# Beyond Habitat: Conceptualising the role of sediment in sustaining ecosystem services

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**Introduction:** Until recently, most regional sediment risk prioritizations and site-specific sediment Ecological Risk Assessments (ERAs) have focused primarily on the risk of *contaminants* in sediments on associated organisms. There is, however, a growing trend to include a consideration of ecosystem services, the benefits that people obtain from ecosystems, within decision frameworks. Expressing ecological processes and resources in terms of the goods and services they provide links our scientific understanding of the environment to socioeconomic factors. The move to link ERA and Natural Resource Damage Assessments (NRDA) to evaluate impacts; the use of tools such as Net Environmental Benefit Analysis (NEBA) and Habitat Equivalency Analysis (HEA) to compare remediation and restoration scenarios and emerging legislation such as the European Environmental Liability Directive provide opportunities to consider ecosystem services alongside more traditional decision drivers. However, although sediments figure extensively in the Millennium Ecosystem Assessment, *contaminated* sediment was not the dominant concern. Rather, land and water use and management practices on the landscape scale profoundly affect sediment quality and fate. Habitat change and loss, due to changes in sediment inputs, whether reductions (resulting in the loss of beaches, storm protection, nutrient inputs, etc.) or increases (resulting in lake, reservoir and wetland infilling, coral reef smothering, etc); eutrophication and reductions in nutrient inputs, and disturbance due to development and fishing practices were major drivers, with significant consequences for biodiversity and the provision and resilience of ecosystem functions and services. Thus, whilst an evaluation of *contaminated* sediment impact on ecosystem services may consider the impacts of habitat or substrate quality alone, *sustainable* sediment management requires an evaluation of the interacting positive and negative roles of sediment in both the use and sustainability of a broad range of ecosystem services at the landscape scale.

**Discussion:** Given the above, it is clear that a simplistic translation of standard ERA concepts, in which sediment, whether contaminated or not, is treated solely as a stressor, is insufficient to inform sustainable sediment management decisions. Sediment can also be a habitat, resource, or receptor, depending on the process under consideration. It was recently proposed that *hydrologic* service provision could be evaluated in terms of *water* quality, quantity, location and timing [1]. Similarly, the interactions between sediments and endpoints, functions, objectives or services in river basins can be evaluated in terms of *sediment* ***quantity, quality, location and transport***. The ***quantity*** and ***quality*** of sediment generated at the site-specific and landscape scale and the ***transport*** of sediment to and through river systems are driven by both intrinsic landscape characteristics and land and water management practices (the use of ecosystem services at the landscape scale). Sediment can have both desirable and undesirable impacts on the provision of ecosystem services, depending upon receptors and ***locations***. Impacts can result from too much, too little or the wrong kind of sediment, but elimination of sediments from river basins is neither feasible nor beneficial. Using these four characteristics to develop narrative pathways of interaction between the land use practices that affect sediment generation and transport, and their effects on local and downstream endpoints, allows for a more comprehensive evaluation of the complex roles of sediment in the sustainable provision of ecosystem services at the landscape scale, which can then inform a variety of decision frameworks.

**References:** [1] Brauman *et al. (*2007) *Annu. Rev. Environ. Resourc.* 32:67-98.