The co-construction of environmental (instream) flows and associated cultural ecosystem services

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Introduction

Management of water resources of major river basins, particularly of transboundary rivers (multi-state or multi-nation), is complex and has been the subject of much scholarship (Robinson et al. 2011; Bruns et al. 2005; Garrick 2015; Garrick et al. 2014; Bark et al. 2014). Issues surrounding institutional fragmentation, political contestation, scalar factors and challenges for collaboration are prominent in the literature on water governance and integrated water resource management. An emergent theme in the research is the importance of social, economic and especially cultural values associated with river systems and the development of frameworks that treat rivers and river management actions as part of a social, ecological and political system (Bark et al. accepted; Butler et al. 2013; Folke 2006; Jackson and Barber 2013; Lebel et al. 2013). Yet, in the growing number of studies concentrating on water governance, too little attention is given to the critical role of culture and cultural processes that are generated by interactions between humans and their environment and influenced by the dynamics of social experiences and interactions (Johnston et al. 2012).

Human cultures have developed around water and in their numerous religious systems and diverse poetic and musical forms they have a capacity to revere rivers and celebrate symbols or rituals relating to water (Palmer 2015; Strang 1997). Social science has long been interested in interpreting the ways in which 'natural' land and waterscapes are socially-constructed and invested with symbolic meaning. This work has been used to consider the social processes by which cultural landscape meanings are created and transmitted, to understand the profound differences in the ways that cultural groups define or construe the natural environment and the role these differences play in the cultural politics of natural resource management (e.g. Head 2000; Strang 1997; Jackson 2006). For example, at local levels in some countries, Indigenous cosmologies and environmental philosophies have endured colonial encounters and social science has shown the continuing impact of settler landscape ideologies on Indigenous rights and relationships with land/waterscapes (Jackson and Barber 2013; Robinson in press). The multiple connections that social groups maintain with rivers represent particularly tight bonds between local social and environmental interactions because of water’s essential role in sustaining human civilisations, indeed in many cultures, the source of life itself is attributed to water (Klaver 2012).
Human–society relations with rivers are also evident and mediated through the formal and informal institutions established to make human decisions about how water is managed, used and shared. There are many ways in which modes of resource governance are influenced by cultural processes beyond the foundational role of religious belief and ontologies. Learned patterns of behaviour shape not only water access and use, but also the local design of institutions, such as, property relations, water sharing rules and payment for ecosystem services. Rather than being an objective neutral process, economic valuation ‘efforts to create the “right prices” for environmental assets entails political choices about which classes of people, in which geographic locations, will have access to natural resources and their benefits now and in the future’ (McAfee and Shapiro 2010, p.595; see also Robertson 2004). Formal and informal (laws, norms, etc.) institutions that seek to internalise environmental impacts mediate human–water interactions and resource relations in a given context and locality and at particular moments in time. For decades, idealised design principles that ignore culture and cultural processes have been applied to water policy and management (Gupta et al.; Margerum and Robinson 2014) affecting the extent to which they cater for the needs of local communities with diverse and rich connections to rivers and water as well as their own ways of valuing and governing water (Jackson and Altman 2009).

The ecosystem services framework, which is currently so popular, represents a promising option for tackling the challenge of bringing social and cultural processes to the fore in water management and governance (Jackson and Palmer, 2015; Bark et al. 2015). The concept of ecosystem services describes the direct and indirect contributions of ecosystems to human wellbeing (e.g. MEA 2005). Cultural dimensions of ecosystems and the services they offer humans have become an important subset of this effort (e.g. Bark et al. 2015; Poe et al. 2014; Robinson et al. in review; Stevens 2014). The cultural services offered by ecosystems has been defined to include ‘non-material benefits,’ such as ‘cultural diversity, spiritual and religious values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values, recreation and ecotourism’ (MEA 2005). Accordingly, policy agendas have attempted to acknowledge the cultural and social benefits that environments provide and social scientists have considered a typology of cultural ecosystem services (Chan et al. 2012), how they can be mapped (Pert et al. 2015) and valued (Rolfe and Windle 2006; Zander et al. 2010), used to design and evaluate Indigenous payment for ecosystem service agreements (Robinson et al. in review), operationalised into water management practice (Bark et al. 2014) and to inform international standards for linking different types of knowledge to assess the state of the planet’s biodiversity (Díaz et al. 2014).

A new goal emerging in the water planning literature is to expand understandings and applications of cultural ecosystem services including attention to the implications that human–environment relationships are active, dynamic and often interdependent. Jackson and Palmer (2015) make a compelling argument for drawing on Indigenous practices and ethics of environmental care to provide a more holistic approach to payment for ecosystem services (PES). They argue that people *create* cultural ecosystem services through their care and action, that is, that nature is socialised and through the processes of socialising, people co-produce ecosystems services. This analysis, based on an Indigenous PES, questions an unsocialised nature as supposed in the cascade of ecosystem services where ecosystems and the ecosystem services that they provision supply human needs (Haines-Young and
Potschin 2010). McAfee and Shapiro (2010) show how the ecosystem services paradigm separates nature and society (or culture) and then reconnects these two categories of Western thought. As a consequence, the conventional ecosystem services framework reductively constructs ‘nature’ as the sole provider of services so that it can be encompassed within ‘economy.’

In this chapter we argue that a fuller understanding of nature–society interrelationships and localised modes of resource governance is required to advance all major areas of integrated water resource management: from the assessment and amelioration of impacts of water infrastructure developments on local livelihoods and ways of life, to the design of allocation or water distribution/allocation mechanisms, regulations and incentives for aquatic conservation, public or citizen participation in catchment-scale governance institutions and in the effective restoration of degraded aquatic ecosystems. Specifically, we add to this innovative area of scholarship by tracing the expression of cultural ecosystem services over the life cycle of a restoration event in the Colorado River delta, the spring 2014 pulse flow. The pulse flow of 2014 was a negotiated restoration flow released down the unusually dry river bed south of the border between the US and Mexico: it was released in spring to recreate a snow-melt flood pulse of water timed to prepare (removing salts and stirring up) the river bed and banks for spring germination.

This restoration flow was released in accordance with Minute 319 (Minute 319 2012)¹ to the 1944 Treaty governing water allocations between the US and Mexico. The significance of this restoration event is that it was the first international transboundary restoration event in the basin. The river had not reached the sea since 1998 during a particularly wet year in the basin. The contrast between such unplanned flows and the pulse flow is that the pulse flow was the outcome of bilateral negotiation and it incorporated a monitoring protocol tasked to a binational team of biophysical scientists. Furthermore, the planned nature of the restoration flows also made it an event suitable for study. Just as ecologists were interested in the ecological response to a water release, we were keen to observe and reflect on the social agency manifest in this pulse event and the human community responses to it. We find that the pulse flow represents an interesting case study of the rich and understudied interrelationships between people and ecosystem services.

Our chapter builds on previous work that has tracked the ebb and flow of cultural ecosystem services as the environmental flow moved down the river and reached the sea (Bark et al. accepted) and efforts to reconceptualise ecosystem service frameworks to recognise the interconnections between human–environment relationships and care (Díaz et al. 2015; Jackson and Palmer 2015; Robinson et al. in review). The breakthrough comes from seeing nature as socially-constructed and thus conceiving of cultural ecosystem services as generated or produced through human action, cognition and affect (see Jackson and Palmer 2015). We apply this reconceptualisation to reveal the dynamics of human care and concern generated over the life cycle of the pulse flow event. We find that revelation of nature–society interrelationships were: (1) amplified over the course of the flow period; (2) that the event itself gave

¹ A Minute is the name giving to an amendment to the 1944 Treaty (1944 Treaty relating to the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande) that does not require full Congressional approval. As such, Minutes provide a more flexible and timely approach to modify Treaty arrangements.
expression to a new vision or paradigm for negotiating and delivering the passage of amendments to treaty law between the US and Mexico that was reinvigorated when restoration water crossed international and state borders and pulsed past receiving communities; and (3) resulted in further post-event reflection on the social dimensions of environmental/instream flows and future management of water resources in the basin to attain them.

Case study background

The Colorado River Basin is a transboundary river basin comprising four Upper Basin States (Wyoming, Utah, Colorado, New Mexico) and three Lower Basin States (Nevada, Arizona, California) in the US and two states (Baja California, Sonora) in Mexico. As the downstream nation the delta ecosystem is entirely within Mexico. Water resources in the basin are highly regulated and allocation of water resources between the nations and the states is governed by a collection of treaties and rules, known as the ‘law of the river’ (see Bark et al. 2014). A consequence of over-allocation and the absence of water entitlements for the environment is that regular flows to the Gulf of California (which is in Mexico) ceased in 1960, as the upstream Lake Powell reservoir filled. Delta landscapes either dried out or were converted to irrigated agriculture. The last time that the Colorado River had reached the sea was in 1998, when upstream reservoirs were full and excess snowmelt was released to protected upstream dams and had nowhere else to go but into its dry riverbed in Mexico and out to sea.

Subsequent to a decade-long drought in the basin (2000 to ongoing), 2014 was an inauspicious year for the first environmental flow to the delta. The drought has been dramatically portrayed with photographs of the white bathtub ring around Lake Mead, one of two main reservoirs in the basin, formed behind Hoover Dam. The low level of the reservoir, which has exposed the usually flooded sides of the lake, should not be alarming in and of itself as a reservoir’s function is to improve water supply reliability (Moy et al. 1986) which is imperative in a basin with inter-annual supply variability; however, the over-allocation of the river’s resources combined with little near-term prospect of filling the reservoir and growing demand, is a concern for water managers and communities reliant on water. A pulse flow, as per Minute 319, was set for spring sometime before 2017: the first environmental flow to cross the international boundary was released from Morelos Dam, a diversion dam that straddles the US-Mexico border, on March 23, 2014. During the next eight weeks, 130 million cubic metres (130 gigalitres; 105,000 acre-feet) flowed downstream in a managed experiment to water ecological restoration sites along the path of the once free-flowing Colorado River and to flush salts from the delta. Subsequent to the pulse flow, an additional 65 million cubic metres will be delivered to river reaches and restoration sites up until the end of 2017 (Flessa et al. 2013). The goals of the pulse flow and base flows are to restore managed ecological sites, not the whole Delta ecosystem, and there was no explicit goal for the pulse flow to reach the sea. Groundwater levels at the restoration sites are sufficiently high to ensure that restored vegetation has a greater chance of survival. Bilateral monitoring will incorporate water quality, vegetation, wildlife and groundwater level measurements.

Method

The pulse flow was the focus of local, national and international attention, celebration and commentary and we drew on media articles and blogs to uncover particular nature–society interrelationships associated with the Minute 319 pulse flow (see Bark et al. accepted). Specifically, we collected media
reports on the pulse flow between December 30, 2013 and June 14, 2014 using a daily Google News Alert using the search terms ‘pulse flow’, ‘Colorado River Delta’, ‘Colorado River’ and ‘Minute 319’. The coverage period included time before and after the pulse flow. We acknowledge that while in-person surveys provide immediate, intimate reflections, the need to apply a pragmatic cost-effective approach guided our choice to rely on media articles and blogs (cf. McKellar et al. 2015). Analysis of 25 in-person interviews undertaken on March 27, 2014 – coincident with an official binational ceremony – can be found in Bark et al. (accepted). For this book chapter the dataset consists of 153 English language articles, opinion pieces and blogs.

To effectively manage the large number of individual articles and to address challenges about the rigour and credibility of social science research we coded all the articles using content analysis software. Qualitative analysis tools like NVivo 10 or dedoose are often used to transform social data for analysis. Content analysis can reveal themes in data; however, ex ante consideration on how and what to code is necessary. There are two main approaches to coding, grounded theory and frameworks. Grounded theory is a systematic approach to coding that is flexible to the data and themes that emerge (Strauss and Corbin, 1990; Charmaz, 2006). Using a framework is also a systematic approach to coding but it is inflexible and requires application of an appropriate framework.

For this research we used the framework approach, specifically adopting the cultural ecosystem services framework of Chan et al. (2012) which classifies cultural ecosystem services into twelve types: Activity, Aesthetic, Employment, Existence/bequest, Identity, Inspiration, Knowledge, Material, Option, Place/heritage, Social capital & cohesion, and Spiritual. We added a thirteenth coding option, Aspiration, as suggested by Bark et al. (2014). Each article was read and text was either left uncoded or coded for one or more cultural ecosystem service(s).

To further develop the explanatory power of the coding exercise we also coded each article by its date: this date was then cross-referenced with the temporal phase of the pulse flow, that is Pre, Start, Peak, Connect(ion to the sea) and Post. In this way each article was coded by a pulse flow phase and by the incidence of cultural ecosystem service(s) codes. Given the small number of codes for the cultural ecosystem service, Material, we exclude it from this chapter.

The coded dataset enables us to test two hypotheses, H1 and H2, based on Johnston et al. (2012) where \( H_0 \) is the null hypothesis and \( H_1 \) is the alternative hypothesis. The outcome of hypothesis testing is that the evidence will either lead us to: 1) reject \( H_0 \) and accept \( H_1 \) because of sufficient evidence to support \( H_1 \); or 2) not reject \( H_0 \) because of insufficient evidence to support \( H_1 \). The two hypotheses we test are shown below. Note that we are essentially testing whether the evidence supports \( H_1 \).

\[
H_0 = \text{cultural processes are not stimulated or generated by interactions between humans and their environment. That is there is no sequencing of, or progression in, the presentation of cultural ecosystem services in the data/media reports.}
\]

\[
H_1 = \text{cultural processes are stimulated or generated by interactions between humans and their environment. That is, there is sequencing of, or}
\]

\[
[H1]
\]
progression in, the presentation of cultural ecosystem services in the data/media reports.

\[ H_0 \text{ = cultural processes are not influenced by the social experiences and interactions triggered by the pulse flow. That is, the distribution of cultural ecosystem services is constant over the course of the flow.} \]
\[ H_1 \text{ = cultural processes are influenced by the social experiences and interactions triggered by the pulse flow. That is, cultural ecosystem services intensify during the pulse flow.} \]

**Results**

First we provide an example of each code type from the transcripted media reports. **Activity**: “The pulse flow was made possible by a 2012 amendment to a 70-year old treaty between the United States and Mexico”. **Aesthetic**: “a once-lush area that has gone dry in recent decades with diversion of water upstream”. **Aspiration**: “Now we are taking a major step to right the wrong that has been done to the Colorado River Delta”. **Employment**: “This is a farm that’s essentially in the riverbed, pumping groundwater. You see this type of farming on both sides of this stretch of the river”. **Existence/bequest**: “For me, some of the most powerful experience have come from visiting the same location twice – before the river got there, and then again after its arrival”. **Identity**: “Happy to have the river back?...Of course, amigo...It’s our name!”. **Inspiration**: “To be involved with something on this geographic magnitude is really quite remarkable”. **Knowledge**: “Research teams from agencies, universities and environmental groups from both the United States and Mexico will monitor the effects of this pulse, analysing the area before the flood, immediately following it and into the future”. **Material**: “The river’s freshwater estuary once nourished the sea for dozens of miles, creating an especially rich breeding zone”. **Option**: “It’s hard not to think of the lost potential of an ecosystem that once thrived”. **Place/heritage**: “All this a long time ago was the river”. **Social capital & cohesion**: “I think I underestimated the social impact...This is aligning more than just river channels”. **Spiritual**: “Just below the dam, at least, the river truly looked reborn” “I try to keep myself open to the spiritual aspect of this work, instead of making it all about salinity and hydrology”.

The coding exercise provides count data for each cultural ecosystem service by pulse flow phase, see Table 1. It can be seen that the dominant cultural ecosystem services we coded for is **Activity**. **Activity** codes included negotiation, cooperation, celebration and implementing the pulse flow. The second most coded category was **Aspiration** which coded language around the outcomes of the pulse flow, the meaning of the pulse flow and the opportunities to have one more (or many more) pulse flow(s). The least coded category was **Option** where we coded mention of charitable donations made by the general public to support ongoing restoration flows even when they are unlikely to ever visit the Delta, that is, option value. In terms of pulse flow phase, **Connect**, when the river and sea connected, had the most codes, followed by **Peak**, the peak water release of the pulse flow and **Pre pulse flow**, that is, those stories written before the pulse flow event. The initiation of the pulse flow release, **Start**, was the least coded time phase.

**Table 1 Cultural ecosystem services by pulse flow phase, count data**
<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Start</th>
<th>Peak</th>
<th>Connect</th>
<th>Post</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>78</td>
<td>54</td>
<td>73</td>
<td>74</td>
<td>61</td>
<td>340</td>
</tr>
<tr>
<td>Aesthetic</td>
<td>31</td>
<td>13</td>
<td>12</td>
<td>18</td>
<td>12</td>
<td>86</td>
</tr>
<tr>
<td>Aspiration</td>
<td>85</td>
<td>22</td>
<td>47</td>
<td>66</td>
<td>36</td>
<td>256</td>
</tr>
<tr>
<td>Employment</td>
<td>15</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>6</td>
<td>48</td>
</tr>
<tr>
<td>Existence / bequest</td>
<td>7</td>
<td>3</td>
<td>21</td>
<td>40</td>
<td>20</td>
<td>91</td>
</tr>
<tr>
<td>Identity</td>
<td>12</td>
<td>14</td>
<td>50</td>
<td>53</td>
<td>25</td>
<td>154</td>
</tr>
<tr>
<td>Inspiration</td>
<td>25</td>
<td>10</td>
<td>35</td>
<td>64</td>
<td>25</td>
<td>159</td>
</tr>
<tr>
<td>Knowledge</td>
<td>63</td>
<td>19</td>
<td>41</td>
<td>50</td>
<td>25</td>
<td>198</td>
</tr>
<tr>
<td>Option</td>
<td>12</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>33</td>
</tr>
<tr>
<td>Place / heritage</td>
<td>13</td>
<td>14</td>
<td>22</td>
<td>39</td>
<td>17</td>
<td>105</td>
</tr>
<tr>
<td>Social capital &amp; cohesion</td>
<td>4</td>
<td>9</td>
<td>20</td>
<td>13</td>
<td>6</td>
<td>52</td>
</tr>
<tr>
<td>Spiritual</td>
<td>6</td>
<td>5</td>
<td>25</td>
<td>22</td>
<td>10</td>
<td>68</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>351</td>
<td>173</td>
<td>362</td>
<td>454</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Column total=total for each pulse flow phase. Row total=total for each cultural ecosystem category*

Figures 1 and 2 display the information in Table 1 in two different ways that enable us to visually test our two hypotheses. Figure 1 shows the data with the cultural ecosystem services ordered not alphabetically as in Table 1 but ordered by frequency in the Pre pulse flow phase, i.e. the most coded cultural ecosystem service in this phase is Activity and the least is Social capital & cohesion. This allows us to test H1.
Figure 1 allows us to reject $H_0$ and accept $H_1$, i.e. cultural processes are stimulated or generated by interactions between humans and their environment. That is, there is sequencing of, or progression in, the presentation of cultural ecosystem services in the data/media reports. In the Pre phase a focus around typical outcomes to stimulate Action, i.e. negotiation and collaboration and efforts of care highlight Knowledge that both underpinned the pulse flow and Knowledge that could be gained. Simultaneously, notions of Aspiration and Option value drove efforts by a dedicated group of conservation NGOs to envision a new paradigm in water sharing between the consumptive uses of water resources and setting aside water for nature. This was not a passive relationship but one of action, of envisioning, or daring to change the status quo. In the Peak phase Identity, Social capital & cohesion were reflected and in the symbolic Connect phase, when the river joined the sea for one of the few times since the 1960s and the first time in 16 years, Existence/bequest and Inspiration were expressed as were strong representations of Identity and Place/heritage as the river returned to its full function as a river and people rejoiced, some identifying a spiritual significance to this final moment in the sequence of events.

Figure 2 displays codes for each phase as a proportion of total codes for each cultural ecosystem service, for instance, coding for Activity in the Peak phase represents 21% or 0.21 of the total codes for Activity, i.e. 73/340=0.21. This allows us to test $H_2$.

![Figure 2 Proportion of each cultural ecosystem service by pulse flow phase and ordered alphabetically](image)

Note: any bar above/below 0.20 is over-/underrepresented by pulse flow phase.

Figure 2 allows us to reject $H_0$ and partially accept $H_1$, i.e. cultural processes are influenced by the social experiences and interactions triggered by the pulse flow. That is, cultural ecosystem services intensify
during the pulse flow. We say partially accept as Figure 2 does not show a build-up in all cultural ecosystem services with flow. Rather it shows a build-up of place-based, social and inspiration type cultural ecosystem services that may be related to the excitement generated by the event – a demonstration of the immediate effect of the restoration flow, i.e. interaction with the pulse flow and with others experiencing the pulse flow.

Discussion
Our goal in this research was to generate data to show the interwoven, sociocultural basis of ecosystem service construction that is conventionally neglected by the cultural ecosystem services approach. Humans are not just encountering nature but radically altering environments, both consciously and inadvertently, and in doing so are creating new value from the social occasion of planning, witnessing and interpreting a flow event. Prior to the pulse flow the Colorado River became the focus of human aspiration, debate as well as fear that it was poorly timed during a drought. The data shows that when it actually flowed people rejoiced, remembered, celebrated, bathed, affirmed their connections, and dreamed. Social and ecological relationships intersected and interacted to prepare and respond to the river being given the water to again flow into the sea, building on the excitement of the moment and, in doing so, people and the river generated more intense and diverse values. The aspiration to revitalise a river was grounded in ideals around ecological conservation and fairness and perhaps surprisingly it was only appreciated when water flowed, that another dimension was evident, namely the human dimension. The return of the river’s flow enhanced interaction with the river and with each other as those involved in the negotiation of the pulse flow, commentators, journalists and locals, were struck with awe, jubilation and hope. The dataset generated from media articles and blogs provided a means to view this interaction and co-production of value; we see that coding for cultural ecosystem services works and we see how cultural ecosystem services change in nature/type and intensity. Furthermore, the coding by time or pulse flow phase facilitated the testing of hypotheses about the dynamic and social constructed nature of cultural ecosystem services and of broader themes such as interdependence, sequencing, engagement and reflection.

The results are suggestive that restoration as an event is a good case study to test concepts of generation and dynamics in cultural ecosystem services, as per Johnston et al. (2012). We did this by testing two hypotheses. The data suggests that cultural process are generated by interactions between humans and their environment and that is there is sequencing of, or progression in, the presentation of types of cultural ecosystem services, and that cultural processes are influenced by the dynamics of social experiences and interactions triggered by a flow event. Akin to Urquhart and Acott’s (2014, p. 15) contention that fishing practice in Cornwall puts in motion events that manifest sense of place and identity on land, the pulse flow restoration event precipitated changes in the riverscape that in turn co-construct identities and cultural ecosystem services (or values) such as place attachment. The data is also supportive of Jackson and Palmer’s (2015) reasoning about the interconnections between human–environment relationships and care. There is clear evidence of the effect of a reborn river on the co-produced cultural ecosystem services expressed in media reports. The Colorado River is a socialised river – nations, locals and commentators around the world engaged with different phases of the flow – and this engagement peaked when the flow peaked and then again when it connected to the sea. The
results suggest that human aspiration and action were determinative for the delta environment and that these actions and aspirations in turn prompted a suite of other human–environment relationships and interpretations of the event. Aspirations for future management of this river were embedded in narratives that were revealed through the media analysis.

This final reflection phase wraps back around to the role of human care and action needed for the next pulse flow. The (first) transboundary flow in 2014 was shepherded through bilateral negotiations by a determined group of NGOs whose aspirational goals were to renew a river. They were supported by scientists and scientific information that showed that the delta ecosystem was not dead, but rather dormant, and that it had responded in the past to previous floods or excess flows (Glenn et al. 2007; Glenn et al. 2013). The connection of the river and sea, though not an ecological goal of the pulse flow, was not only symbolic of the river reaching its final destination but it was reflected in media coverage as symbolic of a new paradigm in people’s relationships with the river that would necessarily release a community consensus and perhaps the political will to change future management of the river along its entire journey.

The method used, namely content analysis, is reproducible and rigorous. Our sampling of media articles was transparent, however, the approach relied on the pulse flow being a big media event. The short time horizon of the pulse flow might also have contributed to ongoing media interest. Thus the replicability of this method relies on other restoration case studies being newsworthy and with a discrete start and end date. Furthermore, our analysis would be enriched with inclusion of Spanish language media. We noted that we excluded Material cultural ecosystem services from our analysis (e.g. mention of irrigation output or commercial fishing). It was not included as it was rarely mentioned in our dataset. This might be because the volume of water in the environmental flow was deemed so small that its effects would be negligible on irrigation output, or because the trade-off with irrigation output was implicit and therefore not mentioned, or that the water delivered was viewed as having a zero opportunity cost (see, Bark et al. 2014). Whatever the explanation, the low profile of what can be a contentious trade-off may have helped in the illumination of what we contend is a socially-constructed riverscape and delta.

Conclusions
The pulse flow restored and strengthened shifting and dynamic cultural ecosystem services. The research highlights the interactive and dynamic nature of cultural ecosystem services as communities, NGOs and scientists built knowledge, negotiated the pulse flow release, engaged in political coalitions and built the consensus need to realise this huge restoration event, revealing an active relationship with nature and with a suite of subsequent cultural ecosystem services. This analysis points to the limitations of considering nature as a ‘service provider’ and of ignoring the diverse and important ways in which humans contribute to what are in fact socio-ecological processes and functions. We note the critical contribution social scientists have brought to the thinking around the ecosystem service framework that is so influential in global environmental management (e.g. Dempsey and Roberston 2012; Kosoy and Corbera 2010). This includes the growing concern that the ecosystem service framework considers humans detached and insulated from ecosystem processes, which, as Armsworth et al. (2007, p. 1384) note, is both outdated and dangerous.
Social scientists have offered pragmatic approaches to improve the thinking and application surrounding ecosystem services that pays appropriate attention to the active, reflexive human–environment relationships that ‘service’ each other. The example of the pulse flow in the Colorado River highlights the nuances involved in this interactive and reflexive relationship. By reviving, returning, reformulating and re-enchanting these services, the restoration event highlights the immediacy of this interconnected relationship, one that was, in this case, dormant awaiting restoration. It also acts as a reminder or challenge for scientists, researchers and policymakers to look for and value these kinds of relationships in other contexts as they explore ecosystem services.

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