

1 **Reply to Comment on ‘Promoting fluvial geomorphology to “live with**
2 **rivers” in the Anthropocene Era’ (García et al., 2021) by D. Rosgen (2021)**

3 J. Horacio García^{1,2}, Alfredo Ollero³, Askoa Ibisate⁴, Ian C. Fuller⁵, Russell G. Death⁵, Hervé
4 Piégay⁶

5 ¹ Department of Geography, University of Santiago de Compostela, Galicia, Spain

6 ² Laboratory of Environmental Technology (Institute of Technological Research), University of Santiago de Compostela, Galicia, Spain

7 ³ Department of Geography and Regional Planning, University of Zaragoza, Zaragoza, Spain

8 ⁴ Department of Geography, Prehistory and Archaeology, University of the Basque Country, UPV/EHU, Vitoria-Gasteiz, Spain

9 ⁵ Innovative River Solutions & Geosciences Group, School of Agriculture & Environment, Massey University, Palmerston North, New
10 Zealand

11 ⁶ CNRS UMR5600, Université de Lyon, Lyon, France

12 **Abstract**

13 In his comment on our recent article “Promoting fluvial geomorphology to ‘live with rivers’ in the
14 Anthropocene Era” (García et al., 2021), Dave Rosgen (2021) suggests that we make three
15 erroneous claims about him and his technical protocol Natural Channel Design (NCD). In this
16 reply, we contextualize and address his comments, analysing the repeated critiques in recent
17 decades of NCD. In doing so, we touch on issues such as scientific and technical knowledge,
18 the need to adapt to advances in science and techniques, the need to understand inherent gaps
19 present in technical protocols and what is and is not a classification tool, as well as the narrow
20 line between science and ethics.

21 **1. Context**

22 We thank Dave Rosgen for his comments on our paper that provides the opportunity to open
23 such an interesting and necessary debate. We would like to apologize if we caused any offence;
24 in no case did we want to make a “propagation of baseless claims”. We do not believe that this
25 was so, but we will try to clarify and justify our view in this reply to Rosgen's comments.

26 To put our reply in some context, and to clarify our position, note that the discussion and
27 conclusions of the article are based on (i) our own experience as professionals in fluvial
28 geomorphology, (ii) the diverse existing scientific literature, and (iii) 24 interviews with
29 specialists (researchers (i.e., biologists, ecologists, geomorphologists), engineers, river

30 managers, planners) from different countries. Therefore, the paper moves into a challenging
31 space and “it does feel somewhat stuck” in-between these three different modes. In other
32 words, it is not a conventional scientific contribution, it is a position paper. It is our opinion, we
33 did not mean our science but our experience or expertise, which is shared to provide a debate
34 within the community. In this way, the comments by Rosgen are welcome.

35 Note also the position paper is published in a scientific journal because two reviewers and an
36 Editor of the Journal considered these ideas worthy to be shared within this community. A
37 technical contribution, which does not per se or in essence provide scientific facts, can be also
38 published in a scientific journal.

39

40 **2. Response to the claims**

41 *2.1. The scientific knowledge*

42 Who produces scientific knowledge? How is this produced? These questions focus on the term
43 “non-specialist” employed to define Rosgen's figure. Such appellation is inspired from Lave
44 (2012b) (see Kirk (2017) for a quick reading), who present Rosgen as: “(...) a private producer
45 of commercialized science”, “(...) an individual ‘expert’ does not fit the typical profile of a
46 scientist”, or “(...) an inspiring figure in a self-made scientist who learned everything through
47 direct field work”. In addition, “Critics argue that Rosgen's knowledge claims have no scientific
48 basis, that he does not follow the norms of scientific practice, and that, far from restoring
49 streams, his approach instead does considerable environmental damage” (Lave, 2012b). These
50 descriptions and claims can be shared, or not, but we should justify this claim to enrich the
51 debate. Additionally, the term “non-specialist” was used by other colleagues, we just reported
52 these opinions, this was not intended as something pejorative.

53 Anyway, those questions were widely discussed in the work of Lave et al. (2010) or Lave
54 (2012b), so we do not consider it part of this reply. We only remarked on these two statements
55 for their relevance: (1) “The book argues that neoliberalism privileges certain types of scientific
56 knowledge production, application, and circulation, through an in depth look at the field of
57 stream restoration in the United States. The controversy in this field centers around a man,

58 Dave Rosgen” (Kirk, 2017). (2) “The rise of neoliberal science management regimes since
59 1980, particularly their insistence on the commercialization and privatization of knowledge, has
60 created a decisive and substantive shift in the organization and practice of science in the United
61 States” (Lave, 2012b).

62 *2.2. Trying to answer Rosgen's question: Why put such intense and extended effort into*
63 *repeated critiques rather than gathering data to resolve the core empirical questions about NCD*
64 *(i.e., does it work or not)¹*

65 We will try to give an answer below, but the solution depends mainly on Rosgen. Why is it
66 mainly up to Rosgen? First, because he is the author of NCD, and therefore has the power to
67 modify it, and second because with his claims as “propagation of baseless claims” or “attacks
68 on a method without scientific rigor does not help advance the science” (Rosgen, 2021), he is
69 assuming (i) he is the possessor of the truth, and (ii) that the critical papers of Rosgen (1994)
70 (Miller and Ritter (1996) or Simon et al. (2007), to cite two examples) are made without scientific
71 rigor. Is Rosgen using the criticisms of NCD to resolve the core empirical questions or improve
72 it?

73 Regarding our explanatory answer, we will try to make it as concise as possible. Remember
74 that this is the sum of our own experience + scientific literature + interviews with specialists.

75 *2.2.1. All technical protocols have gaps. NCD is a technical protocol*

76 Natural Channel Design (NCD) is a classification system for natural rivers in which a
77 morphological arrangement of stream characteristics is organized into relatively homogeneous
78 stream types (Rosgen, 1994). NCD is therefore a technical protocol to simplify reality, it is
79 based on subjective choices and expert knowledge and, as such, it is subject to a
80 transformation process that inherently produces gaps. Many classifications exist, not one, and
81 all have weaknesses because they are generalisations, they are not the “absolute truth”.
82 Usually, a classification is done to answer one question, not many. There is never one solution,
83 and all must be discussed carefully to evaluate pros and cons (Kondolf et al., 2016). Natural
84 channel design cannot be solved by any classification but by a good geomorphic diagnosis,

¹ Question posed by Lave (2012a, p. 374-375): “Why put such intense and extended effort into repeated critiques rather than gathering data to resolve the core empirical questions about NCD (i.e., does it work or not)?”

85 good knowledge of river responses in the natural context in which we operate, and a good
86 understanding of the social expectations within which such management practice is conducted.
87 It must also have in mind such expectations are not easy to appreciate or change through time.
88 In short, we need to understand the river system in its different components, physical (possibly),
89 biological, and even social.

90 *2.2.2. Living in the eye of the hurricane*

91 We can agree that this is a reality, regardless of why: Rosgen and his NCD system live in the
92 eye of the hurricane. In effect, as he said citing Lave's works, her contributions explain that "(...)
93 despite my (Rosgen's) relative lack of the traditional sources of scientific credentials —university
94 degrees in geomorphology, peer review publications, and university employment— I (Rosgen)
95 have become the most broadly acknowledged scientific expert in the field of stream restoration"
96 (Rosgen, 2021). Plus, we expect that decades of field experience studying streams, as in
97 Rosgen's case, is a potential added value to effectively exercise the art of river restoration.

98 That is one side of the coin, but there is also another. Take one fact as an example using his
99 most relevant scientific contribution (Rosgen, 1994), for which SCOPUS has registered 991
100 citations (as of June 4, 2021). A brief bibliometric analysis was done, highlighting an upward
101 trend in the number of citations from 1995 to 2020. We have analysed what explains this and
102 we have reached two conclusions: (i) the NCD domain in the production of stream restoration in
103 the US, successfully explained by Lave (2012b), and (ii) a strong critique to NCD tool of
104 numerous works (cf. Lave, 2012a). Taking some of the most critical papers on Rosgen (1994)
105 (Kondolf, 1995, 1998; Miller and Ritter, 1996; Doyle and Harbor, 2000; Juracek and Fitzpatrick,
106 2003; Smith and Prestegard, 2005; Simon et al., 2007; Roper et al., 2008), 492 works have
107 cited these articles, namely, ~50% of his citations come from criticisms of Rosgen (1994) (since
108 before the tool was normalised in practice (e.g., Sear, 1994) until today, therefore, it seems that
109 these are not criticisms derived from the commercial success of NCD). All this without taking
110 into consideration Rosgen (1996) (for example, Kondolf et al. (2001) only cites that reference)
111 or the cross relationships between Rosgen (1994) and Rosgen (1996), which could be
112 considered as a citation of the same work. Is Rosgen's contribution controversial or are all those
113 researchers wrong?

114 Of course, Rosgen (1994) is a well-cited paper published in a scientific journal, which was
115 considered of interest for a scientific audience by the editor and peer reviewers as relevant for
116 the audience. It does not mean it is science; it can be a technical innovation they considered as
117 being of interest for a scientific audience. Moreover, the reviewing process is managed by
118 humans with weaknesses we try to minimise as much as we can (the editors and reviewers may
119 not always have the capacity to evaluate the papers and may be wrong). For example, many
120 articles were published showing braided index evolution through time and concluding that there
121 were critical channel changes without considering that the braided index is discharge-
122 dependant. Many articles have also shown overlapping satellite images and concluded that
123 there was channel shifting even though it is not possible to say anything because we are in the
124 confidence intervals of the change due to the image resolution. Giving examples like these we
125 can see how unfortunately peer review sometimes failed. In fact, numerous scientific articles are
126 withdrawn each year.

127

128 *2.2.3. Science and techniques always advance and we must adapt*

129 Criticism is away forward that advances science. Many of these criticisms focus on the fact that
130 it is a rigid application. Several of us have used the NCD approach with different results and
131 issues, and this is not an attack, rather it is a well-founded critical evaluation, which is part of the
132 scientific process. For that, we are closer to the vision offered by Dufour and Piégay (2009)
133 about the role of reference reach in river restoration than to NCD application.

134 Science goes forward when we doubt and have a critical appraisal of what we are doing:
135 falsification is the bedrock of science (Popper, 1963, 2013), paradigms need to shift for science
136 to advance (Kuhn, 2012). The path is easier when cooperation prevails over competitiveness,
137 just as a critical gaze and humility must prevail over the extreme defense of a technique or a
138 protocol. However, it seems that Rosgen repeatedly defended his classification and perhaps did
139 not have a critical appraisal about it or how it can go further or be improved?

140 Perhaps to think in terms of being “the most broadly acknowledged scientific expert in the field
141 of stream restoration” (from Rosgen, 2021) does not help the reception, analysis, assessment,

142 and implementation of criticism. Reaching a success, in this case, the use of the NCD tool in
143 river restoration does not exempt it from errors and problems. The success of its
144 implementation, as R. Lave well explains, encompasses a much greater complexity that goes
145 beyond the scientific quality of the technical appraisal.

146 *2.3. Between science and ethics*

147 We are scientific if the new knowledge is providing good things for humanity. Certainly, this is
148 highly debated because, unfortunately, science does not only provide good things. But
149 scientists must have ethics. Can we make money with science? With technological
150 applications? It seems it is not so controversial in disciplines such as in Biology or Engineering
151 (especially if you are successful), but a bit more controversial if your protocol fails. Can we
152 make money and significantly alter rivers because some technical protocols have weaknesses
153 or are misapplied? This is a point considered by some of Rosgen's detractors.

154

155 **3. Final reflection: A scientific plea in a pandemic period**

156 The broad international consensus on the need to conserve our planet and its biodiversity could
157 be seriously affected by the COVID crisis, leading to an even greater environmental
158 deterioration than before the pandemic. Rivers and wetlands have been identified by experts as
159 the largest providers of ecosystem services. Caring for and restoring them is a sign of maturity
160 and responsibility towards future generations and also a smart and profitable strategy.
161 Consequently, we are at a critical moment to raise the value of rivers and the need to restore
162 them using large investments of public funds.

163 Scientific discussions like this are necessary, but it is of even more importance to reach
164 common points of agreement that allow science to contribute effectively to human well-being.
165 We finished our paper (García et al., 2021) by questioning if we can think of River Science as
166 an independent academic field. So, can we think of an interdisciplinary centre for river
167 restoration? Yes, we should! Yes, we can!

168 We thank Rosgen for his comment and engagement with our paper, and for this opportunity to
169 respond. We intend nothing personal!

170

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