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REVIEW

A zoological perspective on payments for ecosystem services

Jeffrey A. McNEELY

IUCN – The World Conservation Union, Gland, Switzerland

Abstract

The concept of payments for ecosystem services is being developed as an important means of providing a more diverse flow of benefits to people living in and around habitats valuable for conservation. The Kyoto Protocol, under the United Nations Framework Convention on Climate Change, includes a Clean Development Mechanism to provide for payments for certain forms of carbon sequestration that may benefit animal species (at least as an incidental benefit). Other market-based approaches for paying for carbon sequestration services outside the Kyoto framework are being promoted in various parts of the world. Another common form of payment for ecosystem services is compensating upstream landowners for managing their land in ways that maintain downstream water quality; this can include habitat management that benefits wild animal species. While biodiversity itself is difficult to value, it can be linked to other markets, such as certification in the case of sustainably-produced forest products. This paper expands on some of the markets for ecosystem services that also benefit wildlife, identifies relevant sources of information, and highlights some of the initiatives linking such markets to poverty alleviation. Making markets work for ecosystem services requires an appropriate policy framework, government support, operational institutional support, and innovation at scales from the site level to the national level. Zoologists have much to contribute to all of these steps.

Key words: biodiversity, carbon trading, ecosystem services, payments, watersheds.

INTRODUCTION

The Millennium Ecosystem Assessment (MA) offers a productive framework for communicating environmental issues more effectively to decision makers, through a broader consideration of the benefits of ecosystems for people (Millennium Ecosystem Assessment 2005). These so-called "ecosystem services" include:

- provisioning services: goods produced or provided by ecosystems, such as food, fresh water, fuel wood, and genetic resources (including wildlife)
- regulating services: the benefits obtained from regulation of ecosystem processes, such as the regulation of pollinators, climate, diseases, nutrients, and extreme natural events
- cultural services: the non-material benefits from ecosystems, including spiritual, recreational, esthetic, inspirational, and educational benefits; in many ways, these cultural services help to define who we are as citizens of our respective countries
- supporting services: the services necessary for the production of the other ecosystem services, which include soil formation, nutrient cycling, primary production, carbon sequestration, and so forth.

The approach taken by the MA implies that ecosystem services have value to people, which in turn implies that these ecosystem services have an *economic* value that can be internalized in economic policy and the market system. Some of these services are relatively easy to quantify,

Correspondence: Jeffrey A. McNeely, Chief Scientist, IUCN – The World Conservation Union, 1196 Gland, Switzerland. Email: jam@iucn.org

which facilitates the estimation of their economic value and the development of appropriate market incentives. Others are more abstract, but are nonetheless valuable. For example, developing a market for non-use values of biodiversity (such as existence value) can be extremely challenging, especially when lack of resource tenure discourages people from caring about biodiversity. Current markets are often imperfect, so in this paper I will describe some new approaches to building efficient markets for ecosystem services that can benefit wild species (either intentionally or as an "accidental" benefit).

All ecosystem services are supported by biodiversity, which includes the full range of genes, populations, species, communities, and ecosystems. The MA did not consider biodiversity conservation to be an ecosystem service on its own. Nonetheless, conserving biodiversity provides many values because genes, species, habitats, and ecosystems support the provision of numerous services, such as producing trees and other plants, enabling genetic resources to continue evolving, and providing attractions for the tourism industry. However, the multiple relationships between biodiversity and ecosystem services remain only partially understood and are areas of active research (Cardinale *et al.* 2006).

Together, the ecosystem services contribute to the constituents of human wellbeing, which include security, basic material for a good life, health, good social relations, and the ability to make choices on how to live one's life. This model demonstrates to decision makers how important ecosystem services, and the biodiversity that supports them, are for all aspects of human development. Ecosystem services also underlie virtually all of the Millennium Development Goals approved by the governments of the world at the 2000 Millennium Summit (UN Millennium Project 2005), though this link has not yet been clearly stated.

The concept of ecosystem services also implies that those who are providing the services (in the past, often as a public good) deserve to be compensated when they manage ecosystems to deliver more services to others. Payment of conservation incentives can reward forest managers, pastoralists, and farmers for being good stewards of the land, and ensure that payments are made by those who are receiving benefits. Similarly, those who degrade ecosystems and reduce the supply of ecosystem services should be expected to pay an appropriate level of compensation for the damage they cause, in line with the "polluter pays" principle.

People who live close to nature know better than anyone that a healthy, resilient ecosystem rich in species is essential for a productive and profitable ecosystem. Basing the conservation of ecosystem services on economic incentives recognizes the capacity of managers to care for the land, and it supports practices that may not necessarily provide the greatest short-term financial return, but pay off in the longer term through greater sustainable flow of benefits and the capacity to adapt to changing conditions. With appropriate incentives, rural people can become land managers as well as commodity producers, ensuring that areas under their control are sustainably managed to provide multiple ecosystem benefits.

VALUES OF ECOSYSTEM SERVICES

Assessing the economic values of ecosystem services remains very much a work in progress (Boyd & Banzhaf 2005). However, some detailed estimates have been made, and a few of these are presented here. In the relatively small US state of Massachusetts, the annual value of non-market ecosystem services is over US$6.3 billion annually, in addition to the US$1.9 billion from marketed ecosystem services. Saltwater wetlands were found to have extremely high value per unit area (Mass Audubon 2003).

The value of pollination services has not been estimated at a global level, but some indications are available. For example, the value of pollination to alfalfa seed growers in the Canadian prairies is estimated to be 35% of annual crop production (Blawat & Fingler 1994), amounting to a value of about US$8 million per year. The value of native pollinators to the agricultural economy of the US is estimated to be in the order of at least US$4.1 billion per year (Southwick & Southwick 1992). In Costa Rica, forest-based pollinators were found to increase coffee yields by 20% within 1 km of forest, and improve coffee quality as well. Pollination services from two forest fragments of 46 and 111 ha yielded a benefit of US$60 000 per year for one Costa Rican farm (Ricketts *et al*. 2004). The study of pollinators may be of growing interest to zoologists, as dramatic decline in their populations are beginning to plague agriculture; zoologists may help solve the riddle of disappearing pollinators before it is too late.

A 1994 independent study of the water catchment of Melbourne, Australia, found that the value of clean fresh water outweighs that of the timber in the forest. It showed that extending the current harvest rotation from 80 to 200 years would deliver benefits of US$81 million, whereas shorter 20-year rotations would decrease the benefits derived from the catchment by US$525 million and require a US$250 million water treatment plant to be built.

These figures clearly indicate the value of maintaining forests in Australia, to the benefit of the species that occupy the forests. More details on water values can be found in Emerton and Bos (2004).

The value of carbon sequestration in forests has received considerable attention (for example, Swingland 2003). The value of the tropical forests contained in 10 tropical countries was estimated at US$1.1 trillion on the basis of carbon stored, using the then-current rate of US$20 for a 1-t unit of carbon dioxide (rather high: the first buyers in Asia offered $4–7 per ton; Mongabay.com 2005). Lubowski *et al.* (2005) concluded that about one-third of the US target under the Kyoto Protocol (if it had ratified the protocol) could have been cost-effectively achieved by forest-based carbon sequestration that would benefit biodiversity. At a global scale, some US$11.3 billion worth of carbon credits were traded on the international market in 2005.

Most ecosystem services have been seen as public goods that benefit large groups of people and resist private ownership, much like biodiversity. A major challenge is to align private incentives with the public interest. For detailed references on payments for ecosystem services, see Pennington (2005). A useful valuation website is http://www.naturevaluation.org.html.

MARKETS FOR ECOSYSTEM SERVICES

Over the past 10 years or so, markets and other payments for forest ecosystem services have emerged in many parts of the world (Pagiola *et al.* 2005; Wunder 2005). For example, Landell-Mills and Porras (2002) identified 287 initiatives for forest ecosystem service payments, 61 of which were specifically associated with watersheds that also benefited biodiversity. The emergence of these markets has been driven by frustration with traditional government regulatory approaches, growing recognition of the limits of the contributions that protected areas can make to conserving biodiversity, the demands of society for ecologically sound and sustainably grown products, and the need for forest-based industries to find additional revenue sources to remain competitive. The expectation is that such markets can contribute to forest protection and restoration and become a sustainable source of new income for the forest-dependent poor who occupy a large share of the world's forests (Scherr *et al.* 2005).

In the present paper I discuss five categories of market and payment schemes: (i) eco-labeling of forest or farm products, an indirect form of payment for ecosystem services; (ii) open trading under a regulatory cap or floor, such as carbon trading or mitigation banking; (iii) user fees for environmental and cultural services, such as hunting licenses or entry to protected areas; (iv) public payment schemes to private forest owners to maintain or enhance ecosystem services, such as "conservation banking" and watershed protection; and (v) biodiversity offsets: conservation activities intended to compensate for the residual, unavoidable loss of biodiversity caused by development projects.

Eco-labeling

Many certification schemes are being used as an incentive for both producers and consumers. Perhaps the best established is the Forest Stewardship Council (FSC), which has been working for well over a decade (see http://www.fsc.org). Over the past decade, some 50 million ha in more than 60 countries has been certified according to FSC standards. Several thousand products have been produced using FSC-certified wood and carry the FSC trademark. Using consultative processes, it sets international standards for responsible forest management and accredits independent third party organizations who are authorized to certify forest managers and forest product producers to FSC standards. Its trademark provides international recognition to organizations that support responsible forest management and allows consumers to recognize products that have been responsibility produced. The FSC membership includes a wide range of social, community, and indigenous groups as well as responsible corporations (such as IKEA), development aid agencies, and other public organizations. In several countries, companies have formed "buyers groups" that have committed themselves to selling only independently certified timber and timber products. The FSC-labeling scheme is preferred by at least some buyers groups in Japan, the UK, the Netherlands, Belgium, Austria, Switzerland, Germany, Brazil, and the USA. Other forest labeling schemes are also in operation, such as the Programme for the Endorsement of Forest Certification (PEFC; http://www.pefc.org) and regional initiatives based on the international forestry management standard ISO 14001.

Organic products have long been labeled, and the organic movement, through its International Federation of Organic Agriculture Movements (IFOAM; http://www.ifoam.org), is seeking to ensure that organic farming is also biodiversity-friendly. The global organic market was worth more than US$35 billion in 2006 and is

expected to reach US$133.7 billion by 2012, with the greatest growth in China (although credible certification remains a limitation). Other eco-friendly labels are also being used; for example, shade-grown coffee (which has been shown to benefit biodiversity; Perfecto *et al.*, 1996; Blackman *et al.*, 2005) has a market of US$5 billion in the US alone.

For more on certification, see http://www.certificationwatch.org.

Carbon sequestration and trading

The most widespread of the marketed ecosystem services is carbon sequestration. Forests, grasslands, and other ecosystems remove carbon dioxide from the atmosphere through the storage of carbon as part of the process of photosynthesis. A reasonably prosperous industry has been established in trading certified emission reductions within the Clean Development Mechanism (CDM) of the Kyoto Protocol or verified carbon emission reductions (CERs) outside of the Kyoto regime (see, for example, Swingland 2003). The carbon market is substantial, with 64 million metric tons of carbon dioxide equivalent exchanged through projects (most transactions intended for compliance with the Kyoto Protocol) between January and May 2004, nearly as much as during the whole of 2003 (78 million tons) (Lecooq 2004). Japanese companies are the largest market buyers, with 41% of the 2003–2004 market, and Asia is the largest seller of emission reduction projects, accounting for 51% of the volume supplied.

The Kyoto-compliant carbon emission offset market is expected to grow to a minimum of 15 million tons of carbon dioxide in 2008–2012 (Scherr *et al.* 2005). The European Union Emissions Trading Scheme began in 2005, with futures and spot contracts trading on several exchanges across Europe. The scheme is used mostly by the high-emission power and steel sectors. The European carbon market is now being linked to CDM projects in Asia, including Asia Carbon Global activities in China, India, Vietnam, and Indonesia. It is not clear how these payments are affecting forest carbon sequestration, or biodiversity. The International Emissions Trading Association (http://www.ieta.org) is a useful source of information on these issues.

Carbon taxes also affect forest management. Joining several other countries that have already imposed a carbon tax, the Ministry of the Environment in Japan unveiled a plan on 25 October 2005 for a carbon tax aimed at curbing global warming. The tax will be levied on carbon contained in fossil fuels, with the tax amounting to 2400 yen per ton of carbon contained in fuels. It is not clear how the funds raised will be used to address global warming, but many hope that this will include carbon sequestration projects affecting forests and their biodiversity (Japan for Sustainability 2006a).

At the Ninth Conference of Parties of the Climate Change Convention in 2005, a group known as the Coalition for Rainforest Nations, consisting of Papua New Guinea, Costa Rica, Chile, Gabon, and a dozen others, proposed that parties explore potential new mechanisms to encourage conservation of *existing* forests under the United Nations Framework Convention on Climate Change (UNFCCC). Parties agreed to discuss this potential further, and it is widely recognized that conservation of old-growth forests is the most cost-effective means of sequestering carbon (and keeping it sequestered). Avoidance of deforestation is likely to become a significant area of discussion for post-Kyoto efforts to reduce (or at least stabilize) atmospheric carbon dioxide; biodiversity will be a major beneficiary if this approach were to materialize.

Payments for cultural services

Among the many cultural services ecosystems support are the provision of scenic beauty and other esthetic values that contribute to recreation, tourism, and a sense of identity of place to those who have long lived in a particular locality. Biodiversity is a major contributor to cultural services. One mechanism to finance scenic beauty and biodiversity is through entrance fees to protected areas: a “user pays” market approach. Numerous other ways of paying for protected areas are discussed in Quintela *et al.* (2004) and on the Conservation Finance Alliance website (http://www.conservationfinance.org).

Rural people may require government-supported payments to encourage them to protect habitats or endangered species (Fox & Nino-Murcia 2005). Species conservation banking – the creation and trading of “credits” that represent biodiversity values on private land – is about a decade old. In the US, for example, some 76 properties are identified as conservation banks but only 35 of these have been established under a Conservation Banking Agreement approved by the US Fish and Wildlife Service (USFWS; Fox & Nino-Murcia 2005). The 35 “official” conservation banks cover 15 987 ha and support more than 22 species listed under the US Endangered Species Act. Financial motives drove the establishment of 91% of the conservation banks, and a majority of for-profit banks are breaking even or making money. With credit prices ranging from US$7000 to

US$325 000 per hectare, banking agreements offer financial incentives that compete with development and provide a business-based argument for conserving habitat. Although the bureaucracy of establishing an agreement with the USFWS was burdensome, nearly two-thirds of bank owners reported that they would set up another agreement given the appropriate opportunity. Increasing information sharing, decreasing the time to establish agreements (currently averaging 2.18 years), and reducing bureaucratic challenges can further increase the amount of private property voluntarily committed to banking. While many ecological uncertainties remain, conservation banking can offer at least a partial solution to the conservation versus development conflict over biodiversity.

The International Habitat Reserve Programme (IHRP) is a system of institutional arrangements that facilitates conservation contracting between national or international actors and individuals or groups that supply ecosystem services. The IHRP involves a contract that specifies that the outside agents will make periodic payments to local actors if a targeted ecosystem remains intact or if target levels of wildlife remain in the ecosystem (Ferraro 2001).

Watershed protection

Another very well known ecosystem service is watershed protection, often linked to forests and the biodiversity they support. Watershed services are far more numerous and complex than is usually appreciated, and provide numerous kinds of benefits to people, including the rural poor (Dyson *et al*. 2003). A partial list includes:

- provision of water for consumptive uses, such as drinking water, agriculture, domestic uses, and industrial uses
- support of non-consumptive uses such as hydropower generation, cooling water, and navigation
- storage of water in soils, wetlands, and flood plains to buffer floods and droughts
- control of erosion and sedimentation, which can benefit productive aquatic systems
- maintenance of a flow of water required to enable river dynamism, riparian habitats, fisheries, and water management systems for rice cultivation and fertilization of flood plains
- maintenance of mangroves, estuaries, and other coastal ecosystems that may require fresh water infusions
- control of the level of groundwater tables, potentially preventing adverse effects on agriculture by keeping salinity far below the surface
- maintenance of water quality that may have been reduced through inputs of nutrients, pathogens, pesticides, fertilizers, heavy metals, or salinity
- support of cultural values including esthetic qualities that support tourism and recreational uses as well as supporting traditional ways of life and providing opportunities for adapting to changing conditions.

The services provided by forests protecting watersheds overlap with many other ecosystem services, indicating that synergies can be realized through improved management of forest systems. Many of these services have market values, while others have non-market values that are nonetheless significant.

Many countries in various parts of the world are developing mechanisms for collecting payments for watershed protection. Some of these are:

- Brazil: A water utility in Sao Paulo pays 1% of total revenues for the restoration and conservation of the Corumbatai watershed. The funds collected are used to establish tree nurseries and to support reforestation along riverbanks.
- Costa Rica: A hydropower company pays US$10 ha^{-1} $year^{-1}$ to a local conservation non-governmental organization for hydrological service in the Peñas Blancas watershed. In the town of Heredia, the drinking water company earmarks a portion of water sales revenue for reforestation and forest conservation.
- Ecuador: Municipal water companies in Quito, Cuenca, and Pimampiro impose levies on water sales, which are invested in the conservation of upstream areas and payments to forest owners (Landell-Mills & Porras 2002).
- Lao PDR: The Phou Khao Khouay Protected Area currently receives 1% of the gross revenues from a downstream hydropower dam, and the Nam Theun 2 hydropower project is expected to provide more than US$1 million per year for the management of the Nakai-Nam Theun Protected Area.
- Japan: The Kanagawa Prefectural Assembly adopted an ordinance in October 2005 that will impose an additional residence tax to be used exclusively for protecting water sources, with the funds going to projects aimed at conserving and restoring forests and rivers. The new tax will be introduced in April 2007 and continue for 5 years (Japan for Sustainability 2006b).
- Colombia: In the Cauca valley, water user associations have assessed themselves additional charges and used

the revenue to finance conservation activities in their watershed areas (Echevarria 2002).

IUCN has just begun a 3-year project in Vietnam (with USAID funding) to design and initiate a payment for an environmental services scheme for Don Nai watershed/Cat Tien National Park. Payment for ecosystem services will include partnerships with Coca Cola (for water payments) and Masterfoods/Snickers (for payments for shade/organic grown cocoa).

The value of watershed services will depend on:

- maintaining the integrity of ecosystem functions or processes that support the watershed protection service
- the scale at which the benefits from watershed protection have economic significance
- the effectiveness of the institutional arrangements that have been put in place to ensure provision and access, including such issues as land secure tenure (Tognetti *et al.* 2005).

Payments for watershed services are often politically popular, as the value of water is well-recognized. Regular information on recent developments in this field is available from http://www.flowsonline.net. Linking watershed protection services with improved livelihoods is the objective of a project carried out by the International Institute for Environment and Development (IIED) in London (International Institute for Environment and Development 2005).

Biodiversity offsets

Payments to protect habitats come not only from government – for example, highway departments that need to offset habitat loss due to road building – but also from private developers who need to offset habitat loss arising from residential, commercial, or industrial development. The main role of government in these cases is to regulate offsets so as to ensure that the policy goal of no net loss of habitat is being met, and that the "exchange rate" uses the proper currency (for example, not just area, but also ecosystem function and habitat for key species). Based on broad consultation among government officials, academic organizations, non-governmental organizations, and representatives of the private sector, ten Kate *et al.* (2004) found broad support for the idea of biodiversity offsets. Offsets can enable companies to undertake projects that might otherwise not be possible, provide a practical tool for managing social and environmental risks and liabilities, reduce costs of compliance with environmental regulations, and provide strategic opportunities in the new markets and businesses that emerge as biodiversity offsets become more widespread. For environmental regulators and policy-makers, offsets provide a means to ensure that development projects designed to meet the growing demand for minerals, food, fiber, energy, and transport are nonetheless planned in the context of sustainable development and can appropriately balance the costs and benefits of biodiversity conservation and economic development. For conservation organizations, offsets provide a way to ensure better conservation outcomes when they can trade areas of natural habitat that have relatively low value for conservation for other sites that may be more valuable because of their location (for example, a corridor linking two protected areas). Offsets can also help integrate conservation into development planning in countries that are under heavy pressure for resource exploitation while giving greater economic value to biodiversity. Finally, local communities affected by development projects can benefit from offsets that leave a legacy of properly rehabilitated project sites and provide additional conservation benefits in the surrounding area.

Although offsets can provide substantial benefits, they are often controversial because they may not deliver on their promises. Some conservation groups may oppose the concept in principle, while developers may be concerned about the costs of compensation. ten Kate *et al.* (2004) conclude that these risks, and others, "point to the need for credible and transparent standards, methodologies and guidelines for biodiversity offsets, if the approach is to be adopted more widely." Zoologists can play an important role in ensuring that the biodiversity offsets provide a net benefit to conservation and help to provide the best available sources of information to the private sector.

A non-marketed value: protection against extreme natural events

Recent human disasters caused by extreme natural events, including the 2004 Indian Ocean tsunami and the 2005 Kashmir earthquake, have demonstrated the value of intact ecosystems in reducing the impact of such extreme natural events on human wellbeing. In the case of the tsunami, intact coral reefs and mangroves greatly reduced the negative impact of the tsunami on people (Danielsen *et al.* 2005), and in Kashmir, slopes that remained forest-covered suffered far less landslide damage than those where forests had been willfully over-exploited.

The value of ecosystem services to protect human wellbeing against the implications of such extreme natural events is seldom quantified as no market exists for them, but the implications in terms of human fatalities, economic disruptions, and social disruptions carry a very real cost: in the two events mentioned above, human fatalities totaled over 300 000 and the economic costs of restoration exceed US$5 billion. Such costs need to be better quantified and incorporated in decision-making that affects ecosystem functioning. These costs were externalized in Kashmir and along the coasts of the Indian Ocean, to the great detriment of the people living there. One element in the payment for ecosystem services, therefore, is to avoid expenditures that lead to ecosystem destruction or degradation.

BUILDING MARKETS FOR FOREST ECOSYSTEM SERVICES

As seen above, many systems of paying for ecosystem services are supported by taxes. The US Conservation Reserve Program is funded through general tax revenue. Costa Rica's National Fund for Forest Financing (FONAFIFO), a program of payments for ecosystem services that includes protection of watersheds, is in part funded by a fuel tax, with the remainder funded through payments from beneficiaries; for example, tourism agencies pay for biodiversity and landscape beauty, and foreign energy companies purchase carbon offsets. Watershed management in Colombia is partly funded through a 6% tax on the revenue of large hydroelectric plants (Tognetti *et al.* 2005).

In New South Wales, Australia, the Forest Department has initiated an Environmental Services Scheme that compensates land owners through credits for multiple benefits of forests, including biodiversity, carbon sequestration, soil conservation, and protection of water quality that offsets the rise in salinity levels (State Forests of New South Wales 2004).

In support of the implementation of the Millennium Development Goals, the World Bank and Organisation for Economic Co-operation and Development (OECD) have promoted environmental fiscal reform (EFR), stressing that poverty reduction and improved environmental management go hand-in-hand. They advocate a range of taxation or pricing instruments that can raise revenue while simultaneously furthering environmental goals. This is achieved by providing economic incentives to correct market failures in the management of natural resources and the control of pollution (World Bank 2005). They believe that EFR can mobilize revenue for governments, improve environmental management practices, conserve resources, and reduce poverty. EFR includes a wide range of economic instruments, including:

- taxes on natural resource use (for example, forestry and fisheries) that will reduce the inefficient exploitation of publicly owned or controlled natural resources that results from operators paying a price that does not reflect the full value of the resources they extract
- user charges or fees and subsidy reform that will improve the provision and quality of basic services such as water, while providing incentives to reduce any unintentional negative environmental effects arising from inefficient use
- environmentally related taxes that will make polluters pay for the "external costs of their activities and encourage them to reduce these activities to a more socially desirable level."

Payment for environmental services may also have some hidden dangers. For example, if payments for ecosystem services become commonplace, this may risk eroding the sense of an environmental duty of caring for natural resources and managing them sustainably. It may even discourage private investment in the environment by creating the impression that environmental stewardship is the duty of governments rather than individuals (Salzman 2005). Other potential dangers to consider include rent-seeking behavior, where certain individuals may exaggerate their potentially negative impacts on ecosystem services in hopes of gaining greater compensation. Others are concerned that at least some subsidies may pay the recipients for precisely the behavior that the subsidies are seeking to overturn. Payments for ecosystem services also need to be provided equitably, so that those who are already providing an ecosystem service are paid as well as those who are expected to change their behavior to come into conformity with the provision of the service (for example, watershed protection). But in any case, the establishment of an appropriate system of payments for ecosystem services will certainly change the perception of rural people about how they should manage their land.

The issue of payment for ecosystem services is still in its infancy, and further experimentation and research is required involving interdisciplinary teams of zoologists, economists, ecologists, and entrepreneurs to determine what ecosystem functions support the provision of specific benefits, how their key parameters can be measured or estimated, and how efficient economic incentives can be created to encourage the sustainable supply of eco-

system services.

CAPTURING THE WILLINGNESS TO PAY

As with any ecosystem service, it is essential to establish an enabling framework for any transactions that include payments. The ecosystem services are provided by those who own or manage the ecosystem. The markets for ecosystem services often work through an intermediary who issues certificates for the ecosystem services, with a verifier who controls and monitors the sustainable management of the ecosystem providing the services. The buyer of certificates from the intermediary is the source of financial resources into the system. The intermediary plays a critical role in managing the transaction, though of course it is also possible for the owner or manager of the ecosystem to provide the services directly to the buyer and to receive the funding immediately.

Formal legislation is not always necessary. For example, most certification is voluntary, yet the system seems to work relatively well and meets a market demand. And in the case of carbon, at least, the Kyoto Protocol provides a supporting policy framework.

The certificates that are issued can represent units such as hectares of the ecosystem that is providing the service, tons of carbon being sequestered, area of crops being pollinated, cubic meters of clean water being provided, or amount of certified timber being produced. A system of certificates for ecosystem services may enable them to be traded, as carbon sequestration certificates are now on the market in many parts of the world.

INSTITUTIONS SUPPORTING PAYMENTS FOR ECOSYSTEM SERVICES

A group of international organizations has formed an international working group composed of leading experts from forest and energy research institutions, the financial world, and environmental non-governmental organizations that is dedicated to developing markets for some of the ecosystem services provided by forests. Known as the Katoomba Group (http://www.katoombagroup.org), it seeks to address key challenges for developing markets for the ecosystem services discussed above. It builds on the knowledge and experience of network members in the fields of establishing new market institutions, developing strategies for pricing and marketing, and monitoring the effects of such measures.

Serving as a source of ideas on ecosystem markets and providing strategic information on them, the Katoomba Group provides a service where providers and beneficiaries of ecosystem services can work together to capture the benefits associated with ecosystem services. It has also established a global information service to report on developments in new ecosystem service-based markets (http://www.ecosystemmarketplace.com).

Not everyone supports “conservation banking” if it is used to offset damage to old-growth forests. While money to support thinly-stretched conservation activities is always welcome, some worry that even the best-managed habitat “banks” can seldom supply the range of services provided by the ecosystems whose destruction they are meant to offset. Many habitats, and the biodiversity they support, may simply be irreplaceable, and for these it is often best to establish and effectively manage classic protected areas (which now cover approximately 12% of the world’s land area); but even these areas can be seen to provide multiple ecosystem services that can be valued.

An essential element to the effective functioning of any market is access to information. Generating a market for ecosystem services will require knowledge about the values and functions of the various services. One effort to provide such information is the Conservation Commons (http://www.conservationcommons.org), a cooperative effort of non-governmental organizations, international and multilateral organizations, governments, academia, and the private sector, to improve open access to data, information, and knowledge related to the conservation of biodiversity, including ecosystems.

CONCLUSIONS

Ecosystem services have four major market characteristics:

- First, payments have grown dramatically over the past decade and are especially significant to low-income producers. Some ecosystem services are not yet linked to significant commodities, but instead support niche markets for products of special value to a narrow range of buyers. Scherr *et al.* (2005) estimate the annual value of direct payments through ecosystem markets in tropical countries is in the order of hundreds of millions of US dollars, while indirect payments via eco-labeled products such as certified timber generates several billion dollars per year.
- Second, markets for forest ecosystem services are expected to grow quickly over the next 20 years. The potential for increased demand for watershed services is immense, providing significant opportunities for

increased payments. The growth of these markets can generate new forms of financing and open up new opportunities for non-extractive management regimes for forest ecosystems and the biodiversity they support.

- Third, governments play a critical role as the direct buyers of many ecosystem services and catalysts for many private sector direct payment schemes. Since many ecosystem services are public goods, government intervention may be required to establish a market. This may entail directly paying for a service, establishing property rights, or establishing regulations that set caps and govern trading schemes.
- Fourth, ecosystem service payments will usually cover only a modest share of the costs of good ecosystem management, but this contribution can be important in conserving biodiversity. The prices of ecosystem services are not yet sufficient to justify conservation in areas with moderate to high opportunity costs for the land. Even so, these payments can have a disproportionate catalytic effect on forest establishment and management of ecosystems important for biodiversity conservation (Scherr *et al.* 2005).

In order to enable payments for ecosystem services to become a significant part of rural economies, several strategic policy issues need to be addressed. These include:

- Property rights and national legal frameworks are required to enable ecosystem service markets to develop. Such steps are often politically contentious and costly, yet they are fundamental to establishing payment schemes of any type.
- Zoologists need to generate more information about the functioning of ecosystems, and the multiple contributions of biodiversity to these functions.
- Markets for ecosystem services will contribute substantially to poverty alleviation only if proactive efforts are made to recognize rights and establish markets that will provide equal access to low-income producers of ecosystem services (Landell-Mills & Porras 2002). Rules governing the market tend to be set by the more powerful sectors of society who have the capital and capacity to invest in designing the rules, thereby marginalizing the rural poor who most require assistance to be brought into the market.
- New market institutions are needed to reduce transaction costs and financial risks. It is often helpful to provide intermediaries between buyers, sellers, investors, certifiers, and other key groups in the value chain.
- Information about ecosystem service markets is scarce and the capacity to assess and develop markets is currently limited. Few national, provincial, or local government entities have access to the information needed to shape policy on market design. Realizing the potentials of ecosystem service markets will require leading organizations to fill these knowledge gaps.

In the present paper I have briefly introduced the vast topic of payments for ecosystem services. Applying the principles and examples outlined here to the specific needs of any specific country will require information and analysis, policy support, and political will. The result will be better-managed ecosystems and more prosperous rural people: comprehensive, harmonious, and sustainable development to which zoologists can make important contributions.

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