Ecosystem Services in the Appalachians: the Human Landscape

The benefits that people derive from landscapes depend not only on what kinds of ecosystems are present, but also on who uses them and how. The ways in which people use and impact land depends upon social preferences and needs, and on economic and demographic patterns. Land use information is clearly important for understanding human relationships with ecosystem services, but it is not sufficient in itself. Social and economic data are also crucial, but they can be more challenging because they are rarely tailored to meet the needs of resource management and conservation efforts. Nonetheless, using these kinds of information to better understand how and why people interact with their environment can improve conservation efforts in a variety of ways, including better directing local efforts to community needs and helping promote community participation.

Demographics And Social Values

How resources are used depends on who is using them

The ways in which people obtain benefits from the landscapes around them can depend on culture, age, and many other social factors. For example, the land use preferences and opportunities of people living in rural areas can be very different from those of people in cities. Even within a single Appalachian community, the ecological benefits that different people choose to utilize vary (e.g., hunting versus bird watching). These differences can be associated with income, age, and other demographic factors.

Demographic patterns across landscapes may relate in unexpected ways to natural resource use and to the consequences of environmental change. Factors at work in Appalachia include race, income, culture and religious beliefs. Communities in poverty may lack the means to adapt to extreme weather events such as droughts and flooding, for example, and they can therefore be more vulnerable than others to climate change. Poverty can also restrict basic access to many ecosystem services such as recreational uses and even clean water. Rural Appalachian communities can be cultural repositories of traditional ecological knowledge that drive activities such as harvesting nontimber forest products (e.g., Ginseng).

Societal needs and ethics inform choices about resource use

Social values strongly shape how people interact with landscapes, because they define what kinds of ecosystem services people are interested in. Where different people hold different values, conflicts over ecosystem services can and do arise, underscoring the importance of including these considerations in land management strategies. However, finding ways to integrate social values into inclusive decision making processes can be challenging. Demographic factors have been used as proxies for social values with some success. Another strategy is to estimate monetary values for ecosystem services, for example by evaluating people's "willingness to pay" for a particular service; this translates social values into perhaps more tangible economic terms.

These efforts can be complex, because demographic and economic realities interact with social values, or preferences, in ways that are

(Duncan and Lamborghini 1994, Southern Appalachian Man and the Biosphere (SAMAB) 1996, Tarrant and Cordell 1999, Nesbitt and Weiner 2001, Tarrant and Hull 2004, Chamberlain 2006, Cho et al. 2008, Cordell et al. 2011, Lal et al. 2011, Cordell et al. 2012, US Department of Agriculture Forest Service 2012, Bowker and Askew 2013, Bowker et al. 2013, Cordell et al. 2013, Law and McSweeney 2013, Wear et al. 2013, Wickham et al. 2013, Brandt et al. 2014, Butler et al. 2014, Keyser et al. 2014, Cooper et al. 2015, Morzillo et al. 2015)

different from one community to the next. For land managers, this makes it important to consider different landscapes in terms of their unique social, as well as ecological, contexts. The complexity of conservation in Appalachia arises not only from the diversity of ecosystems in the region, but also from its varied demographics.

Demographic data can help to reveal geographic patterns in ecological benefits and risks, and how these change over time with societal shifts. Rural communities, for example, may be displaced as regions urbanize, land values rise, dominant social values shift, and land uses change. Social and ecological change are thus intertwined, and addressing the concerns of everyone involved can improve outcomes for Appalachian communities and landscapes. In summary, understanding how and why people make the decisions they do about land and natural resources is important for understanding ecosystem service use. Incorporating these realities into resource management decision-making can be an opportunity for building community consensus and improving sustainability.

Economics and Business

Economic activities depend on, and impact, nature's productivity

The primary economic activities of a region are closely intertwined with how communities interact with their natural surroundings. Just as demographic and cultural factors influence how people benefit from nature, economies influence the utilization of and impacts on natural areas and resources. Economic data contained in documents such as environmental assessments, resource demand assessments, and carbon footprint reports are all clearly connected to land management and ecosystem services.

On one hand, factors such as wealth and employment influence the abilities of people to benefit from outdoor recreation opportunities and other amenity uses of Appalachian natural areas. The ways in which people utilize forests and agricultural lands can also reflect cultural preferences, which are themselves strongly related to economic factors. On the other hand, economic activities in rural Appalachia such as surface mining and other forms of energy development are dramatic drivers of landscape change. These activities can provide economic anchors in rural areas, but they can also be regionally associated with entrenched poverty and even population decline. Other economic activities such as forestry and outdoor recreation and tourism do impact the natural environment, but they also depend on the maintenance of functioning ecosystems. Less obvious aspects of economic activity, such as infrastructure connectivity, also impact natural resource use and sustainability.

Many businesses use and affect ecosystem services directly. One premier example in Appalachia is water use—for example, water quality is very important to the brewing industry, but brewery effluent and water treatment after use can cause pollution. Unless companies make an effort otherwise, they may enjoy free ecological services like clean water

(Duncan and Lamborghini 1994, Southern Appalachian Man and the Biosphere (SAMAB) 1996, Chamberlain 2006, Fillaudeau et al. 2006, Merricks et al. 2007, Wickham et al. 2007, Cho et al. 2008, Hanson et al. 2010, Lal et al. 2011, US Department of Agriculture Forest Service 2011, Cordell et al. 2012, Jackson et al. 2012, Shifley et al. 2012, Abt 2013, Bowker and Askew 2013, Bowker et al. 2013, Chamberlain et al. 2013, Cordell et al. 2013, Wear and Greis 2013, Wickham et al. 2013, Evans and Kiesecker 2014, Keyser et al. 2014, Matthews et al. 2014)

production while ignoring costs that the landscape around them also absorbs for free. Waste disposal directly into local environments has historically been a popular and inexpensive strategy for many industries, with outcomes for human and natural communities ranging from trivial to highly detrimental. Mediating or even participating in the development of individual company conservation policies is a key opportunity for conservation stakeholders. Industry increasingly recognizes the value of this relationship, given their dependence on sustainable ecosystem services such as clean water, timber and non-timber forest products, and natural landscapes that attract outdoor recreation and tourism.

Land Use

Where people meet the land

Land use is what it sounds like—the multitude of different uses to which people put different parcels of land, including such things as agriculture, forestry, urban development, and protections for fish and wildlife. Because land use is influenced by economics, demographics, social values, and natural ecosystem properties, land use information helps to reveal how our activities are both shaped by, and impact, ecosystems. This people-land relationship is crucial for understanding ecosystem services.

Mapping economic activities in the Appalachians like agriculture, outdoor recreation, forestry, and energy development against demographic patterns, infrastructure, conservation areas, and ecosystem types can help to reveal how communities and regional populations interact with ecosystems. Agricultural land use, for example, can have both positive and negative effects on soil and water quality, depending on particular practices. Those practices may be determined by farmers' cultural preferences, wealth, and access to transportation infrastructure and markets. Different land uses can also influence one another in important ways. For example, outdoor recreation in the Appalachians helps drive the development of second homes, increasing both land values and forest fragmentation, which in turn affects additional recreational uses.

Managing these kinds of land use changes through various planning and conservation strategies can make the difference between promoting or impairing the capacities of landscapes to provide ecological services. Conservation and restoration efforts occur both inside and outside of official conservation areas like parks, and they can be difficult to map to particular land uses without additional information. For example, former mine sites in the Appalachians are subject to forest restoration requirements, but different reclamation practices can have different outcomes in terms of forest regrowth, water quality improvement, and the restoration of other ecological functions. Designated conservation areas help protect ecosystem services, but heavy recreational use in these places can compromise the sustainability of some services. In multi-use areas, sustainable harvests of non-timber forest products like wild ginseng may depend on managing land uses as diverse as mountain biking and energy infrastructure development, not to mention the harvesting activities

(Burcher and Benfield 2006, Chamberlain 2006, Burcher et al. 2007, Wickham et al. 2007, Zipper et al. 2007, Amichev et al. 2008, McTammany et al. 2008, Hanson et al. 2010, Kuhman et al. 2010, Ford et al. 2011, Kuhman et al. 2011, Lindberg et al. 2011, Zipper et al. 2011, Jackson et al. 2012, Shifley et al. 2012, US Department of Agriculture Forest Service 2012, Bowker and Askew 2013, Bowker et al. 2013, Butler and Wear 2013, Chamberlain et al. 2013, Law and McSweeney 2013, Lemke et al. 2013, Lockaby et al. 2013, Wear et al. 2013, Wickham et al. 2013, Keyser et al. 2014, Larsen et al. 2014, Matthews et al. 2014, Souther and McGraw 2014, Daniel et al. 2015, Morzillo et al. 2015)

themselves. Detailed land uses can be difficult and expensive to map, and accurate data are often only available for dominant uses such as agriculture and urban areas.

In summary, mapping land use across large landscapes can be a key source of information about ecosystem service use and sustainability, and it has rapidly become a cornerstone for understanding regional ecological change. However, it is usually at its most useful when paired with additional information about specific economic activities, management practices, and so on.

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