

# The Worth of a Watershed

No. 11

Obed Watershed Community Association

September 2006

## Undervaluing Watersheds

**Nature Undervalued:** The services flowing from watersheds are greatly undervalued by society. For the most part, watershed services are not traded in formal markets and so do not send price signals that warn of changes in their supply or condition. Most people are not aware of the role natural systems play in generating those watershed goods that are traded in the marketplace. This lack of awareness helps drive the conversion of natural living systems into human-dominated systems. Once such a conversion takes place, an economic value is then attached to the watershed's goods or service and expressed, at least in part, in standard currency. Such conversions on the Plateau generally entail the destruction of natural living system through deforestation by clear cutting or conversion of forest into cropland or subdivisions.

**Disruptions to Natural Systems Difficult or Impossible to Reverse:** Humans have a habit of disrupting natural systems. We introduce exotic species like kudzu, multiflora rose, privet, or Japanese honeysuckle which grow wildly and smother native species. Carelessly, we destroy species without a thought, easily dismissing them from the living community because they cannot make us a profit or because they did have monetary value and we hunted them to extinction. We have pumped so much carbon dioxide from the burning of fossil fuels into the atmosphere that we have changed the global climate. It will be very difficult or impossible to reverse these disruptions to the natural systems within any time scale relevant to our community.

## Watershed Goods and Services

### Production of Watershed Goods with Economic Value

- Clean water
- Extracted forest products - wood, herbs, pharmaceutical sources, genetic improvements of crop productivity.
- Game and fishes
- Outdoor recreation

### Watershed Goods and Services with No Assigned Economic Value

- A deeply loved natural beauty
- Many different species living within the same natural community
- Native plants and animal species.
- Intact forests
- Atmosphere
- Generation and preservation of soils and renewal of their fertility.
- Soil that is allowed to erode and wash away by farming and construction
- Streams used to carry away human generated wastes
- Trees that provide habitat and food for countless species, prevent soil erosion, and assists in recharging groundwater.
- Birds that eat insect pests, disperse seeds, and add joy to daily life.
- Pollinators that assist in plant fertilization, including agricultural crops.
- Dispersal of seeds
- Purification of air and water.
- Mitigation of droughts and floods.
- Detoxification and decomposition of wastes
- Cycling and movement of nutrients
- Control of the vast majority of potential agricultural pests
- Protection of stream channels from erosion by streams.
- Protection from the sun's harmful ultraviolet rays.
- Partial stabilization of climate
- Moderation of weather extremes and their impacts

- Artistic and intellectual stimulation that uplifts the human spirit.

### **Value of Biodiversity**

**Defined:** Biodiversity refers to the variety of life within the same habitat. Biodiversity is generated and maintained in intact watersheds where life forms encounter a wide variety of living conditions and chance events that shape their evolution in unique ways. Diversity means many different relationships and many different approaches to the same interaction. A diverse community is a resilient community because it has the richness of links and connections that help it survive through difficult times. Species living with a highly diverse watershed have overlapping community functions that can partially replace one another. This layered redundancy maintains the smooth functioning of vital feedback loops through times of stress and disturbances. The more diverse the community, the greater its network complexity and resilience.

**Watershed Resiliency:** Sometimes a link within the living network is destroyed by the loss of a species from the living community, often caused by conditions exceeding the range for that species. Generally, a healthy community can repair that kind of damage by another species taking over the vacant niche. Within a healthy community, you will find a redundancy of links. Most animals will feed on or fertilize more than one plant species. More than one species feeds on the detritus to recycle the nutrients back through the living community system.

**Watershed Limitations:** However, life persists only within tolerance limits. When environmental conditions move beyond the range to which a system can adapt, the network's integrity collapses. Adverse conditions exceed the abilities of individual species to adapt, and the species is lost. If the living community loses too much of its network, its resiliency is degraded and the feedback loops disintegrate, interrupting the flows of energy and information within the system. This has occurred throughout natural history - asteroids smashing into the earth, glacial periods, volcanic eruptions, and the current mass extinction caused by human activities. People destroy natural communities every day in the name of progress and profit.

**Global Diversity:** The world has more than 500,000 plant species. Humans have utilized 7,000 plants for food and another 70,000 plants are known to have edible parts. Only 150 food plants have been cultivated on a large scale. 82 plant species contribute 90% of the plant food Americans eat. If we count another 500 plants that we value for wood, ornamentals, fiber, and the like, that leaves approximately 499,000 plant species that most people view as weeds and in their way.

**Mass Extinction:** From one-third to half of global plant species face extinction. The loss of habitat is the main reason species are wiped off the planet. Human activity is responsible for habitat loss: mountain top removal, inundation of valleys by dams, clearcutting, clearing of land for crops or houses, building of roads. All these activities plow through habitats that people regard as worthless. Resistance to the *Endangered Species Act* indicates the degree to which humans believe that other species do not deserve to live on this planet. Unless a case can be made that a threatened life form has some potential benefit to humans, that species is history.

**Loss of Native Biodiversity:** A conservative estimate of the rate of species loss is about one per hour. This exceeds the rate of evolution of new species by a factor of 10,000 or more. Complete extinction of species is only the final act in the process. The rate of loss of local populations of species - the populations that generate watershed services in specific localities and regions - is orders of magnitude higher. Destruction of life forms disrupts the web of interactions within a watershed; consequently, the loss of species degrades the entire watershed.

### **Mitigation of Floods and Droughts**

**The Soil Sponge:** Cumberland County gets an annual average of 52 inches of rain. Much of this water is soaked up by the soils and then gradually absorbed by plant roots instead of just running off into streams or into groundwater. The soil slows down storm water runoff and reduces flash floods. For the soil to provide this service, it has to be protected with plants and plant litter to shield it from the destructive force of raindrops.

**Erosion:** When landscapes are denuded, rain compacts the surface and rapidly turns soil into mud. The mud clogs

surface cavities in the soil, reducing infiltration of water and increasing runoff. Detached soil particles are splashed downslope and carried off by running water.

Erosion degrades not only the site where the soil was lost but also aquatic system where the soil sediments accumulate. Siltation of streams is the primary cause of water quality impairment in Tennessee, much of the sediment coming from agriculture, deforestation, construction, and urban runoff.

**Wetlands:** Floodplain forests and vegetated floodplains slow the flow of floodwaters and allow sediments to be deposited within the floodplain rather than washed downstream. Wetlands also serve as detention areas during times of high rainfall, delaying saturation of upland soils and overland flows into rivers, damping peak flows. Retaining the integrity of wetlands by leaving vegetation, soils, and natural water regimes intact can reduce the severity and duration of flooding along streams.

### Other Services of Soils

**Irreplaceable:** Soil represents an important national asset, one that, at least here on the Plateau, takes hundreds of thousands of years to build up and yet very few years to be lost. The loss of soil productivity limits the options of any community and civilization. Today, soil degradation caused by human activities afflicts nearly 20% of the Earth's vegetated land surface.

**Support and Nurture Plant Growth:** Soil shelters seeds and provides support for plants as they sprout and mature into adult plants. Soil also retains and delivers nutrients to plants. Tiny soil particles, which are mainly bits of humus and clays, carry a surface electrical charge that is generally negative. This property holds positively charged nutrients - cations such as calcium, magnesium, and nitrogen - near the surface, in proximity to plant roots, allowing them to be taken up gradually. Without this electrical charge, the nutrients would be quickly leached away.

**Decomposition and Recycling:** Soils play a central role in the decomposition of dead organic matter and wastes. Like assembly line workers, diverse microbial species process the particular compounds whose chemical bonds they can cleave and pass along to other species the end products of their specialized reactions. The simple inorganic chemicals that results from natural decomposition are eventually returned to plants as nutrients. The ability of soils to supply nutrients to plants is largely the results of the activities of diverse species of bacteria, fungi, algae, crustacea, mites, termites, springtails, millipedes, and worms.

**Regulating Major Element Cycles:** The amount of carbon and nitrogen stored in soils dwarfs that in vegetation. Carbon in soils is nearly double that in plant matter, and nitrogen in soils is about 18 times greater. Alteration in the carbon and nitrogen cycles may over the long term be irreversible on a scale of interest to society. Increased fluxes of carbon to the atmosphere, such as occur when land is deforested or converted to farmland or when wetlands are drained, contribute to such a loss.

### Community Services

**Pollination:** Animal pollination is required for the successful reproduction of most flowering plants. More than 90% of plant species depend upon an animal for pollination, including the 70% of agricultural crop species. 100,000 different animal species are known pollinators. However, the continued availability of pollinators depends on the existence of a wide variety of habitat types that meet their needs. The diversity of natural pollinators available to both wild and domesticated plants is diminishing. More than 60 genera of pollinators include species now considered to be threatened or extinct.

**Pest Control:** Humanity's competitors for food, timber, cotton, and other fibers are called pests, and they include numerous herbivorous insects, rodents, fungi, snails, nematodes, and viruses. In addition, numerous weeds compete directly with crops for water, light, and soil nutrients, further limiting yields. Chemical pesticides can have harmful unintended consequences. Resistance to pesticides is now found in more than 500 insect and mite pests, in over 100 weeds, and in about 150 plant pathogens. Populations of the natural enemies of pests are decimated by heavy pesticide use. Natural predators are often more susceptible to synthetic poisons than are the target pest. Destruction of predator populations leads to explosions in prey numbers, not only freeing target pests from natural controls, but often "promoting" other non-pest species to pest status. Exposure to pesticides and herbicides may pose serious health risks not only to humans but also to amphibians, reptiles, and birds. Most crop pests can be controlled by natural enemies, a strategy used successfully by a growing number of organic farmers.

**Seed Dispersal:** Plants depend on seed dispersal for species movement to new sites. Many seeds have evolved ways of getting around by using animals as their dispersal agents. Some are packed in sweet fruit to encourage an animal to eat them. Others require burial for eventual germination, a service often completed by squirrels. Others have sticky or spiny surfaces to catch a ride on a passing animal before dropping or being rubbed off. Disruption of seed dispersal services may reduce the recovery of land that has been disturbed by human activity.

### **Drivers of Human Threats to the Ecosystem**

**Rapid Unsustainable Growth:** In Cumberland County and elsewhere around the globe, we are experiencing an explosive growth in population, an increase in per capita consumption, and an intensification in the environmental impacts that technologies and institutions generate as they produce and supply energy and consumables.

**Dominance of Individual Profit Over Community Well-Being:** The frequent mismatch between short-term individual economic incentives and long-term societal well-being leads to destruction of watersheds. Ecosystem services are generally greatly undervalued because they are not traded or valued in the marketplace. Most watershed services serve the public good rather than provide direct benefits to individual landowners. Private property owners often have no way to benefit financially from the watershed services supplied to society by their land. Economic subsidies often encourage the conversion of such lands to other market-valued activities. The highest and best use of a land is understood to mean its potential to generate the most economic gain.

**No Penalties and Few Incentives:** People whose activities disrupt ecosystem services often do not pay directly for the cost of these lost services. Society does not often compensate landowners and others who do safeguard watershed services for the economic benefits they lose by foregoing more lucrative but destructive land uses.

### **Valuation of Watershed Services**

**Marginal Values:** Humanity as a species would cease to exist in the absence of watershed services; thus, they have immense value. Yet society does not have the capacity to quantify the value of these services in specific localities and measure their worth against that of competing land uses. Marginal value is an emerging tool that could be used as a measure. For example, by how much would the flow of watershed services be augmented (or diminished) with the preservation (or destruction) of the next acre of forest or farmland?

**Uncertain Economic Values:** Valuing a natural ecosystem, like valuing a human life, is fraught with difficulties. It may be prudent to establish fundamental watershed protections even though uncertainty over economic values remains. The human economy depends upon the services performed “for free” by watersheds, yet their replacement costs are unaffordable. Economic development that destroys habitats and impairs watershed services can create costs to the community over the long term that greatly exceed the short term economic benefits of the development. These costs are generally hidden from traditional economic accounting, but are nonetheless real and are usually borne by society at large. A short-term focus in land-use decisions often sets in motion potentially great costs to be borne by future generations. This suggests a need for policies that achieve a balance between sustaining watershed services and pursuing the worthy short-term goals of economic development.

**Resource:** Gretchen Daily, et. al., “Ecosystem Services,” Watershed Academy (US.EPA.)

The Obed Community Association has as its purpose community appreciation and volunteer involvement in ongoing research of the natural and cultural heritage of the Obed River watershed within Cumberland County. Louise Gorenflo, OWCA director, produced this fact sheet. Those wanting to join this membership organization or more information may contact OWCA at 484-2633 or at 185 Hood Drive, Crossville, TN 38555.