Study on the state of the art of the "guiding image" – The rescue of a river's memory in favor of an urban river restoration project

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ABSTRACT

The progressive transdisciplinary discussion and the preference for an ecological restoration of degraded water courses over rigid engineering solutions currently influence the urban water management and the construction of a guiding reference image is indispensable for its realization. This review article discusses how this set of goals has been approached, in different fields of knowledge, derived from the term "guiding image". As part of the technical literature about river restoration, the concept commonly alludes to the rescue of the memory of a river, even if the restoration of the original conditions is not part of the final project goal. This work is part of a larger research on the development of an adequate methodology to leverage the river restoration design, in which natural and urban demands coexist in a resilient state, while the river, as a natural element, has been lost and does not exist in collective memory. The various factors that make up the goals of a project of such complexity made up the questions from which this work was developed. As a result, a systematic literature review was carried out with the support of the free scientific search platform "Google Scholar". Among the results, nine international theses, two books and seven journal articles were found. The research showed the similarities in the discussions and practices around the world, as well as the continuity of the concepts integrated to the reference image in the restoration project with ecological objectives.

KEYWORDS: Urban planning. Urban river restoration. Guiding image.

1 INTRODUCTION

Urban rivers frequently suffer degradation, end up responsible for waterborne diseases, decreased quality of life and devaluation of the surroundings. Consequently, rivers end up lost among the landscape and are no longer acknowledged in the community. The perception is often that there is nothing natural about these waterbodies and the common solution for these "ghosts" is channeling and capping under the ground. That is an alternative that ends any environmental value and creates difficult and costly maintenance conditions. How is it possible, then, to create favorable conditions for social acceptance for an urban river restoration plan, if the river no longer exists among the community?

The search for a river's memoryscape by creation of an image used to guide the restoration, considering the impacts on its surrounding, reveals a significant object of research, as it aims to present a healthier alternative for the urban area and for the inhabitant population. The term "guiding image" was coined in the work of Palmer et al (2005), which depicts the process of designing the river restoration locally, socially, and ecologically responsible by determining general goals and conditions. Therefore, it is understood the importance of building a guiding image for degraded rivers, considering its potential for awakening the collective interest in river recovery. The construction of a guiding image must contain recovered natural elements and multifunctional urban infrastructure elements, which allows the achievement of environmental and social objectives.

The above-mentioned definition of guiding images for rivers populated the technical literature in the first decade of this century. However, it is not enough to recreate a reference image based on the memory of its original delineation. Two problems arise from that task: the first refers to the river's own capacity, under natural conditions, to change over time, which

creates a gap between the past and current image; the second comes from the urban characteristic of the rivers of interest, which necessarily takes the guiding image to incorporate urban functions.

The work presented is developed from the perspective of building an image that guides the urban fluvial recovery, with synergies to leverage the surrounding quality of life, based on the understanding of its natural aspects and uses. The study of river restoration from this perspective can favor the construction of scenarios that support decision making in public policies, in the sense of emerging trends in favor of urban sustainability. Furthermore, it can provide specific knowledge that enables designers to adopt technologies that are more consistent with current paradigms and in a transdisciplinary way.

2 GOALS

The work aims to develop a bibliographic review on the rescue of the river's memory in favor of urban river restoration, having the term "guiding image" as a starting point and considering productions from different fields of knowledge. It is intended to address the various factors that make up the goals for a design to requalify degraded urban rivers, thus considering all its complexity. This is the first step of a larger research, which proposes to develop an updated methodology that allows the restoration of degraded urban rivers and, consequently, of their associated surroundings, adding natural and urban demands in the final design.

3 THE RIVER'S MEMORY AS A REFERENCE FOR RESTORATION PROJECTS

According to Veról (2013), preserving or restoring rivers has been considered a consistent way to face the growing risk of floods and morphological imbalances. River restoration plans aim to maintain or increase ecosystem goods and services. It is necessary therefore to understand that each situation must be considered locally, since there is no universally applicable solution, given the regional differences in geology, climate, vegetation, history of land use and species distribution. Still, the river's original outline cannot necessarily be considered the best response to the current situation, whatever it may be. Hence, it is considered for purposes of application in the study, the concept of rehabilitation or remediation and not of restoration to the original conditions, prior to the degradation.

Another issue can be rated as challenging. According to Liao et al. (2019) apud Lourenço et al. (2020) flood prevention, a predominant practice in risk mitigation, still perceived as a technical exercise, can lead to environmental injustice, since the measures do not eliminate, but only redistribute flood waters. Thus, they end up imposing new risk on people elsewhere. This scenario is characteristic of the complex urban expansion in Brazil. Therefore, restructuring its complexity as a way of minimizing the impacts of floods, is an added layer to the efforts in built environments.

When focusing on the Brazilian literature discussion about geomorphic, hydrological, and ecological integration, Pellegrino et al. (2006) cite the recent recognition of ecological services arising from the maintenance of biodiversity in urban planning as a way of leveraging the sustainability of the remaining fragments in urbanized areas. Despite this, they also highlight that both built and natural environments are constantly seen as exclusive. They recognize that such a recent interest in biodiversity in urban areas began in the 1990s, although the focus on ecological studies is given in highly conserved environments. In 2006, many works were restricted, therefore, to well-preserved areas, with little to no human activity.

In the context of the recent recognition of ecological services in leveraging sustainability, Palmer et al. (2005) propose five criteria to measure the ecological success of river restoration projects, aiming to reach an agreement, still unprecedented, on what constitutes a successful process. The emphasis on an ecological perspective is given since, according to them, the restoration success can be assessed in different ways, under a three-axis perspective: Success for stakeholders, which reflects satisfaction human with the result; learning success, which reflects advances in scientific knowledge and management practices that will benefit future actions; and, finally, ecological success. This should be the main goal axis in a river restoration project. They argue it with support of examples that demonstrate the insufficiency of the goals set that do not consider the ecosystem conditions of a waterbody. For example, a restoration effort may be successful in increasing economic and social activity in the surroundings, but they can also restrict the natural processes of the river and the floodplain.

Figure 1 shows the proposed scheme based on the relationship between the three axes mentioned. In an ideal situation, efforts that meet the needs of stakeholders and that promote science in the practice of river restoration (learning success) could also be ecological successes.

Figure 1: Diagram of primary axes for successful river restoration.
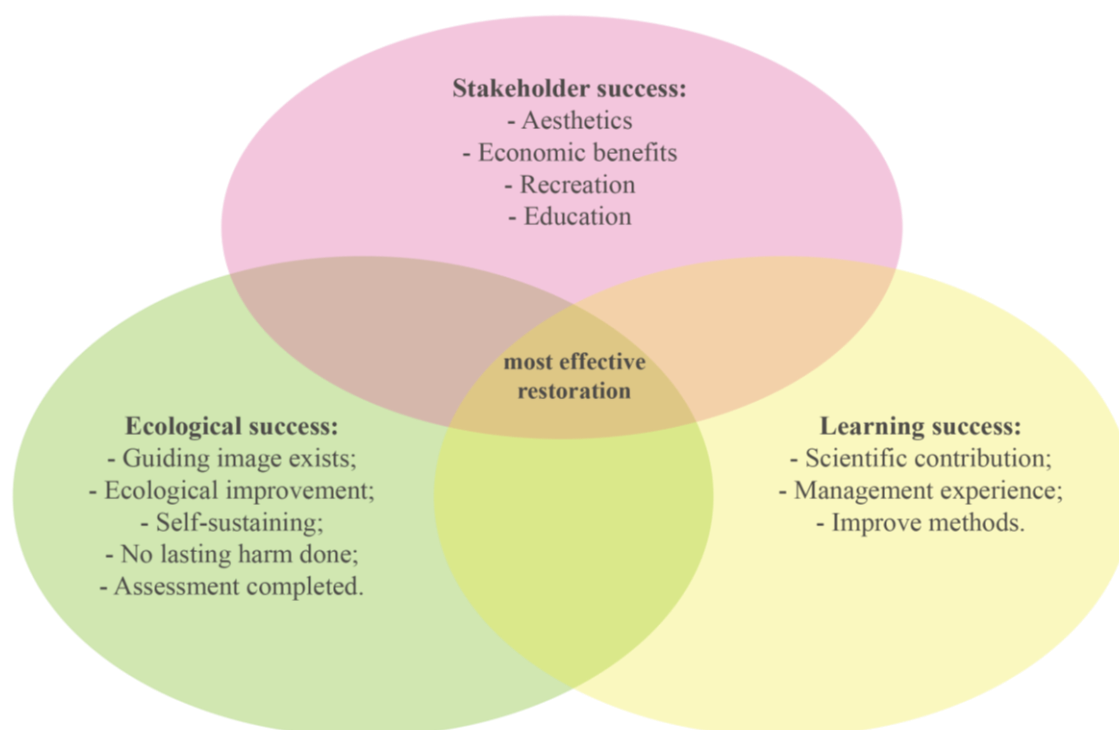
Source: PALMER et al., 2005

The criteria for measuring ecological success in river restoration would then be as follows: Firstly, the ecological design for a river restoration must be based on a specific guiding image, formed by goals and conditions of the most dynamic and healthy river that could; Secondly, the ecological condition of the river must be measurably improved; Thirdly, the river must become more self-sustainable and resilient to external disturbances then before, so that only minimal follow-up maintenance is necessary; Fourthly, during the construction phase, permanent damage to the ecosystem must be avoided; And finally, assessments before and after the implantation must be carried out and the data must be made available.

The authors emphasize that they proposed these considerations to reach consensus on a set of standards, as well as a broad contribution from the scientific community, including criticisms and suggestions for expansion or revision. They would, then, have the opportunity for debate that would provide careful considerations by the community in the field of applied ecology, made up of scientists, managers, and public policy makers. The next step would then involve seeking the effective approval of professionals and other scientific societies, internationally. The so-called guiding image, cited as the first of the five criteria in the text, is built on the idea of leitbild (Kern 1992, 1994), a German term that can be freely translated as "general goal". The concept had been used to guide canal restoration efforts in Germany at the end of the last century. Thus, this image must consider not only the average condition or some fixed value of the key variables of the system (hydrology, chemistry, geomorphology, physical habitat, and biology), but also consider the range of these variables and the probability that they would not be static. It must explicitly recognize the human-induced changes in the system, including changes in the range of key variables. Ideally, the plan should consider two scales: local stressors and, also, the hydrographic basin scale. In other words: the design or description plan of the desired goals must be built not oriented around a single fixed and variable end point (for example, static channel, temporally invariant water quality). Rather than trying to recreate unattainable or even unknown historical conditions, the authors advocate a more pragmatic approach in which the goal of restoration should be to move the river to the least degraded and most ecologically dynamic state possible, given the regional context (Middleton 1999; Choi 2004; Palmer et al. 2004; Suding, Gross & Housman 2004).

Thus, to apply the concept, four aspects must be considered (Palmer et al., 2005):

1- The use of historical data, such as satellite images, maps, and records of terrestrial and biological research, which can establish preconditions (Koebel 1995; Kondolf & Larson 1995; Toth et al. 1995) for providing relevant information about how the river or the biota may have changed.

2- Reference sites relatively intact or already recovered can be used to help define restoration objectives (Reinhardt et al. 1999), particularly where historical information is missing. In the selection of analogous basins, inherent differences between locations, with respect to geology, climate, position in the hydrographic basin, fluvial geomorphology and hydrology must be considered.

3- An analytical or process-based approach using empirical models can be used to guide the project.

4- And, finally, an approach that considers river classification systems. These have been used as a basis for the development of the reference image for restoration in North America and Europe, since the late 1990s. Categorization based on common characteristics has been widely applied to river channels (Rosgen 1994; Poole , Frissell & Ralph 1997). Factors such as channel pattern, gradient, bed material size and sediment load, were considered (Kondolf et al. 2003).

Many of the above considerations contribute to the understanding of the dynamics of the water system, consistent, above all, with the character of an urban landscape. Based on these aspects, it is possible to structure the proposal for an initial, simplified methodology. To guide the development of Brazilian river restoration efforts, considering the construction of a guiding image for the river as the starting point of its rescue, we have:

As a first step, consultation on historical documents of the local and regional administration should be carried out, according to the mentioned different scales of analysis of the water system, such as master plans of the municipality, for example; the use of maps, aerial photographs and satellite images should assist in this step of understanding the current and past characteristics as the temporal transformation of the landscape; as well as consulting the literature that addresses facts about the region or similar behaviors and characteristics in comparison; and, in addition, pre-existing studies in the study watershed should be evaluated.

According to Ribeiro et al. (2019) the study of landscape, and the development of landscape ecology as a discipline, was mostly made possible by the advance of geographic information systems. In a country of continental dimensions like Brazil, understanding the structure and dynamics of landscape changes is essential for the proper establishment of priority actions for the conservation of biodiversity and for sustainable development.

Then, the mapping of three categories of analysis is proposed, to spatialize the consultations carried out in the previous step. They are:

• Hydraulic interventions in the hydrographic basin, in confrontation with flood events and an increase in population.

• The so-called "Events" (Santos, 1999) that join the notions of space and time on a macro scale and reveal, therefore, the historical materialization of the landscape by its structuring elements and occupation, as well as its applied urban planning instruments and logics.

• Strategies for appropriating space on a micro scale can be identified with consultations on photographs and literature.

The third step takes place with the analysis of the mapping carried out previously, focusing on the following questions: the evolution of land use and vegetation cover, population dynamics, the mosaic of protected areas, the formation of territories, the conformed urban

fabric, its characteristics, and its system of free spaces.

Finally, an assessment of the technical arsenal of measures associated with the following topics should be carried out: river restoration, multifunctional landscapes, and sustainable urban drainage techniques. In order to identify useful tools in the composition of alternatives that rescue the functioning, even if partial, of the river, and, thus, to restore the community's perception of the functions lost over time. Thus, the proposal is built on concepts that make up the so-called guiding image. In short, the supporting materials for the initial methodology would be the geoprocessing tools, the consulting historical documents, photographic material, and local literature.

4   ANALYSIS METHOD

The research carried out here seeks to contribute to the debate generated among different scientific communities about the concept of a guiding image in fluvial restoration efforts, as idealized by the authors initially. It aims to rescue the concept as an initial tool for the holistic understanding of the local and ecologically conscious hydric landscape. Hopefully, this will help to situate the advances in the discussion (two decades after the reference publication), and to improve the methodological proposal of interest, together with a general understanding of the current situation for river management and restoration.

In order to establish the state of the art of the object of analysis, we sought to identify it in productions from different fields of knowledge. Hence, the methodology used in the literature review research can be divided into two stages. The first corresponds to the selection and reading of works related to the concept of "design goals and conditions", within the scope of river restoration, using the primary base term "guiding image", presented in the article by Palmer et al. (2005). The research was carried out in different bibliographic sources, in Portuguese and English, using the free scientific search platform "Google Scholar". From this, in a second step, a deeper analysis of the theme was made, establishing relationships between the terms searched, considering that, in this phase, there was already a contextualized systemic understanding about the secondary terms used and related fields of knowledge.

5   RESULTS

The first stage began with the identification and selection of works that cited the article by Palmer et al. (2005), initial reference for the use of the term "guiding image" in river restoration efforts, on Google Scholar, scientific research platform. The first result, without any date or term filter, resulted in 1,533 jobs. The Google tool "Sort by relevance" was applied, which indicated most texts in the fields of knowledge of Applied Ecology, Biology and Human Geography.

Then, the works cited in the body of the text by Palmer et al. (2005), in particular, in the item dealing with the use of an image to guide river restoration efforts, this being considered the first stage (out of a total of five) for ecological success., Chart 1 was elaborated from this research, which systematizes the existing academic framework over the concepts discussed here. Figure 1 presents a diagram on the general state of the art of the "guiding image" for ecologically conscious river restoration based on the academic framework. It should be noted that the first two lines of Chart 1 represent the primary terms summarized in the previous section of this work. The consecutive terms, starting by the third line, were considered as secondary terms that make up the processes of the built-up guiding image.

Chart 1: Systematization of the existing academic framework in Palmer et al. (2005)

Approach	Field of knowledge	Reference
Guiding Image	Applied Ecology	PALMER, BERNHARDT, ALLAN, LAKE, ALEXANDER, BROOKS, CARR, CLAYTON, DAHM, FOLLSTAD SHAH, GALAT, LOSS, GOODWIN, HART, HASSETT, JENKINSON, KONDOLF, LAVE, MEYER, O'DONNELL, PAGANO, SUDDUTH (2005)
Project motivations or goals	Human geography	FOX, MAGILLIGAN & SNEDDON (2016)
Historical analysis	Aquatic Sciences	KONDOLF & LARSON (1995)
	Applied Ecology	KOEBEL JR. (1995)
	Applied Ecology	TOTH, ARRINGTON, BRADY, MUSZICK (1995)
	Environmental management	BRAGG &TATSCHL (1977)
	Environmental management	YIN & NELSON (1996)
	Biology	GALAT; FREDRICKSON; HUMBURG; BATAILLE; BODIE; DOHRENWEND; GELWICKS; HAVEL; HELMERS; HOOKER; JONES; KNOWLTON; KUBISIAK; MAZOUREK; MCCOLPIN; RENKEN; SEMLITSCH (1998)
	Biology	SPARKS, R.E.; NELSON, J.C.; YIN, Y., 1998.
	Applied Ecology	PEDROLI; DE BLUST; VAN LOOY; VAN ROOIJ (2002).
	Biology	STRANGE (1999)
Reference site	Applied Ecology	RHEINHARDT; RHEINHARDT; BRINSON; FRASER (1999)
Analytical model or empirical experience	Civil Engineering	SKIDMORE; SHIELDS; DOYLE; MILLER (2001)
	Environmental management	GEIST; DAUBLE (1998)
Typological classification	Hydrology	ROSGEN (1994)
	Broad multidisciplinary approach to water resources issues - riverbank ecology, geographic information systems (GIS), adaptive management and water policy.	POOLE; FRISSELL; RALPH (1997)
	Physical geography	KONDOLF; MONTGOMERY; PIÉGAY; SCHMITT (2003)
	Environmental management	KONDOLF; SMELTZER; RAILSBACK (2001)

Source: Julia Bahiana, 2020

Figure 2: Diagram for the state-of-the-art of the guiding image for ecological river restoration, according to the results established in Chart 1.
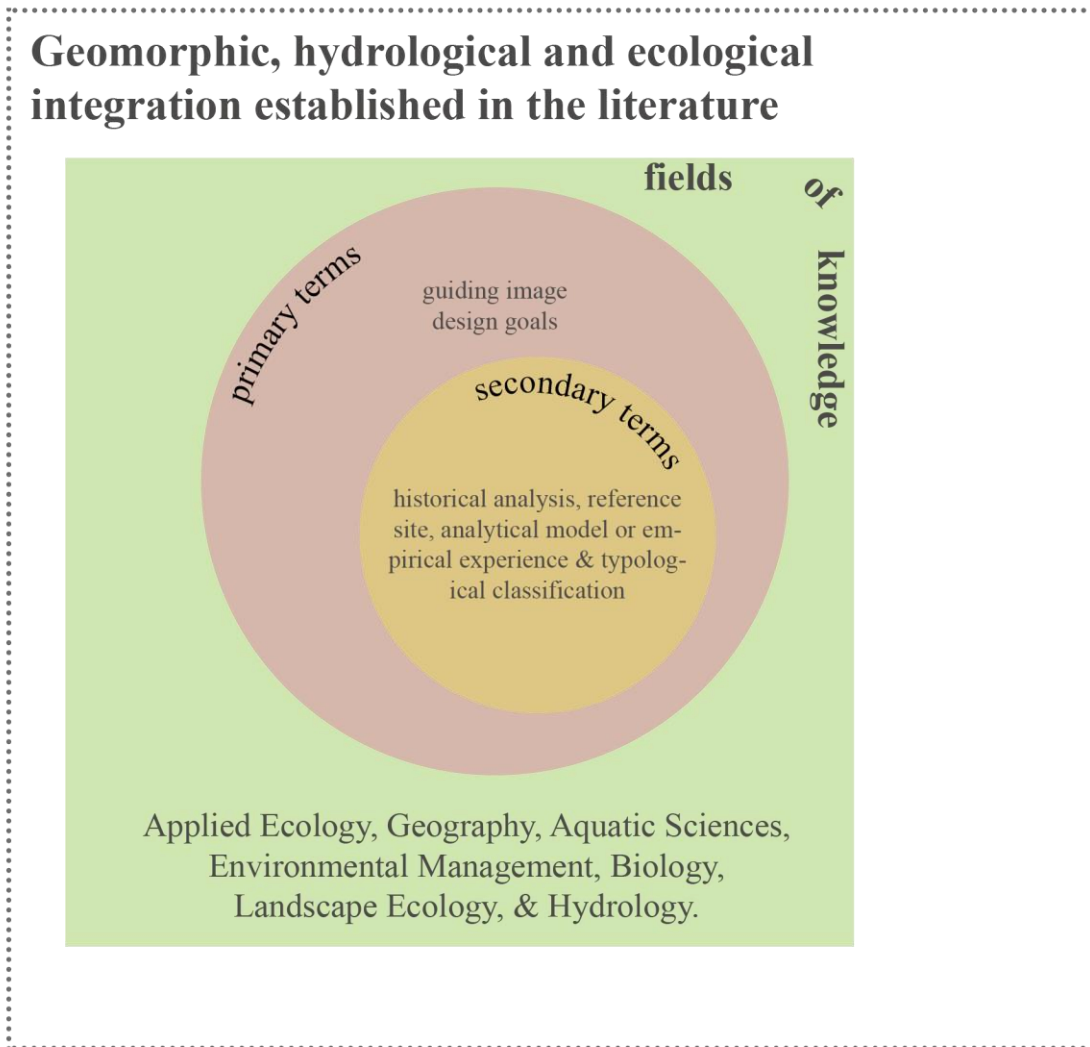
Source: Julia Bahiana, 2020.

The second stage consisted of a review of the specific literature. A research strategy was taken that considered the term "guiding image", the field of knowledge "urban planning" and the nationality of the clipping (Brazil). Through this strategy, the key question was: "How does the discussion about geomorphic, hydrological and ecological integration in non-conserved environments take place in Brazil? In this sense, the first of the five criteria established by Palmer et al. (2005) for a successful river restoration, the creation of a guiding image, was considered.

Another search, through the same tool, was carried out, in order to guide this specific investigation. Covering a period of fifteen years (from 2005, year of the reference article, until 2020) eighteen results were obtained in total. All fit the initial number of works that cite the reference (1,533 works from the first search stage) and mention the keywords "urban planning" and "Brazil". Among these eighteen results, only seven corresponded to scientific articles. The

focus was then on these seven articles, as they contain more objective considerations and bring together more internationally recognized researchers, on the following aspects: year of publication; main field of knowledge; mention of primary and / or secondary terms to the concept established as "guiding image", within the scope indicated here and country of publication. Chart 2 shows the result of this calculation.

Chart 2: Result of the investigation on the reference article based on Google Scholar research.

Mentions the term "guiding image"	Field of knowledge	Nationality	Reference
No, but presents an analytical approach and historical analysis	Civil Engineering	Brazil	MIGUEZ, VERÓL & CARNEIRO (2012)
No, but presents a typological classification	Biological, Environmental and Ecological Sciences	USA	WENGER, ROY, JACKSON, BERNHARDT, CARTER, FILOSO, GIBSON, HESSION, KAUSHAL, MART, MEYER, PALMER, PAUL, PURCELL, RAMREZ, ROSEMOND, SCHOFIELD, SUDDUTH, WALSH (2009)
Yes, as "goal to be set to achieve ecological status"	Ecology, Bio evaluation, Conservation and restoration, Environmental management	USA	WALSH, BOOTH, BURNS, FLETCHER, HALE, HOANG, LIVINGSTON, RIPPY, ROY, SCOGGINS, WALLACE (2016)
No, but presents a typological classification	Applied ecology	China	WU, CHE, LV, YANG (2017)
Yes, as "guiding image"	Environmental Planning and Management	Chile	MAZZORANA, NARDINI, COMITI, VIGNOLI, COOK, ULLOA & IROUMÉ (2017)
Unavailable work	Geology	London	SMELROR (2020)
Unavailable work	Applied ecology	Iceland and Norway	ARADOTTIR & HAGEN (2013)

Source: Julia Bahiana, 2020

In addition to the selected articles, among the eighteen results, some corresponded to books and theses. Due to the relevance of this book, it is mentioned here below, despite not being included in the calculation table: Forman (2014).

Among the seven results, only five articles were analyzed, regarding their themes, according to their fields of knowledge, in order to provide clues about the current focus of discussion on the object of analysis. The themes of the first five articles, in order of lines in Chart 2 are, respectively:

1. Consulted historical aspects over local urban floods are emphasized as methodological tools for developing sustainable drainage solutions. An integrated approach is established between hydraulic engineering design, urban land control and natural aspects in river revitalization. This is the only article, among the results, developed by a team of Brazilian researchers.

2. Urban water management and river ecology - Addresses research needs, limited understanding of the mechanisms that drive urban sprawl over rivers and variability in the characteristics of urbanization effects in different bio geoclimatic conditions, stages of development, government policies and standards cultural. This is the less recent article among the results.

3. Urban water management and fluvial ecology - The lack of ecological goals considered for the in the scope of rainwater management is highlighted in this work. They argue that it is common to concentrate on flood and pollution mitigation without an explicit focus on altered hydrology. The resulting management approaches end up failing to adequately protect the ecological structure and function of rivers.

4. Classifying ecosystems as part of establishing management goals with the potential to support decision making for urban planners based on urban ecological principles and indicators.

5. Critical analysis and case study about participatory planning processes during river restoration efforts with a focus on solving socio-ecological problems.

The works listed above as 1, 4 and 5 present practical applications to case studies, in order to discuss ecosystem restoration processes in complex urbanization contexts. With the exception of work 4, both articles present the river system as the main object of analysis. Likewise, works 1 and 4 present secondary approaches to the process of construction of the guiding image, explained above. Works 2 and 3 discuss conceptually the theme of urban water management and river ecology, both published in North America.

Usually, the topics covered in a research reflect the researcher's personal relationship with the problem situation over time, locally or internationally. In this sense, there is a similarity in the approach between discussions around the world in which environmental challenges, loss of biodiversity, quality and quantity of water resources, urban expansion, and climate change, appear as significant scientific interests. The issue of transdisciplinary can be seen in the Chart 1 and is understandable according to the demands of the most efficient environmental management of the urban environment.

6   CONCLUSIONS

The present work aimed to analyze the state of the art of a concept present in productions of different fields of knowledge: the rescue of the river's memory in favor of urban river restoration with the help of a "guiding image". The starting point was the North American article from 2005, which develops the term in the context of restoration on an ecological perspective. In view of these analyzes, it was possible to perceive the relevance of the base article in the discussion of the fields of Ecology, Geography, Biology, Engineering and

Environmental Management and Planning. However, the term coined by the authors 15 years ago did not succeed in the same way that the work was cited. In addition, the focus given on the development of general project goals as an important process tool is more discussed with regard to the stage of historical analysis. Possibly because it is a work method little explored by designers, planners, and managers of the natural and built environment.

It was also possible to note some references to the Brazilian process of planning and requalifying the water environment, generally as a way of alerting to its challenges. Among these seven articles found that cite the base work, only one was developed by Brazilian researchers, one mentions the exact term "Guiding Image" and other mentions goals for finding an ecological balance as the first step in the development of the restoration. Some focuses on one of the five development criteria for the guiding image, mainly the use of the typological classification base to design, for example.

Other relevant considerations about this research are not related to the analysis of the results directly. Firstly, the appearance of Forman's book (2014) in the search stands out. This is an important work on the interaction of natural and built aspects by one of the parents of Landscape Ecology. In addition, it is worth mentioning the nine international theses, among the eighteen search results, and the difficulty of analysis found in the lack of free access to two of the seven scientific articles that cite Palmer et al (2005).

Regarding the in-depth reading of the reference article, an observation is necessary. The authors point out the criticality of the pre- and post-intervention assessment for restoration, although it is not determinant on its success to have all the goals set achieved. In fact, they warn that well-documented projects that fall short of initial objectives may contribute more to the future health of waterways than projects that meet their predictions. It is also noted that the issue of data registration is important not only for carrying out a historical rescue of data in order to analyze and interpret the case study in creating a guiding image, but also for the subsequent maintenance and awareness involved after the requalification. Therefore, when it comes to the recovery of the memory of a river, as an integral part of the development of a restoration plan focused on ecological aspects, the methodological approach of historical bias is adequate for the discussion about its success. Whereas a successful process focuses on the value of the survey and the subsequent availability of data and records for the communities of interest.

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