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Ecomarkets for conservation and sustainable development in the coastal zone

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ABSTRACT

Because conventional markets value only certain goods or services in the ocean (e.g. fish), other services provided by coastal and marine ecosystems that are not priced, paid for, or stewarded tend to become degraded. In fact, the very capacity of an ecosystem to produce a valued good or service is often reduced because conventional markets value only certain goods and services, rather than the productive capacity. Coastal socio-ecosystems are particularly susceptible to these market failures due to the lack of clear property rights, strong dependence on resource extraction, and other factors. Conservation strategies aimed at protecting unvalued coastal ecosystem services through regulation or spatial management (e.g. Marine Protected Areas) can be effective but often result in lost revenue and adverse social impacts, which, in turn, create conflict and opposition. Here, we describe 'ecomarkets' – markets and financial tools – that could, under the right conditions, generate value for broad portfolios of coastal ecosystem services while maintaining ecosystem structure and function by addressing the unique problems of the coastal zone, including the lack of clear management and exclusion rights. Just as coastal tenure and catch-share systems generate meaningful conservation and economic outcomes, it is possible to imagine other market mechanisms that do the same with respect to a variety of other coastal ecosystem goods and services. Rather than solely relying on extracting goods, these approaches could allow communities to diversify ecosystem uses and focus on long-term stewardship and conservation, while meeting development, food security, and human welfare goals. The creation of ecomarkets will be difficult in many cases, because rights and responsibilities must be devolved, new social contracts will be required, accountability systems must be created and enforced, and long-term patterns of behaviour must change. We argue that efforts to overcome these obstacles are justified, because these deep changes will strongly complement policies and tools such as Marine Protected Areas, coastal spatial management, and regulation, thereby helping to bring coastal conservation to scale.

Key words: ecomarkets, incentives, ecosystem services, property rights, coastal spatial planning and management, coastal conservation, marine conservation, ocean conservation.

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I. INTRODUCTION

Coastal ecosystems such as salt marshes, seagrasses, coral reefs, mangrove forests, and upwelling zones provide myriad services for society. These include provisioning (e.g., seafood, fibre, timber), regulatory (e.g. waste assimilation, carbon sequestration), and cultural (recreational, aesthetic, and spiritual benefits) services as well as processes that support the production of these services, such as photosynthesis and nutrient cycling (Agardy *et al.*, 2005; UNEP, 2006). Despite the enormous importance of these services for maintaining biodiversity, human welfare, and indeed life on earth, many coastal ecosystems have been destroyed and many others are being degraded, resulting in a substantial reduction in the quantity and quality of the ecosystem services they provide. According to the Millennium Ecosystem Assessment, approximately 60% of ecosystem services are degraded or used unsustainably, including capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests (Agardy *et al.*, 2005).

At the global scale, a recent synthesis suggests that over a third of the ocean is heavily impacted by human activities (Halpern *et al.*, 2008). Overfishing, high bycatch rates, and habitat damage from fishing gear has depleted many fish stocks and reduced food security (Pauly *et al.*, 2003; Srinivasan *et al.*, 2010). Coastal development results in the cutting of mangrove forests and the filling of salt marshes (Adam, 2002; Alongi, 2002). Dams eliminate important flood flows, interrupt salinity regulation, and eliminate connectivity with floodplains and upland ecosystems (Ligon, Dietrich & Trush, 1995). Sewage pollution and poor land use resulting in erosion, as well as anomalously high water temperatures, are degrading coral reefs (Bryant *et al.*, 1998). Moreover, most coastal ecosystems are subject to multiple impacts (Halpern *et al.*, 2008).

What is causing these adverse outcomes? All outcomes have both proximate and ultimate drivers or causes. Proximate drivers are directly linked to outcomes; for example, excessive use of fertilizer is a proximate cause of nutrient pollution and eutrophication. But proximate drivers are often themselves effects of other drivers. Excessive use of fertilizer can be the result of low fertilizer prices and the lack of feedbacks from the adverse effects of the pollution to the fertilizer user. By repeatedly asking 'why', one can arrive at ultimate drivers; e.g. 'why are farmers using so much fertilizer; why are fertilizer prices so low?' The ultimate drivers of the widespread loss of coastal ecosystem services are less clear than the proximate drivers and thus more difficult to address. However, failure to identify and reverse these ultimate drivers may seriously impede the scaling up of conservation efforts that will be necessary to maintain and restore these services. This is because addressing the symptoms without changing the ultimate drivers creates conflict and incentives for circumventing regulations in order to meet the needs or desires that are motivating the harmful activities. In our fertilizer example, addressing the proximate driver with a ban on nutrient pollution or regulations prescribing the amounts of fertilizer farmers may use may not reduce nutrient pollution, if low fertilizer prices and lack of feedback (negative consequences to the farmer) continue to incentivize excessive fertilizer use. What are the ultimate drivers of coastal ecosystem degradation?

Lack of awareness and of accurate information can of course result in actions that unintentionally harm coastal ecosystems (Van Beukering & Cesar, 2004). In other cases, people are fully aware of the consequences of their actions, but still take actions that harm coastal ecosystems. The lack of sustainable alternatives to extractive activities is also a driver of ecological degradation (Barbier & Cox, 2003). These drivers of human impact on coastal ecosystems can largely be addressed with conventional tools such as educational campaigns, poverty alleviation initiatives, and microfinancing to facilitate the development of alternative livelihoods.

Economists have long held, however, that certain features of existing economies and markets create strong incentives for short-term extraction of natural resources at the expense of long-term ecosystem health (Gordon, 1954; Clark, 1973) and hence drive ecosystem degradation. While some common property problems have been successfully solved through cooperative efforts, the persistence of environmental degradation and resource depletion, along with the emergence of new common property problems like climate change, call for new approaches that can be scaled up (Stavins, 2010). Here, we describe one view of what the ultimate drivers of coastal ecosystem degradation might be and some potential ways to address them, in the hope that reversing these ultimate drivers and creating appropriate incentives will result in more pervasive stewardship at scales commensurate with the problem of coastal ecosystem degradation.

II. CONVENTIONAL MARKET FAILURE

One key feature of markets that appears to drive coastal ecosystem degradation is that typically only a few of the many goods and services that coastal ecosystems produce are valued (priced) by markets (Daily, 1997; McLeod *et al*., 2005). For example, people will pay for seafood, but generally not for biodiversity or for the quite salient service of protection from flooding provided by salt marshes and mangrove forests. Markets fail to provide strong signals about the value of most ecosystem services, the benefits of conserving them, and the costs of activities that degrade them. This encourages short-term exploitation of priced services at the expense of unpriced ones. In some cases, the value of a portfolio of ecosystem services is recognized (if not priced), but goods and services that can yield benefits in the short term are extracted at the expense of goods and services that yield benefit over a longer time horizon (Sanchirico, Smith & Lipton, 2008; Stronza, 2009). Long-term benefits can be realized through better management systems. For example, resource managers in the Chesapeake Bay could have increased long-term revenues from fishing by adopting a portfolio approach that explicitly recognized the value of interactions among species (Sanchirico *et al*., 2008). Placing short-term gain ahead of long-term benefit can result from poverty, an urgent need for resources or revenues, or a perception that this is the only path to economic development.

Degradation of ecosystem services is a market failure that likely stems from the inflexibility of established markets to incorporate the full spectrum of ecosystem goods and services. Some ecosystem services are rival and excludable, meaning that use by one user reduces availability for others and that one user can exclude others. These types of services, such as timber and fibre, are termed market goods and services, and have been the easiest to price and incorporate into markets. Unfortunately, many other ecosystem goods and services are rival and non-excludable (meaning that users cannot exclude others). These services are open access resources, such as pollution assimilation and fish in the ocean. Open access resources are amenable to cooperative solutions and market solutions such as tradable pollution reduction obligations/credits and catch shares that restrict access and clarify rights and responsibilities. Still other goods and services are non-rival at low use levels (CO_2 storage) and but become rival goods with high use (Fisher, Turner & Morling, 2009). This spectrum of ecosystem goods and services – from 'pure public' to 'open access' to 'club' to 'private' – fundamentally impacts market integration of ecosystem goods and services. Each category of good is associated with unique market interactions, governance structures and institutions, and resource users, and hence requires unique solutions (Fisher *et al*., 2009).

A second ultimate driver of coastal ecosystem degradation is the fact that economic benefits of environmental stewardship often do not accrue to the people who are best able to practice stewardship, reducing or eliminating stewardship incentives. For example, property values may be high near a beautiful estuary, benefiting coastal landowners but not the ranchers and farmers whose land management practices can either degrade or benefit the estuary [Lake Rotorua in New Zealand is an excellent example (Kerr & Lock, 2010)]. This imbalance may stem from the fact that people who benefit from unpriced ecosystem services (e.g. fishermen who benefit from support services that produce fish) and who therefore might otherwise act as stewards of the ecosystem are often disempowered relative to other 'economic' stakeholders and lack defensible rights to prevent others from harming these services, or to obtain compensation for losses in these services (Sathirathai & Barbier, 2001). In many cases, rights (to extract resources, use land, pollute, etc.) are disconnected from stewardship responsibilities (Lam & Pauly, 2010).

Third, conventional markets tend to allow individuals to privatize gains, while sharing some of the costs associated with activities producing those gains (including environmental costs). The famous illustration used by Hardin (1968) involved livestock grazing on common pastures, but there are countless modern examples ranging from industrial pollution to complex financial instruments that allow a few to profit but Ecosystem Marketplace, hhttp://www.ecosystemmarketplace.com many to suffer. Thus, the environmental costs of economic activities are often borne by a different set of actors than those who benefit from the activities, driving unsustainable resource use and pollution (Lam & Pauly, 2010). Moreover, anecdotal evidence from resource harvesters, processors, and buyers suggests that many supply chains for ecological goods cause resource extractors (e.g. fishermen) to bear most of the costs of extraction, while entities higher in the chain largely keep profit margins intact by reaping benefits without much additional cost. The key to addressing this market failure is to assign the costs associated with environmental impacts to those responsible for the impacts.

At an even more fundamental level, ethics, values, and social mores drive the distribution of rights, the nature of social contracts, and the distribution of benefits and wealth which control how markets function with respect to conservation and stewardship. Natural resource ethics vary considerably at different scales (e.g. individuals, local entities, central governments, international governance bodies) and within each scale. For example, the strength of our human tendency to care more about those we know than those we do not know can determine the scale threshold beyond which a group excludes other groups from reaping benefits from natural resources. High levels of this tendency, arguably, have played an important role in establishing a dominant ethic – reflected in the distribution of rights, responsibilities, and benefits through laws, regulations, contracts, and other kinds of understandings – that allows individuals or small groups to extract most of the value from natural resources at the expense of others currently living (but relatively disempowered) or yet to be born (Collier, 2010). Naturally, when people regard the interests of people who live far away and/or are not related to them (including future generations) as important, the distribution of rights, responsibilities, and benefits shifts to favour this larger collection of individuals and generations to a greater extent.

III. CONSERVATION RESPONSES TO MARKETS

For all of these reasons, conventional markets often fail to protect coastal ecosystems. Perhaps the most common approach to addressing these failings has been to try to protect certain areas and implement regulations to counter incentives that maximize short-term profits from natural resource extraction or to externalize costs such as pollution (Stavins, 2010). Regulations are often based on the desire to forge a connection between rights and responsibilities, creating a new social contract that forces resource users to assume more responsibility for the impacts of their activities on sustainability, other stakeholders, and other ecosystem services.

While critically important, these approaches – protecting areas and regulating activities – have a number of limitations that have reduced conservation and economic performance and impeded the scaling up of conservation and sustainable development, perhaps especially in coastal zones. Despite over 20 years of effort, Marine Protected Areas comprise just 1.17% of the ocean (Spalding *et al*., 2010). Many Marine Protected Areas suffer from lack of enforcement, compliance, and sustainable funding (Carr, 2000; Burke, Selig & Spalding, 2002; Burke & Maidens, 2004). Regulations that run counter to short-term economic incentives often require strong institutional capacity, rule of law, and enforcement – conditions that are lacking in many parts of the world. Moreover, regulations often create perverse incentives and impose costs that are perceived as unnecessary (Fujita & Bonzon, 2006; Sanchirico, 2008). This is especially true if regulations are formulated and introduced without the meaningful participation of affected stakeholders (Mascia, Claus & Naidoo, 2010), and if they are not coupled with efforts to prevent or alleviate the adverse economic and social impacts of the regulations (Christie, 2004). Both protected areas and regulations are often highly controversial and viewed as threats to livelihood or profit because they impose costs on resource users (Agardy *et al*., 2003; Christie, 2004). Controversy and conflict make conservation costly and difficult, limiting efforts to scale conservation up to levels commensurate with the scale of threats to coastal ecosystems.

Another approach to address these failures has been to estimate natural ecosystem value to account better for natural capital in development decisions (National Research Council, 2004; Tallis *et al*., 2011). Valuation of ecosystem services is difficult analytically (Goulder & Kennedy, 2009) but can result in positive outcomes if computed values are realistic, recognized as such by most stakeholders, and used as part of a comprehensive conservation strategy. For example, the valuation can serve as a starting point for negotiations between the parties to generate a Payment for Ecosystem Services (PES) program or to influence cost-benefit analyses that are then used as the basis for deciding whether or not to grant permits (McConnell & Sutinen, 1979; Salzman, 2009). This approach is limited by data availability, reliability of the data used, the methods used to compute value, and, most importantly, by skepticism on the part of relevant stakeholders and decision makers. Nevertheless, there are a few examples of the successful application of ecosystem valuation (Chichilnisky & Heal, 1998; Gowan, Stephenson & Shabman, 2006; Fisher *et al*., 2008).

IV. CREATING ECOMARKETS

Here, we outline an approach intended to address the market failures that drive coastal ecosystem degradation by reversing the ultimate drivers of this degradation. The key is to create new kinds of markets – ‘ecomarkets’ – founded on area-based resource-use privileges and new kinds of financial instruments that more effectively bring future benefits of conservation into the present (i.e. reduce ‘discount rates’ associated with deferred benefits). Naturally, such markets and financial instruments must operate within legal constraints designed to prevent the adverse impacts that would be expected to result from unconstrained markets for ecosystem services, including the overexploitation of services and inequitable distribution of benefits to the detriment of the poor (Pitcher & Lam, 2010). Ideally, an appropriate ethic and social mores would be in place so that laws, regulations, and behaviour consistent with stewardship would flow from them. However, this is a long-term proposition and coastal ecosystem degradation is occurring rapidly, resulting in considerable loss of ecosystem services. Creating model ecomarkets and changing behaviour first (to stem further loss of ecosystem services), if done appropriately, may contribute to a longer-term shift in attitudes, ethics, and values that would in turn reinforce stewardship behaviours and the institutionalization of new values (David, 1985; Andreasen, 2002).

(1) Devolution of area-based rights

The importance of rights in the functioning of markets has long been recognized by economists (de Soto, 2003). To create ecomarkets, new kinds and distributions of rights, privileges, and responsibilities will be required, along with stronger governance regimes with clear objectives (operationalized as performance standards). The allocation of new kinds of resource-use privileges (i.e. area-based privileges) in exchange for commitments to enforceable environmental performance standards gives rise to new social contracts that can connect rights to responsibilities, produce just compensation and distribution of benefits, and conserve ecosystem services.

In theory, real markets are created when parties agree on a price, which represents a shared perception of value. In reality, many factors influence price and how the market operates. If one party (e.g. a fisheries cooperative with an interest in healthy coastal ecosystems) is disempowered relative to the other (e.g. an upstream mineral extractor), the more empowered party can externalize his/her costs (e.g. by polluting streams) and maximize his/her benefits (e.g. by selling the extracted minerals) at the expense of the other party. Negotiations to set prices for ecosystem services that internalize costs (e.g. harm to ecosystems) are difficult or impossible under these circumstances – which, unfortunately, are quite common (Coase, 1960; Porras, Grieg-Gran & Neves, 2008; Leimona, Joshi & van Noordwijk, 2009; Pascual *et al*., 2010). Adding to the challenge, stakeholders in the coastal zone are often numerous and geographically separated, sometimes making transaction costs of negotiations very high. High transaction costs and an imbalance of power likely contribute to the commonly observed degradation of estuaries by ranchers and farmers (who hold property rights and sometimes water rights) that are critically important to fishermen (who have no defensible fishery rights).

One of the keys to creating ecomarkets, then, is to 'level the playing field' by creating new rights and privileges, and attaching stewardship responsibilities and accountability measures to them (Lam & Pauly, 2010). Rights and privileges, with respect to open access resources, exist along a spectrum ranging from zero or weak privileges to strong, well-enforced property rights (when open access resources become privatized). The strength of the right or privilege is a function of its tenure, legal status, and enforceability (Ostrom & Schlager, 1996), and these features all probably influence stewardship behaviour or the lack thereof. Generalizations are difficult because the nature of resource-use rights or privileges varies widely from country to country, or even between parts of one country, depending on a number of social, cultural, and legal factors including differing interpretations of the public trust doctrine. The willingness of governments and land-holders to devolve rights and privileges to co-management entities also varies considerably (e.g. El Salvador outlawed community land management whereas Mexico has extended the concept into mangrove forests and fisheries concessions). It is therefore useful in this context to consider rights and privileges as bundles of rights, including access, use, management, and exclusivity rights, which can vary regionally (Ostrom & Schlager, 1996).

The strength and distribution of a variety of rights and privileges among resource users, governments, and other entities – determined by who holds which elements of the rights bundle, and by the specific nature of each element – is critically important for correcting market failures. While rights or privileges by themselves may not always generate stewardship attitudes and behaviours (Levy, 2010; Pitcher & Lam, 2010), the lack of secure rights or privileges to a share of the resource appears to contribute to competition to maximize exploitation of the resource (Gordon, 1954; Clark, 1973; Anderson, 1976), often resulting in the expenditure of excessive amounts of effort and capital and adverse ecological, social, and economic outcomes (Hilborn *et al*., 2003; Hilborn, Punt & Orensanz, 2004). Overfishing in open-access fisheries is a classic example.

The scope of rights and privileges likely has a strong effect on behaviour that affects coastal ecosystems. When secure privileges are limited to single species, most conservation and management actions are directed towards that species (Gibbs, 2010). When multiple species are harvested together, additional measures are necessary to reduce by catch and serial depletion of less-productive species (Ricker, 1958), including the provision of secure catch privileges for incidentally caught species allocated as portions of total allowable catch limits aimed at conserving these species Bonzon *et al*. (2010). Conceptually, then, rights and privileges over areas rich in ecosystem services (rather than over species) should be necessary, but not sufficient by themselves.

(2) Empowered stewardship entities

Another key condition for ecomarkets is the presence of effective stewardship entities that can hold area-based rights and privileges, create new ecomarkets, negotiate prices, and hold parties accountable to (and themselves be held accountable to) environmental performance standards designed to protect ecosystem service provisioning. Not all stewardship institutions are created equal, and not all are effective. Governments are sometimes thought of as the default stewards of natural resources owned by their citizens; however, governments are not always good stewards (Eagle & Kuker, 2010). Different institutions at different scales may be a necessary feature of effective common pool resource management (Ostrom, 1990). This and other design principles that appear to be related to effective resource management have been articulated and tested, albeit largely in terrestrial settings such as watersheds (Ostrom, 1990; Cox, Arnold & Tomás, 2010). The effectiveness of stewardship entities (e.g. fishing cooperatives and community-based management groups) is under active investigation (Gutierrez, Hilborn & Defeo, 2011). Some examples of effective coastal resource stewardship by co-management groups do exist (Gelcich *et al*., 2008).

Whenever secure rights or privileges to use public goods and services are being allocated, good governance and legal institutions are essential. Without governments that are willing to both set limits on the use of environmental goods and services and also grant, protect, and uphold rights and privileges, effective markets cannot develop or function (Bayon, 2004). In addition, local monitoring and enforcement by diverse stakeholders can help to tailor regulations to local conditions and to improve compliance with these regulations while reflecting economic and social concerns in the wider community (Fujita, Foran & Zevos, 1998). Several examples of self-policing through informal social sanctions and traditions exist in fisheries management, and could be expanded to other ecosystem service markets (Palmer, 1993; Defeo & Castilla, 2005).

(3) New markets for ecosystem goods and services

New kinds of markets and financial instruments will be required. These markets and financial instruments must be designed to: (*i*) value portfolios of ecosystem goods and services; (*ii*) transform future benefits associated with conservation into capital that is usable in the short term; and (*iii*) generate revenue for the stewardship entity not only to offset opportunity costs but also to finance alternative livelihoods and achieve other immediate social and economic goals. Moreover, they must be constrained to avoid the many adverse impacts that could otherwise occur (Pitcher & Lam, 2010). Among the more widely recognized coastal ecosystem services, many are already incorporated into markets or could be if (*i*) limits were set on their use, and (*ii*) rights to that use were allowed to be sold or traded. Here we examine potential approaches for capturing the value of some ecosystem services (fish production, aesthetics/recreational services, water purification, flood control and shoreline protection, biodiversity support, carbon sequestration, and renewable ocean energy) while simultaneously conserving them.

(*a*) *Direct payments for ecosystem services*

Direct payments for ecosystem services (PES) stands as one of the most promising market-based initiatives for addressing market failures that result in ecosystem degradation. PES stems from the idea that ecosystem services such as carbon storage and sequestration are public goods, and thus not naturally supplied in sufficient quantities by individuals acting out of self-interest. As a result, those who currently destroy ecosystems and the services they provide in the course of making a living must be provided with alternative, direct incentives to preserve them. From this, the central idea behind PES is that external ecosystem service beneficiaries should make direct, contractual, and conditional payments to local rights holders (those who own/control important aspects of ecosystems) in return for stewardship practices that secure flows of ecosystem services (Wunder, 2007).

While most current PES schemes concern terrestrial ecosystems, many coastal areas appear promising for this approach because of the many ecosystem services that they provide and the increasing pressure on them. Implementation of coastal PES is still at an early stage, but several examples exist (Ecosystem Marketplace, 2010). PES differs from many conventional conservation strategies by explicitly recognizing difficult tradeoffs for resource users and seeking to reconcile conflicting interests through direct compensation (Wunder, 2005). By implementing direct compensation measures, conditional upon appropriate ecosystem preservation and management, and competitive with alternative local income sources, PES has the potential to succeed where previous strategies have fallen short. Some of the most successful PES programs are in high-income nations, where government agencies provide financial incentives to farmers to change farming practices to increase the provision of environmental services; PES is difficult to implement in developing countries and low-income regions (Ferraro, 2001).

Like many economic incentives for conservation, PES makes the most sense on marginal lands, where relatively small payments can tip the balance in favour of a desired land use (Pagiola, Arcenas & Platais, 2005; Wunder, 2005). Under prevailing market conditions, most individual service payments will prove insufficient to offset opportunity costs fully in many coastal systems. However, the potential of PES looks more favourable when services are ‘bundled’ or ‘stacked’ so that revenue streams can be realized from multiple services provided by the same ecosystems. In coastal ecosystems where opportunity costs are high, complementary income flows, either from extraction within sustainable thresholds or from stacked or bundled payments, could prove critical to the success of PES. Many different kinds of PES options and strategies exist (Pagiola *et al*., 2005; Salzman, 2009).

As is the case for ecomarkets generally, the lack of clear property rights is likely to prove challenging for PES implementation in the coastal zone. Landowners are clearly the logical and rightful recipients of terrestrial PES as they have land tenure and stewardship responsibilities; as landowners, they also have rights of access, management, and exclusivity. In coastal environments, these rights are often fragmented among many stakeholders and the government instead of being held by a single entity. Therefore, the ability of various parties to negotiate and attract payments for ecosystem services is impaired. Changes in the distribution and bundling of rights will be necessary to facilitate PES and other market mechanisms.

(*b*) *Catch shares for fisheries*

To address the market failure in fisheries associated with open access to fishery resources (competition to maximize catch when one’s share is unknown), many countries have implemented catch-share systems in which the total allowable catch is divided up and allocated to individuals as secure-catch privileges or fishing territories (Individual Quotas, Individual Transferable Quotas), fishing sectors (sector allocations), communities (Community Development Quotas), or other groups (e.g. cooperatives). These privileges, while not property rights (because they are generally revocable by the state), nevertheless are valuable assets that provide shareholders with rights of access and exclusivity. Catch shares can be allocated for both targeted catch and bycatch species. Over 520 species of fish and shellfish are included in over 275 catch-share programs in 35 countries worldwide (Bonzon *et al*., 2010).

Well-designed catch shares (Bonzon *et al*. 2010) can restore economic and environmental health to fisheries by providing hard conservation targets and other performance standards while at the same time giving fishermen flexibility in choosing how to meet those targets (Branch *et al*., 2006). Accountability measures (i.e. monitoring and enforcement) are essential for holding catch-share owners accountable to science-based allowable catch limits. The secure-catch privilege allows fishermen to reduce fishing costs (by eliminating competition to maximize catch) and fish for value instead of for volume. If conservation measures result in fish population growth and higher allowable catches (or reduced discards and associated increases in fishing opportunity), the value of the catch shares increases proportionally, providing a direct financial stake in long-term conservation.

By catch (the incidental take of organisms in fisheries) can result in unintentional overfishing and depletion, and poses risks to coastal ecosystems. Bycatch caps can be incorporated into catch-share management, and shares of the cap can be allocated to individuals or groups. Allocation can be carried out using processes that give weight to desirable fishing histories and outcomes, such as selective fishing.

Because catch-share management often increases fishing revenues and reduces fishing costs [sometimes dramatically (Sanchirico, 2008)], catch-share fishermen become potential buyers of the fisheries provisioning ecosystem service. While some profit must accrue to fishermen, some should be captured by the public (as owners of the resource); these payments can be structured as *ad valorem* fees or captured in auctions of the catch privileges. Responsibilities for cost-sharing and compliance with management measures can also be attached to the allocation of the catch privileges. Catch-share holders are potential stewardship agents, who are more empowered to demand reductions in pollution and other externalities that harm fish populations (or to demand payments to compensate for damage) because of their stake (monetized by a market in catch privileges) in the conservation of fish populations and the habitats that support them.

(*c*) *Water quality markets*

Some coastal ecosystems can assimilate large amounts of pollution, depending on a number of factors including residence (or 'turnover') time of the water and the characteristics of resident biodiversity. However, this service usually remains unvalued and so, in the absence of strong regulation, individuals and firms pollute coastal waters irrespective of their assimilative capacity. Reduced water quality in coastal systems can dramatically degrade other ecosystem services. Dead zones in the ocean resulting from excessive pollution, hydrological modification, and habitat degradation pose an important threat to ecosystems and to human welfare (Agardy *et al*., 2005).

Methods to reduce these threats are readily available. For example, farms and livestock operations – the primary contributors to eutrophication, hypoxia, and dead zones (Rabalais, Turner & Wiseman, 2002) – can significantly reduce run-off by changing tilling, fertilization, and planting practices, often without additional capital costs, and sometimes with cost savings. Studies show that these kinds of behavioural changes can be implemented at about 2% of the cost of what point sources of pollution (e.g. manufacturing or processing facilities) would have to pay to abate their pollution (Zwick, 2010).

Farms and livestock operations, however, vary widely in their ability to reduce pollution and in the costs associated with those reductions. It is these abatement-cost disparities that create the potential for an ecomarket to reduce pollution. For this market to function, a stringent regulatory regime compelling pollution reductions is needed. An artificial, constrained market can be established based on a pollution cap (which makes the assimilation service more scarce) and transferable pollution reduction obligations imposed on each pollution source. Entities capable of reducing pollution cheaply in excess of their obligation would earn credits that they could sell to other entities for which pollution abatement would be more expensive (e.g. large farms or point sources). These pollution cap and trade systems can work for pollutants such as carbon, nitrogen, or phosphorus which have low potential to create dangerous hot spots as a result of pollution obligation transfers (Wiener, 2004).

The steps taken to reduce selenium non-point-source pollution in California provide a case study illustrating how pollution cap and trade systems can work. Beginning in the late 1970s, selenium discharges from farms into California's Kesterson Wildlife Refuge resulted in avian mortality and birth defects (Ohlendorf *et al*., 1988). A program with an enforceable cap on selenium discharges from a watershed coupled with a transferable pollution reduction obligation was adopted by farmers in California's San Joaquin Valley after a voluntary Best Management Practices program failed to reduce discharges sufficiently. The cap and trade program, in concert with a revolving loan program and economic incentives to conserve water, reduced discharges 23% below the allowable total, while reducing costs. According to the Environmental Protection Agency, 'selenium loads in 1999 and 2000 were the lowest ever discharged from the drainage in the past 15 years' (U.S. EPA, 2010). The program also increased water use efficiency and may have reduced nutrient and pesticide pollution.

(*d*) *Rethinking insurance for flood control and shoreline protection*

In the United States, typical annual coastal flood and storm insurance premiums range from \$274 to 1760 for residential properties and \$897–2285 for commercial buildings for \$100000 of coverage – with the actual price depending largely on the level of risk that a particular building faces (Floodsmart.gov, 2011*a*,*b*). Because this risk can be mitigated by particular ecosystems such as mangroves, seagrasses, or salt marshes, a market could be established wherein insurance providers hedge their risks by investing in ecosystems that provide shoreline protection. Where coastal erosion is caused by stakeholders other than coastal landowners, an effective approach may be Payments for Ecosystem Services from landowners to these stakeholders in exchange for refraining from activities resulting in erosion (or, conversely, fines on these activities), since the property right held by landowners may be interpreted to include security from external threats. Alternatively, or perhaps in complement to such a market, insurers could be encouraged by government agencies and others to incorporate flood risks associated with coastal ecosystem destruction into premiums, along with discounts to policyholders who can demonstrate conservation of such ecosystems. All of these approaches must be designed to address the relatively high variability in flood protection afforded by coastal ecosystems through both space and time.

(*e*) *Mitigation banking*

A conservation or mitigation bank is a privately or publicly owned parcel of land managed for its natural resources. In exchange for protecting the land, the bank operator is allowed to sell habitat credits to developers who need to satisfy legal requirements to compensate for environmental impacts of development projects. In essence, conservation banking is in-kind (i.e. of the same habitat type), off-site mitigation of multiple projects with similar impacts at a single location (Carroll, Fox & Bayon, 2009). This form of third-party compensatory mitigation both incentivizes the protection of ecosystems and their resources for landholders while also saving developers time and money by providing the certainty of pre-approved compensation lands (CDFG, 2011).

Conservation and mitigation banking establishes a market around the concept of legally mandated 'offsets',defined as 'measurable conservation outcomes that are the result of activities designed to compensate for significant and unavoidable impacts on biodiversity' (Abdulla, 2010). For unpreventable impacts associated with project development (construction and operation), offsets, and mitigation banks that employ them, work best in a policy environment that mandates 'no net loss' of species community structure, habitat integrity, ecosystem function, and the associated social values. Apart from the roughly 30 countries with a policy mandate of 'no net loss', this mechanism stands only as voluntary best practice, motivated by business benefits such as access to foreign capital and easing of permitting processes (Carroll *et al*., 2009).

Many examples of mitigation banking exist in terrestrial and freshwater ecosystems. Increasingly, coastal marine ecosystems such as salt marshes, oyster reefs, mangrove forests, and seagrass meadows are being restored, albeit with mixed success. Restoration projects deemed 'successful' according to clear metrics agreed upon by buyers and sellers of offsets and credits have been used to offset impacts of development projects in coastal zones; however, offset designs and methodology for project impacts on coastal biodiversity remain untested to our knowledge.

One potential strategy for coastal compensatory mitigation might be in the form of levies assessed on a fishery that is impacting a wildlife species through bycatch. These fees, if levied at an appropriate point in the supply chain, could then be used to fund bycatch reduction or conservation in areas expected to achieve much greater conservation benefit per unit cost (ideally affecting the same life stage of the species to be conserved, to reduce uncertainty about the effects of the offset) (Peckham *et al*., personal communication). Given the logical connection between mitigation banking and defined property rights, coastal species that are tied to specific terrestrial habitats for feeding or nesting (e.g. sea turtles and salmon) would be ideally suited for mitigation crediting (Carroll *et al*., 2009). Many implementation issues and uncertainties remain, so caution should be exercised; where appropriate, disproportionate offsets should be required to hedge against risk and uncertainty (Finkelstein *et al*., 2008).

(*f*) *Blue carbon markets*

Emerging carbon markets provide an opportunity to direct funds towards conserving important coastal carbon stores (thereby preventing conversion of these stores into greenhouse gases, which would exacerbate climate change) and sinks (thereby reducing the fraction of greenhouse gas emissions that remain in the atmosphere).

Ocean ecosystems serve as the largest store of carbon dioxide (40 Tt), capturing and redistributing over 90% of the earth's carbon dioxide (Nellemann *et al*., 2009). Furthermore, although vegetated 'blue carbon' sinks – mangroves, seagrasses, and saltmarshes – cover less than 0.02% of the seafloor and comprise only 0.05% of the earth's plant biomass, these blue carbon sinks contribute between 50 and 71% of total organic carbon burial in ocean sediments (Duarte, Middelburg & Caraco, 2005; Nellemann *et al*., 2009). Because these coastal ecosystems are among the most productive on earth, and because some ocean carbon stores persist much longer than other planetary stores (on the order of a thousand years for deep ocean water and on the order of millions of years for ocean sediments), carbon absorption and storage services provided by the ocean are enormously important for slowing the rate of climate change. Moreover, ocean ecosystems that sequester carbon are often also exceptionally rich in other ecosystem assets, including shoreline protection, nursery areas for fisheries, aquaculture, recreation, and tourism opportunities, with the result that investment in projects that protect or expand coastal carbon sequestration can have multiple benefits.

Ocean carbon sequestration services may be weakening due to rapid coastal habitat loss and degradation (Duarte *et al*., 2005). Some studies suggest that vegetated blue carbon sinks such as seagrass meadows and mangrove forests are being destroyed faster than are tropical rainforests (Duarte *et al*., 2008), and the rate of loss is accelerating (Nellemann *et al*., 2009; Waycott *et al*., 2009). The main proximate drivers of these trends vary by region, but include deforestation (largely due to aquaculture and coastal development), pollution by nutrients and chemicals from agricultural and industrial runoff, water diversions, dams, oil spills, dredging, and mining (UNEP, 2006; Nellemann, Hain & Alder, 2008). For mangroves, this leads to the release of 112–392 tC/ha cleared, depending on how much soil carbon is affected (Donato *et al*., 2011).

Because blue carbon is not currently covered by the United Nation's Framework Convention on Climate Change, countries are not responsible for increased emissions from blue carbon, nor can they benefit from blue carbon emissions reductions or restoration through the Clean Development Mechanism (Murray *et al.*, 2011). However, amended versions of Reducing Emissions from Deforestation and Forest Degredations (REDD+) programs, in which owners receive payments from carbon emitters elsewhere to reduce or eliminate felling, could be applied to mangroves (if interpreted as 'forests') and eventually to other blue carbon sinks such as salt marshes and seagrass beds. This latter scenario will depend on expanding the terms of REDD+ to include a wider variety of emissions and sequestration activities (Murray *et al.*, 2011). Of critical importance to blue carbon policy will be accounting for below-ground carbon, which comprises 50–99% of the total carbon stock of mangroves, seagrasses, and salt marshes (Donato *et al.*, 2011; Murray *et al.*, 2011). In the near term, voluntary carbon markets, which credit forest-based sequestration activities, look most promising despite the much lower carbon credit prices than those in the compliance markets.

While blue carbon markets have yet to be launched formally, they could eventually prove attractive to investors. On the voluntary market, credits trade at a premium if they are perceived as simultaneously promoting biodiversity and/or human welfare (Murray *et al.*, 2011). From this standpoint, blue carbon appears to have the potential to generate jobs and alternative livelihoods for local communities while protecting the environmental benefits of storm and tsunami protection, protection of water resources, and fisheries and critical species production.

(*g*) *New economic entities for improving land-sea interactions*

Obviously, coastal ecosystems are intimately connected with terrestrial systems through rivers, and so activities within watersheds and in streams have strong effects on coastal ecosystem services. However, costs associated with reductions in coastal ecosystem services caused by land and fresh water users are not internalized by these users, and so no incentives for better upland and aquatic stewardship exist except those introduced by regulation and enforcement. Unfortunately, even in developed countries with strong regulations and rule of law, incentives to maximize profits by over-exploiting land and water resources persist, with adverse consequences for downstream stakeholders and ecosystems, often resulting in poor outcomes (e.g. silted-in bays, polluted coastal waters, degradation of coastal fish spawning and rearing habitat).

The ecomarkets challenge in this context is to connect the upstream and downstream economies and stakeholders in ways that reflect the ecological connections that already exist and ensure that all stakeholders are rewarded for conservation behaviour, no matter which part of the ecosystem is affected. To achieve this, Hawken (1993) proposed the establishment of 'utilities' with a double bottom line: sustain a portfolio of ecosystem services and maintain revenue streams from natural resources. At the heart of this concept is the fact that any resource degradation reduces the value of the utility to its owners, and that the owners live and work throughout the integrated land-sea system (the watershed plus the coastal zone). Such ecosystem service utilities could combine aspects of the public and private sectors in that they (*i*) could be regulated by their constituencies through public commissions or other forms of public sector input, and (*ii*) in return for accepting regulation, the utilities could be given monopoly power and guaranteed a certain level of profit. This second characteristic guarantees a more predictable rate of return on investment, which would allow the utility to manage long-term projects and attract capital at low interest rates (Hawken, 1993).

Ecosystem service utilities can be focused on just one or a number of ecosystem services and thus can range in scope considerably. For example, a utility could assess fees on ratepayers spanning the land-sea system and invest in water conservation, land stewardship, coastal restoration, or other activities if it was persuaded that such activities could have a positive effect on fishery, ranching, or farming revenues, and thereby generate an economic return.

Proposed ecosystem service special districts in the United States offer a promising model upon which to develop this mechanism (Heal, Daily & Ehrlich, 2001). Such an entity could help to reverse primary drivers of coastal degradation by (*i*) giving value to a portfolio of services to promote their rational use, (*ii*) aligning economic incentives with environmental stewardship for stakeholders spanning the land-sea interface, and (*iii*) creating an administrative unit that integrates the patchwork of conflicting objectives and jurisdictions inherent to traditional coastal-zone management. In addition to these benefits these districts could also provide the logical governance unit for comprehensive coastal spatial planning and cumulative impact capping in line with the Priority Objectives of the new U.S. National Ocean Council (Obama, 2010). An initiative to create an ecosystem service utility or special district could start with total mass daily load limits for water-quality pollutants (with plans detailing how a planning area would comply with those limits), and could potentially be expanded [given evolving methods to quantify cumulative impacts (Halpern *et al.*, 2008)] to all adverse coastal ecosystem impacts and capped given the delimited watershed/coastal zone management area.

(*h*) *Ocean energy concessions*

The ocean contains vast stores of renewable energy, enough in theory to supply the world with all of its energy needs (Takahashi & Trenka, 1996). However, the patchy distribution of renewable ocean energy (from offshore winds, waves, currents, tides, and thermal gradients) makes the efficient capture and distribution of ocean energy very challenging (Pelc & Fujita, 2002).

On the other hand, the potential for some of these technologies to produce power at relatively small scales for isolated communities and to generate important ancillary benefits such as fresh water, food, and refrigeration/air conditioning (Fujita *et al.*, 2011) without additional energy or nutrient inputs creates opportunities for ecomarkets. Communities holding access, exclusion, and management privileges over areas rich in ocean energy potential could auction exploration and development rights and insist on both performance bonds to incentivize good environmental performance and on royalties or other forms of ongoing compensation.

While renewable ocean energy is generally preferable to fossil fuel combustion with respect to climate change, air pollution, and oil spills, it is possible that serious environmental issues could arise if ocean energy technologies are brought to scale without sufficient attention to these issues (Pelc & Fujita, 2002).

(*i*) *Markets to capture aesthetic and recreational services*

Tourism is one of the fastest growing industries in the world. According to the World Tourism Organization of the United Nations (UNWTO), tourism has sustained a more than 6% annual growth rate since the 1970s (UNWTO, 2011). Based on current growth, UNWTO projects that one billion people will be travelling as tourists by the end of 2012 (UNWTO, 2012). The UNWTO also reports that tourism alone generates 5% of the world's gross domestic product and accounts for around 6–7% of global employment (UNWTO, 2011).

Many ocean ecosystems have mass appeal for tourism because of their beauty (e.g. coral reefs) and recreational opportunities (e.g. SCUBA, snorkeling, kayaking). As awareness spreads, and as tourists seek more adventure in their vacations, more ocean ecosystems in ever more remote locations seem likely to draw tourists. In some cases, tourism has developed in ways that benefit local communities and the environment. For example, dive tourism in Fiji is tied to a Coral Reef Sustainable Destination Model, which includes environmental performance standards and revenue capture by local communities (Coral Reef Alliance, 2010).

In general, however, conventional markets and social contracts have facilitated the development of mass tourism to generate revenue from these ecosystem services, allowing relatively few individuals and firms to benefit from them while externalizing costs to local stakeholders (in the form of pollution, trampling, crowding, and other impacts) (Mungatana, Hassan & Lange, 2005; Honey & Krantz, 2007). One example of this type of tourism can be found in Cancun, on the Mexican Mayan Riviera. Cancun was the result of a master plan developed by the Mexican government to increase foreign investment, create jobs, and promote tourism in five of the poorest regions of Mexico (Wilson, 2008). The plan succeeded in many ways, and today Cancun – which 40 years ago was just a fishing camp – is an urban coastal development with over 500000 inhabitants and an conomy that produces more than $3 billion dollars per year. It is calculated that each dollar that Mexico invested to create this tourist destination was matched 10-fold by foreign investment (Murray, 2007). But the economic benefits of this type of development have come with high socio-economic and environmental impacts (Murray, 2007). Mayans have been displaced from their communities and have received few of the benefits of the wealth created by Cancun. Sewage is creating serious environmental problems in lagoons and coral reefs, diminishing many of the environmental services provided by these ecosystems. For example, pollution may have contributed to the loss of offshore reef structure (Alvarez-Filip *et al*., 2011). This, in turn, reduces protection from storm surge; many of Cancun's beaches were lost during Hurricane Wilma in 2005.

Because mass tourism brings with it undeniable social and economic benefits, often at the very large scales necessary to meet social and economic needs, the challenge is to increase the scale of tourism development that results in environmental stewardship and to incentivize practices that reduce environmental impacts of tourism developments. Where there is tension between these three tourism models – mass tourism without environmental protection, mass tourism with environmental protection, and smaller scale 'sustainable' tourism development – proponents with the strongest rights and the most political clout, generally large developers and cruise ship companies, usually win. Thus, efforts to redistribute rights and increase political power of proponents of tourism development (large or small scale) that result in the stewardship of ecosystem services will be necessary to create a more level playing field for competing development proposals and better social and environmental outcomes.

Some ocean tourism operations have made progress in capturing more of the recreational and aesthetic value of ocean ecosystems by collecting payments for the ecosystem service of recreation from divers in the form of dive fees levied on individual tourists (Hawkins *et al*., 2005). However, these payments are probably very small relative to the value of the service provided. One way to capture more of this value is for central governments, as stewards of the public trust, to reserve coastal areas and charge high fees for the tourism privilege – a privilege that can be made even more valuable by establishing an annual cap on the number of visitors. However, this mechanism may or may not benefit coastal communities, which would likely incur costs resulting from lost fishing or other opportunities.

Another way to capture aesthetic and recreational value that could generate more local benefits would be to allocate area-based rights of access, management, and exclusion to community-based entities. These entities could then create scarcity by establishing a cap on the number of recreational concessions that can operate in an area, establishing performance standards that the operators must be accountable to, and then auctioning the concessions. Royalties could also be charged to compensate ongoing opportunity costs associated with the concessions (e.g. lost fishing opportunities due to the establishment of a coastal reserve that attracts divers). Some precedents exist (Smith *et al*., 2010). This approach seems more likely to result in realistic valuations of this service, as actual prices paid, than a valuation analysis would.

V. FINANCIAL INSTRUMENTS FOR INCREASING THE PRESENT VALUE OF CONSERVATION

The challenge of applying anticipated future benefits to address urgent challenges today is of course not unique to coastal ecosystem conservation or coastal sustainable development. Consequently, many different kinds of instruments have been developed to achieve these goals and the related goal of financing conservation (World Wildlife Fund, 2009).

Ecomarkets, and conservation in general, have the potential to generate revenues as a result of conservation actions over the long term, but in many cases capital may be urgently needed to build schools, provide food, staff hospitals, or meet other needs. In the absence of interventions, these urgent (concrete and tangible) needs often trump longer term (less salient) potential revenues from sustainable resource use or conservation. This can result in rapid depletion of resources and ecosystem degradation. In other sectors, credit in the form of loans can be used to meet urgent needs for capital. Commonly, collateral is required to create incentives for re-payment and/or to compensate the lender in the event of default. However, loans tailored to the cultural, legal, and economic contexts in which ecomarkets are operating may provide the greatest economic and conservation benefits. For example, special loan funds created with 'philanthropic' capital can make higher-risk investments. The California Fisheries Fund (www.californiafisheriesfund.org) is designed in this way to provide capital to fishermen wishing to transition to more sustainable fishing practices and to others with business plans aimed at increasing the sustainability of fishing.

Venture capital can also be applied to conservation financing. Environmental investment funds (also known as biodiversity enterprise funds) can support conservation through investments in companies that promote environmental sustainability or responsible business practices (World Wildlife Fund, 2009). Traditionally, these funds have been able to offer a mix of equity investments and credit to finance social enterprises or industry-specific certification programs such as that of the Marine Stewardship Council. Regardless of their structure, ecomarkets could prove attractive for private equity investment, providing an arena for testing innovative lending and investment strategies, which, if successful and scaled appropriately, can be integrated into mainstream financing channels.

In addition, bonds – essentially, agreements by groups of people (instead of individuals) to assume debt in exchange for capital – can be proposed to groups of any size, from local agreements that do not require elections to propositions on national ballots. The success of bonds depends largely on the strength of the case that can be made that the capital will be invested in ways that will generate sufficient revenue to accomplish stated goals and repay the debt. In the case of ecomarkets, the 'value proposition' (i.e. the logical connection between the conservation action and the expected revenues) must be compelling enough to motivate lenders to lend, whether the lender is a financial institution or a group of citizens.

Many different kinds of financial instruments are commonly used to reduce volatility (e.g. crop yield and price volatility due to weather) and hedge against the risk inherent in that volatility (Harwood *et al*., 1999). These tools are far less developed for coastal resources. However, in principle, many of them could be adapted to provide capital based on expected revenue streams from ecomarkets. For example, futures contracts which guarantee a price in exchange for a stable supply of fish could reduce competition to maximize catch in some fisheries (Fujita *et al*., 1998). Derivative instruments could also be applied to ecomarkets, wherein individuals, companies, or organizations use bets to hedge against risks. Derivatives have been designed for risks associated with weather, pest damage, and endangered species conservation (Mandel, Donian & Armstrong, 2010).

VI. MOVING TOWARDS ECOMARKETS

Ecomarkets are not entirely new; rather, ecomarkets implement and combine several existing concepts and strategies in ways that we believe will create strong synergy, especially in coastal zones. Many environmental markets already exist, such as the U.S. SO_2 reduction credit market, the EU CO_2 reduction credit market, and transferable development rights for land. While the coastal zone presents special problems, many of the elements of coastal ecomarkets – area based rights, stewardship entities, and markets for services – are already in place or being developed.

Valuation studies have provided a foundation for understanding the value of ecosystem services, while payments for ecosystem services have demonstrated that it is possible to convert this perceived value into revenue for conservation and compensation. Mitigation banks already provide the flexibility that is needed in some cases to achieve development and conservation goals. Well-designed catch-share programs for fisheries create a new asset class and privilege, markets that are constrained to achieve social and economic goals, and new social contracts that include cost-sharing and accountability for the sustainable use of public trust resources. Cap and trade programs for non-point source pollution create incentives for pollution reductions below enforceable caps, indirectly valuing the assimilation service provided by coastal waters. Various kinds of financing, from microloans to bonds, are becoming available for conservation and sustainable business concepts.

In addition to these ecomarket elements, new initiatives create opportunities to reform markets so that they support ecosystem health and human welfare rather than degrade them. Marine spatial planning (MSP), if it results in management areas and new, empowered institutions that can benefit economically and socially from stewardship, is one such opportunity. MSP could clarify ecosystem boundaries and areas of ownership (or at least exclusion), ushering in the development of ocean ecomarkets by creating clear bundles of rights and responsibilities. The coupling of MSP with the devolution of rights and responsibilities to promote coastal stewardship will, however, require exceptionally strong political will and visionary leadership.

The process by which ecomarkets are established will depend greatly on the cultural, economic, and ecological attributes of specific sites. However, to illustrate how the elements of ecomarkets may fit together, we offer a hypothetical process and structure of an ecomarket initiative: (*i*) The management area is delimited and ecosystem services are assessed; (*ii*) A coastal co-management entity is put into place, which has legally defensible rights to exclude others, access resources, lease use rights to others, limit access, and promulgate and enforce performance standards. The entity is broadly based to reflect multiple ecosystem services and social capital in the area; (*iii*) A system for holding the co-management entity accountable to performance standards is put into place; (*iv*) Target ecomarkets are identified; (*v*) Performance standards are articulated (ideally aimed at protecting the resilience of the system as well as for ecosystem service sustainability) for each activity to be permitted; (*vi*) The co-management entity negotiates agreements with upstream stakeholders to protect coastal ecosystems and ecomarkets.

VII. CONCLUSIONS

(1) There are many causes of coastal ecosystem degradation, and many factors that impede coastal conservation efforts. Here, we have argued that conventional markets have failed to protect coastal ecosystems and to improve the welfare of coastal communities in many cases, primarily because of the poor distribution of rights, the resulting failure of coastal communities to capture the value of a broad portfolio of ecosystem services, and the lack of social contracts that require accountability and responsibilities in exchange for rights and privileges to use coastal ecosystems.

(2) Many approaches attempting to address this market failure have been put in place. They generally focus on establishing Marine Protected Areas and excluding human use to varying degrees, and on regulation and enforcement designed to counter strong economic incentives to overexploit natural resources, pollute coastal waters, and engage in other harmful activities. While these approaches are critically important and have been successful in many cases, they may be less effective when governance and institutional capacity are relatively weak, and they often generate local opposition. Perhaps because of their dependence on strong governance and enforcement, resulting from the misalignment of economic incentives with stewardship goals, these approaches have sometimes failed to keep pace with the scale of coastal ecosystem destruction and degradation.

(3) Valuation studies, payments for ecosystem services, and the creation of new markets that create incentives for conservation (e.g. catch shares for fisheries) and make ecosystem services scarce and therefore more valuable (e.g. cap and trade programs for reducing pollution) all represent positive steps towards addressing the fundamental drivers of market failure that result in coastal ecosystem degradation.

(4) The next steps towards this goal will be to create rights bundles and social contracts that encompass whole ecosystems or portfolios of ecosystem services and to empower management entities to extract revenue for the privilege of using these services in compliance with stringent environmental performance standards. New financial instruments will be required. Secure rights of access, management, and exclusion are also likely to accelerate ongoing efforts to finance conservation by creating more secure revenue streams flowing directly from conservation and sustainable development.

(5) Like regulatory or protected area responses to coastal conservation and management problems, ecomarkets will require strong governance, legal institutions, and social capital. However, ecomarkets have the potential to reverse the failure of conventional markets and regulations to protect coastal ecosystem services and greatly to reduce opposition to ocean conservation. They also, perhaps, can operate successfully at different scales of governance while attracting significant external funding. These attributes of ecomarkets should facilitate the scaling up of coastal-zone conservation.

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