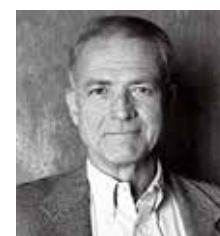


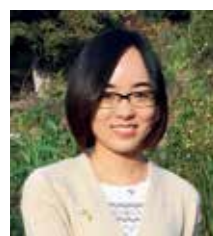
结合科学与社会方法的河流修复： 访G·马蒂亚斯·康道夫

COMBINING SCIENTIFIC AND SOCIAL METHODS IN RIVER RESTORATION: AN INTERVIEW WITH G. MATHIAS KONDOLF



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摘要

本次访谈聚焦于美国河流生态修复的教育和实践，及其对中国的借鉴意义。G·马蒂亚斯·康道夫介绍了他在加州大学伯克利分校的教学和研究，阐述了对水坝建设的看法，并提出了河流修复的几大原则。另一位对话者史书茵在中国的语境下提出了与该主题相关的主要问题。本次访谈旨在通过全新视角，为研究者和实践者提供解决中国水问题的思路，为景观设计师和规划师未来的研究和实践提供整合科学与社会方法的新理念。

关键词

河流修复；水坝建设；沉积物；非点源污染；使用后评价

ABSTRACT

This interview focuses on discussion of education and practice in river restoration in the United States and its possible lessons for China. G. Mathias Kondolf introduces his teaching and research at University of California, Berkeley and gives his views on dam construction and the principles of river restoration. Shuhan Shi, the interviewer, puts forward several important questions related to the topic within Chinese contexts. Together, through a fresh perspective, this work could help researchers and practitioners to consider ways to solve water problems in China. For landscape architects and planners, it provides new perceptions to combine scientific and social methods for future research and practice.

KEY WORDS

River Restoration; Dam Construction; Sediment; Non-Point Source Pollution; Post-Occupancy Evaluation

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① 可访问<http://riverlab.berkeley.edu/>了解G·马蒂亚斯·康道夫的更多研究与实践工作。

G·马蒂亚斯·康道夫简介

G·马蒂亚斯·康道夫教授既是河流地貌学家，也是环境规划师，其专注于河流环境的管理和修复。作为加州大学伯克利分校环境设计学院的教授，他教授水文、河流修复和环境科学等课程。他的研究主要涉及人与河流之间的相互影响，尤其关注洪水多发地区的管理、水库和调控性河道的沉积物管理，以及河流修复。他为美国国会、加州议会和美国诸多法律程序提供专家意见。他曾两度获得富布赖特奖，并获得景观设计教育工作委员会的嘉奖。此外，他也是景观设计基金会会员，及两个美国科学院专家组——卡弗德生态系统恢复科学委员会和美国陆军工程兵团环境顾问委员会——的成员。他在国际科技期刊和书籍中发表了百余篇论文，他的著作《河流地貌学的工具》（约翰·威利出版社）已成为该领域的参考书目。^①

史书茵（以下简称史）：您拥有地理学和河流地质学背景，这一背景似乎与加州大学伯克利分校地理系的关系更为密切，可您却选择在环境设计学院任教。这是出于怎样的考虑？

G·马蒂亚斯·康道夫（以下简称康道夫）：当时，知名的河流地貌学和地质学家卢纳·B·李奥波德即将从环境设计学院离

任，因此学院空出了一个职位。在他退休后，我申请了这个职位。学院当时已经形成了任用科学家的传统，而我也非常喜欢学院多样化的氛围，这里的学生与传统院系里的学生相比，也大有不同。而且这里的研究也更侧重于以实践应用项目为导向。

史：您不仅教授与环境规划相关的课程，也经常和景观设计师合作。在教学和实践的过程中，您是否感受到景观、水文和环境这些学科之间存在隔阂，如何克服它们？

康道夫：的确如此，不同学科之间经常存在沟通障碍。在教学方面，我专门为规划师和景观设计师开设了水文课程。正如你所知，水文学其实是土木工程学院的课程，这些课程往往涉及大量的公式假设，目前则十分强调应用模型。根据我的经验，在教授例如景观设计师这类学生时，最好方法是把他们带到场地，在那里，你可以看到雨水是如何形成径流的，溪流是如何流淌的，这是更为体验式的学习方式。

从实践方面来说，其分为两个步骤。首先，需要向合作伙伴或甲方——这其中就可能包括景观设计师——传授河流过程的相关知识。同时听取他们的需求，并了解工作任务中的局限。建筑师往往喜欢将其个人设想强加于世界，而景观设计师更容易意识到在项目中融入科学研究的重要性。所以

作为环境科学家，我们有必要提供更易于理解、更契合实际项目的信息。而第二步则是为项目规划和设计提供水文分析和土地适用性分析。

史：中国的污染问题已非常严峻，可供人们嬉戏的城市河流已经越来越少了。您能为中国的城市河流修复提供一些建议吗？您认为最亟待解决的问题是什么？

康道夫：污染控制最首要的问题是源头控制。美国和欧洲都经历过一系列漫长的治水过程。最初，我们通过立法来控制工厂等大型的点源污染源。在这些地方，废水主要从管道排出；随后工厂被要求处理其排出的废弃物，城市被要求处理污水。这些规定日趋严格，但水质问题并没有因此而得到缓解。因为来自停车场、农场和道路等区域的径流造成的非点源污染尚未得到有效控制。因此，对绿色基础设施规划的新需求即有效应对非点源污染问题。美国60年前的河流状况与中国目前的情况并无分别。那时美国也同样拥有大量的重工业，人们直接把污水排入河流。美国的第一个重要的清洁水法案颁布于1948年，其支持建立了大量水处理厂。20世纪70年代初，该法案的修正案出台。这次法案修改的目的是提高立法在污染控制和防止湿地填埋方面的执行力。这一修改法案也就是我们通常所指的《清洁水法》。实际

上,《清洁水法》的目标是:到1984年,全美的所有河流都可供人们游泳和捕鱼,但这并没有实现。后来还出台过一些类似的期限,它们也都没有实现。但现在,美国的大多数河流都已经非常干净,例如草莓溪,现在我和我的儿子经常会去那里游玩。美国花费了约40年的时间来解决河流污染问题,也许对中国而言,也需要如此长的时间。

史:您是否了解中国目前的一些河流修复工程?您如何评价这些项目?

康道夫:我所见过的中国项目并不多,但我试图去思考自己所见到的一些现象。诚如你所知,在中国,很多河流治理是出于城市审美和景观美化的目的。这种治理方式改变了河流的自然过程,甚至波及城市以外郊区中的河流,使其被硬化或渠化。这导致未来将有更多的地区需要进行修复。

史:您的研究主要关注河流的泥沙沉积和堤坝建设对河流沉积物的影响。您也曾主持过一个有关三峡大坝的论坛,您能否就中国的水坝建设提出一些意见?

康道夫:我认为水坝的建设是必要的,但目前在中国以及世界各地,建造的水坝过多,且大多投资都只注重短期效益。所有水坝最终都会废弃。可是我们在规划和建造水

坝时,却没有制订相应的水坝废止计划。我们知道,混凝土的构筑并不会永世长存,它们的使用年限只有100~200年。在基于效益计算来设计使用年限时,人们通常关心其15年、35年,最多100年间所需要的投资,却没有考虑到此后的成本。如果该区域有较高的沉积物负荷(河流含沙量很高),那么水坝在很短的时间内就会被沉积物填满,从而导致下游出现问题。所以我认为,水坝对于我们来说是必不可少的,但目前建造得过多,而且大多不是以可持续方式建造的。很多水坝在不久的将来会因沉积物淤塞而失去效用。我们只能投入更多资金去维系它们。因此,选择适合的区域建造水坝是十分必要的。

对于既定的流域,需要进行具有逻辑性的规划过程。以湄公河为例,我们曾根据下湄公河流域的环境条件,对所有可能建设水坝的区域进行了分析。分析得出,如果仅在上游区域开发水坝,由于位于流域上游,截获的沉积物较少,且对鱼类洄游的总体影响较小,但仍然可以获得约80%的电力。因此,我们可以对既定的河流流域进行优化。我们需要考虑鱼类会怎样迁移,沉积物源自哪里、会在哪里积沉,并遵循最小化影响的原则,来确定水坝的位置。这样的方案所带来的效益未必最大,但却是最优选择。但遗憾的是,我们这样的规划最终并没有实现。因为对于湄公河来说,已然太迟了。

但是我们正在考虑,能否在缅甸的伊洛瓦底江流域推行这样的思路,那里的大坝规划才刚刚起步。

史:中国河流修复项目的主要目标之一是美观性。我参加了您上学期的课程,注意到美国的一些河流修复的项目往往不够整洁有序,甚至有点儿凌乱。您能否谈一谈在您的实践中如何平衡公众的美学感官和生态目标?

康道夫:琼·纳绍尔曾写过一篇很好的文章,题为《凌乱的生态系统,有序的框架规范》。在这篇文章中,她探讨过同样的问题。例如,在明尼苏达郊区,有些人将草坪退还为天然草场,看起来就像是未经修剪的草坪,邻居们不愿意看到这样的场景。她提到,如果你在草场四周设置围栏,并标注“天然草场”,那么大家就会说:“哦,这里是天然草场!”这是观念问题,当人们心怀草坪应该被修剪这种定式期望时,他们会说,“哦,这里没人管!”但是,如果在其四周建起围栏,人们就会认为理应如此。

但对于美观和生态二者的平衡,我们需要认清一个事实,那就是在城市河流中我们究竟能获取多少生态价值。它们的自然状态在很大程度已经被改变了,因而即使在城市水系投入再多资源,河流也不会具有更大的生态价值。但对公共教育或城市休闲来说,

城市河流却有着巨大的价值,它能为儿童提供接触自然和类野外环境的途径。因此,意识到这点非常重要,但我不认为我们在城市进行河流修复就会拥有稀有物种、复杂的食物网,或诸如此类的生态效益。那里仍会有像老鼠之类的城市动物,我们也无法让城市溪流摆脱这样的困扰。所以,基于这样的思考,我认为还有很多问题值得商榷,如“密植柳树还是保留开敞的空间?”(密植的柳树可为鱼类遮蔽阳光,为特定鱼类提供适宜的栖息场所;但密植的植物群落会带来犯罪等安全隐患)。此外,在很多情况下,还需要尊重当地社区的偏好,不要总是试图在城市区域建立密集的栖息地。我想说,在很多城市环境中这样的情况是真实存在的,因为这类栖息地真正的生态价值其实非常有限,我们应该更多地关注人文生态学。

史:在您的教学实践中,您的很多学生都拥有景观设计或城市规划的背景,您如何培养这类学生针对水系统问题提出干预策略的能力?拥有设计或规划背景的人在解决此类问题时是否具有优势?

康道夫:我认为,在做河道项目时,需要考虑的一个重要因素是能否让河流自我修复,即只在必要的情况下,才采取干预或固化河岸的措施。这也是我在课程中提到的

第一条准则。而事实上,非真正必要的干预措施多得惊人。河流修复中最不可取的方法就是工程建设,我们应该尽全力去避免。在极度城镇化的区域,人们还是会建造这些固化的驳岸,因为别无选择。但即使是在公园这类可以允许河流发生侵蚀和演变的地方,人们依然会选择建造固化驳岸。对于河流修复,最好的方法就是保留功能性过程和栖息地,留出供河道演变的区域,“为河流留出空间”。次好的办法是恢复水系的连通和水循环的过程,实现河流的自愈。再其次,应保留现有栖息地,但如果河流动态过程已经发生了改变,这样的修复也将是不可持续的。

瑞士日内瓦的艾尔河是一个很好的案例。这个项目的设计师是建筑师和景观设计师,他们并没有接受过水文学和河流地理学的专业教育,他们所提出的解决方案是,创建公共区域,并让河流自由流淌形成自己的路线,这在我看来是一个卓越的解决方案。

史:您认为在河流修复实践方面,哪些领域有待进一步研究?

康道夫:我认为在城市环境中,有一个切实可行且仍需深入的领域,就是对项目的可靠监测和评估。大部分项目仅仅是建造起来了,但尚未进行真正的评估。这听起来很

疯狂,但事实就是如此。进行建成后评估并不困难,但将受益匪浅。即便对于从业者而言,去对已建成的项目进行评估,也会从中受益。这一开拓性的理念来自克莱尔·库珀·马库斯。她在建筑和景观设计学领域倡导使用后评价,将这一方法应用于城市区域,包括记录什么样的人在使用场地(如公共广场),以及他们在做些什么。我们可以在河流修复项目中应用相同的理念,不仅仅包括人们如何使用河流,也包括这一修复项目是否为鸟类和其他野生动物提供了栖息地,比如是否在炎热天气下创造了凉爽的微气候等。**LAF**

1. G·马蒂亚斯·康道夫带领学生进行场地调查
1. G. Mathias Kondolf took students to the field



Introduction

G. Mathias Kondolf is both a fluvial geomorphologist and an environmental planner specializing in environmental river management and restoration. As a professor of College of Environmental Design at the University of California, Berkeley (UC Berkeley), he teaches courses in hydrology, river restoration, and environmental science. His research concerns human-river interactions broadly, with emphasis on management of flood-prone lands, sediment management in reservoirs and regulated river channels, and river restoration. He has provided expert testimony for the US Congress, the California legislature, and in various legal proceedings in the US. In addition to the recipient of two Fulbright awards and the Merit Award from the Council of Educators of Landscape Architecture, and a fellow of the Landscape Architecture Foundation, he is also a member to two National Academy of Science panels, the CalFed Ecosystem Restoration Science Board, and the Environmental Advisory Board to the Chief of the US Army Corps of Engineers. He is author of over 100 papers in international scientific journals and books, and his book *Tools in Fluvial*

Geomorphology (published by John Wiley & Sons) is a reference in the field.^①

Shuhan SHI (SHI hereinafter): With your background being a geologist and fluvial geomorphologist, which is more related to the department of Geography in UC Berkeley, why do you prefer to stay at the College of Environmental Design? Is there any special reason?

G. Mathias KONDOLF (KONDOLF hereinafter): This position became available because the department was replacing a well-known fluvial geomorphologist and geologist, Luna B. Leopold, after his retirement — that was the job I applied for. They had the tradition already in the department of having scientists in residence, and I enjoy the diversity in the department. Also, there are more different students than that in a traditional academic department. And the research here oriented more in practical applied projects.

SHI: I know you have courses related to environmental planning, and you often work with landscape architects. During your teaching and practices, is there any obstacle between landscape, hydrology

and environmental sciences? How do you overcome it?

KONDOLF: Yes, there are always communication issues between the disciplines. In terms of teaching, I teach a hydrology course specifically designed for planners and landscape architects. As you know, Hydrology is a discipline taught in civil engineering departments, in which we assume a lot of equations and now often with emphasis on models. In my experience, the best way to teach students like landscape architects is to take them to the field, where you see how the runoff formed and how the stream flows — that is a more experiential learning mode.

As to practices, there are two processes. First is to explain fluvial processes to your partners, including clients, who may be landscape architects. You also have to listen to their needs, so as to understand any constrains in your work. Many architects tend to impose their vision on the world, whereas landscape architects are more likely to recognize the need for scientific input. Therefore, it is of extreme significance for us (environmental scientists) to provide information that is more comprehensible and relevant to the project. The second

^① Please visit <http://riverlab.berkeley.edu/> for more research and practice information.

process is providing hydrology and land suitability analyses for uses in project planning and design.

SHI: As we all know, pollution has become a serious problem in China. There are very few urban rivers for people to swim in. Could you give us some suggestions on urban river restoration in China? And what is, in your eyes, the most urgent issue for us to concern?

KONDOLF: Well, certainly the first priority to control pollution is to control the sources. Both the US and Europe went through such a process: initially, water pollution legislation is passed to control large point sources such as factories, where the effluent comes out of a pipe (a “point source”); and so then factories are required to treat their effluent and cities have to treat their sewage. These regulations become more restrictive every year, yet the water quality problems remained unsolved, mainly because of the “non-point source pollution” in runoff from parking lots, farms and roads. Therefore, the new need for green infrastructure planning is a response to the non-point source pollution. If you look back at the US 60 years ago, the situation of the rivers were

just the same as that of China now. There was a lot of heavy industry, and people were putting their sewage directly into the rivers. The first major water pollution control act in the US was issued in 1948, which supported establishment of a mass of water treatment plants. In early 1970s, an amendment to this act was issued. Changes made to the act in purpose of conducting more aggressive initiatives in controlling pollution and prohibiting wetland landfills. This act is what we usually call the Clean Water Act. In fact, one of its goals was that by the year of 1984, all rivers in the US should be suitable for people to swim and fish in, which, however, did not happen. There then were some similar deadlines which failed to be met all the same. Fortunately, most rivers are clean enough now, such as the Strawberry Creek, where I often take my son to play. It took about 40 years for the US to deal with the river pollution problems, and China might need just the same long.

SHI: Have you learned about any of the river restoration projects in China? What is your view on these projects?

KONDOLF: I have not seen many of that, though I am trying to think about

what I have seen. As you see, in China a lot of rivers are treated more from an urban aesthetic and beautification perspective. These approaches change the rivers’ natural processes, and if you go out into the countryside, you will notice that even rivers there are impacted, being hardened or channelized. This creates more areas that have to be restored in the future.

SHI: Your research focuses mainly on the sediment of rivers, and the effects of dam construction. You have also held a forum related to the Three Gorges Dam. So what are your opinions on the dam construction in China?

KONDOLF: I think we have to have some dams, but it is excessive now, both in China and all over the world, and most of the dams are for short-term benefits. Considering that all these dams are going to decay eventually, we seriously lack decommission plans when planning and building the dams. We know that concrete structures cannot last forever, with their service life ranging from 100 to 200 years. In the design of their life period based on calculation of benefit, people typically look out 15 years, 35 years, or 100 years the most,

without considering the cost after that period. If the area has high sediment loads (i.e. high sediment concentration of river), the dam would become filled in with sediment in a short time, thereby causing problems in downstream. In brief, we certainly need some dams, but there are too many being built, and they are not being built in a sustainable way. Instead, many will be filled with sediment and become unusable, for which we will have to invest more for maintenance. So, we should select sites carefully to build dams.

For a given river basin, there should be a logical planning process. Take the Mekong River as an example, we have done an analysis looking at all areas possible for dam building in the Lower Mekong basin. The analysis results showed that if we only built dams in the upstream areas, due to the higher up location in the basin, less settlement would be trapped, the total impact on fish migration could be less, and still 80 percent of power would be generated. So, it is after all possible to optimize the given river basins. We need to take into account where the fish migrate, where the sediment sources are, and where the sediment comes down, then you could locate the dams in a way to minimize

the impacts. It might not be the plan with maximum benefits, but it would be the optimal choice. Sadly, however, we failed to realize this planning, for it was already too late in the Mekong's case. But we are going to see if we can make this happen in the Irrawaddy River basin in Myanmar, as they are just starting the dam planning there.

SHI: Based on my experience, one of the most important goals for river restoration projects in China is aesthetic appearance. I participated in your class last term, and I noticed that some projects in the US are not so tidy, or even being a little messy. Based on your experiences, is there any valuable lessons to share regarding the balance between the sense of public aesthetics and the ecological goals?

KONDOLF: There is a good paper titled Messy Ecosystem, Orderly Framework by Joan Nassauer, in which she discussed such problems. For example, in suburbs of Minnesota, some people returned their lawns into native prairie, which look just like lawns without mowing, and the neighbors would not like to see such scene. However, she stated that if you put a

fence around the lawn and a sign "Native Prairie" next to it, then everybody would say: "Oh, that's native prairie!" It is just a matter of perception — with the preconceptional expectation of lawn should be mown, people would say, "Oh, that's not taken care of!" But then if you have a fence around it, they would think it is supposed to be in this way.

As to the balance between aesthetics and ecological goals, I think one thing we should be realistic about is how much ecological value we could get from an urban stream. Because they are so altered from their natural status that, I think, even if you devote a lot of resources to an urban stream, it will never become that valuable ecologically. It does have, however, a lot of value in terms of public education or recreation, for it provides a way for children to be in nature and wild-like environments. It is really important for us to realize this, I do not think we can bring rare species or complex food web or any other ecological benefit to the city. There still will be urban animals like rats, and we can never get rid of those troubles in an urban river. Therefore, with that in mind, I think there are a lot of questionable issues, such as whether to have dense willows or keep it wide open (the dense willow wood can shield

the sunshine and provide a suitable habitat for some particular types of fish, while the plant community might allow criminal behaviors and other safety risks). I think, in a lot of cases, it probably makes sense to respect more the preferences of the local community, instead of trying to have this kind of very dense habitat everywhere in urban environments. I would say that is probably true in a lot of urban settings, because the real ecological value is actually so limited. It is more reasonable for us to focus on human ecology.

SHI: In your teaching, many of your students have a background of landscape architecture or urban planning. How would you cultivate these students' ability to figure out intervening strategies for water systems? Is there any advantage for people with such background?

KONDOLF: I think, for a river project, one of the key things is whether you can leave the river alone for self-restoration, that is, not to intervene or to harden the banks unless it is really necessary. This is also the first rule I mention in my courses. While in fact, it is surprising how many interventions there are that are unnecessary. The least

desirable way to restore a river is by construction, thus we should avoid it wherever we can. In extremely urbanized areas, people build hardened banks because they have no choice. However, even in parks where we should allow some extent of erosion and migration in rivers, people still build hardened banks. For river restoration, the best way is to preserve the functioning process and habitats, in order to set aside a channel change zone and "leave room for the river." The next best way is to restore the river's connectivity and process, thereby letting the river heal itself. Thirdly, we should at least preserve existing habitats. But if the fluvial processes have already changed, such restoration would not sustain either.

There is a good example of the Arie River in Geneva, Switzerland. As architects and landscape architects, the designers of the project are not trained in hydrology or fluvial geomorphology. They came up with a solution which I thought was brilliant — to create public areas and let the river find its own way.

SHI: To support the practice in river restoration, in what areas do you think we need to do more research?

KONDOLF: I think there is an area practicable, in which we still have lots of work to do, that is the credible monitoring and evaluation of projects. Most projects are just built, and then never really evaluated. It might sound crazy but it is true. It is simple for us to conduct evaluation after completion, and is highly beneficial. It is, even for the practitioners, a great idea to go out and evaluate project that was built. This pioneering idea stems from Clare Cooper Marcus. She was a pioneer in post-occupancy evaluation in Architecture and Landscape Architecture. In urban contexts, the evaluation involves documenting what people are using a site (e.g., a public plaza), and what they usually do in the site. The same idea can be applied in river restoration projects, including not only how people use the river, but also whether the restored river provides habitat for birds and other wildlife, for example whether it provides a cooler microclimate on hot days. **LAF**