Stream ecosystem health

Project team

Fran Sheldon, Stuart Bunn, Erin Peterson & Bronwyn Harch (CSIRO)

Timeframe

This project ran from 2006 – 2010 and the outcomes are still being implemented and formed the background to a current ARC Linkage.

Project description

Stream ecosystem health is strongly influenced by the surrounding landscape, especially at the scale of the riparian zone. Given such linkages, it is not surprising that human activities in catchments comprise one of the greatest threats to the ecological integrity of streams and rivers and that catchment and riparian degradation has resulted in declining ecosystem health of streams worldwide. With catchment and riparian restoration a priority in many regions, there is an increasing interest in the scale at which land use influences stream ecosystem health; and therefore the scale at which restoration should be targeted.

This project explored the relationships between indicators of stream ecosystem health (water quality, nutrients, macroinvertebrates and fish) and catchment land use in Southeast Queensland, Australia, across multiple spatial scales. The aim was to determine the relative influence of riparian and catchment land use and identify the appropriate spatial scale of rehabilitation required to improve the health of streams in the region. Specifically we asked:

- Is the observed variation in stream ecosystem health across the region best explained by riparian land use at the local/reach scale, or by the riparian land use several tens of kilometres upstream?
- How much of the observed variation in stream ecosystem health is explained by land use adjacent to the stream or is it influenced more by the aggregative effects of land use in the catchment upstream?
- Does a single patch of intensive land use have the same influence as a number of smaller ones of the same size?
- Does it matter where in the catchment these are situated?

We have known for some time, that stream ecosystem health is strongly influenced by adjacent land use, with some indicators apparently responding to local scale (i.e. riparian) factors and others influenced by the cumulative effects of land use in the upstream catchment. This project quantified the degree of influence of land-use at nested spatial scales (catchment, reach and site) on commonly used indicators of stream health, drawing on an extensive data set of 16 indicators, measured from over 120 sites in SEQ over many years. This allowed the generation of predictive models that can guide restoration activities in catchments to improve river health.

Outcomes

The project quantified through statistical relationships the role of three scales of land-use (catchment, reach and site) on commonly used indicators of stream health. This has allowed the generation of predictive models that should provide quantification on the degree of land-use change required to improve stream health.

Our goal was to use a substantial dataset collected as part of a long-term monitoring program (the South-east Queensland, Australia, Ecological Health Monitoring Program dataset, collected at 116 sites over six years) to identify the spatial scale of land use, or the combination of spatial scales, that most strongly influenced overall ecosystem health. In addition, we aimed to determine whether the most influential scale differed for different aspects of ecosystem health.

Dense forest close to the survey site, mid-dense forest within the riparian areas of the catchment, urbanisation in the riparian buffer and tree cover at the reach scale were all significant in explaining ecosystem health, suggesting an overriding influence of forest cover, particularly close to the stream. Season and antecedent rainfall (pattern of recent rainfall events) were also important, with some land-use variables showing significant seasonal interactions, suggesting a greater influence of catchment land-cover on ecosystem health in the post-wet season. Each indicator also responded to land use changes differently.

The outcomes of the analysis allowed us to predict the scale and catchment position of restoration that would result in the greatest improvement of ecosystem health in the regions streams and rivers. The models we generated suggested that good ecosystem health can be maintained in catchments where 80% of hydrologically active areas in close proximity to the stream have mid-dense forest cover and moderate health can be obtained with 60% cover.

Funding

ARC Linkage

Partners

- CSIRO
- Healthy Land and Water

For more information, contact

Associate Professor Fran Sheldon

Email: f.sheldon@griffith.edu.au

Publications

Sheldon, F., Petersen, E., Boone, E., Sippel, S., Bunn, S., Harch, B. (2012) Identifying the spatial scale of land use that most strongly influences overall river ecosystem health score. *Ecological Applications* 22(8): 2188–2203. http://dx.doi.org/10.1890/11-1792.1

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Bunn, S.E., Abal, E.G., Smith, M.J., Choy, S.C., Fellows, C.S., Harch, B.D., Kennard, M.J., Sheldon, F. (2010) Integration of science and monitoring of river ecosystem health to identify potential causal factors of degradation and guide investments in catchment protection and rehabilitation. *Freshwater Biology* 55:223-240