

Extended Abstract for

Palmer, M. A., H. L. Menninger, and E. Bernhardt. 2010. River restoration, habitat heterogeneity and biodiversity: a failure of theory or practice? *Freshwater Biology* 55:205-222.

What was the scientific question addressed?

Palmer et al. (2010) asked if there was enough evidence in the literature to determine whether an increase in physical habitat heterogeneity lead to an increase in aquatic biodiversity.

What was their conclusion(s)?

They did not find enough evidence to conclude that when increasing the complexity or heterogeneity of habitat this increased aquatic macroinvertebrate fauna. Furthermore, that habitat complexity was not a primary factor controlling macroinvertebrate diversity and abundance.

How was their conclusion developed?

They conducted a literature review of articles that included restoration, stream and aquatic macroinvertebrates, and a supplementary review of articles that explored the relations between stream and aquatic macroinvertebrates. For the first review, they set the following standards to select which studies to include and which ones not to: 1) describing monitoring results, 2) provide quantitative data on aquatic macroinvertebrate richness, 3) the or one of the restoration goal must be to increase habitat heterogeneity, and 4) must report all habitats within a stream, not just one. Of the papers that met these expectations, they recorded the design of the restoration project and evaluated the outcome based on the macroinvertebrate result.

What assumptions did they make?

Considering only articles with the main goal or one of the main goals to increase in habitat heterogeneity limits what they afterwards explain that there are other factors controlling macroinvertebrate richness, not just habitat heterogeneity.

What are your concerns about study designs?

That if they are really after looking at the effect habitat heterogeneity has on macroinvertebrate richness, then it would have been reasonable for them to do a statistical meta-analysis by collecting all the data needed.

Why is this conclusion happening today?

This is happening today due to national mandates on restoring stream's biological integrity and with a national mandate comes funding.

Is there a counter argument mentioned (or not mentioned) in the article?

The counter argument is that habitat heterogeneity is not the primary factor controlling macroinvertebrate species richness, but instead there can be other determinants such as water quality and hydrologic regime.

What is the MOST important information in this article?

To inform restoration practices that if the goal of the project is to increase macroinvertebrate richness, this will not happen when only habitat heterogeneity and complexity are the means to achieve this goal.

What are the implications and consequences of the conclusions developed?

The implications and consequences are that future restoration efforts should not concentrate solely on increasing habitat complexity and heterogeneity, but instead should concentrate on assessing the limiting factors in streams that is impeding ecosystem functioning. These limiting factors include habitat heterogeneity, but also include water quality and quantity and restore watershed processes among others.

What is the best way to move forward from this state of affairs?

For restoration efforts to first assess the limiting factors of stream that prohibit proper aquatic ecosystem functioning, and from that assessment to then determine the most reasonable on-the-ground intervention to improve that limiting factor.

Where would you choose to invest your stream restoration funds?

I would invest my stream restoration funds in assessing what the most urgent need of the stream is to bring back biologic integrity. I would first invest in water quality and quantity as these are ubiquitous aspects that flow through streams, and their fix cannot be placed-based.

Which of the priority strategies of Roni et al. 2008 (see attached) were addressed by this study?

This study mainly addressed the improvement of instream habitat, however Roni et al. (2008) argued that this is one of the strategies of stream restoration that has the least evidence of actually providing effective. Further, in order of priority the protection of high quality habitat, improving water quality and quantity and restoring watershed processes are of higher priority than improving instream habitat.

Reflection

The following reflection is on delving deeper into the implication and additional information that would have been useful of the Palmer et al.'s (2010) findings, and then reflecting on Roni et al.'s (2008) prioritization scheme for rehabilitation projects as they relate to the reality of streams (where they occur).

To me, the title of Palmer et al.'s (2010) paper drove home what the authors were after. Is the links between river restoration, habitat heterogeneity and biodiversity a failed theory? Their paper showed that in fact there had never been a theory that related an increase in aquatic biodiversity – measured with macroinvertebrates – to increases in habitat complexity and heterogeneity. In other words, a big initial assumption lead people to believe that when habitat heterogeneity increased this lead to an increase in aquatic biodiversity however Palmer et al. (2010) show that there is in fact no evidence to show this.

With this initial assumption then, 78 independent stream restoration projects – according to Palmer et al. (2010) - put their efforts into increasing habitat complexity and heterogeneity to increase aquatic ecosystem functioning. Results showed that very little evidence showed that this was actually the case, and that using the assumption, was leading these restoration efforts astray as their main objectives were not being met.

From this study, I would have liked to see what were the limiting factors, – high quality habitat, water quality or quantity, watershed processes and/or instream habitat – for the degraded streams where restoration efforts were carried out. To me, this seems to be the other side of the puzzle that Palmer et al. (2010) did not fully address. To inform future restoration efforts, it would have been interesting to understand what the condition of the degraded stream was in relation to what the objectives or goals of the restoration actions entailed.

Stepping away from this study, and looking at Roni et al.'s (2008) figure 2, where they show the logical sequence of rehabilitation techniques without considering real world matters (funding, politics, costs etc.), the reality of stream rehabilitation is that it is a complex matter given the nature of streams. Streams go through a huge spatial extent, they take up relatively little area compared to the terrestrial counterpart, and nobody owns the river per say. This makes rehabilitation of reaches more realistic than trying to control the entire river (point and non-point source pollution, water withdrawals and infrastructure), without even getting into crossing political boundaries.

If increasing habitat heterogeneity of instream habitat has shown to do little to increase aquatic biodiversity, and if intervention on a greater scale (watershed level) requires work that is mainly non-scientific (political lobbying, monitoring and implementing regulation), then where is the discipline of stream rehabilitation and restoration going? How do we influence and increase the biological integrity of a stream, without muddling with public policy and regulation?