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Taking cultural landscapes into account: implications for scaling up ecological restoration

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Abstract

Conceptual frameworks for landscape restoration commonly take an approach focused on ecological (biotic and abiotic) aspects. Yet the recent initiatives demanding that restoration be scaled up to restore millions of hectares of degraded land often encounter socio-cultural challenges too, such as competing land-use interests and low stakeholder engagement. Thus, consideration also needs to be given to cultural landscapes, broadly defined as regions that reflect the long-term interactions between people and the environment. Based on a literature survey we here identify and then discuss features from cultural landscapes-ecological restoration research, which can be relevant to ecological restoration upscaling. Overall, research encompassing cultural landscapes is revealed as less narrowly-focused than that on landscape ecology linked with ecological restoration: our selected studies quite frequently considered social and landscape aspects in addition to ecological aspects. Geographically, research is strongly biased towards Europe and North America, although the most ambitious restoration targets are in the tropics. Taking cultural landscapes into account could enhance restoration by (1) moving towards a transdisciplinary approach thereby offsetting the overemphasis on ecological aspects, and (2) mitigating issues of land use and stakeholder engagement. Further research, paying special attention to the tropics, should aim at integrative approaches that would contribute to scaling up restoration, not only in single large-scale projects but also through the sum of small but concerted actions.

Keywords

historical land use; landscape approach; landscape restoration; review; stakeholder participation; traditional practices

1. Introduction

Following numerous global calls for restoration of vast areas launched for 2020, such as Aichi targets, Bonn Challenge, REDD+, etc. (Aronson and Alexander, 2013) and an initiative led by El Salvador, the UN declared 2021-2030 the Decade of Ecosystem Restoration (United Nations, 2019). The restoration of such extensive areas (restoration upscaling) will no doubt involve varied socioecological contexts and multiple stakeholders. This means that assessing completed restoration actions so goals can be compared with achievements (Ruiz-Jaen et al., 2005; Wortley et al., 2013) is no longer sufficient: landscape-scale restoration must also be implemented. Landscape-scale restoration, or simply landscape restoration, encompasses various ecosystem mosaics involving diverse land uses and normally at high spatial scales (e.g., watersheds). Restoration at this scale needs to go beyond “assisting the recovery of *an ecosystem* that has been degraded, damaged, or destroyed” as proposed in the definition of ecological restoration (SER, 2004). While it has been long recognized that the sustainability of small-scale projects depends on taking their surroundings, i.e. the landscape context, into account (Naveh, 1994), most large-scale restoration initiatives have sought to restore large contiguous areas of the same ecosystem, mainly forests (e.g., Cao, 2011; Rodrigues et al., 2011). Often, however, such large-scale contiguous restoration is not feasible, for instance in landscapes characterized by numerous small to medium-sized properties with discontinuous degraded areas to be restored (Powlen and Jones, 2019). Moreover, restoration at a single site to deal with local factors often reveals important higher-scale factors that need to be addressed (Leite et al., 2013). In some regions, restoration upscaling could only be achieved through a number of small-scale initiatives, ideally involving exchanging positive feedback and integrated into a favorable landscape context.

Achieving landscape restoration appears to depend on at least three factors. First, effective landscape restoration requires a better understanding of two types of landscape interrelationship: the links first between social, cultural and economic factors, and second between habitat mosaics and the flow of ecosystem services (Ockendon et al., 2018). This points to a need for a transdisciplinary approach (Jellinek et al., 2019). Second, conceptual frameworks for landscape restoration commonly focus on ecological aspects and overlook historical factors and references, both ecological and cultural (Aronson et al., 2017). This suggests that the overly ecological slant needs to be redressed. Finally, landscape restoration faces considerable

challenges, such as competing interests regarding land use, unstable political contexts and low stakeholder engagement (Holl, 2017; Latawiec et al., 2015). Each of these three factors has a strong social component that should be addressed. However, landscapes vary in the degree of social influence required for their creation and maintenance. Farina (2000) approaches this through interrelationships between what he calls natural, cultural (social included) and economic capitals, the three main drivers in landscapes. Thus, landscapes driven by *cultural capital* (i.e. long-term sociocultural mechanisms), or cultural landscapes, differ from landscapes that mainly result from economic capital influences (Farina, 2010, p. 123).

The literature adopts different terms for the cultural capital in landscapes and restoration, such as cultural ecosystems (Evans and Davis, 2018), cultural practices (Wehi and Lord, 2017), cultural ecosystem services (Plieninger et al., 2015), socio-ecological systems (Swart et al., 2018) and social-ecological restoration (Fernández-Manjarrés et al., 2018). To a large extent, these studies indicate that considering cultural and/or social aspects may lead to more social engagement in restoration through an alignment of restoration actions and traditional land use, including the prevention of conflicts among stakeholder interests, resulting in increased effectiveness of restoration programs. However, often focused on ecosystems, they fail to adopt the landscape approach (i.e. “a multi-faceted integrated strategy that aims to bring together multiple stakeholders from multiple sectors to provide solutions at multiple scales”, Reed et al., 2016) that we believe is central to restoration upscaling. Taking the cultural landscape into account should boost ecological restoration (e.g., Moreira et al., 2006; Naveh, 2005) by clearly integrating cultural capital and the landscape approach.

In practice, considering cultural landscapes (CL) in ecological restoration (ER) (hereafter CL-ER) implies highlighting the role of long-term relationships between societies and their landscapes. The ultimate aim is to maintain these relationships and to integrate them into restoration initiatives. In an ever-changing world, conserving CLs might appear unfeasible, while restoring them might seem sentimental. However, seen from a broader perspective, “landscapes of the past” can make multiple contributions. For a start, they provide information relevant to landscape management (Antrop, 2005). Additionally, recent trends in landscape change may favor CL maintenance. For instance, land use changes involve not only the intensification of deforestation but also its decrease, with the consequent recovery of forested areas (Aide et al., 2013; Beilin et al., 2014).

CL-ER has been endorsed directly (Macdonald and King, 2018; Moreira et al., 2006; Naveh, 2005, 1998) and indirectly (through the use of the above-mentioned associated terms). It also appears fragmented in ER scientific, outreach and policy documents. However, CL-ER itself has not been systematically reviewed; while landscape ecology in ER was reviewed (Leite et al., 2013) such an approach lacks a clear focus on the cultural capital. Here, we review how the literature has reported the consideration of cultural landscapes in various ER contexts in an attempt to capture features from CL-ER research that are potentially relevant to ER upscaling. Specifically, we evaluated the sampled literature to: (1) determine the type of research undertaken on CL-ER (theoretical and practical, i.e. case studies), the different aspects covered by such research (social, spatial, ecological) and their geographical location; (2) compare our findings on bibliometric trends with a literature review on landscape ecology in ER (Leite et al. 2013); and (3) identify potential implications and future perspectives for taking CLs into account so as to scale up ER.

2. Methodology

We performed a literature survey of the CL-ER link in terms of: (1) number of papers per year and areas of research, to assess the topic development through time and disciplinary scope of coverage; (2) research type, scope, and aspects assessed; and (3) geographical location of the studies, to assess how and where research has been conducted. Specifically, we searched the literature through the ISI Web of Science platform, looking for papers published up to 2019 that clearly link cultural landscapes (CLs) and ecological restoration (ER). To access papers, we used the following search string: TOPIC: (restor* OR recover* OR rewet* OR reforest*) AND TOPIC: (cultural near/2 landscape) AND TOPIC: (ecolog* OR ecosyst*). Our approach was partly inspired by Kollmann et al. (2016) for terms related to ER, adding terms associated with CLs. We found 168 entries spanning 1995-2019 of which 25 were excluded as proceedings papers or book chapters (quite often not accessible). Thereafter, abstracts were examined for the presence of both target subjects (CL and ER) and for their relationship (CL-ER). Papers that did not establish any relationship between CLs and ER in their abstract were discarded (34). We ended up with 109 papers spanning 1995-2019 that were examined in detail (see Table A.1, Appendix A for a list of selected papers).

For each paper, we accessed the following information: (1) publication year, research area and journal; (2) research type (theoretical/ practical), theoretical papers being reviews, opinions/ perspectives or proposing a theoretical framework, basing their assumptions on evidence from the literature, while practical papers involved data collection, either primary or secondary (documentary/ modeling analyses, e.g., using historical maps or data on species occurrences); (3) scope of the paper (general/ location-specific/ baseline/ evaluation), a subdivision of research type. Theoretical papers were divided into general (applicable to a broad range of situations) and location-specific (applicable to a specific site or region). Practical papers were divided into baseline (searching for a baseline or baseline elements that could contribute to future restoration actions) and evaluation (assessing the outcome of completed restoration actions); (4) aspects assessed in practical studies, categorized as ecological (vegetation dynamics, soil dynamics, vegetation types, modeling species, indicator species, biodiversity changes, carbon stock, conservation and management practices, and traditional practices), landscape (landscape scenarios, landscape connectivity, land-use history, selection of priority ER sites) and people (people's preferences on ER, people's general perceptions); (5) location of the study, categorized as general (not having a focal zone or country), zone (encompassing supranational regions not specifying countries), and continent/country, and also applied to theoretical papers with a general scope when such papers presented case studies (for location-specific papers, the location was the site or region it addressed).

We assessed the research areas of screened studies and attributed them to at least one corresponding broad category from the ISI Web of Science (Arts & Humanities, Life Sciences & Biomedicine, Physical Sciences, Social Sciences, and Technology), as shown in detail in Table A.2, Appendix A. When there was more than one research area in the same broad category, we counted it as a single record. We compare our results with a similar study on landscape ecology in ER, by performing the same research area assessment for 52 of the 54 studies screened by Leite et al. (2013) and provided in their supplementary material (2 studies were not indexed in the database). We acknowledge methodological differences between our study and that from Leite et al. (2013), but this comparison was restricted to broad categories and with percentages. The two studies not indexed in the database were probably captured from the Scopus database they also assessed, which we considered too low and uninfluential to general focal patterns. Venn diagrams were made using the R package "eulerr" (Larsson, 2020).

3. Results and discussion

3.1. Bibliometric overview

We reviewed 109 studies published from 1995 to 2019. It represents much less publications than other subjects related to ecological restoration, such as restoration success (Wortley et al., 2013) and restoration of ecosystem functions (Kollmann et al., 2016), but, when comparing the same time span, it is a number of publications similar to that found by Leite et al. (2013) looking at links between landscape ecology in ER. The limited number of publications retrieved on CL-ER may be either a sign that CL-ER is being reported using other terms (e.g., socioecological systems, socioecological production landscapes, and semi-natural landscapes) or that it has not reached the scientific arena. Many restoration projects do not highlight links between environmental objectives and patterns of traditional resource use (economic or utilitarian benefits) (Wehi and Lord, 2017), and those that do highlight these links often fail to present their results as scientific outputs. While we did not assess the grey literature and acknowledge that this would have yielded more publications and reports, we believe that our review is still representative as we retrieved all the publications found on the subject. We found studies in 30 countries, compared, for instance, to the 9 and 49 countries covered in peer-reviewed papers and grey literature, respectively, found by Reed et al. (2017) for integrated landscape approaches.

3.2. Type of research and aspects assessed

Theoretical (48%) and practical papers (52%) were rather balanced (Fig. 1). This suggests that CL-ER is being addressed based not only on opinions but also on practical evidence obtained from data collection, modelling and assessment of stakeholders' opinions. Theoretical studies approach the topic in different ways, ranging from merely briefly mentioning the importance of considering cultural aspects in ER, to more in-depth analysis of the importance of CL-ER research and application (Kueffer and Kaiser-Bunbury, 2014; Naveh, 2009, 2005, 1998; Pfadenhauer, 2001; Weinstein, 2008). Yet a central theoretical study, in which the authors contrast ER focused on ecosystems and on CLs and propose ways of applying ER principles to CLs, is not included since it was published in a non-indexed journal (Moreira et al., 2006). However, we were able to capture another study of this kind, which compares the literature on CLs and ecosystem services and stresses the importance of linking them (Schaich et al., 2010).

They advocate taking cultural services into account, and this is followed in several studies which either strengthen this recommendation (Collier, 2014; Guo et al., 2016; Rey-Benayas and Bullock, 2012; Schirpke et al., 2016) or quantify cultural services to guide future restoration efforts (Barbedo et al., 2014; van Berkel and Verburg, 2014). Still, there are fewer theoretical studies with a general scope (the present study would fit this category) than location-specific ones, suggesting that research is directed more toward specific local or regional issues in CL-ER.

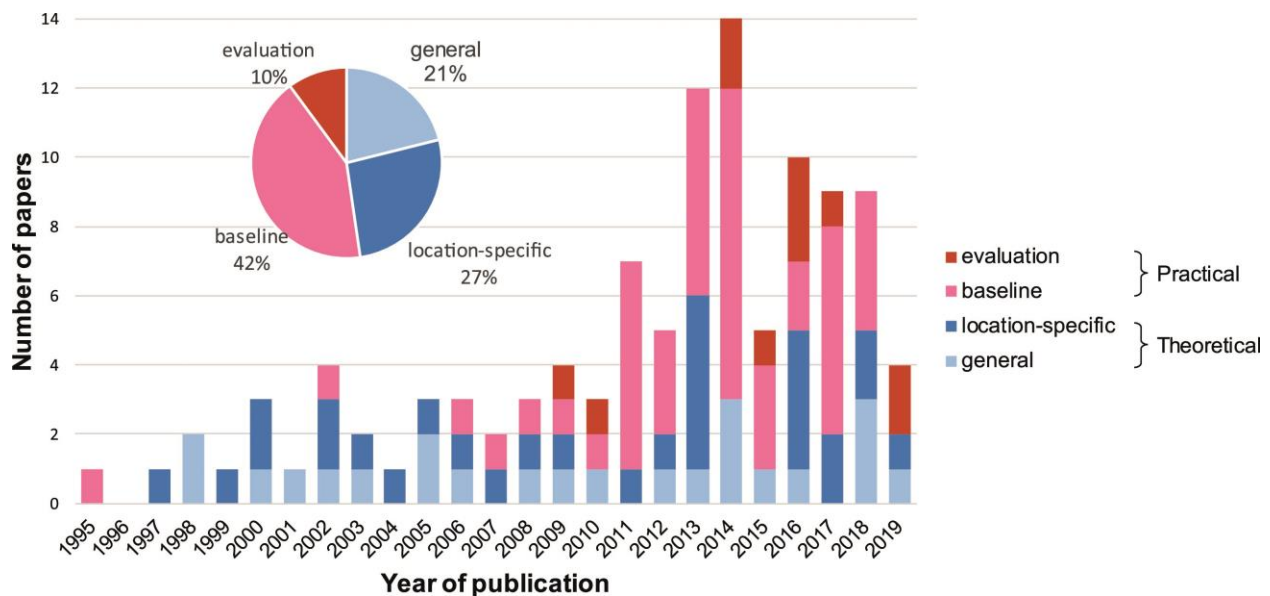


Fig. 1. Number of papers per year linking cultural landscapes and ecological restoration (N=109), grouped by type of research into theoretical or practical, and by scope into general (applicable to a broad range of situations) or location-specific (applicable to a specific site or region) as well as into baseline (seeking a baseline or baseline elements that could contribute to future restoration actions) or evaluation (assessing the outcome of restoration actions already performed). Total percentages for the different paper categories are shown in the pie upper left.

We examined the practical studies in more detail to identify the aspects actually being assessed in CL-ER research. We found widespread assessment of ecological aspects, consistent with what is reported by studies on the evaluation of restoration success (Aronson et al., 2010; Ruiz-Jaen and Aide, 2005; Wortley et al., 2013). Examples include diversity of plants (Osland et al., 2011) and insects (García-Tejero et al., 2013; Verdasca et al., 2012), vegetation dynamics through pollen and charcoal records (Pellatt and Gedalof, 2014) and topsoil characteristics (García-Tejero et al., 2013). Aspects related to landscapes (e.g., landscape scenarios and

connectivity, and land-use history) and people's perceptions (e.g., general perceptions and preferences about ER) are also well represented (Fig. 2). Several studies develop landscape scenarios for future restoration (Barbedo et al., 2014; Hainz-Renetzeder et al., 2015) and also describe landscape history (Pellatt and Gedalof, 2014; van Mourik et al., 2012) to provide baselines for CL restoration. Historical landscapes are investigated through aerial photography combined with local knowledge (Rescia et al., 2008), and additionally evaluated through people's perceptions of past social changes together with biodiversity and land-use changes (Beilin et al., 2014). Preferences on landscape scenarios are also evaluated, for instance in Swiss mountain areas (Soliva and Hunziker, 2009). However, we found less frequent reporting of a combined CL-ER approach to assessing the outcome of restoration actions (N=11; although it might be happening "on the ground", see Wehi & Lord 2017). Interestingly, an example of a study of this kind encompasses various research categories, assessing people's perceptions and preferences regarding a floodplain restoration project and finding that restoration of historic landscapes is perceived positively (Schaich, 2009).

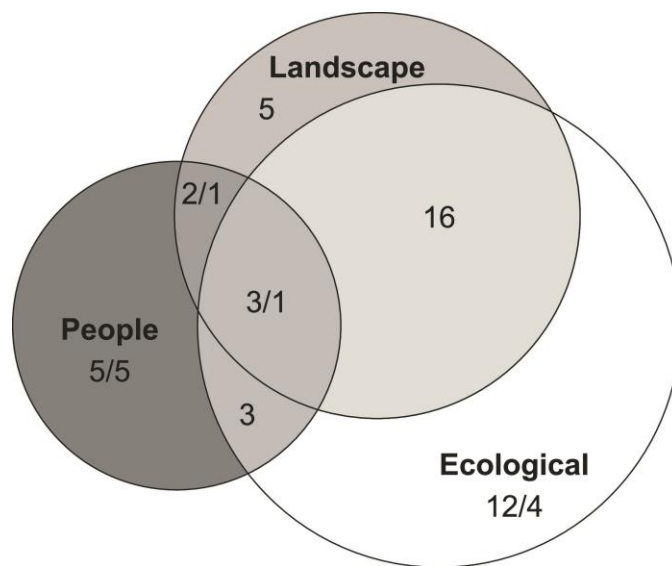


Fig. 2. Venn diagram of the aspects assessed by practical studies (N=57). Numbers before the slash or alone indicate the number of baseline studies (seeking a baseline or baseline elements that could contribute to future restoration actions); numbers after the slash indicate the number of studies on evaluation of restoration actions (assessing the outcome of restoration actions already performed).

3.3. Trends in geographical distribution

Although the papers report studies performed on all long-term inhabited continents (thus excluding Antarctica), in 30 countries and three zones (Mediterranean, temperate and boreal forests, and temperate zone) we found that 65% of the studies were from Europe and North America (Fig. A.1; Table A.3, Appendix A). This appears to be a general pattern in ER research, as reported several times by literature reviews on ER (e.g., Kollmann et al., 2016; Wortley et al., 2013). It is not surprising that 50% of the studies are based in Europe, as the concept of cultural landscapes emerged there (Kirchhoff et al., 2012), so we expected to find more Europe-related research and practice in CL-ER. However, only one paper was found for France, where we know such projects have taken place or are on-going (Liron, 2018). In addition to the literature search limitations described above, an explanation may be that CLs are often not mentioned because they are considered inherent to the European context, in line with the more holistic European view of the landscape concept. This might have reflected upon the clear difference in numbers of papers for the two types of research being only observed for Europe, where there has been twice as much practical research (Table A.3, Appendix A). This could be interpreted as an effect of the implementation of the European Landscape Convention, signed in 2000 and implemented in 2004 (Déjeant-Pons, 2006), which almost coincides with the increase in practical studies since 2006 (Fig. 1). Trends in CL-ER research in Europe and elsewhere are discussed in more detail below (section 4.2). Yet regions such as the Biancane badlands in Italy (Marignani et al., 2008; Torri et al., 2013) and the Stubai Valley in Austria (Fondevilla et al., 2016; Schirpke et al., 2016) are the focus of two studies each.

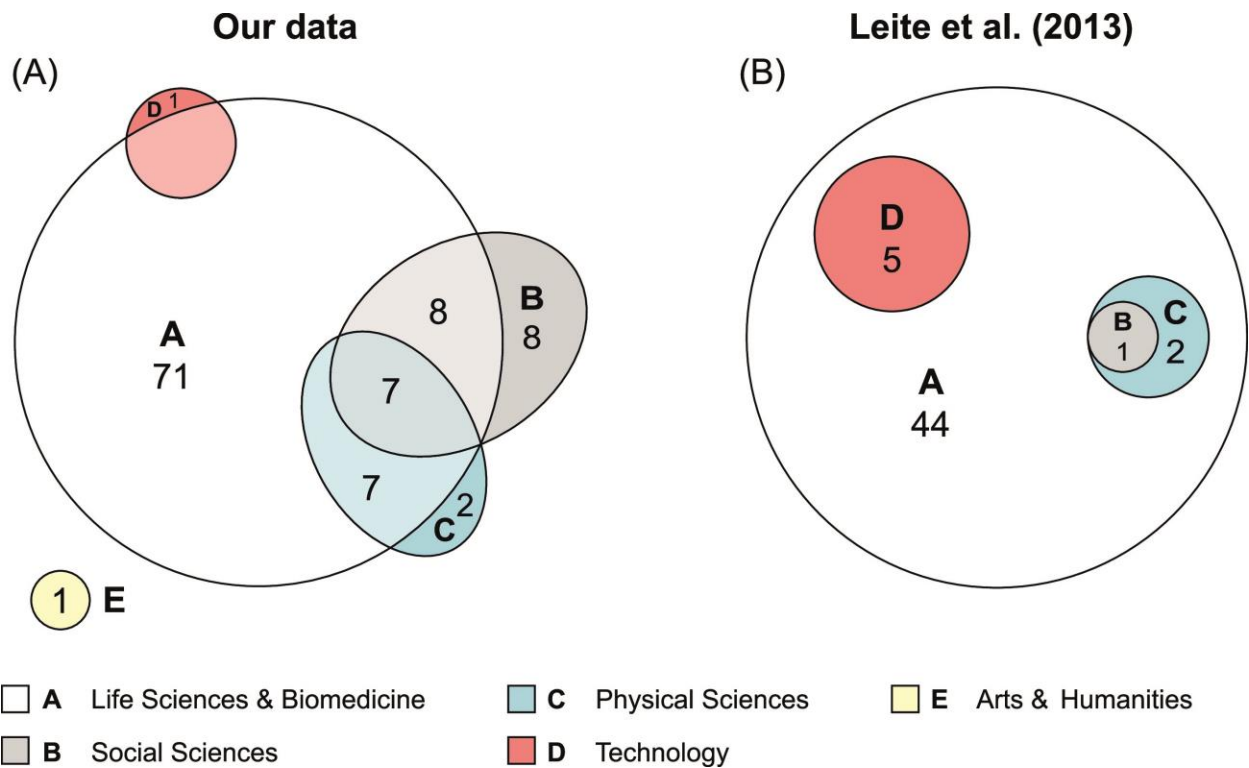
A good number of papers addressing CLs are from North America (16% of the studies), which is strange given that the SER Primer (SER, 2004) states “the North American focus on restoring pristine landscapes makes little or no sense in places like Europe where cultural landscapes are the norm”. However, cultural landscape preservation has been one of the US National Park Service missions for decades (Page, 2009) and indigenous peoples have embraced restoration challenges (Higgs, 2003; Martinez, 2003). Indeed, in North America as in most places in the world, native peoples have shaped the landscapes (e.g., Keeley, 2002; Vale, 2002). This mismatch frames a recent discussion over whether there is a “nature-culture dichotomization” (Evans and Davis, 2018) or a nexus (McDonald et al., 2019) in SER documents referring to cultural ecosystems and landscapes.

259 Additionally, representability of papers on CL-ER for continents such as Africa and Latin
260 America, where large-scale restoration projects are being implemented, is strikingly low: for
261 example, Brazil (Brazil's Atlantic Forest Restoration Pact, PRMA, 2016; and Rodrigues et al.,
262 2011) is represented by only one study (Barbedo et al., 2014). We did not find any studies
263 mentioning South Africa (Working for Water programs) or Rwanda (Forest & Landscape
264 Restoration program) (Aronson and Alexander, 2013). Interestingly, all but one (Velázquez-
265 Rosas et al., 2018) of the papers from Africa and Latin America involve a North American or a
266 European researcher (based on institution affiliation). This is further discussed in section 4.2.

267 *3.4. Comparing research on cultural landscapes and landscape ecology*

268 We found that 2/3 of the studies (71 studies) fall exclusively into the broad category of
269 life sciences (Fig. 3), the majority concerning ecology (Table A.2, Appendix A). Twenty-one
270 percent (21% or 23 studies) of the studies fall into the social sciences category solely or in
271 combination with other categories. Several studies fall exclusively into one of the other
272 categories (one study solely in arts & humanities, Fig. 3). These proportions differ somewhat
273 from the findings of Leite et al. (2013) in their review on the landscape ecology perspective in
274 ER, where the distribution among research areas (Table A.2, Appendix A) is even more skewed
275 towards life sciences (44 studies or 85% of the studies exclusively in life sciences), particularly
276 ecology, with only one study concerning the social sciences (Fig. 3, Table A.2, Appendix A).
277 Moreover, 26 of our CL-ER studies (24%) encompass two to three broad research categories,
278 contrasting with only eight (15%) such studies found in the Leite et al. (2013) landscape ecology
279 in ER review (Fig. 3). In our review, one set of papers stood out by encompassing three or more
280 broad research categories, and these papers contained unusual features. For instance, the research
281 included within an ER approach subjects like changes at the landscape level (Pelorosso et al.,
282 2011), sometimes associated with diversified parameters for ER planning (Marignani et al.,
283 2008; Meurk and Swaffield, 2000) or social-ecological systems (Rescia et al., 2008), and
284 perceptions by local residents (Schaich, 2009). On the other hand, the sole study common to both
285 our review and the Leite et al. review is classified under the Environmental Sciences & Ecology
286 research category (i.e. Life Sciences broad category) and explores management techniques,
287 including one traditional technique ("fanguero") used in this case to enhance biodiversity (Osland
288 et al., 2011).

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304 4. Implications for ecological restoration upscaling

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Fig. 3. Venn diagrams of research areas in broad categories for (A) 109 papers from the present literature survey on cultural landscapes and ecological restoration, and (B) 52 papers from a literature review on the landscape ecology perspective in ecological restoration (Leite et al., 2013). Numbers indicate the number of studies in each broad category or their combinations. Papers fitting in more than one research area in the same broad category were counted as a single record.

Regarding journal of publication, 43% were published in 12 journals (three or more papers) out of a total of 66 journals (Table A.4, Appendix A). Although our review differs from that of Leite et al (2013) in total number of papers (109 vs. 54), CL-ER research clearly appears to be more evenly represented over a range of journals. This points to a broader disciplinary scope for research on CL-ER compared with landscape ecology in ER (Fig. 3).

Since CLs are landscapes characterized by a social influence in their creation and maintenance, stakeholders play an important role in the achievement of restoration outcomes.

Landscape restoration relies on the collective engagement of multiple stakeholders (Jellinek et al., 2019), through CL-ER as we propose here, with the ultimate aim of scaling up restoration so that it shifts from single isolated to multiple concerted initiatives (Fig. 4). Our literature survey afforded a comprehensive overview of how CL-ER research has been performed, and we now point to the main challenges for the restoration of CLs and landscapes in general (Fig. 4): (1) building a transdisciplinary approach, especially to balance the overemphasis on ecological aspects; and, for major world regions, (2) coping with competing interests regarding land use, with unstable political contexts, and with low stakeholder engagement.

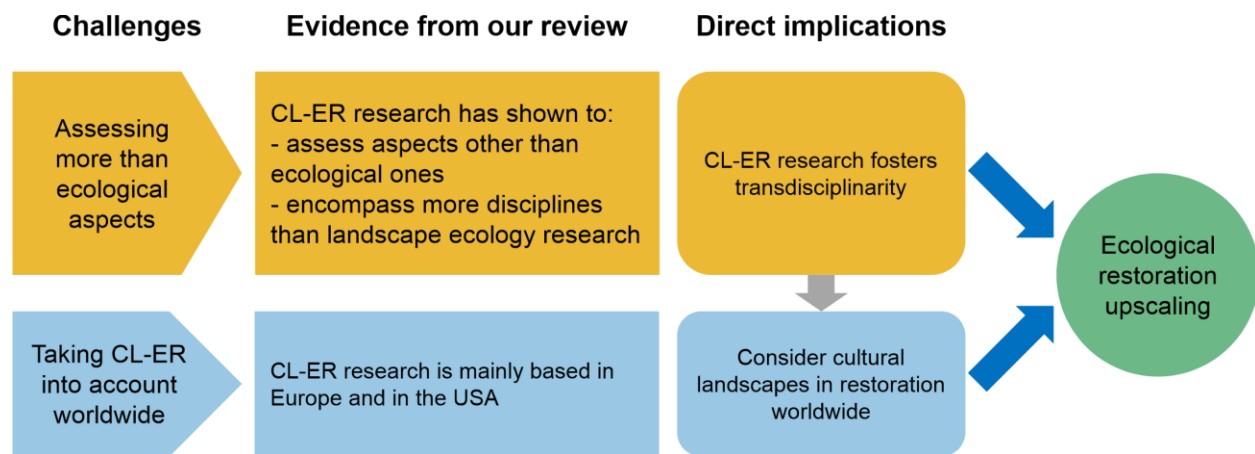


Fig. 4. Overview of challenges, evidence from our review, and direct implications to ecological restoration upscaling gathered from considering cultural landscapes in ecological restoration (CL-ER). Yellow forms correspond to challenges related to assessing more than ecological aspects; Blue forms correspond to challenges related to where CL-ER is being considered. Potential benefits from fostering transdisciplinarity through CL-ER research could imply that it is worth considering cultural landscapes in restoration worldwide.

4.1. Towards transdisciplinarity

ER has strong ecological foundations, which is fairly reasonable in view of its definition (SER, 2004). Yet much more is being demanded from the discipline, and it can no longer remain restricted to ecology with a strong focus on natural capital (Fig. 4). Ecology needs to be integrated with other disciplines to support the quest for sustainability, as repeatedly suggested (Aronson and Van Andel, 2012; Jellinek et al., 2019; Naveh, 2005). Landscape restoration clearly requires transdisciplinarity, even regarding the conceptual basis of both landscape (Wu

and Hobbs, 2007) and restoration ecology (Andel and Aronson, 2012). This applies even more to CLs and their long-term mechanisms based on inter-relationships between natural, cultural and economic capitals. In fact, we found that the representability of research areas is less biased towards life sciences when research is focused on CL-ER (as in our study) than on landscape ecology in ER (as in Leite et al., 2013) (Fig. 3). For instance, the establishment of reserves can generate conflicts that could be attenuated if integrative and more holistic approaches were implemented, as suggested for a Norwegian case (Daugstad et al., 2006). In another example, one study evaluating ER actions in a floodplain restoration project in Luxembourg and presenting results on people's perceptions comprises five research areas: Environmental Sciences & Ecology; Geography; Physical Geography; Public Administration; Urban Studies (Schaich, 2009). Being transdisciplinary allows different perspectives to be combined in a manner likely to enhance ER upscaling.

Ideally, landscape restoration goes beyond ecological aspects, i.e. biotic and abiotic factors related to ecosystem functioning (e.g., Holl, 2017; Macdonald and King, 2018), because it involves stakeholders with competing interests regarding land use and different degrees of engagement. Therefore a concerted effort on their part is required when scaling up ER. Moreover, cultural aspects are essentially integrated into stakeholder engagement and landscape approaches through the recognition of traditional practices, often embodied within concepts related to CLs, such as cultural ecosystems (e.g., Evans and Davis, 2018), cultural practices (e.g., Wehi and Lord, 2017), or cultural ecosystem services (e.g., Plieninger et al., 2015). CL-ER research tackles this through the assessment of people's perceptions and landscape features (Fig. 2), which implies in contributing more towards transdisciplinarity and, ultimately, to ER upscaling (Fig. 4). Interestingly, of the 57 studies evaluated for three categories of assessed aspects (i.e. ecological, landscape, people), only 16 (28%) are restricted to ecological aspects, while more than half (N=31, 54%) assess a combination of aspects from two or even from all of our three categories. One study stands out, assessing aspects within all three categories and performed in three countries: Portugal, Sweden and Australia (Beilin et al., 2014). The authors assessed plant species diversity (ecology), historical changes in land cover (landscape) and farmers' perspectives on landscape, land use or abandonment, and their current and future activities (people). They found that the drivers of agricultural land abandonment (viewed as an opportunity for ER) in the study areas are related to social and historical contexts.

4.2. *Towards a more realistic consideration of historical land use outside Europe*

Ambitious restoration aims have been established worldwide, and for regions facing important issues such as unstable political and socioeconomic contexts, sometimes directly related to ER (Ceccon et al., 2015; Fernández-Manjarrés et al., 2018), as well as conflict of interests regarding land use. For instance, there are regional agreements for Africa (AFR100) (WRI, 2019). However, we found only two CL-ER studies in Africa and only one fits our category of practical studies (Fig. A.1, Table A.3, Appendix A). This is not surprising: the general trend is for ER research to be biased towards northern countries (e.g., Kollmann et al., 2016; Wortley et al., 2013). Yet the lack of research where it is needed most is an important issue that should be seriously addressed, as already recommended for conservation (Wilson et al., 2016).

In Europe, there are well-established continent-wide regulations and directives, such as the European Landscape Convention and the Habitats Directive (European Commission, 2017; Ockendon et al., 2018), which consider CLs. Moreover, Natura 2000, the European ecological network of protected areas and a pillar of the EU's Biodiversity Strategy, highlights and enhances the links between cultural and natural heritage (European Commission, 2017). However, this is not common in other parts of the world, with the exception of the United States (Page, 2009). Native Americans and indigenous people worldwide have managed landscapes through traditional practices implemented over millennia (e.g., Martinez, 2003). Thus, it is reasonable that cultural capital (i.e. CL) should be taken into account in regions where such long-term social mechanisms still operate, acknowledging that such consideration is not specific to Europe (Fig. 4). For instance, recent studies on the Chilean Espinal call for consideration of CLs in ER, after concluding that reinstating the traditional silvopastoral system is likely to yield conservation benefits for that cultural landscape (Root-Bernstein et al., 2017; Root-Bernstein and Jaksic, 2013), especially if combined with an affirmative image of this landscape as a cultural landscape (Root-Bernstein, 2012).

We should also bear in mind those situations where a minimum essential standard of living needs to be restored (Fernández-Manjarrés et al., 2018). The Primer on Ecological Restoration (SER, 2004), states that for many regions in Africa, Asia and Latin America “ecological restoration is untenable unless it manifestly bolsters the ecological base for human

survival.” For such regions, approaches centered on ecosystem-services (e.g., focused on carbon and invasive species control) should be applied with caution, since they can often be disconnected from local social issues. Integrative approaches such as CL-ER can be preferable, offering trade-offs between sociocultural and ecological needs. This is illustrated by a case study on the control of coconut trees in the Indian Ocean archipelago of Chagos, where a compromise between removal and management of coconut trees was proposed as the most conciliatory option for conservationists and Chagossians (Jeffery, 2014). In tropical countries, taking CLs into account could thus contribute to a wider perspective in ER, allying landscape and cultural approaches. A more limited perspective not taking CLs into account could otherwise result in conflicts and reduced chances of ER sustainability, which could undermine upscaling efforts.

5. Conclusions

We reviewed the literature on how CLs are given consideration in ER research and explored two possible implications for taking CLs into account in ER to scaling up restoration. First, CL-ER research shows signs of expanding towards a somewhat wider range of disciplines, which amounts to a move towards transdisciplinarity. This is aligned with the recurrent call for a more holistic approach in ER, and in particular for consideration of aspects other than the purely ecological, aimed at restoration upscaling for multiple-use landscapes under long-term cultural influence. Second, scant consideration has been given to historical land use in regions with less scientific coverage, where there is often an assumption of fewer local cultural influences. Transcending traditional perspectives in historical land use could enhance restoration upscaling, through trade-offs between dynamism, local needs and heritage. This is of particular interest for tropical regions, usually characterized by unstable contexts (social, economic and political) while at the same time often the focus of international agreements on restoration with ambitious targets.

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Appendix A.

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