# Paying Poseidon:

## Financing the Protection of Valuable Ecosystem Services

THE KATOOMBA GROUP'S
Ecosystem Marketplace

2010


This publication is made possible by the generous support of the American people through the United States Agency for International Development (USAID), under the terms of the TransLinks Cooperative Agreement No.EPP-A-00-06-00014-00 to The Wildlife Conservation Society (WCS). TransLinks is a partnership of WCS, The Earth Institute, Enterprise Works/VITA, Forest Trends and The Land Tenure Center. The contents are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.

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# Introduction

*Global climate-change talks in Copenhagen might not have yielded a new greenhouse-gas protocol, but they did yield an agreement on the need to develop financing mechanisms that reward people in developing countries for saving their rainforests and adopting sustainable land-use practices — both of which can reduce greenhouse gas emissions by capturing carbon in trees and soil. Meanwhile, scores of projects across both the developed and developing worlds are using environmental finance to preserve endangered species, improve water quality, and preserve wetlands — all based on the premise that nature's living ecosystems deliver valuable services that make them worth more alive than dead. Now it's time to expand this reasoning to the ocean, where fish are vanishing, coasts are eroding, and algae are having a field day.*

Coastal fishing provides half the animal protein and minerals consumed by 400 million people in the least developed countries in the world, and the World Bank says oceans pump more than $25 trillion into the global economy every year.

This same economy, however, is destroying the living ecosystems that protect our coasts, provide our food, and regulate our atmosphere. In an effort to help incorporate the value of these services into our economy, the non-profit Forest Trends launched the Marine Ecosystem Services Program (MARES) in 2009. The organization is built on the belief that by providing reliable information on prices, regulation, science, and other market-relevant factors, markets for ecosystem services will one day become a fundamental part of our economic system, helping give value to environmental services that, for too long, have been taken for granted.

These articles were commissioned by Ecosystem Marketplace to serve as context and provide background for the MARES Katoomba Meeting, held in Palo Alto, California, on February 9–10, 2010. The conference is the sixteenth in a series of meetings designed to stimulate and strengthen environmental markets around the world.

Ecosystem Marketplace (www.ecosystemmarketplace.com) is a web-based, non-profit information service founded by Forest Trends to help spur the development of environmental markets worldwide. It is a leading source of information on markets and payments for ecosystem services such as water quality, carbon sequestration, and biodiversity.

Launched in Katoomba, Australia, in 1999, the Katoomba Group is an international working group composed of leading thinkers and practitioners from academia, industry and government, all committed to enhancing the integrity of ecosystems through market solutions that are efficient, effective and equitable.

**Dr. Tundi Agardy**
MARES Program Director, Forest Trends

**Dr. Winnie Lau**
MARES Program Manager, Forest Trends

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# Uncharted Waters: Saving the Seas by Recognizing their Economic Value

**by Rob Luke**

*We can help save a swamp by recognizing the value of the water it filters and the floods it regulates, and then enticing beneficiaries of these ecosystem services to pay for wetland preservation. But how do we apply this reasoning to the oceans, where water flows in all directions and ownership is often unclear? The Forest Trends Marine Ecosystem Services Program is working to answer that question.*

**25 January 2009** | Our ancestors evolved on land, but they prospered on or near the sea — over which they traveled and from which they drew sustenance. Even today, America's coastal states contribute more than four-fifths of the overall U.S. GDP, according to the California-based National Ocean Economics Program (NOEP).

"The coastal economy drives the [overall] market system," says NOEP director Judith Kildow — adding that the very same economy can also end up poisoning the coastal systems upon which it depends if it fails to account for the cost of environmental degradation.

Ecosystem Marketplace is dedicated to avoiding that dilemma by highlighting efforts to measure the economic value of services provided by wetlands, forests, and other living ecosystems and then enticing those who benefit from these services to pay for their upkeep.

That's what payments for ecosystem services (PES) are all about, and some of the more exciting emerging PES schemes involve water. Indeed, water quality trading (WQT) schemes are proliferating in streams, rivers, and lakes across the United States, Latin America, Europe, and Africa.

As we outlined in our 2008 series on WQT, these schemes promote healthy rivers, streams, and lakes by creating a financial incentive for practicing good stewardship of the watershed surrounding them — an idea that's now being tweaked and applied to the world's oceans.

## The Ocean Challenge

Recent Gulf-Coast hurricanes and the 2004 East Asian Tsunami helped focus attention on efforts to quantify and value "marine" ecosystem services — or those associated with the ocean. One key marine ecosystem service (MES) is the protection of vulnerable coastlines, which is delivered through the maintenance of dunes, beaches, mangroves and sea grass. Another is the preservation of our food supply, which is delivered by preventing overfishing and maintaining biodiversity.

A flurry of studies have examined the economic value of ecosystem services delivered by oceans, but little has happened to bring this theoretical value into the real modern economy. Until these ideas are practiced in places where money changes hands, the cost of environmental degradation will not be embedded in the cost of producing goods and services derived from the sea — and there will be no economic incentive to preserve the sea for future generations.

"Most people under-appreciate marine ecosystems and what they do for us," says Tundi Agardy, director of the Marine Ecosystem Services Program (MARES) launched by environmental non-profit Forest Trends (publisher of Ecosystem Marketplace). MARES aims to quantify the values of marine ecosystem services and develop markets for them. She says that more attention has been given to upstream ecosystem services — especially those that provide clean drinking water — while the more indirect services provided by coastal ecosystems "are taken for granted by the public."

## Markets Discovering the Sea

The tide, however, may be turning. In 2008, a World Bank study entitled "Valuing Coastal and Marine Ecosystem Services" put the total annual figure for all marine ecosystem services (MES) at more than $20 trillion — and that's only taking into account marine ecosystem goods and services for which a market already exists.

"Non-market values such as biodiversity and climate regulation are incalculable," the World Bank said in a statement. "And the spiritual worth of an intact seascape and the wonder of a coral reef are impossible to quantify."

## What Do We Value?

Researchers are also refining their definitions of which ecosystem services they are valuing.

For example, an October, 2008, paper from the Mediterranean Science Commission outlined 16 separate marine ecosystem services provided by environments of the Mediterranean Sea, ranked in order of their origin within six distinct habitat types: beach/dune systems, estuaries and marshes, littoral rocks, sea grass beds, pelagic waters and deep seas. CIESM's key new additions to the original 1997 list include erosion control, waste processing, aesthetics and "biological regulation", while food and raw materials are given separate categories and recreation is divided into three.

MES are often grouped into four types — provisioning, regulating, supporting, and cultural. Provisioning mainly refers to the food, water and raw materials the ecosystems provide for harvesting; regulating refers to less obvious services like protection from storms and supporting tourism; supporting refers to services like waste processing; and cultural refers to the less tangible benefits of recreation and education.

## The Fundamental Four

With so many different ecosystem services functioning in different costal environments, MARES has chosen to focus on four marine ecosystem services:

- Water quality
- Marine biodiversity
- Coastline and beach stabilization
- Fish nurseries.

MARES Program Manager Winnie Lau says these four were chosen not only because they are at particular risk around the globe, but also because they were less recognized by the marketplace and therefore present a greater challenge for generating payments for their ecosystem services.

“Except for fisheries, we’re not even sure yet if markets will work for these services,” she says.

## Harvesting Existing Practices

For inspiration, the program has turned to non-marine ecosystems and PES schemes already up and running. For example, amended versions of the forest-based REDD (reduced emissions from deforestation and forest degradation) scheme, in which owners receive payments from carbon emitters elsewhere to reduce or eliminate felling, could easily be applied to coastal carbon sinks such as mangroves and sea grass beds.

Agardy says that these ecosystems in turn produce other valuable ecosystem services such as housing fish nurseries, generating biodiversity, forming beaches, reducing erosion, and protecting shorelines from disasters like major storms or tsunamis.

Pollution of marine ecosystems by upstream emissions of nutrients and waste water could be addressed through a cap-and-trade program on the emitters similar to the existing one for atmospheric sulphur dioxide, Lau adds. Marine biodiversity could benefit from species banking similar to existing terrestrial programs, where developments impacting a species in one area can be offset by conservation efforts in another.

## Commons Problem

Unfortunately, valuing the services of any coastal ecosystem faces challenges that terrestrial-based schemes do not. With the possible exceptions of commercial fish and seafood, and the carbon sinks of mangroves and sea grasses, the benefits of many marine ecosystem services are often felt far from the ecosystem that generates them. The property rights situation is also more complex.

This problem is outlined in a 2008 paper by Stefano Pagiola of the World Bank entitled “Can payments for environmental services help protect coastal and marine areas?”

Some claim that coastal and marine environments suffer from what economists call the “tragedy of the commons”. With no titled ownership and resources considered “free” public goods, there is no incentive to reduce consumption of those resources over time, even when this clearly leads to degradation. The best-known example is fishing, where each boat is in competition with the others. Left unrestricted, they compete for a supply they all know is dwindling, but have no incentive to save for next year because, as Kildow notes: “Only caught fish have value.”

## Shifting the Focus: from Ownership to Use

MARES feels that a focus on “use rights” as opposed to ownership can help overcome this problem.

The US federal government and two of the country’s coastal states are pioneering a trend that could make it easier to determine which marine ecosystem services exist — and where.

Massachusetts and California, along with the National Oceanographic and Atmospheric Administration (NOAA), are using a combination of techniques called marine spatial planning to map their coastlines both geographically and biologically. Such maps could then empower local, regional and state authorities to enforce zoning regulations on coastal ecosystems under their jurisdictions the way local governments place zoning restrictions under their terrestrial domain. The maps would show the locations of significant ecosystems and their services, as well as provide clear authority and ownership rights over the coastal areas containing them.

## Modeling for Action

Mapping coastline ecosystems is one thing, but getting all the stakeholders to agree on what marine ecosystem services should be the focus of conservation — let alone what they're worth and how to protect them — may be quite another.

The West Coast Authority and the Natural Capital Project recently launched a project to map the western coast of Canada's Vancouver Island. It will employ a computer-modeling program called Marine InVEST to identify the coasts' most significant ecosystem services.

The project also aims to create a coastal zoning agreement that satisfies four different levels of government, three kinds of harvesters, seven different economic interest groups, and various other coastal communities.

Meanwhile the University of Vermont Ecoinformatics Group is developing a tool called ARIES, which serves to map linkages between habitats that provide ecosystem services and the beneficiaries of those services.

## Paying for Beauty

With so many different interests competing economically and socially for coastal resources, significant political will needs to be generated to protect marine ecosystem services. For example, a 2007 paper by Robin Craig suggests that a 'user pays' philosophy based around tourism might be one way to generate momentum for PES.

That would mean divers, for example, could be charged an entry fee to snorkel a particular sea grass bed. Craig said this would create a new market based on "competition between commodities and amenities users — to translate the new economic demands into a political will to better protect marine ecosystems and the services that they provide."

These are intriguing ideas that we will be exploring later in this series, but the bulk of attention is focusing on exercises in freshwater systems. These seem, on the surface, to most closely resemble the challenges of the sea — and will be the subject of our next installment.

# Water Trading: The Basics

**By Steve Zwick**

*Water trading has been hailed as the "next carbon", and schemes for valuing and trading both water usage and water "inputs" are proliferating across North and South America, Asia, and Africa. The Ecosystem Marketplace reviews the fundamentals of this promising ecosystem market.*

**16 April 2008** | In the early 10980s, the de la Motte family realized that cow dung and fertilizers were finding their way into the aquifer that fed the family's famous (and lucrative) mineral water plant in the town of Vittel, in northeastern France, after upstream farmers had replaced natural, filtering grasslands with corn.

By the end of the decade it had become clear the problem needed an innovative solution — one Vittel's new owner, Nestle, spent the 1990s hammering out with local farmers. The company purchased 600 acres of sensitive habitat and signed long-term conservation contracts with farmers whose corn and cows had polluted downstream waters.

Nestle now pays these farmers to manage their animal waste, graze their dairy cows the old-fashioned way, and reforest sensitive filtration zones. Though costly, it's a lot cheaper than the alternative. Competitor Perrier (now also owned by Nestle) once spent more than $260 million on a global recall after benzene made its way into millions of its distinctive green bottles, and its market share has never recovered.

## Payments for Ecosystem Services

Vittel's action, like New York City's payment to upstate farmers, has become a textbook example of a successful "PES" deal — short for Payments for Ecosystem Services — or, in this case, "payments for watershed services" (PWS). Such schemes, as frequent visitors to this site know, are based on the premise that ecosystems deliver valuable services that most of us take for granted — like filtering water in the above example — but whose value our economy doesn't normally take into account.

PES schemes try to quantify the economic value of services that an ecosystem provides, and then either entice or mandate those who benefit from the service to pay the people who maintain them.

Unfortunately, for every successful PES scheme, there are scores of failures and near misses, and much debate about what works and what doesn't. These issues are high on the agenda at the upcoming June Global Katoomba Group Meeting, and over the next two months we'll be focusing on water-based PES schemes: the history, the theory, the practice, the successes, and the challenges.

## Trading Water: Quantity and Quality

The Kyoto Protocol has put the trading of greenhouse gas emissions and offsets on everyone's radar, but emissions trading actually began decades before the Kyoto Protocol was signed. The US Environmental Protection Agency's (EPA) Emission Trading Program started in 1974, and allows a limited exchange of emission reduction credits for five air pollutants: volatile organic compounds, carbon monoxide, sulfur dioxide, particulate matter, and nitrogen oxides.

It kicked in at the height of the environmental movement in the United States. The first Earth Day was fresh in everyone's mind, and the federal Clean Water Act (CWA) and the Endangered Species Act were laying the groundwork for today's markets in water and biodiversity.

## A Wetlands Savings Account

So-called "mitigation banking" covers the quantity of biodiversity and wetlands — which are more than just standing bodies of water. A well-functioning wetland plays a key role in filtering water and thereby "delivering" the ecosystem service of reliable water quality, as well as providing habitat for many plants, insects and animals that are part of the biodiversity of an area. These "services" are difficult to quantify — one reason environmentalists are up in arms over schemes that replace true wetlands with ponds and other bodies of isolated water.

Mitigation banking involves building up reserves of water capital, and is a key response to the CWA's section 404.

The Act mandates that anyone who plans to dredge a wetland that nurtures other waterbodies try to find a way to avoid its destruction. When this is not possible, the developer must first get a permit through a program administered by the U.S. Army Corps of Engineers and the US EPA. Then, if a permit is granted, the developer must "establish, enhance, restore or preserve" an amount of wetland equal to or greater than what is being dredged — usually in the same watershed.

Mitigation banks are essentially wetlands that have been pro-actively established, enhanced, restored, or preserved — in exceptional circumstances when the land was under significant threat — with the goal of generating credits that can be sold to developers later as offsets. The CWA requires mitigation banks to replace function as well as acreage of jeopardized wetlands, although many complain that the function requirement is often overlooked.

## The Drive for Distribution

In addition, you have schemes that cover the distribution of water for drinking and agriculture, and no one has taken this further than the Australians, who've turned water into a commodity that is almost as easily-traded as electricity is in other parts of the developed world.

But it's in the developing world that such schemes could have their greatest impact. Studies show that the poorest usually pay the most for clean drinking water, while many industries simply waste it for free. Trading could put a uniform price on clean, delivered water, thus both reducing industrial waste and enabling delivery to areas that currently have poor access for drinking.

## Using Markets to Control Pollution

So-called “nutrient trading” covers the bulk of the quality side — although the boundaries between quantity and quality blur and overlap.

Most watersheds contain two types of polluters — “point” sources and “nonpoint” sources.

Point sources are the ones we hear about the most: industrial enterprises or urban waste treatment plants that directly pollute a watershed from a single pipe or point. Most point sources are regulated by the National Pollutant Discharge Elimination System (NPDES), and have been the cornerstone of water pollution control in the US since the passage of the CWA.

Nonpoint sources, on the other hand, account for a whopping 80% of the nitrogen and phosphorous that ends up in US waters — and most of these are unregulated, for a variety of political, social, economic, and logistical reasons.

These sources include farms, such as those that leached into the de la Motte’s watershed, as well as septic systems and new development whose pollution washes into a watershed over a diffuse area, usually in the form of run-off.

When run-off comes from agriculture, it’s called a “nutrient” — but it’s not the kind of nutrient your mother encourages you to eat with your Wheaties. Instead, these nutrients feed organisms that gobble up oxygen and lead to “dead zones” like those found in Europe’s Black Sea and the Gulf of Mexico. Such dead zones have been labeled a greater threat to humanity than global warming by the Millennium Ecosystem Assessment, a United Nations-sponsored project that engaged over 1,300 scientists and is easily the most extensive research program to date focusing on ecosystems.

The technology for alleviating the problem of agricultural run-off is readily available. Farms can reduce their run-off by changing the way they till, plant, or fertilize — at a cost of about 1/65 of what factories in the developed world would pay to reduce their levels of pollution emissions, according to one study.

That’s where “nutrient trading” schemes come in. They put the reduction burden on factories and other point sources, but give them a chance to pay nonpoint polluters to reduce their pollution outtakes instead — so-called “point-nonpoint” transactions. In theory, industrial polluters will opt to pay farmers to reduce their pollution emissions along a river when those factories can’t afford to invest in technology to further limit their own discharges.

This is the current holy grail of water quality trading, but most activity remains “point-point” — partly because nonpoint sources are difficult to monitor, but also because it’s difficult to measure results. Also, non-regulated entities such as farms may be afraid of getting involved in voluntary schemes, no matter how lucrative, because they fear it will bring them into what they see as a regulatory boondoggle. In the weeks ahead, we will be addressing solutions on the table for addressing these and other issues.

## The Beat Goes On

And there is, indeed, plenty on the table — with water schemes being proposed and implemented across Latin America, Asia, and Africa — as well as the United States, which got started in the early 1980's with point-point effluent trading on Wisconsin's Fox River and point-nonpoint trading on Colorado's Dillon Reservoir.

In 1996, the US EPA formally threw its support behind these trading programs, and several state initiatives have followed suit: Michigan with draft rules for nutrient trading in 1999, followed by the Chesapeake Bay Program in 2001.

The Chesapeake Bay Program, a multi-jurisdictional partnership that is working to restore and protect the Bay and its many resources, encompasses the three Bay states (Maryland, Pennsylvania, and Virginia), the District of Columbia, and the US EPA. But rather than being a unified trading program across the entire watershed, it is more of a hodgepodge of efforts with each state running its own trading scheme.

In early 2003, the US EPA released its Water Quality Trading Policy, identifying general provisions the agency considers necessary for creating credible watershed-based trading programs. Over a decade in the making, this policy identifies the purpose, objectives and limitations of these and other trading opportunities. The EPA has even gone so far as to publish a map of trading programs in the US and a trading toolkit.

The policy is flexible by design, letting states, interstate agencies, and tribes develop their own trading programs that meet CWA requirements and localized needs. Critics, however, say it's too flexible, failing to identify tradable pollutants and other basic parameters. This leaves the system undefined and fails to generate the kinds of certainty a true market requires.

## Drivers for Water Quality Trading in the US

Two major factors in the mid to late 1990's prompted not only the rapid increase of water quality trading programs in the US, but also a fundamental change in the way that water quality trading programs are developed and implemented. The first factor is the highly-publicized success of the Acid Rain Program, which demonstrated the efficacy of market mechanisms when coupled with proper government enforcement mechanisms. This convinced many policy makers that emissions trading could be applied to water pollution control.

The second factor is the increasing number of so-called "TMDLs" (Total Maximum Daily Loads) being developed by states and US EPA as mandated by the CWA.

A TMDL is the maximum amount of pollution that a water body can assimilate without violating state water quality standards, and individual states determine the specific TMDLs for specific pollutants in specific bodies of water. TMDLs don't just cover chemicals, but also things like temperature. In theory, they can act as de-facto caps for emissions in cap-and-trade water schemes, and approaches based on TMDLs and a handful of other tools are already being tested across the United States.

The calculations themselves are complex and the subject of much debate, but the existence of TDMLs identifies the sources and estimates the quantity of pollutants targeted for possible trading. This debate, in part, helps create the driver for a market — for in a well-structured market, the price of a pollutant will be tied to the actual amount of reduction necessary to meet the TMDL, and not to an arbitrary cap.

Water-quality trading can also occur on a "non-TMDL" waterbody (one that is not impaired or one that the government has not gotten around to developing a TMDL for), and trading can occur much sooner because nonpoint sources do not have to meet the TMDL minimum before a trade can occur. This is generally referred to as "pre-TMDL" trading.

This allowance was made because the TMDL minimum threshold may, in many cases, be too high and too expensive for nonpoint sources to meet, and could discourage them from pursuing a trade.

For a trade to occur in a TMDL waterbody, nonpoint sources must first meet their load allocation, then any additional amount of reduction they can accomplish can be sold to offset point source loads.

The TMDL trading unit is the specific pollutant identified in the TMDL. For example, in nitrogen TMDL, the unit is one pound of nitrogen removed from the waterbody; for a temperature TMDL, the unit is one degree of temperature lowered in the waterbody.

Despite the availability of these promising mechanisms, however, demand has been slow to materialize. For these markets to reach their true, enormous potential, awareness must be spread across both the private and public sectors — and to the community at large.

*This introductory was compiled from essays submitted to Ecosystem Marketplace over the past two years, and we would like to thank Mark S. Kieser and "Andrew" Feng Fang of Kieser & Associates, Ricardo Bayon of EKO Asset Management Group, Amanda Hawn of New Forests, and regular Ecosystem Marketplace contributors Alice Kenny and Erik Ness.*

# What can Oceans Gain from Freshwater WQT Schemes?

**By Rob Luke**

*Water quality trading (WQT) schemes have helped reduce pollution in rivers and lakes by paying farmers to adopt sustainable land-use practices, but no such schemes exist in oceans. Ecosystem Marketplace examines the potential for expanding freshwater WQT schemes to the ocean — and the challenges such expansion would face.*

**February 2010** | Not everyone believed Al Appleton back in the 1980s, when he started pushing for the city of New York to pay farmers in the surrounding Catskill Mountains to adopt better land-use practices. Doing so, he argued, could save the city billions in filtration costs — a projection since borne out by the success of the Catskill Watershed Corporation, which has slashed the city's water budget and become a model for water-quality trading (WQT) schemes around the world.

WQT schemes aim to slash the amount of pollution running into streams and lakes by enticing small farmers and other emitters into voluntarily reducing their discharges in exchange for payments from larger, regulated emitters. Advocates believe such schemes can generate deeper, cheaper cuts than can standard regulation, and scores of projects are up and running around the world.

With the degeneration of coral reefs, mangroves, and other ocean-based ecosystems upon which our land-based economies rely, more and more people are asking whether the WQT model can be expanded beyond watershed-bound streams and lakes to include the coastal ocean (where runoff from land spills directly into the sea) and deltas (where rivers and streams dump their cumulative runoff into the ocean).

Appleton believes the WQT model can lay the foundation for more ocean-specific payment for ecosystem services (PES) schemes, but warns that oceans carry obvious challenges that lakes and rivers don't.

Chief among them is size: after all, a cornerstone of most WQT schemes is the establishment of a total maximum daily load (TMDL) or some similar science-based cap on the amount of discharge a certain body of water can absorb. Such caps have proven difficult to establish in rivers and larger lakes — and that difficulty grows exponentially in the deep and boundaryless ocean.

Douglas L. "Dusty" Hall concedes the challenge for marine areas, but also believes WQT schemes that focus on reducing specific pollutant levels — especially those associated with agricultural runoff like nitrogen or phosphorous — can be extended gingerly into the sea. That, he believes, will create an infrastructure onto which schemes for reducing other pollutants can be grafted.

As manager of program development at the Miami Conservancy District in the US state of Ohio, Hall ranks alongside Appleton as a true WQT pioneer. Both schemes have helped raise funds for upstream mitigation from

money saved from deferred investments in water filtration plants. New York's savings paid Catskill farmers and local residents to change some of their land-management practices, and New York City subsequently saved about $4 billion on new filtration installations, while nutrient discharge from the Great Miami River watershed (GMRW) was cut by 650,000 pounds in its first three years of the Great Miami WQT program.

## Impact on the Ocean

The Great Miami River Watershed project is home to only two of the Mississippi River's 818 tributaries, but they still have a measurable impact on the both the Mississippi River and the Gulf of Mexico.

Indeed, recent scientific testing by the US Geological Survey (USGS) suggests reduced emissions into watershed streams were likely a significant factor in the Gulf's "dead zone," which had threatened to wipe out shrimp fishing in the Gulf of Mexico. The USGS in mid-2009 noted that the spring delivery of nitrogen from the Mississippi and Atchafalaya Rivers to the Gulf of Mexico that year was 23% lower than the figure for 2008.

## Beyond Nutrients

Results like that have inland water-quality schemes like Great Miami River looking to the coast for expansion. For example, Hall believes that Gulf-coast industries like oil that are currently looking to reduce their emissions along coastlines will begin looking to offset those emissions by joining inland water-quality schemes. Industry offset credits would, for example, fund new projects on the Great Miami River watershed aimed at reducing dangerous discharges levels of nutrients like nitrogen and phosphate from agricultural sources.

Those nutrients, flowing downstream and concentrating, deposit where the Mississippi emptied into the Gulf of Mexico, caused the hypoxic conditions that helped create the dead zone.

Hall said the Great Miami River Watershed credit scheme could easily accommodate large coastal polluters like oil drillers and refiners looking to participate by purchasing offset credits for their Gulf-water emissions.

"It doesn't get any simpler," he says. "We've got all the market mechanisms in place — we can sell, we can buy, and we have a program with checks and balances. Our program is designed to work in a marine environment."

## Building Participation

But getting all coastal and estaurine industries involved in pollution-credit schemes is a big challenge when so much marine pollution is almost impossible to trace. Hall accepts that this inability to account accurately for marine-pollution's source could hamper water-quality market development, but believes this can be overcome by encouraging as many coastal stakeholders as possible to join credit schemes for inland watersheds and waterways, likely the source of at least some of the coasts's nutrient pollution.

"Short of address labels on individual molecules, there's no way [of telling where the contaminants come from]," Hall says. "We just know that reducing non-point-source agricultural emissions in watersheds improves water quality downstream."

*A longer version of this story is available at www.ecosystemmarketplace.com.*

# Fishing for Solutions: Coupling Marine Biodiversity Offsets with Marine and Coastal Development

**by Ameer Abdulla, PhD**

*Biodiversity offsetting has helped promote conservation of endangered species on land, but can the same ideas be applied to the sea? Ameer Abdulla lays out a process for developing marine-based biodiversity offsets.*

**February 2010** | We humans are naturally drawn to the sea. Those of us who don't live along it have probably gone there for vacation, while more and more of us earn our livelihoods drilling for oil off the coast or erecting massive wind and wave farms to capture energy for our ever-expanding population. Then, of course, there are the fishermen who comb the sea for ever-dwindling supplies of food.

All of these activities put pressure on marine and coastal ecosystems, which must be more efficiently managed if the abundant life of the sea is to survive. Biodiversity offsetting has proven to be a valuable tool for preserving endangered species of animals on land, and the same concept can be applied to the sea.

## Biodiversity Offsets

Biodiversity offsetting presents a new and important opportunity for the private sector and society to work together to conserve and manage biodiversity while engaging in sustainable development.

Offsets are defined as "measurable conservation outcomes that are the result of activities designed to compensate for significant and unavoidable impacts on biodiversity". Contrary to popular opinion, biodiversity offsets do not give developers the right to run roughshod over fragile ecosystems in exchange for cash, but are seen as a last resort to be utilized only in certain circumstances.

Indeed, the process of developing biodiversity offsets is only initiated once realistic efforts and action have been undertaken to avoid, reduce, and manage the impacts associated with development. As such, it is based on the "avoid, minimize, offset" hierarchy established under the United Nations Convention of Biological Diversity. The ultimate objective of the process is to achieve no net loss of species community structure, habitat integrity, ecosystem functioning, and the associated social values due to unpreventable impacts associated with project development (construction and operation).

A conceptual framework and methodology exists for compensatory mitigation, ie using a levy on fisheries bycatch to fund conservation actions, but true offset design and methodology for project impacts on marine and coastal biodiversity is in the early stages.

## Scoring Marine Biodiversity

Before we can design biodiversity offsets, we have to clearly define our objectives. This means identifying a reference point for biodiversity within the local context of the project development.

The reference point comes from an intact, healthy marine ecosystem that provides a benchmark against which other locations can be compared. In this case, these "other locations" will be the site that is being negatively impacted and the site that we plan to rescue or restore in order to generate offsets.

If the development and associated impacts have not begun, then a survey of the major attributes of the different habitats is undertaken. This assessment includes a prori identification of major habitats such as mangrove systems, seagrass meadows, and coral reefs.

If the development site has already been disturbed by construction, then we have to find a proxy impact location to represent the impact location prior to disturbance. The proxy impact location should share similar biological and physical characteristics with the impact location, but be sufficiently far enough as not to have been disturbed by the impact activity.

## Assessing the Attributes

The attributes of the habitats (in the development or proxy site) are then evaluated and scored based on their current condition and integrity. Attributes are critical characteristics of the habitat that maintain ecological function and food web integrity.

In coral reefs, for instance, the high abundance and cover of hard coral species are vital for accretion and growth of the reef, which provides shelter, food, and reproductive areas for a multitude of other species. Such an attribute can be used as a sign of a healthy or "high-quality" coral reef.

Another attribute, abundance of reef herbivores, is also vital to the quality of coral reef as this guild of species maintain the growth of algae at a level that will reduce competition with coral (recruitment and growth). Some attributes have greater importance than others and are therefore given a higher weighting.

The characteristics of marine habitats vary widely, so it's important to sample multiple sites per habitat per location — despite the fact that rapid field survey methods are used to score these attributes. Furthermore, by standardising the sampling units, observer variability is reduced.

In this stage, it's especially important that your team have relevant field and scientific expertise so they can best identify the main habitat attributes, design the sampling, and score the attributes in the field. Finally, scores are compiled for each habitat at the development location (pre-impact or proxy) and are compared to those in other locations that have been selected as potential offsets.

## Designing a Marine Offset

Designing an offset entails understanding which of the habitats at the development location have been impacted, and whether that impact is partial, significant or total, then quantifying this per unit area (square meter or square kilometre, for example) while weighting its "biodiversity significance" with a score.

Offset locations should be those with the highest potential for biodiversity gain. This means they should have the highest quality of biodiversity per unit area, and they should also be realistically doable.

For instance, land areas under formal legal or management schemes may best contribute to reducing threats to marine environments from future land-based activities such as pollution or coastal fishing. This is especially successful if adjacent marine waters are included in the legal framework as managed or "no-take" zone.

Areas with high marine biodiversity values such as coral reefs may be particularly advantageous, as they can potentially harbour a higher concentration of species, threatened or otherwise, than adjacent marine areas without significant structurally complex habitat. Finally some areas may be politically easier or cheaper to designate and manage compared to other areas and may represent a more pragmatic and guaranteed biodiversity gain than other more controversial or costly sites.

## The Future of Marine Biodiversity Offsets

Biodiversity offsetting is one emerging multidisciplinary tool that has the potential to enhance corporate environmental responsibility in a multitude of different settings where human and biodiversity values may conflict. These settings are critical pressure points where science-based conservation planning may be able to affect maximum change and ultimately, greatly enhance conservation of biodiversity within the context of unavoidable impact.

However, offsets are currently a voluntary mechanism and one that is not readily available to many practitioners. Often, project development and construction is rapid and will not wait for what may be perceived as "lengthy or unnecessary biodiversity studies".

This is complicated in marine offsets due to the inherent logistical difficulty in accessing and studying marine systems such as deep water or pelagic habitats, coral reefs, and seagrass meadows. Undertaking evaluations in such habitats increases the time necessary to evaluate or score biodiversity and consequently the costs associated (expertise, equipment, etc.).

## Emerging Pilot Projects

As in all disciplines, theory must precede practice and implementation. Biodiversity offsets are a rapidly evolving multi-discipline within the Business and Biodiversity Offsets Program (BBOP) of Forest Trends and the Wildlife Conservation Society. BBOP is a partnership between companies, governments and conservation experts to explore biodiversity offsets. The Program is currently engaged in:

- Demonstrating conservation and livelihood outcomes in a portfolio of biodiversity offset pilot projects;
- Developing, testing, and disseminating best practice on biodiversity offsets; and
- Contributing to policy and corporate developments on biodiversity offsets so they meet conservation and business objectives.

The partnership aims to show, through a portfolio of pilot projects in a range of industry sectors, that biodiversity offsets can help achieve significantly more, better and more cost-effective conservation outcomes than what normally occurs in infrastructure development.

The future of better implementation of offset design theory lies in understanding how field-derived metrics play into larger landscape-scale measures and analyses.

## The Expanding Tool Chest

Furthermore, as the discipline of spatial conservation planning evolves rapidly, the associated modelling tools are more able to deal with the spatially sophisticated and complex cost/benefit scenarios and situations of uncertainty that are characteristic of offset design.

These tools will be able to integrate rapid site assessments and field information to provide multiple solutions for offset sites or compensation areas. The spatial optimisation tools are also capable of canvassing multiple and cumulative impacts of one or a series of development projects with the potential to developing biodiversity offset “banking”.

Most significantly, developing computer visualization tools for decision makers is now possible, which can simplify developing offsets in complex projects and streamline biodiversity offsetting within Environmental Impact Assments and the under resourced management authorities that are typically engaged with impact assessment and mitigation.

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## In a Nutshell

**Main Principles and Steps for developing Biodiversity Offsets**
(adapted from EPA 2006; Parkes and ten Kate 2006; Abdulla and Rouphael)

| Principles | Activity |
|---|---|
| **Quantify impact at evelopment site** | • Prepare benchmark for marine habitat types relevant to offset site. The benchmark is a reference location for marine habitat types relevant to impact site(s) using key habitat attributes and appropriate weighting of how important these attributes are to food web integrity and ecosystem function.<br>• Measure and score habitat attributes at impact site(s) against benchmark(s) site(s).<br>• If impact/disturbance onsite has started already, measure attributes at a proxy site (site similar to the impact site) against the benchmarks. |
| **Identify potential offset sites and actions** | • Identify sites/actions for the offset.<br>• Select the most appropriate candidates, giving consideration to the feasibility and direct socio-economic benefits of proposed locations and management scenarios. For instance, these could include high biodiversity areas such coral reefs and/or areas where conservation interventions such as fishing regulation, pollution management etc are highly likely. |
| **Quantify potential gain at offsite** | • Measure offsets sites against benchmarks prior to conservation activities |
| **Define the offset** | • Select offset components and areas for the conservation activities taking into account local and national legal mechanisms and social benefits and values<br>• Calculate ration of impact to predicted conservation outcomes per unit area.<br>• Establish appropriate area required for conservation based on impact/outcome ration |
| **Implement the offset activities** | • Undertake the offsetting activities |
| **Monitor impact and offset sites** | • Monitoring biodiversity gain in offset site as a real conservation outcome |

Source: Ecosystem Marketplace, New Carbon Finance, World Bank

Last year we accounted for 13.4 MtCO2e transacted on the OTC market in 2006. Because we were able to gather information from additional suppliers this year, we've now accounted for 14.3 MtCO2e transacted on the OTC market in 2006.

# Catch Shares and the Economics of Overfishing

**by Erik Ness**

*When and where the first humans caught the first fish is long lost in pre-history. But what happened next is pretty easy to imagine: First they wondered if they could catch another. Then they began to ponder whether there were enough fish to feed their family or village.*

**February 2010** | When and where the first humans caught the first fish is long lost in pre-history. But what happened next is pretty easy to imagine: First they wondered if they could catch another. Then they began to ponder whether there were enough fish to feed their family or village.

Fishing — along with agriculture — became a defining technological and resource foundation of many societies. The quest for fish and the accompanying maritime skills set the course for global exploration and trade. Fishing would become the economic bedrock of entire regions, making (and breaking) many fortunes. For centuries, the bounty of the sea seemed inexhaustible.

## Hitting the Wall

Now we know better.

Of the 230 fish stocks under US management, about a quarter are still being exploited at unsustainable rates. Cod stocks in New England collapsed in the 1990s and still haven't recovered. Atlantic halibut have been fished to commercial extinction, while other prized fish such as bluefin tuna are on the brink. Salmon stocks in the Pacific continue to decline, and the red snapper fishery in the southeast has just been closed for six months.

While researchers have reported the loss of 90 percent of large fish in 50 years since the advent of industrial fishing and warned of an overall collapse of most major global fisheries by mid century, some fishermen accuse the scientists of crying wolf.

Meanwhile, the US Congress has mandated an end to domestic overfishing by 2011, and the National Ocean and Atmospheric Administration, now under new chief Dr. Jane Lubchenco, is pushing "catch shares," a promising but controversial market-based solution to fishery management.

## The Game Thus Far

Fisheries to date have run largely on a catch-it-while-you-can basis. Quotas are set, and then each vessel harvests what it can while the season is open. It was something of a lottery — stumble upon good hunting while prices are up, and you're set; lose a net or blow an engine and you could lose out altogether.

Under a catch share, the quota is allocated to individual fishers. If the overall quota is one million pounds and your share is one percent, you get to harvest 10,000 pounds of fish. Some 300 catch shares systems already operate in more than 25 countries. Catch shares use economic tools to vest fishermen in their resource like never before. Early indications are that the technique can work, but to be effective they must overcome questions about equity and ecological impact.

## To Share a Fish

Dr. Chris Costello of the University of California at Santa Barbara is an economist at the forefront of the catch shares push. In a 2008 analysis in the journal Science, he and his co-authors examined the fate of 11,135 commercial fisheries around the world. They paid particular attention to 121 fisheries using a form of catch share called **individual transferable quotas**.

"Implementation of catch shares halts, and even reverses, the global trend toward widespread collapse," the paper concluded. "Institutional change has the potential for greatly altering the future of global fisheries."

Costello favors such programs over command-and-control because he believes they offer the right balance between regulation and flexibility.

"There are thousands of little decisions these guys make out on the water," he explains. "We can either regulate every little thing they do and try to monitor it all, or we can try to create an institution, a set of rules, that creates incentives for him to want to do what we think is the right thing."

Fishing policies vary by country, but usually a nation's offshore fishery is a publicly-owned resource, with government-regulated access. In the US, for example, fisheries generally are governed by an overall catch limit. Called the Total Allowable Catch, or **TAC**, it's supposed to be a scientifically-determined target that leaves enough fish in the water for the fishery to renew itself.

## Unintended Consequences of TAC

TAC alone, however, has its limitations.

First, the formulas rely on imperfect data and are subject to political pressure. Second, the TAC formulation does not take into account ecosystem connections and effects, so while a particular target species may end up being fished within its own sustainable limits, the harvest may harm whole ecosystems. Third, the TAC is enforced by regulating effort: season length, days at sea, trip limits, gear.

The result can be a race to fish: individual boats have no incentive to limit their catch, and the TAC is routinely exceeded. In the Alaskan halibut fishery, for example, regulators kept shortening the fishing season to try to reach their harvest goal. But fishermen just employed more boats and better technology. In 1990, the entire season was compressed into a six-day derby, and still the catch exceeded its target by 6%.

Ironically, the fishermen needed that overage because the catch overwhelmed the market, and prices dropped. Fishery and fisherman both lost.

## Blending TAC and Catch

In 1995, the Alaskan halibut fishery adopted a catch shares system. The TAC is now divided proportionally between participants, using a formula designed by the local fishery. Shares were divided according to catch history, and also divvied up between different sizes of boats to allow for a diverse fleet. Under the new system, if the harvest target of the fishery increases, so too does the amount that each share may harvest.

Now the fishermen have a vested interest in the sustainability target. And instead of managers struggling to come up with regulations to restrict the harvest, fishermen can fish any time during a nine-month season. Fishermen are accountable to harvest only their allowable share. But freed from the race to fish, they can also space out their catch, selling more to the higher-value fresh seafood market. Revenue per crew position nearly doubled from 1995 to 2008, and target harvests were finally attained.

Brad Warren of the Sustainable Fisheries Partnership explains how catch shares implementation transformed the Pacific groundfish fishery in British Columbia. It took time for the captains to trust the data, but once they realized just how significant their overfishing was, the tide turned. “We’re destroying our future,” they realized. Once catch shares was implemented, the fishermen insisted that each boat carry an observer. A bycatch trading system also allowed the boats to minimize their collateral damage to the ecosystem.

“You have a huge incentive for the industry,” says Warren. “It wasn’t just that their fishing practices changed, and they got cleaner. It was also that they started accounting for what they removed. Then the removals could actually be contained at the levels they were meant to be contained at.”

The catch shares downside?

“The smaller boats couldn’t afford it,” he says. “It crushed them. That was a tough political decision. It was necessary, but not fair.”

When issues of equity are not addressed, large operators can corner the market in catch shares. In fact, soon after Alaska adopted its successful halibut catch shares program, the US Congress placed a moratorium on catch shares development that was only lifted in 2002.

## Share Trading

The ability to meet harvest targets is one strong argument for the conservation value of catch shares. Share tradability is another potential conservation tool, but it’s also more controversial. The market is set first by the right itself, which depends on the country. In New Zealand a share is essentially property, and the law requires compensation if the share is taken. In the US, however, the fishery is a public resource and access to the fishery is a revocable privilege, reviewed every decade.

Most catch shares fisheries have been designed so that shares can be traded, though rules may limit who can own the shares. Trading among vessels helps maximize efficiency — if a skipper’s hold is full but she still has share, she could plan another trip, or perhaps sell the remainder to another vessel, maximizing her own profit.

But tradability also worries some fishing communities. Overall, the industry has already seen significant consolidation over the last few decades, with bigger boats and fewer owners working out of larger ports and

selling to larger processors. Catch shares opposition often comes from owners of smaller boats in smaller ports, who worry that they could lose out to bigger operations. And unless ownership is restricted strictly to those on board the vessels, argues Zeke Grader of the Pacific Coast Federation of Fishermen's Associations, fishermen could become seagoing sharecroppers.

"At that point much of the stewardship that's claimed for these programs … is lost," he says.

## What Drives the Fishing Industry?

It's ultimately a design question: Is the performance goal of the fishery primarily economic, social, or biological?

Some of the first catch shares programs were driven by economic goals to reduce a fishing fleet that had grown too large and thus inefficient. But in the Alaskan example, reserving shares for different size boats was intended to help support a diverse maritime infrastructure. In New England, some of the pushback on catch shares is because some people believe current plans don't sufficiently support the small coastal fishery that helps maintain the state's bucolic waterfronts, which could impact tourism down the line.

"The specific needs of the fishery are the first part of that equation," says Amanda Leland, national policy director for the oceans program of the Environmental Defense Fund, a major proponent of catch shares. While it may make little sense for a lobster fishery with lots of small boats operating in many small communities to allow outside investment, other fisheries may be more industrial in nature, with some fraction owned by investors.

Indeed, investors may be critical in salvaging at-risk fisheries where banks fear to tread.

"Transitioning to catch shares can be quite challenging economically in fisheries that are under-performing economically, as many of the most troubled fisheries are," says Leland. "Financial arrangements are ways that fishermen can help stay in business in the short term as the fishery starts to rebuild."

## The Conservation Argument for Trading

Costello adds that when shares are tradable it opens up a new tool kit for ocean conservation.

"All of a sudden conservation easements and all of the other tools we use on land are now viable in the ocean," he says. For example, the only way to establish a marine reserve right now is to lobby for legislative or executive action. With catch shares, it becomes possible to simply buy up the relevant shares.

"If you assign rights in an appropriate manner, it creates a platform for investment," he argues. "From the fisherman's point of view he can invest in his own fishery and make more money and be a better steward of the resource. But it also creates a platform for trade and investment from the conservationists who want to transact with that fisherman to make more conservation minded decisions. None of that is possible without the right."

## Neglecting the Ecosystem?

Lubchenco was a strong advocate of catch shares before her appointment, but she would be the first to acknowledge that single-species harvest management is not particularly ecosystem-oriented.

"What tends to happen is you only set limits on the commercially valuable parts of the system, while neglecting other parts of the ecosystem," explains Tony Charles, a professor at Saint Mary's University in Halifax, Nova Scotia. "You forget about the quality of the habitat and the ecosystem generally."

What about the Costello Science paper, which predicts catch shares fisheries are less likely to collapse?

"What they couldn't control for are the other management measures that came along with the catch shares system," counters Charles. "People have said for decades that better enforcement will lead to better fisheries management and better stock rebuilding. There is no way they can separate what came along with the catch shares system at the same time."

Costello admits this could be true, but counters that catch shares are more likely to set a better TAC because the fishermen are vested in the overall value, and understand that overfishing could cause the value of their share to decrease. "Lots of the fisheries that don't have catch shares set TAC and they screw it up. They set them too high. If it takes a catch share to get the right TAC, then fine."

## Ocean Zoning

Catch shares won't solve all the ocean's problems, but the principals at least dovetail with potential solutions being put forward to overhaul ocean management on a grander scale.

When we look at the vastness of the ocean, some marine areas stand out for their exceptional biological value. Coastal wetlands, estuaries, reefs, submarine mountains, and major nutrient-bearing currents and upwellings are vital pieces of the oceanic ecosystem. Unfortunately, our current patchwork of national and international laws, regulations, and economic rights don't allow us to use management tools and policy instruments in a practical, ecosystem-oriented way to protect these critical areas.

One alternative that's gaining ground: zoning the ocean. A few countries have set aside a few marine protected areas, but to make a difference zoning would have to be enacted on a far grander scale. Ocean zoning could play a role the development of markets for oceanic ecosystems because it would help establishes clear rights and responsibilities, reassuring potential investors. A comprehensive zoning approach could include "trading zones" where payments for ecosystem services transactions could be established.

Ideally, every blue spot on the map would be assessed for its value, from commercial to recreational to conservation. These plans should be developed locally and not imposed from above. The waters of Asinara, a small island in the in the Mediterranean Sea, is but one place that has been zoned for mutliple use. And the North Pacific Fishery Management Council recently closed a vast stretch of western and northern coastal Alaska to commercial harvest.

In this context, catch shares, particularly territorial user right fisheries, or TURFs could be combined with marine protected areas. Both approaches are commonly advocated as solutions to failing fisheries. Protected

zones limit harvest to certain areas, but may enhance profits outside via spillover. TURFs incentivize local stewardship, but may be compromised when the TURF is too small to retain the offspring of adult fish in the TURF. Strategically-sited MPAs may be an effective complement to spatial property-rights based fisheries, increasing both profits in the fishery profits and the overall health of the local marine ecosystem.

## To Be Continued

In December the Proceedings of the National Academy of Sciences, seeing the debate unfolding, fast-tracked a new analysis of catch shares. Dr. Tim Essington, a fisheries biologist at the University of Washington looked at ecological indicators in catch shares fisheries in North America and found that they did more to improve the consistency of fisheries than the ecological health.

“They work very well to avoid erratic swings. They generally do not lead to more fish to catch,” says Essington. “Catch shares are one potential method for improving fisheries management, but we shouldn’t expect these programs to be a panacea.”

Ironically, both proponents and opponents of catch shares cite Essington’s research as supporting their case. Indeed, the seas are very rough indeed when it comes time to discuss catch shares policy. In some fishing circles EDF is viewed suspiciously as a tool of big business, with catch shares being akin to the same kind of financial instruments that brought on the current economic crisis. Meanwhile Pew Environment Group has put tens of millions of dollars into some of the research suggesting fisheries are in trouble. And because NOAA’s Lubchenco worked with both groups when she was an academic, the whole catch shares push is seen as tainted and top-down conspiracy, aligned with environmental special interests.

Dr. Bonnie McCay is a Rutger’s scientist who has studied social dynamics of fishery regulation for decades. NOAA’s draft policy “allows for the kind of decentralization of decision-making that many of us have called for a long time,” she says. Unfortunately, the “emerging reality is so narrow,” she adds. While catch shares can accommodate many different kinds of fisheries management through creative design, people in the industry see it as most likely to mean a highly tradable system that will favor the big players, continuing the trend of consolidation.

That’s partly because “NOAA as a fishery management agency has never, ever favored local management” she explains. “There is not much evidence that it could operate otherwise.”

It may just be that the short term reality is more governed by budgetary wrinkles. Implementing catch shares at the scale imagined by NOAA won’t be cheap, which could jeopardize other programs.

In the end, the biological backdrop doesn’t make the debate any easier, warns Leland, from EDF.

“Many of the stocks are not doing well. If a major goal of the program is to recover fish populations, the catch limits are going to have to be set at a level at which the recovery can occur, which is the really tough part of all of this. That is a core issue: whether they are going to catch shares or not.”

NOAA is accepting comments on the draft catch shares policy until April 10.

# Can the "New" Ecotourism Preserve Ecosystems by Paying for Beauty?

**by Alice Kenny**

*Low-impact tourism — classic "ecotourism" — has become a reliable niche within the global tourism trade, but it's nothing compared to mass tourism that brings hundreds of millions of vacationers to oceanfront resorts around the world. This traffic, however, is taking its toll, and now savvy environmentalists are tapping the trade to fund the preservation of ocean ecosystems on which it depends.*

**22 January 2009** | Ah, Cancun in the winter. Warm sun, clear skies, cool drinks and…

Hey… what happened to the sand?

After focusing on tourism while turning a blind eye to the beach's underpinning ecosystems for more than three decades, Cancun and its celebrated white sands are washing away. This Caribbean barrier island became a veritable who's who of five-star hotels with the Ritz Carlton, the Hyatt Regency, the President InterContinental and a host of others squeezing for space across the entire 12-mile sandbar. Now it is so bogged down by development that it can no longer withstand the seasonal ebbs and flows of its native sands.

Some scientists say it may be too late to restore Cancun. Its degradation is so severe it spawned a new noun: the "cancunization" of marine coastland.

Tourism caused the problem. And tourism could offer the solution for similar vulnerable coastal vacation spots around the world and the threatened marine species they host, before the degradation becomes irreversible.

The tourism industry could fund payments for ecosystem services to underwrite and insure its investments. And by harnessing private-sector investment, billions of dollars worth of vulnerable yet valuable marine and coastal ecosystems could avoid Cancun's fate, says a growing group of governmental organizations, environmental groups and non-governmental organizations.

## Sexy Seagrass… Not!

Coral reefs, mangroves and sea grass beds that naturally form and maintain beaches do not count among the sexy stuff the tourism industry focuses on. Yet they provide essential ecosystem services upon which the industry depends. They buffer storms, prevent beach erosion, and provide homes to the thousands of fish, sea turtles, lobsters and starfish that tourists, diners and recreational fishermen expect to enjoy on their visits to the beach.

So far, no one has offered to foot the full bill for their preservation. After all, coastal conservation management is expensive, and waterborne patrols cost significantly more than land-based police.

Businesses in lesser developed countries have been happy to pocket the influx of tourist dollars. But with limited government coffers they have been hard-pressed to finance environmental protection. Meanwhile, conservation NGO’s typically lack the funds needed to carry the full weight.

Currently, between US$2 and $3 billion per year are spent on protected areas throughout the world, according to statistics provided by Conservation International. But the amount needed to adequately protect most of the world’s threatened biodiversity has been estimated at between two and 20 times that amount — this according to Barry Spergel, an international lawyer and environmental consultant who cited them during a roundtable discussion at the Hague Conference on the Environment.

Fortunately, untapped dollars along with a determination to preserve coastal vacation spots already exist.

Tourism is one of the world’s largest industries, employing over 220 million people and generating more than nine percent of the world Gross Domestic Product (GDP), according to the World Travel and Tourism Council. International travelers spent over $500 billion US dollars last year alone.

By thinking creatively, environmentalists can funnel tourism dollars into conservation, says Tundi Agardy, a marine ecologist and coastal planner who directs the Marine Ecosystem Services (MARES) Program of Forest Trends (publisher of Ecosystem Marketplace).

## Tourism as the White Knight

Coastal communities began drawing on dollars generated from ecotourism — loosely defined as tourism intended to promote ecological awareness and limit damage to the environment — to help fund their protection in the 1990s. Examples abound. Ecuador’s Galapagos Islands National Park, for instance, collects a $100 park entry fee from each of its annual 80,000 foreign tourists. Australia charges commercial tourism operators $4 per tourist per day to explore its Great Barrier Reef. The Caribbean island of Bonaire gets a $10 annual flat fee from scuba divers to protect its coral reefs and coastal environment.

But ecotourism with its snorkelers and rain forest explorers accounts for only 20 percent of international travel, according to the World Tourism Organization. Agardy says that, to generate significant funding for coastal conservation and marine management, the mass tourism dollars of sunbathers and pina colada sippers must be tapped. This could be achieved by creating flexible mechanisms that include direct payments, offset markets and payments for ecosystem services.

By harnessing these markets, tourism could become the white knight that saves marine ecosystems rather than the black knight that harms them.

“The conservation community considered the mass tourism industry the enemy,” says Agardy. “Now we’re looking at the potential for partnering with mass tourism to find ways they and the environment can benefit.”

## From Tourist Trap to Ecosystem Solution

Several tourist destinations already draw on mass tourism dollars to support ecosystem services. Belize and the Republic of the Cook Islands require foreign tourists to pay a conservation fee when they enter or leave the country. Some hotels in the eastern Caribbean and on islands off of Spain charge guests a tax directed

towards ecological conservation and restoration. And Maldives President Mohammed Nasheed announced in September a $3 a day green tax for all tourists of this Indian Ocean nation's popular island resorts.

This existing foundation can be used to launch a multi-faceted ecosystem service approach that draws on tourism dollars to support threatened coastal areas. For ecosystem service solutions to work, Agardy adds, they must be flexible enough to respond to the specific needs at threatened tourist sites.

Species banking and trading programs could help. A resort owner whose development caused the unavoidable loss of protected turtle habitat could purchase credits from a species bank that promoted turtle biodiversity. A marina project that unavoidably destroyed a patch of reef could purchase credits from a trading program that restored coral reefs.

## The Mesoamerican Reef

The issues are complex, and effective strategies typically rely on government regulation paired with payment for economic service approaches. For example, Forest Trends is working with partner organizations to design a multi-tiered program along the coast just south of Cancun where hope for sustained tourism is all but lost.

The plan would benefit overall the much-stressed Mesoamerican reef that stretches from the Yucatan Peninsula to Honduras. Here, overfishing, as well as "over-zealous fishing" (tossing dynamite into the waters to quickly bring up fish) and coastal pollution caused by sewage and runoff are destroying the reef. Forest Trends is investigating ways of using tourism revenues for marine management — paying fishermen not to overfish and subsidizing water treatment.

These new market mechanisms must be designed in a manner, however, that recognizes the significant risks that they come with, Spergel says. An untold variety of unpredictable events such as hurricanes, terrorism and financial collapse could cause tourist dollars to dry up. Moreover, conservation may be beyond government and market control. In Mauritania, for example, where Spergel worked to create coastal conservation programs, boats operated by Senegalese pirates and prowlers caused far more damage to marine life than tourists and their cruise ships. Ecotourism solutions require a flexible perspective that custom-tailors itself to locations, governments, markets and funding.

## Backhoes, Beaches and Borrowed Time

Unfortunately for Cancun, this barrier-island-cum-tourist-trap became a sacrificial lamb for ecologists wagging "I told you so" fingers at developers who, they say, should have known better than to build big on a barrier beach and remove mangroves in the first place. It offers a clear example of what happens when the tourism industry pockets its profits without reinvesting in the ecosystem services on which the profits depend.

"We can't do much about Cancun," says Agardy who watched from her hotel in November as backhoes on beaches hoisted millions of dollars of borrowed sand pumped in from the sea floor and brought in from the banks of nearby islands. "But we can use creative ecosystem markets and solutions to prevent the 'cancunization' of the rest of the coast.

# The Allure — and Elusiveness — of Mangrove Forests as Carbon Sinks

**by Steve Zwick**

*Two major reports highlight the ability of mangroves to pull carbon from the atmosphere and bury it in coastal soils, where it can remain for thousands of years. So, why aren't mangroves the darlings of the REDD set?*

**February 2010** | It's hard to imagine a more valuable ecosystem than a mangrove forest. These rugged coastal woods protect the shoreline from both sudden storms and gradual erosion; they provide shelter for young fish, breeding grounds for shrimp, and wood for local villagers — all of which are the fruits of clearly delineable ecosystem services, each of which has a clear line to who benefits the most.

This should, in theory, make it easy to entice those who benefit into paying for the ecosystem services that mangroves generate. Tourism operators and fishers, for example, could both pay mangrove guardians for the upkeep of coral reefs; fishers could pay for the nurturing of their prey; and anyone along the shore could pay to keep the sea at bay and prevent their houses from falling into the sea.

There's just one catch: in most developing countries, the people who benefit the most from mangroves don't have the money to make payments for ecosystem services. This leaves the carbon market as the most promising way to fund the rescue and restoration of mangrove forests, with payments from fishers who export and tourists who visit trailing far behind.

## Gold in Blue Carbon

Virtually ignored by carbon markets until recently, "blue carbon" became a hot topic with the 2009 publication of two reports: "Blue Carbon: the Role of Healthy Oceans in Binding Carbon" and "The Management of Natural Coastal Carbon Sinks".

Both explored the value of ecosystem services that mangroves provide, but they ultimately concluded that more study was needed before such services could form the basis of payments.

## The Rising Tide

Mangroves are especially suited for carbon capture because they accumulate large amounts of carbon in their soil, while terrestrial forests keep most of it in trees and branches.

Both mangroves and terrestrial forests put down roots and drop leaves, of course, but when mangroves do it, the ground beneath them rises — as does the level of the sea, as it has for thousands of years, says McGill University professor Gail Chmura, who runs the Global Environmental and Climate Change Centre.

“Mangroves accrete soil vertically as the sea rises,” she says. “Then they also accrete laterally — which means they move inland as the sea moves up.”

The same applies to salt marshes, which move so far inland that when Chmura digs into the mud marshes of New Brunswick, Canada, she often finds the remains of forests below them.

As the levels of both the ocean surface and the mangroves soil rise, so too does the amount of carbon sequestered in the earth — and it can stay there for millennia.

That same rise, however, has a downside: namely, it often makes things more hospitable for another species of mangrove that replaces the original soil builder, says McGill researcher Paola Fajardo. She’s studying the carbon storage accumulated in the soils of mangroves in Mexico, with an eye towards developing carbon offsets.

It doesn’t take much of a change in elevation for one species to have better possibilities to survive than other species — both in nature and in restoration projects, she says. But if there’s no room for the mangroves to move inland if the sea rises, the mangrove forest can die.

“In some areas species can change based on differences in elevation of just centimeters,” she says. “So, if you have a change in elevation of just some centimeters, you may get another species altogether.”

As a result, mangroves tend to be segregated along species lines within a single forest, as different types of trees seek different elevations within that forest.

## Salt Please?

And it doesn’t stop there. Different species also have different taste and tolerance for salt.

“Some species can handle up to 90 units of salinity,” she says. “Each species is adapted physiologically to different conditions, and some can be under stress if salinity gets above 36.”

Seawater, by comparison, usually has about 35 units — so some species thrive on the coast, some a bit inland, and others in areas where seawater gets trapped and salinity increases.

Global warming, therefore, poses a double-whammy of rising sea levels and altered salinity levels for these valuable resources — threatening not only mangroves as they exist today, but making it difficult to project with certainty the amount of carbon that any local action can sequester over time.

“We will be able to do this,” says Fajardo. “But we need to calibrate the soil carbon storage rates in different scenarios (e.g., natural areas, reforestation plots and cutting areas), considering different variables, such as species composition and salinity.”

Ultimately, that means developing sophisticated coastal plans that take into account the entire ecosystem in which mangroves lie. Many of the current plans for adapting to global warming, for example, involve the erection of dikes to hold back water, while networks of dams have been erected to keep cities from going dry.

Unfortunately, says Fajardo, many of those dikes and dams are altering the flow of runoff from land to sea — depriving the buffering mangroves of the fresh water and sediments they need for the ecosystem to be sustained. Even if done right in the short term, dikes provide a barrier against which mangroves can't accrete inland — meaning as they rise but can't migrate inland, they will have to either adapt, perish, or be altered artificially.

## When Ecosystem Services Collide

Mangroves are a type of wetland, and one ecosystem service that wetlands provide is filtration: they extract unwanted elements from water passing into them, so that water passing out of them is relatively pure and clean. Chief among these unwanted elements are agricultural nutrients — fertilizers that farmers use to help their plants grow, but which feed unwanted growth like algal blooms when dumped into the sea.

Those nutrients, however, have a tremendous impact on the amount of carbon that mangroves capture and store — and salt has an equally tremendous impact on the net amount of greenhouse gasses that wetlands capture and emit.

Increasing the flow of agricultural runoff from coastal lands can spur the growth of mangroves in height, but it could also diminish the amount of carbon they store in the soil.

"Some counterintuitive things happen when you start to look at root production and soil carbon, at least with grasses in salt marshes," says Chmura. "For example, the more nutrients you give these grasses, the less root production there is — and therefore the less soil carbon — because the plants don't need to reach out so much. We suspect it is the same for the mangroves."

## Salt, Again…

On the other hand, she says, more salt in the water usually means more sulphur as well — which usually translates into less methane released into the air and a better impact on the atmosphere, according to research conducted on the Chesapeake Bay back in 1987.

In fact, because methane is 23-times more powerful as a greenhouse gas than carbon dioxide, many freshwater swamps and bogs may be doing more greenhouse damage than they're preventing — while saltwater mangroves are, she believes, most certainly doing more good than harm.

## Not Out of the Woods

Both the Clean Development Mechanism and the Voluntary Carbon Standard have established methodologies for measuring, monitoring, and paying for the carbon captured in mangrove forests, but critics say the tools available so far don't adequately address the most important aspect of mangrove carbon: the soil.

Several efforts are underway to correct this, and one of the most promising is the Danone Fund for Nature, which is an initiative being spearheaded by the International Union for Conservation of Nature (IUCN), the Ramsar Convention on Wetlands and Danone (aka Dannon in the US). The fund has developed guidance and standards for sequestering carbon through wetland restoration projects which also deliver community benefits.

A first plot project has been undertaken by the Senegalese NGO Océanium to test the efficacy of using carbon finance to fund mangrove restoration in Senegal. Danone hopes the project will sequester enough carbon to offset some of the greenhouse gas emissions of its Evian mineral water operations, and it enlisted 80,000 villagers from 350 villages to plant 36 million trees last year.

The pilot phase is focusing on planting mangroves, while a subsequent phase might look at the broader hydrological stresses of the mangrove systems in Senegal.

*A longer version of this story is available at www.ecosystemmarketplace.com.*

# Conclusion

*Mankind takes more from the ocean than it adds, and this cannot continue. If it does, we will soon have nothing left to harvest and nothing to protect us from the ocean's rage.*

The factors driving this trend are complex and difficult to reverse, but they all derive from one basic flaw in the DNA of our global economy: namely, its failure to account for the cost of environmental degradation. One could argue that this one glaring omission has done more harm to our planet than all of the other faulty risk assessments and accounting errors that all of the banks and all of the insurers in all of the world have made in all of history combined.

The answer is simple to conceive but difficult to execute. We need to incorporate the actual value of nature's services into our modern economy, so that those who deliver the value of preservation are rewarded the same way we have long rewarded those who deliver the value of extraction.

The growing field of environmental finance can help achieve this goal, provided it is coupled with solid science, prudent but effective legislation, and widespread awareness among those whose lives it impacts.

Fortunately, this is beginning to happen. A growing number of scientific research institutions, forward-thinking policymakers, and entrepreneurial financiers, together with equally entrepreneurial non-profit organizations and individuals, are drawing on the lessons of land-based schemes like wetland mitigation banking, species banking, and the global carbon markets to create new financing mechanisms that identify the economic value of the ocean's services.

Identifying and quantifying this value is a first step towards preserving it in a fair and equitable way. Next is identifying who benefits (and can pay), as well as who contributes (and should be paid). Here, too, we have seen tremendous progress over the past few years.

Environmental markets will not solve all coastal and marine problems, but they do offer new and evolving tools in the race to preserve the ocean's bounty. Over time, we will learn the limits of these tools — and their potential.

To ensure a fair, equitable, and effective mechanism, it's critical to encourage anyone with a stake in the oceans — and that includes hundreds of millions of people around the world — to actively participate in its creation. That is the mission of this Katoomba Meeting and, in general, the Katoomba Group, Ecosystem Marketplace, and the MARES Program of Forest Trends.

**THE KATOOMBA GROUP'S**

# Ecosystem Marketplace

The Ecosystem Marketplace seeks to become the world's leading source of information on markets and payment schemes for ecosystem services (services such as water quality, carbon sequestration and biodiversity). We believe that by providing reliable information on prices, regulation, science, and other market-relevant factors, markets for ecosystem services will one day become a fundamental part of our economic system, helping give value to environmental services that, for too long, have been taken for granted. In providing useful market information, we hope not only to facilitate transactions (thereby lowering transaction costs), but also to catalyze new thinking, spur the development of new markets, and achieve effective and equitable nature conservation. The Ecosystem Marketplace is a project of Forest Trends. **www.ecosystemmarketplace.com**

FOREST TRENDS

Forest Trends is an international non-profit organization that works to expand the value of forests to society; to promote sustainable forest management and conservation by creating and capturing market values for ecosystem services; to support innovative projects and companies that are developing these new markets; and to enhance the livelihoods of local communities living in and around those forests. We analyze strategic market and policy issues, catalyze connections between forward-looking producers, communities and investors, and develop new financial tools to help markets work for conservation and people. **www.forest-trends.org**

the katoomba group

The Katoomba Group seeks to address key challenges for developing markets for ecosystem services, from enabling legislation to establishment of new market institutions, to strategies of pricing and marketing, and performance monitoring. It seeks to achieve the goal through strategic partnerships for analysis, information-sharing, investment, market services and policy advocacy. The Katoomba Group includes over 180 experts and practioners from around the world representing a unique range of experience in business finance, policy, research and advocacy. **www.katoombagroup.org**

Marine Ecosystem Services Program

MARES

The Marine Ecosystem Services (MARES) Program builds on the core work Forest Trends has done in terrestrial ecosystems and conventional markets, aiming to facilitate the development of innovative coastal and marine market mechanisms for marine conservation around the world. MARES has developed the conceptual underpinnings for doing Payments for Ecosystem Services (PES) markets and biodiversity offsets in the marine realm and is beginning to field testing these ideas with on-the-ground pilot projects, sharing the resources and tools developed with the wider conservation community. The four ecosystem services on which we focus are marine biodiversity, water quality, shoreline stabilization and beach production and maintenance, and fisheries production/nursery habitats. **www.forest-trends.org/mares**