bridges are used collectively with these ingredients
829 ecosystem science becomes embedded in spatial planning domains enabling key actors and
830 gatekeepers to accept, use and ultimately legitimise the concepts within their own policy and
831 practice vocabularies and work priorities thus creating the traction for further exploration and
832 development of the idea within an adoption process (Rogers, 2003). However, significant challenges
833 remain in both the legitimisation of ecosystem science within existing governance frameworks and
834 the sharing of progress and additionality within wider social learning spaces that typify innovators in
835 any diffusion process. In such pioneering endeavours it is the collective social learning from both
836 successes and mistakes that that will provide the opportunity spaces for a culture and behavioural
837 change in policy and decision making.

838

839 Successful ecosystem science mainstreaming can occur at all modes; retrofit, incremental,
840 ecosystem services-led and ecosystem approach-led. However, most progress can be made where
841 use or adaptation of the EcA higher level principles or ES have been embedded from the outset (e.g
842 SDNPA and Birmingham), rather than using the ESF or focusing on ES selectively and uncritically
843 (Gaston et al., 2013). Our research at the EcA SP interface illuminates how hooks and bridges can
844 help to plant the seeds of transition towards a more integrated planning which when combined with
845 the necessary political support, leadership, social learning and a willingness to experiment, innovate
846 and “boldly go”, may help point a way forward.

847

848 **6. References**

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