Conserving Tropical Wetlands Through Sustainable Use

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Wetlands can function as land/water transitional zones when they fringe lakes, ponds, and rivers or as nutrient and organic sinks when they occur as internally drained watersheds. In either case, they act as buffers integrating nutrient export from watersheds through plant growth and animal activity.

Marshes and swamps are dominant landscape features throughout the tropics. Familiar examples include the Tonle Sap of Cambodia; the Okavango Delta, Niger Delta, Sudd, and Kafue Flats of Africa; and the Pantanal of Brazil, the world's largest wetland. Countless smaller permanent and seasonal wetlands also exist.

Historically, local people have relied on tropical wetlands for their principal water supply and for a source of protein (fish); they have used wetlands for livestock grazing and to obtain materials for buildings, furniture, and other needs. In Uganda, for example, several wetland plants serve medicinal purposes, and families generate income by making handicrafts from papyrus and growing vegetables at the wetland fringe. These traditional uses of wetlands provide examples of sustainable use; they allow both communities and wetlands to thrive.

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WETLANDS AT RISK

The world conservation movement largely ignored tropical wetlands until about 10 years ago. The wholesale destruction of terrestrial ecosystems was occurring at such an alarming rate that time was of the essence if critical habitats were to be identified and preserved.

But wetlands also are at risk. Landscape alterations caused by deforestation and increased agriculture have proceeded to a point where the capacity of wetlands both to assimilate inorganic erosion products and nutrients (nitrogen and phosphorus) and to adjust to changes in annual rainfall has been exceeded. Degradation at the ecosystem level is now apparent throughout the tropics. Inorganic sediments fill in wetlands; wetland plants cannot incorporate the nutrient load, and excess nutrients cause eutrophication of open water areas downstream.

Rapidly expanding human populations in the tropics, including the northern Lake Victoria basin, have led to the degradation of small wetlands. Land-tenure issues such as inheritance of family lands have forced young adults to farm marginal lands including small marshes. These lands can be effectively drained at the family or village level, but agricultural production appears to be short-lived because the highly organic soils are rapidly oxidized and depleted of nutrients. Numerous small wetlands in central Uganda are being dredged for brick-making clay to provide building materials for Kampala, thereby supporting the region's growing economy. No attempt is made to return these degraded systems to functional wetlands for sustainable use by villagers.

Large wetlands throughout the tropics have also been threatened by or sacrificed to the demands of economic development. Some have been drained to allow large-scale rice production; others have been dredged to create canals that facilitate transportation between villages. Most of these projects have been funded through foreign assistance programs in the developed world.

CONSERVATION AGENTS

Wetlands play a major conservation role in the tropics. Papyrus wetlands (*Cyperus papyrus*) are widespread in eastern and central Africa, covering approximately 85,000 square kilometers. In the late 1950s, L.C. Beadle and E.M. Lind identified some 6,475 square kilometers in Uganda alone. L.J. Chapman and K.F. Liem have recently shown that such systems are usually characterized by extremely low oxygen concentrations in combination with lush plant growth and decomposition. Most fish species that live in the dense swamp interiors have adapted to breathe air.

But threatened species are appearing in these wetlands. Papyrus swamps fringing the northern shore of Lake Victoria provide a refuge for fish species native to the lake that face extinction as they become the food supply for exotic predator fish. Introduction of the Nile perch (*Laetes niloticus*) into Lake Victoria in the 1960s profoundly altered the ecosystem. Studies by L.S. Kaufman, F. Witte, and others show that the Nile perch has been responsible for the extinction of approximately two-thirds of the lake's 300 native fish species since the early 1980s. We are now finding, however, that several fish species presumed to be extinct because they no longer live in the open waters of Lake Victoria have found refuge from the Nile perch in the papyrus wetlands that fringe the lake shore. The wetlands provide a new home for species that can tolerate extremely low or zero oxygen conditions. At the same time, they provide an effective barrier to the Nile perch, which cannot tolerate such conditions.

Papyrus wetlands appear to be the last bastion for several fish species. But these swamps are under increasing pressure from human activities — particularly from watershed development with its increased nutrient and sediment loads and from the introduction of exotic plant species, such as the South American water hyacinth (*Eichhornia*), into Lake Victoria. Although the free-floating water hyacinth might actually expand refuge areas for native fish species, the fish may face a new threat from herbicides used to control this nuisance aquatic weed in shipping lanes and hydroelectric facilities.

PRESERVATION VERSUS SUSTAINABLE USE

Today's political and economic realities make setting aside large tracts of land for inviolate preservation a luxury that is increasingly only available in the wealthiest nations. Far too often, visiting ecologists in tropical countries are told by government officials that, while they recognize the imperative of sound ecological management and conservation, they need economic and social evidence that such practices can help solve their most pressing political problem — feeding and housing their burgeoning populations. Traditional ecological training in the developed world leaves scientists poorly equipped for dealing with political realities in the tropics.

But wetlands can be used in ways that meet human needs and maintain functioning ecosystems. In the 1970s, major field experiments by R.H. Kadlec in a Michigan marsh and H.T. Odum in a North Carolina salt marsh and Florida cypress swamp clearly demonstrated that wetlands can provide biological treatment options for waste waters from human activities. The use of natural and constructed wetlands for treating household, industrial, and agricultural waste waters has grown exponentially during the past 20 years throughout the temperate zone and subtropical Florida.

Although general principles developed from work in temperate areas are broadly applicable to the tropics, the best examples for direct technology transfer come from experiences in areas of similar climate, such as subtropical Florida. Orlando has developed extensive wetlands for "polishing" municipal effluent. In addition to providing water treatment, these wetlands serve as valuable conservation areas. Orlando Wilderness Park, for example, uses a water-treatment wetland for nature-oriented recreational activities. Building on such experiences with multipurpose use of wetland ecosystems is the best way to promote wetland conservation throughout the tropics.

ECONOMIC INCENTIVES

Tropical wetlands can provide a cost-effective water treatment alternative to traditionally engineered plants that require imported machinery and trained personnel. Turning natural ecosystems of marginal economic interest into pollution-abatement systems can meet both human needs and conservation goals.

Such natural treatment systems, however, are not maintenance free. To be effective, they require active plant growth coupled with nutrient accumulation in sediments. Periodic removal of plant biomass and sediment ensure the most efficient uptake of nutrients. The key to operating wetland water-treatment systems is to provide an economic incentive for system maintenance and biomass harvest.

Housing construction materials, cooking fuel, livestock feed, and biogas are all products that could potentially be developed from harvested swamp plants. Aquacultural production of both fish and invertebrates could be extremely profitable if ponds are integrated into the design of treatment wetlands. Provision of an economic return, especially for workers at the lower end of the economic ladder, will ensure that maintenance schedules for treatment systems are followed.

THE FINAL HURDLE

The final hurdle to multiple use of tropical wetlands as a conservation tool is the argument that human-induced structural changes (hydrology, nutrients, plant composition) adversely affect wetland functional values (wildlife habitat, flood control, biological integrity). Nowhere is this more evident than in the case of development of wetlands for rice production. Evidence from Uganda suggests that birds and fish that prefer sparsely vegetated, well-oxygenated habitats will profit from clearance of papyrus swamps, but the response of indigenous biota is less clear. In Uruguay, conservation groups such as PROBIDES are working with rice growers' cooperatives to protect subtropical coastal wetlands via sustainable use.

Clearly, future conservation efforts for subtropical and tropical wetlands must stress multiple use of these systems within a complex economic and social framework. If local people are fully integrated into wetland conservation (an integration best achieved through self interest), we can perhaps stop the wanton destruction of tropical wetlands.

We must find ways to expand the pan-tropical dialogue and exchange experiences regarding traditional and emerging strategies for sustainable use of wetlands. Within the economic, social, and political realities of the developing world and increasingly in the developed world as well, conservation for a specific management purpose rather than strict preservation is the only means by which the world's wetlands can be protected for future generations.

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Additional Reading

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The GeoRef database contains references on the authors' topic. The following strategy was used to search GeoRef through March 1996.

KEY WORDS	TOTAL REFERENCES
(mangrove* and (conservation or ecology or pollut*)) or ((marsh* or swamp* or wetland*) and tropical and (conservation or ecology or pollut*))	137