Why are wetlands so valuable?

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (Cowardin et al. 1992). But they are more than just places—they are entities that benefit people. In fact, May has been designated “Wetlands Month” in recognition of their “ecosystem services.”

What are ecosystem services?

Many functions carried out by ecosystems are valued by people. For example, a wetland that traps sediment and provides clean water for fish and people is performing a valuable function, a.k.a. ecosystem service. If it produces harvestable fish or timber or peat, then providing those goods is also an ecosystem service. A function like mosquito production, however, is not a service, as few people appreciate biting insects. Ecosystem services are functions that contribute to human welfare and help sustain the biosphere (Costanza et al. 1997). Of all the ecosystem services and functions, only some are renewable. The production of petroleum is an example of a non-renewable service, because once harvested it is depleted, while the production of biomass for ethanol is renewable—we can harvest and regrow biomass.

Which wetland ecosystem services are most valuable?

We value biodiversity, the improvement of water quality, the abatement of floods, and many other functions of wetlands. But putting dollar values on any of these ecosystem services is both difficult and controversial. Ecological economist Robert Costanza and 12 co-authors took the plunge and estimated the annual contributions of 16 global ecosystems to 17 renewable services. In 1997, they estimated that tidal marsh, mangroves, swamps and floodplains produced $4,879 trillion in services per year. If we include estuaries, seagrass/algae beds, and coral reefs, the total is $13,165 trillion. Either of these estimates is a substantial proportion (15–40%) of the estimated global total of $33,268 trillion (Costanza et al. 1997).

The most valued services of wetlands were disturbance regulation, waste treatment, water supply, cultural, recreational, habitat, and food production (ibid.). These were dwarfed, however, by the services attributed to estuaries and seagrass/algae beds. Those two shallow-water ecosystems were highly valued for their nutrient cycling functions, which include processing of nitrogen and phosphorus (ibid.).

What portion of the global surface area is wetland?

The services provided by wetlands are impressive when expressed on a per-area basis, because wetlands occupy so little of Earth’s surface. Although the exact area of wetlands on earth is poorly known (Zedler and Kercher 2005), estimates and relative comparisons clearly suggest a minimal global extent. That is, the open ocean covers about 64% of the globe, terrestrial ecosystems cover 29%, and wetlands cover about 0.6% (or 1.5% when estuaries, seagrass/algae beds, and coral reefs are...
included). Thus, the value of wetlands is extremely high relative to the area they occupy. Up to 40% of global ecosystem services are provided by ecosystems that occupy less than 2% of global area—quite a feat for wetlands.

Even if the estimates of Costanza et al. (1997) are rough and incomplete, it is hard to deny that wetlands serve people well. Rather than debating how to estimate value, let's try to understand the mechanisms responsible for high services per unit area.

How do wetlands serve people so well?

The ability of wetlands to support biodiversity, cleanse water, and abate floods is attributable to their landscape position and their wetness.

Many wetlands are “sinks” within watersheds, and the watersheds transport water, sediments, nutrients, and propagules of plants and animals downslope. The wetlands develop in the low spots where these materials accumulate. Where nutrients accumulate in shallow water, vegetation becomes highly productive, so animals find abundant food and shelter in landscape sinks. A diversity of species can find at least temporary support. As sinks, wetlands also accumulate sediments and materials, making the shallow waters cleaner for fish and wildlife and people. Also as sinks, wetlands collect floodwaters, slow their flows, and reduce peak water levels.

“Wetness” has an additional effect that explains much of the nutrient cycling that confers high value. It has to do with the solubility of oxygen, which is low in water (~1/10,000th that in air). When oxygen in shallow water is used up by roots, animals, and microorganisms, the water become anoxic—and able to support critical microbial processes that make nitrogen available for use by plants (nitrogen fixation) and that convert nitrates into harmless gas, thereby improving water quality (denitrification). A key to microbial processes is having anoxic and aerobic conditions in close proximity, which is a natural property of shallow water. When nitrates (oxidized forms of nitrogen) are readily available to denitrifying bacteria (which thrive in organic soils and anoxic conditions), rates of denitrification are high.

Terrestrial ecosystems and the open ocean are valuable too, but per unit area, wetlands contribute more—perhaps 20 times more—services than their global area predicts. They do so by collecting materials from their watersheds and by retaining shallow water for at least part of the year.

References

