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1 Analyzing constraints to improve conservation decision making: a theoretical framework and
2 its application to the Northern Vosges, France

3

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8

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13

14 **Summary** – *Key to bridging knowing-doing gaps is analysis of the constraints binding*
15 *interactions between decision makers and conservation biologists to clarify the problem they*
16 *address. We apply this analysis to decision situations in the Northern Vosges (France), which*
17 *illustrate three kinds of constraints - governance, framework, and initiative. We explore how*
18 *conservation biologists can mitigate constraints so as to foster more ambitious conservation*
19 *actions in each case. The first case explores attempts at reintroducing the lynx (*Lynx lynx*). In*
20 *this case, we show that governance plays a key role, in the sense that conservation actions*
21 *should focus on improving the acceptability of reintroductions to key stakeholders. The second*
22 *case refers to water monitoring schemes. Here we show that framing is the dominant constraint.*
23 *It means that conservation actions are tightly limited by the use of a restrictive scientific*

24 *apparatus. The last case study, fish stock protection, is constrained by initiative. Here, decision*
25 *makers have too much leverage to implement solutions they favor, even if they are not the best*
26 *options in conservation terms. Exploring how our framework relates to the existing literature*
27 *allows us to highlight its usefulness to rationalize conservation problem framing and to*
28 *strengthen the ambition of conservation actions.*

29

30 **Keywords** – conservation decision, decision support, environmental policy, governance,
31 knowing-doing gaps, decision process

32

33 **1. Introduction**

34 Following seminal calls for evidence-based conservation (Sutherland et al. 2004) and
35 conservation policy evaluation (Ferraro and Pattanayak 2006), numerous articles have recently
36 championed bridging knowing-doing gaps in conservation (Arlettaz and Mathevet 2010; Beier
37 et al. 2017; Jeanmougin et al. 2017, Matzek et al., 2014; Schwartz et al. 2018, Jarić et al. 2019,
38 Knight et al. 2008; Sunderland et al. 2009; Biggs et al. 2011; Game et al. 2015). When
39 conservation biologists, experts or consultants (hereafter, 'CBs') interact with decision makers
40 (hereafter, 'DMs') facing a problem with conservation bearings, they can have the naïve view
41 that bridging knowing-doing gaps simply means solving the problem by providing a
42 scientifically robust recommendation.

43 However, conservation actions often involve series of complex decisions made by human
44 beings in complex social contexts. Insights from decision sciences can help in forming a more
45 informed picture of CB/DM interactions, useful to empower attempts at bridging knowing-
46 doing gaps. Tsoukiàs (2007) synthesises these insights by conceptualizing decision support
47 processes (i.e., processes where a DM and an analyst (in our case: a CB) interact to address the

48 DM's problem) as articulated around: a representation of actors and their roles; a problem
49 formulation, mentioning anticipations of what actors expect; and an evaluation tool.

50 The lesson from Tsoukias (2007) is that the naïve picture above should be overcome by taking
51 into account actors, expectations and tools, but this does not explain the precise role of these
52 elements in shaping the problem and CB/DM interactions. Here, we propose to take advantage
53 of a framework developed by Meinard and Tsoukiàs (2019) to overcome this limitation. We
54 then put this framework to the test in a series of case studies in the Northern Vosges Natural
55 Park (France).

56

57 **2. Methods**

58 **2.1. Theoretical framework**

59 Meinard and Tsoukiàs (2019) argue that the actors, expectations and tools mentioned by
60 Tsoukias (2007) are the building blocks of 'constraints' binding CB/DM interactions. These
61 constraints mold the problem that the process addresses.

62 Typically, most decision processes herald a formulation of the problem they allegedly address.
63 This formulation is used in administrative procedures such as public procurements, in official
64 communications with journalists or the larger public, or when organizing events such as internal
65 meetings. However, the constraints binding CB/DM interactions can make it impossible to
66 address this problem. The latter then becomes what we propose to call a 'proto-problem',
67 heralded but not addressed in practice, as the process in fact tackles a problem that can be
68 operationally addressed, which we propose to call the 'constrained problem'.

69 Meinard and Tsoukiàs (2019) use Habermas' theory of social interactions (Eriksen and Weigård
70 2003; Corchia 2013) to pinpoint three kinds of constraints of distinctive importance: framing,
71 governance and initiative. The distinctive importance granted to these three constraints reflects

72 Habermas’s typology of ‘models of action’. Habermas (1984) claims that the most important
73 sociological and philosophical theories in the literature understand decision making based either
74 on a “strategic model”, a “norm-regulated model” or a “dramaturgic model”. Habermas argues
75 that all three models shed partial but relevant light on decision making, and Meinard & Tsoukias
76 (2019) introduce framing, governance and initiative as constraints determining the most
77 relevant model to apply to a given situation (the strategic models is particularly relevant when
78 framing is binding, norm-regulated when governance is binding, and dramaturgic when
79 initiative is binding).

80 This typology of constraints, and its implications in terms of a discrepancy between proto- and
81 constrained problem, can be easily translated in conservation contexts.

82 ‘Framing’ refers to scientifically authoritative third-parties (formal or informal) monitoring
83 DM/CB interactions and imposing the methodologies that CB should use. Take, for example,
84 the case of a DM who seeks decision support from a CB to elaborate a preservation action plan
85 for a population of an endangered species. In cases where framing is dominant, the CB finds
86 her/himself incapable of truly tackling the proto-problem ‘what does conservation science teach
87 us about how to carve out the preservation plan?’ Indeed, because a scientific authoritative third
88 party, such as a national or international expert agency or funding partner, imposes a specific
89 methodology that the CB cannot question, she/he has no choice but to address the constrained
90 problem ‘what is the best preservation plan that can be produced using the imposed
91 methodology?’

92 The governance constraint refers to requirements that decisions should be validated by some
93 actors, such as a steering committee or an assembly of stakeholders. In our fictitious example,
94 when this constraint is dominant, rather than addressing the proto-problem, the CB is forced to
95 address the constrained problem ‘what kind of preservation plan will be acceptable to those

96 people whose acceptance is key to its implementation?’ In such cases, the job is to identify who
97 those people are and which decisions reflect their legitimate expectations.

98 The initiative constraint characterizes situations where the most important outcome of the
99 process is that the DM should endorse the final decision as its own. In our example, the
100 constrained problem that the CB ends up addressing is no longer the proto-problem, but is closer
101 to ‘what kind of preservation plan will meet the DM’s values and preferences?’ The task is then
102 to identify a decision which is as faithful as possible to the DM’s values and preferences.

103 This model offers a plausible explanation for the existence of a discrepancy between the naïve
104 view of CB/DM interactions, and actual outcomes of such interactions. However, it remains
105 purely theoretical, and leaves basic empirical questions unanswered. What kind of real-life
106 situations correspond to those mentioned in the model? What are the real-life factors
107 constituting the three constraints? What are the concrete implications for practitioners?
108 Answering such empirical questions involves implementing the above framework by analysing
109 concrete conservation decision processes.

110

111 **2.2. Operational implementation**

112 Here we outline the steps of such a practical implementation, specifying the sequence of
113 questions that should be answered, based on consultations of the documents formalizing the
114 decision process and/or on interviews with the actors involved.

- 115 - Step 1: Initial characterization of the decision process. The main *prima facie* features of
116 the decision process should be identified by answering the following questions:
- 117 ○ Q1^{PP}. What is the proto-problem allegedly addressed?
 - 118 ○ Q1^{DM}. Who is the DM? In other terms: which actor or institution claims to be in
119 charge of the resolution of the proto-problem just identified?

- 120 ○ Q1^{CB}: Who is or who are the CB, i.e. who are the actors entrusted to close
121 knowing-doing gaps in the case at hand?
- 122 - Step 2: Constraints identification and description. The point at this step is to identify the
123 actors or institutions representing the framing, governance and initiative constraints, and
124 to characterize the influence they can have on the decision process. This involves
125 answering the following three questions:
- 126 ○ Q2^f. Are there actors who impose a specific approach, methodology or
127 theoretical framework to be used in the process?
- 128 ○ Q2^g: What are the procedures used to validate or invalidate the decisions made
129 by the DM? Who are the actors involved, and what are their prerogatives?
- 130 ○ Q2ⁱ: How important is it for the DM to endorse the responsibility for the decision
131 and to conceive of it as his/her own decision?
- 132 - Step 3: Translation in terms of problem formulation. The proper characterization of
133 constraints is then used to formulate the problem that the process truly tackles, due to
134 the influence of the constraints preventing the DM from truly tackling the proto-problem
135 (or allowing her/him not to tackle it) (Q3^{CP}).
- 136 - Step 4: Diachronic analysis. Most decision processes take time, and actors and
137 procedures evolve over time. As a consequence, the constraints binding the process and
138 the corresponding formulation of the problem addressed also evolve, yielding a ‘refined
139 problem’. The former three steps must hence be reiterated to get a dynamic picture of
140 the decision process, clarifying these refined problems (Q4^{TP}).

141

142 **2.3. Case studies in the Northern Vosges**

143 To clarify the empirical bearings of this constraints analysis framework, following the above-
144 described steps, we analyzed a series of conservation decisions made inside and near the

145 Northern Vosges Natural Park (North-east France), looking for decisions that would illustrate
146 how the three constraints above – governance, initiative, framework –materialize.

147 We explored three conservation decision processes, chosen because each one illustrates one of
148 the three constrains structuring our framework. In the thee decision processes, the Natural Park
149 of the Northern Vosges (hereafter, ‘the Park’) plays a pivotal role thanks to its official
150 attributions, spelled out in a territorial charter regularly revised by local authorities and
151 approved by the central government (the current version covers 2014-2025). Its main missions
152 are: protection and management of the local natural, cultural and landscape heritage, promotion
153 of local actors’ initiatives, ecological monitoring, environmental education, mediation on
154 conservation issues, and coordination of conservation projects. The Park’s charter also
155 identifies key local actors and their commitments.

156 Data were collected through interviews with local stakeholders and analyses of available
157 documentations. During an exploratory phase, we first observed the local context and led face-
158 to-face interviews with stakeholders to identify the responsibilities and tasks of different actors.
159 We then explored official reports and planning documents, relevant laws and regulations,
160 institutional websites, communication flyers and newspapers, before performing a new series
161 of more focused interviews with key actors (October 2019 to February 2020). This recursive
162 process enabled us to answer the series of stepwise questions spelled out above.

163

164 **3. Results**

165 Here we present our case studies and the outcome of constraints analysis. We detail the four
166 steps [paragraphs (1) to (4)] and provide answers to the corresponding questions in each case.
167 The main actors and the constraints analyzed in each case studies are presented in Table 1.

168

169 **3.1. Reintroducing the lynx – a decision process mainly constrained by governance**

170 (1) Protecting and restoring biodiversity at a transboundary level is one of the Park’s chief
171 objectives, especially through its involvement in the Franco-German Palatinate Forest /
172 Northern Vosges Biosphere Reserve. Reintroducing the lynx [*Lynx lynx* (Linnaeus, 1758)] in
173 this Reserve is one of its most ambitious projects.

174 Early trials in 1983 and 1993 eventually failed in the early 2000s. High mortality initially
175 plagued these programs, but a stable population could subsequently be secured for a while. The
176 population then collapsed after 2005. In 2013, the lynx had practically disappeared again. The
177 most credible cause was poaching.

178 During these first trials, the Park was in charge of piloting reintroduction, endorsing the role of
179 the DM (Q1^{DM}). Members of the scientific committee of the Park, consultants, as well as
180 researchers and team leaders from other simultaneous programs in Switzerland, Germany and
181 Italy (Q1^{CB}) were solicited to help address the problem ‘how to reintroduce a stable population
182 of lynx?’ (Q1^{pb})

183 (2) But the dramatic collapse in the 2000s’ testifies to the decision process having been
184 bound by constraints that were insufficiently taken into account at that time, and that the
185 problem the Park used to conceive of itself as tackling was a hollow proto-problem. These
186 constraints were the following. The Park participated in releases, but had no influence on their
187 design. Its ability to skew the process to make it fit with its own understanding or objectives,
188 which is what we have defined above as an initiative constraint, was hence weak (Q2ⁱ). The
189 design of the process did not involve any overarching authority liable to constrain the
190 methodological approaches that the above CB could use. The framework constraint was hence
191 non-existent (Q2^f). By contrast, the stakeholders concerned were numerous, including hunters,
192 farmers, inhabitants, local authorities and forest managers. Most of them were, and still are,

193 well organized in NGOs or federations, regularly invited into meetings through which they
194 could voice their opposition to reintroduction, and put pressure on local elected representatives
195 to undermine the project. Indeed, although the lynx does not create any major risks for human
196 beings (Wyver 2014), stances toward the lynx are cleaving (as witnessed in most carnivores
197 reintroductions; Tokarski, 2019). These various actors hence proved to have an unexpected
198 ability to validate or invalidate the DM's choice, which constitutes a governance constraint
199 which was, and still is, accordingly tightly binding (Q2^s).

200 (3) Acknowledging the importance of this constraint progressively led the Park to
201 understand that taking into account perceptions and human behavioral responses is key to
202 successful reintroductions (Tokarski, 2019). The Park had to accept that it could not tackle the
203 proto-problem 'how to reintroduce a stable population of lynx?', and progressively refocused
204 towards a constrained problem it was able to tackle: 'how to increase the acceptability of the
205 lynx?' (Q3^{cp}) The current Life+ Lynx project (2016-2021; <https://www.lifelynx.eu/>) drew
206 lessons from this experience: the Park now endorses the aim to enhance social acceptability.
207 Having conducted a sociological study, it currently runs environmental education programs and
208 has launched a participatory process, the 'Lynx Parliament', facilitated by independent experts,
209 in which it is involved on a par with farmers, hunters, inhabitants and local authorities.

210 The Park hence followed a path through which it unwittingly analyzed constraints and, based
211 on this, managed to clarify a constrained problem it was truly able to tackle. This eventually
212 enabled it to act more decisively, by focusing on actions it was able to perform, rather than
213 wasting time, money and energy on actions devoted to tackle a proto-problem in which it was
214 doomed to be impotent.

215 (4) Interesting evolutions of the lynx parliament occurred lately. Whereas its first phase
216 focused on information and communication (deployment of information-sharing tools and alert
217 procedures based on mutual commitments), a second phase organized discussions among users

218 to share experiences and expertise regarding attitudes towards the lynx. The decision setting
219 hence evolved, from stages during which acceptance or rejection by stakeholders was
220 considered untouchable, to approaches through which the legitimacy of these attitudes started
221 to be questioned, and stakeholders began to conceive of themselves as actors liable to make
222 new commitments. Such evolutions go in the direction of mitigating the governance constraint,
223 which could eventually lead to restructuring the decision setting towards tackling a refined
224 problem such as ‘How to integrate lynx reintroduction within local development paths?’ (Q4^{TP})
225 Solving such a problem could be a much more meaningful contribution to local conservation.

226

227 **3.2. Water quality monitoring – a decision process mainly constrained by framework**

228 (1) The current charter of the Park stresses the importance of the issue of surface water
229 quality, in part due to its position at the head of numerous watersheds. This concern echoes the
230 broader context in the Rhine-Meuse basin, where more than half the watersheds have had to
231 postpone to 2021 or even 2027 the European objective to reach a good ecological status (Charter
232 of the Park, 2014, p. 26). Tackling the problem ‘how local water quality can be monitored and
233 improved?’ (Q1^{Pb}) is hence at the top of the Park’s agenda.

234 The Park launched in 2012 a monitoring program, the ‘river water quality observatory’, for
235 which it endorsed, along with local public representatives legally in charge of local water
236 quality monitoring, the role of DM (Q1^{DM}). To design the network of monitoring stations,
237 perform measures and interpret the results, the Program Officer in charge of river and water
238 issues consulted specialists in the scientific committee and hired various consultants as part of
239 public procurement procedures (Q1^{CB}).

240 (2) The Park coordinated institutional partners such as local authorities, and funding actors
241 supporting the cost of measurements and analyses involved, such as the Water Agency

242 (overseeing the implementation of the European Water Framework Directive [2000/60/CE;
243 https://ec.europa.eu/environment/water/water-framework/index_en.html]). In this process, the
244 Park did not wield a significant initiative constraint, in the sense that it mainly trusted the
245 competence of other actors to make cogent choices of tools and approaches. The various actors
246 involved did not play a decisive role in validating or invalidating decisions made by the DM:
247 in that sense, the process was not constrained by a tight governance constraint (Q2^g). However,
248 among these actors, the Water Agency exerted another tight constraint: framing (Q2^f). Indeed,
249 water agencies are responsible for regional-scale programs and policies, buttressed on
250 monitoring schemes using standardized indicators, summary statistics and a technical and
251 scientific framework to analyze and interpret these data. The Water Agency brought in this
252 technical and scientific apparatus, which was chosen as self-evidently relevant.

253 (3) Being ensconced in the framework of the Water Agency, far from addressing the proto-
254 problem ‘what is the quality of local water?’ the Park ended up addressing the much more
255 specific, constrained problem ‘How does local water quality fare with respect to European water
256 quality criteria?’ (Q3^{cp})

257 (4) Launched in 2015, the observatory has been fully operational since 2018, addressing the
258 constrained problem through the application of usual indicators to 31 reporting stations. It
259 unveiled that local water quality scores were not as good as expected. These results led some
260 local actors to dig deeper, as they became aware that the process only provided a partial answer
261 to their original, broader concern. Underlying causes were investigated. Ancient mines,
262 sewerage conditions in small isolated villages and insufficient protection of wetlands were
263 pinpointed. This prompted a collective rethinking of the relevance of the framework. The
264 decision process hence evolved towards addressing the refined problem ‘what are the relevant
265 criteria to capture the water quality regarding local situation and concerns?’ (Q4^{fp}) and the

266 Water Agency rallied to the new approach by maintaining its financial support in its current
267 program (2019-2024).

268

269 **3.3. Aquatic ecosystem management and fish stock protection – a decision process**
270 **mainly constrained by initiative**

271 (1) In the Lower Rhine, the fragmentation of aquatic ecosystems is of particular concern
272 (Charter of the Park, 2014, p. 29). Anglers play a key role in the management of aquatic
273 ecosystems. Associations Agréées pour la Pêche et la Protection du Milieu Aquatique
274 (Accredited Associations for Fishing and for the Protection of the Aquatic Environment;
275 AAPPMA) are in charge of regulating, monitoring and promoting angling. These AAPPMA
276 are associated at the departmental level in a Federation (Fédération de Pêche du Bas-Rhin, no
277 date) whose actions are organized by a Plan Départemental de Protection du milieu aquatique
278 et de Gestion des ressources piscicoles (Departmental Blueprint for the protection of aquatic
279 ecosystem and the Management of Fish stocks, PDPG), for the elaboration and implementation
280 of which, as DM (Q1^{DM}), they hired conservation consultancies and benefited from informal
281 discussions with researchers (Q1^{CB}). At first sight, it looks as though local fishing associations
282 implementing actions as applications of the PDPG address the problem ‘How to preserve the
283 ecological functioning of aquatic ecosystems and fish stocks?’ (Q1^{PP})

284 (2) AAPMAs typically solicit technical and scientific advice from program officers and
285 experts on specific projects when needed. However, despite the existence of monitoring
286 frameworks and recommendations promoted by various actors (including calls for rewilding
287 streams [Brown et al., 2018; Hawley, 2011]), they are by and large unconstrained in their choice
288 of a theoretical or scientific framework to address ecological functioning and connectivity
289 (Q2^f). The ability of other stakeholders to constrain the anglers’ approach is weak. Water
290 agencies, NGOs, and political representatives are sometimes involved in decision processes

291 piloted by anglers, but their role remains mainly consultative: there is no formal or informal
292 procedure through which these actors could validate or invalidate the DM's choices. The
293 governance constraint hence also appears limited (Q2^g).

294 The ability of institutions and representatives of fishermen to pilot the monitoring and
295 management of aquatic ecosystems is hence unchallenged (Q2ⁱ).

296 (3) In this context, the initiative constraint takes the upper hand, and fishermen do not really
297 address the proto-problem 'how to preserve ecological functioning and fish stock?' but rather
298 the constrained problem 'how to make sure that the fish stocks we want are available in fishing
299 spots?' (Q3^{cp})

300 (4) Because it witnessed in nearby watersheds the mismatch between ecological concerns
301 underlined by the proto-problem and the fairly limited constrained problem addressed by
302 anglers, the Park recently attempted to improve the way issues of ecological continuity are
303 handled within its perimeter. It solicited 29 organizations representing fishermen to join a
304 program devoted to preserving aquatic ecosystems. Fishermen were invited to share their
305 knowledge and concerns, and they can benefit from technical training and mutual learning
306 (Charter of the Park, 2014 p.33). In this setting, fishermen no longer enjoy any vantage role,
307 which deprives them of the ability to wield a tightly binding initiative constraint, and the
308 constrained problem is here replaced by the refined problem 'How to improve aquatic
309 ecosystem management and local fish stock preservation?' (Q4^{tp}). As a result, up to 12 km of
310 rivers have already been restored since 2012, under the leadership of the Park and thanks to the
311 voluntary commitment of fishermen. Scientific collaborations including the Park, AAPPMA
312 and biologists were also launched in 2019 as part of the ECOSERV INTERREG project.

313

314 **4. Discussion**

315 The above applications of constraints analysis offer retrospective insights into reasons why
316 some conservation projects were successful while others failed, or explaining why some
317 projects changed their objectives or approaches over time. Even though, in these cases, there
318 was no single CB who interacted with the DM, but rather a moving series of actors and
319 consultants (as is often the case), such retrospective insights are useful for CBs concerned to
320 bridge knowing-doing gaps, because they help understanding of the complexity of decision
321 processes in general. However, beyond such ex post analyses, the four steps constituting
322 constraints analysis can also be followed by CBs as a way to rationalize their interactions with
323 DMs as they unfold. Here we discuss the prospects and limits of constraints analysis, with this
324 idea of possible future performative applications in mind.

325

326 **4.1. Promises of constraints analysis**

327 Numerous tools have been recently introduced to improve conservation decision making by
328 acknowledging that social sciences are ‘a vital component, along with the natural sciences, for
329 effective conservation decision-making’ (Bennett et al. 2017). These tools can be classified as
330 (Bower et al. 2018): 1) tools that help selecting, comparing and cumulating decision criteria to
331 identify optimal decisions when the context is not plagued by problematic uncertainties; 2) tools
332 designed to address more uncertain contexts, such as Structured Decision Making (Gregory et
333 al., 2012) or other stepwise frameworks (Schwartz et al., 2018). Deliberative and participatory
334 processes and other devices of collective intelligence (Vercammen & Burgman, 2019) also
335 belong to this second category. Making cogent choices among these tools presupposes a clear
336 understanding of the problem addressed by the decision process. By unveiling major
337 discrepancies between proto-, constrained and refined problems in our three case-studies, our
338 results illustrate that this prerequisite is far from being trivial.

339 In this respect, our results echo the abundant literature emphasizing that framing a clear
340 and solvable problem is an essential step (Hoppe & Hisschemöller, 2001; Bower et al., 2018)
341 the importance and challenges of which are often underestimated (Gregory et al., 2012; Groves
342 & Game, 2016). Many prioritization schemes collapse at this stage (Game et al. 2013). The
343 complexity involved mainly stems from the importance of acceptability to the public (Rose et
344 al., 2018) and the institutional context (Ostrom, 1990; Engen & Hausner, 2018). Value or
345 decision trees, influence diagrams (Bower et al., 2018), and companion modelling (Barreteau
346 et al., 2003) are standard approaches to support problem definition. Constraints analysis is
347 complementary to these approaches, by clarifying the dimensions of the situation (actors,
348 institutions, rules and patterns of behaviour constituting the initiative, governance and
349 framework constraints) that should be analysed and taken into account when defining the
350 problem. Had the above approaches been implemented in our case studies, a prior constraints
351 analysis along the lines spelled out in Results would have facilitated their proceedings.

352 Cases where the governance constraint is binding are of particular interest in this
353 respect. In such cases, as illustrated in our lynx reintroduction case study, problem definition is
354 plagued by a form of complexity and uncertainty that stems from the diversity of points of view
355 represented in bodies and people constituting the governance body (possibly along with other
356 forms of uncertainty). Taking this uncertainty into account is pivotal to make relevant choices
357 of tools (Bower et al., 2018). This can be done through the use of processes and decision tools,
358 which will enable the DM and CB to ensure that they capture all the relevant points of view
359 when identifying the constrained problem and, eventually, when refining it. Depending on the
360 situation and, in particular, on conflicts that could emerge, deliberative/participative tools
361 designed to prevent minority tyranny (López-Bao et al., 2017), deliberative multi-criteria
362 analysis (Davies et al., 2013; Baynham-Herd et al., 2020; Redpath et al., 2004), Structured
363 Decision Making (Gregory et al., 2012), collaborative decision analytics (Mattsson et al., 2019)

364 can prove relevant. When using such deliberative/participative tools, constraints analysis can
365 provide guidance to check if the conditions for meaningful co-production (Turnhout & Van
366 Bommel, 2010; Turnhout et al., 2020) are fulfilled. Indeed, among the factors undermining
367 these conditions, power imbalances are problematic when they participate in skewing a binding
368 governance constraint. Analysing this constraint is hence instrumental to identifying power
369 imbalances and to determining how problematic they are. Similarly, depoliticization, another
370 phenomenon undermining co-production, can materialize as a skewed governance or
371 framework. By highlighting distortions in governance or framework, constraints analysis can
372 hence be instrumental in unveiling depoliticization. Because the arbitrariness and hidden value-
373 judgments that can stem from defective deliberative and participative processes are
374 acknowledged to be major problems plaguing conservation action (Game et al. 2013),
375 constraints analysis can thereby usefully contribute to improving conservation.

376 Clarifying constrained problems can also contribute to enhancing dialogues by
377 homogenising vocabulary (Wilhelm-Rechmann and Cowling 2011), as illustrated by the
378 construction of the common document of mutual commitment as an output of the ‘Lynx
379 parliament’. It can also help better identify or facilitate the expression of the DM’s needs and
380 expectations (Matzek et al. 2015; Toomey et al. 2017), as illustrated in the water quality case-
381 study. Constraints analysis also holds promise for strengthening two key aspects of
382 conservation actions: their legitimacy and their ambition.

383 The legitimacy of decisions is increasingly acknowledged to be key to effectiveness in
384 conservation (Yanco et al., 2019) and beyond (Meinard & Tsoukiàs, 2019). If decisions are not
385 legitimate, DMs will have difficulties finding resources to implement them and stakeholders
386 may refuse to comply with new rules, as witnessed in the first stages of the lynx case-study.
387 The analysis of decision processes through the path from proto- to constrained problem can be
388 instrumental in legitimizing conservation action. By understanding and addressing the right

389 constrained problem, CBs improve their ability to legitimize their actions by placing themselves
390 in a position to account for them and explain them transparently. The evolution of the Park's
391 approach and its perception by stakeholders in the lynx case study illustrate this legitimization
392 process.

393 Because constrained problems are often limited in scope and lack scientific interest,
394 clarifying them can also usefully highlight the need to address more ambitious (in the sense of
395 being scientifically challenging and having wide-range consequences) problems, and motivate
396 DMs, stakeholders and/or CBs to undertake specific actions and mobilise relevant tools to
397 mitigate constraints binding decision processes, so as to be able to address such problems. In
398 such attempts to upgrade the ambition of conservation actions, an important aspect to consider
399 is the extent to which they address systemic links within socio-ecosystems, since this is a
400 precondition to bring global ecological and socioeconomic benefits in the long run (Wilson et
401 al. 2016, Larrosa et al. 2019). This potential to upgrade the ambition of conservation initiatives
402 is illustrated by the recent initiative to strengthen ecological connectivity through information
403 sharing and technical cooperation, in our third case study.

404 By enabling the development of more ambitious conservation actions, constraints analysis
405 can hence play an important role in fulfilling the promise of conservation social sciences, not
406 only to improve conservation decision effectiveness (Bennett et al., 2017), but also to leverage
407 conservation transformative power through behavioural change (Bennett & Roth, 2019).
408 Striving to mitigate constraints in such attempts to strengthen conservation actions may be
409 costly and uncertain, and these costs should certainly be considered in a decision assessment
410 (Pannell & Gibson, 2016). But the status quo can also be costly, especially when public
411 engagement is pivotal.

412

413 **4.2. Scope and limits of constraints analysis**

414 The three case studies above concerned situations where a single constraint plays a conspicuous
415 role. Many situations will be more complicated, with two or more constraints acting
416 simultaneously. Besides, in some situations, the CB who provides decision support can herself
417 or himself be nested in another decision interaction where s/he is provided support by someone
418 else. Very complex nested structures can hence exist, and they call for much more sophisticated
419 analyses than those developed in the present case studies. Future studies exploring our
420 framework should be devoted to such complex situations.

421 The challenges involved in implementing constraints analysis as a performative tool
422 rather than as post hoc analytical tools should also not be underestimated, and call for dedicated
423 future studies. In any case, the application of constraints analysis depends largely on the ability
424 of CBs and DMs to observe and analyse initiative, governance, and framework constraints. It
425 also presupposes that they are not driven by arbitrary judgements and personal interests; our
426 reasoning abstracts from the obvious fact that real-life conservation biologists are not pure
427 representatives of sciences, but rather individuals, with their own interests, constraints, and
428 agendas. Constraints analysis engages researchers' intuition and creativity as well as their
429 analytical skills and allows them to play an active role throughout the process. Although some
430 clues have been given in this article to help diagnosis, our intention was not to delve into the
431 details of how constraints analysis can be deployed in all kind of situations, but to demonstrate
432 its usefulness at a general level. In particular, the last part of each of our case studies illustrates,
433 in broad outline, how CBs can strive to mitigate constraints to clarify and tackle a refined
434 problem that is more meaningful, from a conservation point of view, than the constrained
435 problem to which they are confined if they simply accept existing constraints.

436 However, mitigating constraints is a challenging task. In general terms, mitigating the
437 framework constraint involves questioning the validity of theories, protocols and methods
438 encapsulated in the framework, mitigating the governance constraint consists in questioning the
439 legitimacy of the members of the governance, and mitigating the initiative constraint means
440 questioning the importance granted to the requirement that the DM should see the decision as
441 its own. But beyond these very simple ideas, future studies are needed to clarify methods and
442 techniques to develop successful interventions to mitigate constraints in practice.

443 Based on the reasoning developed here, we claim that constraints analysis can contribute to
444 bridging knowing-doing gaps in conservation and to strengthening the legitimacy and ambition
445 of conservation actions. That said, we do not claim that constraints analysis alone will be
446 enough to solve all the problems associated with the current biodiversity crisis. New, more
447 efficient strategies to influence decision making and mobilise political support for conservation
448 (Johns, 2019) and broad cultural changes such as that promoted by Buscher & Fletcher (2019)
449 have an irreducible role to play.

450

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