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Reply to comment on "Promoting fluvial geomorphology to 'live with rivers' in the Anthropocene era" (García et al., 2021) by D. Rosgen (2021)

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ABSTRACT

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

1. Context

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

To put our reply in some context, and to clarify our position, note that the discussion and conclusions of the article are based on (i) our own experience as professionals in fluvial geomorphology, (ii) the diverse existing scientific literature, and (iii) 24 interviews with specialists (researchers (i.e., biologists, ecologists, geomorphologists), engineers, river managers, planners) from different countries. Therefore, the paper moves into a challenging space and "it does feel somewhat stuck" in-between these three different modes. In other words, it is not a conventional scientific contribution, it is a position paper. It is our opinion, we did not mean our science but our experience or expertise, which is shared to provide a debate within the community. In this way, the comments by Rosgen are welcome.

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

2. Response to the claims

2.1. The scientific knowledge

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

Anyway, those questions were widely discussed in the work of Lave et al. (2010) or Lave (2012b), so we do not consider it part of this reply. We only remarked on these two statements for their relevance: (1) "The

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book argues that neoliberalism privileges certain types of scientific knowledge production, application, and circulation, through an in-depth look at the field of stream restoration in the United States. The controversy in this field centers around a man, Dave Rosgen" (Kirk, 2017). (2) "The rise of neoliberal science management regimes since 1980, particularly their insistence on the commercialization and privatization of knowledge, has created a decisive and substantive shift in the organization and practice of science in the United States" (Lave, 2012b).

2.2. Trying to answer Rosgen's question: 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)[1]

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

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

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

Natural Channel Design (NCD) is a classification system for natural rivers in which a morphological arrangement of stream characteristics is organized into relatively homogeneous stream types (Rosgen, 1994). NCD is therefore a technical protocol to simplify reality, it is based on subjective choices and expert knowledge and, as such, it is subject to a transformation process that inherently produces gaps. Many classifications exist, not one, and all have weaknesses because they are generalisations, they are not the "absolute truth". Usually, a classification is done to answer one question, not many. There is never one solution, and all must be discussed carefully to evaluate pros and cons (Kondolf et al., 2016). Natural channel design cannot be solved by any classification but by a good geomorphic diagnosis, good knowledge of river responses in the natural context in which we operate, and a good understanding of the social expectations within which such management practice is conducted. It must also have in mind such expectations are not easy to appreciate or change through time. In short, we need to understand the river system in its different components, physical (possibly), biological, and even social.

2.2.2. Living in the eye of the hurricane

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

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

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

2.2.3. Science and techniques always advance and we must adapt

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

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

Perhaps to think in terms of being "the most broadly acknowledged scientific expert in the field of stream restoration" (from Rosgen, 2021) does not help the reception, analysis, assessment, and implementation of criticism. Reaching a success, in this case, the use of the NCD tool in river restoration does not exempt it from errors and problems. The success of its implementation, as R. Lave well explains, encompasses a much greater complexity that goes beyond the scientific quality of the technical appraisal.

2.3. Between science and ethics

We are scientific if the new knowledge is providing good things for humanity. Certainly, this is highly debated because, unfortunately, science does not only provide good things. But scientists must have ethics. Can we make money with science? With technological applications? It

[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)?"

seems it is not so controversial in disciplines such as in Biology or Engineering (especially if you are successful), but a bit more controversial if your protocol fails. Can we make money and significantly alter rivers because some technical protocols have weaknesses or are misapplied? This is a point considered by some of Rosgen's detractors.

3. Final thoughts: a scientific plea in a pandemic period

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

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

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

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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