POLICY BRIEF

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Water quality amelioration value of wetlands

Wetlands play a significant role in removal of organic agricultural pollutants from rivers

BY JANE TURPIE - APRIL 13, 2010

Wetlands are among the most threatened habitats globally, and in spite of a plethora of legislation to encourage their protection, they continue to be replaced or degraded by human activities (Bergstrom and Stoll 1993). A major factor contributing to this is that their value is poorly understood. Although numerous studies exist that describe the functional values of wetlands, these tend to be for large wetland systems. Much less is understood about the role played by small wetlands at a local or regional scale. A study conducted in the Western Cape, South Africa, shows that small wetlands can play a significant cumulative role in the amelioration of the quality of water emanating from their catchment areas, and that the value of this service is high enough to warrant their protection.

Wetlands are widely understood to perform valuable functions such as flood attenuation, water purification and the provision of resources such as mangroves, reeds and fish. While it is relatively easy to describe the value of a single large wetland system, it has proven far more challenging to understand the value of small wetlands at a local scale. This requires a more accurate understanding of their capacity to deliver services and the demand for those services. Past valuation studies have been hampered by a lack of information, particularly regarding the ability of wetlands to ameliorate the quality of water passing into systems downstream.

The main water-quality constituents that wetlands influence include the loading and/or concentrations of phosphorus and nitrogen nutrients, ammonia, and various heavy metals, as well as suspended solids and their load of sorbed compounds. As streamflows (flow of water in streams, rivers, etc., from land to ocean) enter wetlands, they slow down, with the result that suspended sediments settle out of the water column. Because many pollutants (e.g., metals and organic chemicals) attach strongly to suspended matter, this process is also important for reducing these materials in downstream systems.

Key Points

- Although artificial wetlands are often created for wastewater treatment, the functions and values of natural wetlands are little known or understood.
- Simultaneous analysis of the water quality flowing from numerous small catchment areas with different land uses and different amounts of wetlands shows that wetlands significantly reduce nitrogen loads.
- Based on the equivalent cost of treating water in wastewater treatment works, the average value of the service in the Western Cape, South Africa, is just over USD2000 per ha year.
- Since this is far greater than the value of alternative land uses, it is society's interest to prevent the loss of wetland habitats.

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A number of studies have researched the function of wetlands in the treatment of waste water (e.g., Peltier et al. 2003, Thullen et al. 2005, Batty et al. 2005), but most have been carried out in artificial or dedicated treatment wetlands, and few have used a landscape-scale approach. In treatment wetlands, absolute removal rates of nutrients, such as nitrogen (N) and phosphorus (P) are often proportional to the concentration of inflowing water, and the proportion of N and P removed tends to increase as water detention time increases (Jordan et al. 2003). In such wetlands, inflowing water quality, loading rates, and detention time are usually known variables, along with outflowing quality and loading, which makes quantification of internal wetlands services possible to a relatively high level of accuracy. Comparatively little research has looked at quantifying the water treatment capacity of natural wetlands (Verhoeven et al. 2006). This requires taking landscape-level processes into account.

Water-quality amelioration functions of wetlands benefit both the ecology and human users in downstream systems. For example, preventing contamination of downstream areas may protect fisheries from harmful pollutants or reduce the impact on human health, such as from the extensive growth of algae or aquatic macrophytes in response to nutrient loading. Reduced sediment loads may reduce the frequency of dredging (and thus the cost) needed to prolong the lifespan of downstream impoundment. Once such services have been quantified, they can be valued using a damage cost avoided or a replacement cost approach (Pearce and Turner 1990, James 1991, Barbier 1993, Emerton et al.1999).

The cleaning power of small wetlands in the Cape

There are large numbers of small wetlands in the Fynbos Biome of the Western Cape, South Africa, but their function and value has hitherto been unknown. As a result, many of these wetlands have been degraded or lost due to farming practices and other land use changes. Using multivariate statistical analysis, this study assessed the contribution of these wetlands to water quality across 100 catchment areas which differed in terms of land use and the proportional area of wetlands. The Fynbos biome is dominated by low shrubland vegetation, though some of this has been degraded by overgrazing and other pressures. Land uses in the study area include dryland and irrigation cropping as well as rangelands and small settlements.

Both wetland area and land use play a role in determining water quality emanating from subcatchments in the Fynbos biome. Irrigated lands (including orchards, vineyards, pastures, parks, and golf courses) and dryland agriculture were found to increase the concentrations of nitrogen (in ammonium, nitrates, and nitrites), probably due to the application of fertilizers in these areas, while wetlands had the opposite effect. Estimated removal rates ranged from 307 kg to 9,505 kg N per ha^{-1} per $year^{-1}$, with an average of 1,594 ± 1,375 kg N per ha^{-1} per $year^{-1}$.

The rates of removal of different substances from water treatment works in the Western Cape suggested that an average of at least 33 mg of N is removed per liter of effluent. Based on the above, the average cost of treatment was about ZAR 26 (USD 3.47) per kg of N removed (from total ammonium). On this basis, using only the removal of ammonium nitrogen to avoid double-counting, and assuming that removal of total P is correlated to that of N, the value of wetlands in the different subcatchments was estimated to have an average value of ZAR 14,350 ± 12,385 (USD 1913 ± 1651) per ha per year, and the total value of wetlands in the study area was estimated to be ZAR 328 million (USD 43.7 million). There was no spatial pattern in the average value of wetlands in different subcatchments, but higher values tended to be associated with smaller subcatchments.

Policy implications and recommendations

These findings suggest that wetlands should be given considerably more attention in land use planning and regulation. If current trends are allowed to persist, then in-stream water quality problems already being experienced over much of South Africa will be exacerbated. Given the potentially high value of wetlands, particularly in stressed catchments, efforts should be made to regulate their protection, and where possible to incentivize this. Indeed, the results of this study suggest that the services provided by wetlands could be sufficiently valuable to warrant the introduction of a payments for ecosystem services mechanism in which downstream users contribute to the protection of catchment area wetlands.

ABOUT THIS BRIEF

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