

10 Solutions to Save the Ocean

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Great ideas can pop open whole new vistas. And they can come in many forms. They can be as big and sweeping as a new business model or as focused as a single piece of equipment. What's key is that they are leverage points that have the potential to turn tides. Saving the world's oceans is going to take more than passionate declarations. So we asked a select group of innovative thinkers to go out on a limb. What string should we pull to give marine conservation a decided edge? Here are their answers.

Edited by Sarah Simpson

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Eat More Anchovies

Eat lower on the marine food web and tap into a bountiful supply of protein

by Martín Hall

How many people do you know who make lions, tigers, or wolves a mainstay of their diet? On land, no one looks to the top of the food chain for protein, yet that is exactly the faulty logic we apply to the sea. Our growing demand for tuna, shark, swordfish, and other top marine predators drives their prices up and encourages fishers to catch more—in many cases threatening the longevity of the stocks. The good news is that we don't have to stop eating fish to preserve these gastronomic delights for the future—but we do have to change our eating habits.

The statement that we are overexploiting the oceans, although true in terms of many of the species we now select, is actually false in terms of protein production. Consider an oversimplified example: it takes close to 60 million metric tons of potentially edible fish per year to feed the three million metric tons of the three major tropical tuna species we harvest annually. If we could replace some of our tuna sandwiches with the anchovies, sardines, squids, and other species the tuna eat, we would open up a substantial supply of protein that could feed millions more.

We can still savor seared ahi and grilled swordfish steaks—they have the best meat and few bones, after all—but we must reserve them as a luxury product. As long as we let the current tastes of the richest nations dictate our ocean harvests, it will be extremely difficult to reverse the overexploitation of many species. We must redistribute our harvests in an ecologically sensible way, not by adding new species to the current harvest but rather by substituting catches of depleted stocks with fishes lower on the food web.

People who are determined to eat top predators regardless of the conservation cost should consider another fact. In our amazing lack of common sense, we already catch thousands of tons of anchovies each year; but instead of consuming them directly, we grind them up and ship them to farms halfway around the world to feed chickens, pigs, and farmed fish. This practice thrives in part because fishmeal is often as cheap as plant-derived animal feeds, yet it wastes a huge source of available protein—not to mention the fuel consumed for transportation.

In some parts of the world, the message is getting through. In Peru, which has contributed up to half the world's fishmeal since the 1950s, the anchovy is beginning to be embraced as fine food. During "Discover the Anchovy Week" last December, some 18,000 people tasted anchovies at 30 restaurants in Lima, the nation's capital. Now fresh anchovies are available in many of Lima's markets, and the government is supplying anchovies as part of its food security program.

It won't be easy. But we should follow the lead of people who fish to feed their families and teach their kids not to be fussy about what is on their plates.

About the Author

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Small But Mighty

Elevate the role of small-scale fishers in the world market

by Daniel Pauly

Conservation biologists have long complained about the vastly greater ecological impacts of large-scale industrial fisheries compared with small-scale, artisanal ones. Yet policymakers continue to grant industrial fishers a competitive edge, in great part due to a widely held perception that they catch the vast majority of the world's fish. Recently, though, more-thorough estimates of annual global catch proved that assumption wrong: it turns out that small-scale fisheries actually land as much as their industrial counterparts, at least as far as fish destined for human consumption are concerned.

This new knowledge that the world does not actually rely on industrial fisheries for food security lends new force to the argument that they are expendable, not vital. Indeed, I argue that the best path toward sustainable fisheries worldwide would be to phase out industrial fisheries in favor of artisanal fisheries, which have a much better track record of sustainability.

Artisanal fisheries usually involve a multitude of fishers working inshore, using mainly small craft and passive gear and thereby consuming relatively little fuel per unit of catch landed. Industrial fisheries, on the other hand, employ relatively few people and tend to use bigger, fuel-intensive vessels—many of which pulverize entire ecosystems as they drag nets and gear along the seafloor. And although they generally operate offshore, more and more industrial fishers are moving inshore—and into direct competition with local, artisanal fishers.

The features of industrial fisheries that, to date, give them a competitive edge may turn into liabilities in the future: the price of diesel fuel may become prohibitive, and more people are challenging the huge ecosystem impact of their practices. More groups are demanding that governments around the world reduce their fisheries subsidies—currently US\$30 billion to \$34 billion per year—which go overwhelmingly to industrial fishers.

In the long term—possibly as little as two or three decades—fisheries and fishing-based cultures will not survive if we do not manage to put small-scale fisheries and resources first. However, for these fishers to assume a more dominant role and to possibly contribute toward sustainability, they will have to be given exclusive access to coastal resources. That means not only reining in competition from industrial fishing operations but also protecting fishing rights from the massive throngs of unemployed farmers and other rural residents who are moving to the coasts and taking up fishing as an occupation of last resort—a central cause of coastal overfishing in many developing countries.

Many examples of small-scale fisheries that work exist throughout the world, and their broad-scale emulation would go a long way toward overcoming the global crisis of fisheries.

Benefits	Large-scale Fishery	Small-scale Fishery
Number of fishers employed	about 1/2 million	over 12 million
Annual catch of marine fish for human consumption	about 29 million tonnes	about 24 million tonnes
Capital cost of each job on fishing vessels	US\$30,000-\$300,000	US\$250-\$2,500
Annual catch of marine fish for industrial reduction to meal, oil, etc.	about 22 million tonnes	almost none
Annual fuel oil consumption	14-19 million tonnes	1-3 million tonnes
Fish caught per tonne of fuel consumed	2-5 tonnes	10-20 tonnes
Fishers employed for each US\$1 million invested in fishing vessels	5-30	500-4,000
Fish and invertebrates discarded at sea	10-20 million tonnes	little

The duality of fisheries prevailing in most countries of the world (numbers raised to global levels) reflects not only the misplaced priorities of fisheries development, but also opportunities for reducing environmental impacts and rebuilding depleted resources while maintaining social benefits. The solution is to phase out large-scale fisheries, notably by reducing the government subsidies they presently and undeservingly enjoy. For more information: Pauly, D., 2006. *Maritime Studies (MAST)* 4(2): 7-22.

About the Author

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Size Matters

Alter harvest strategies to account for evolutionary change by David Conover

For decades we thought we were doing the right thing by encouraging fishermen to keep only the biggest fish they catch. Throwing the little ones back would give those individuals time to grow up and reproduce, thereby ensuring the longevity of the stock—or so the thinking went. But we are now learning that decades of size-selective fishing for species such as Atlantic cod may have had the opposite effect.

Not only are the fish in some stocks getting smaller, but they also are evolving characteristics that make it more difficult to survive and reproduce when fishing ceases. To achieve sustainability, fishery managers may now have to alter their harvest strategies to account for evolutionary change as well as overfishing. They can start by letting some of the big fish go.

The need to reverse this thinking first became clear to me during my lab's experiments on captive populations of a small, fast-growing fish known as the Atlantic silverside. We were the first group to demonstrate experimentally that harvesting only the largest individuals produced subsequent generations of fish that were both smaller and genetically inferior.

Until recently though, many experts assumed that evolutionary changes affecting wild fish (if any) would be

exceedingly slow—requiring thousands of years—and could therefore be ignored. Moreover, wild fish tend to grow faster in overharvested areas because there is less competition for food, or so it was thought. But a slew of new findings, including empirical studies of captive and wild fish as well as modeling simulations, confirm that size-selective harvesting may cause genetic changes inducing fish to grow slower and mature at smaller sizes and at younger ages. Particularly worrisome are clues that the evolutionary changes may happen quickly. Our lab's results suggest that fishery yields could drop by as much as 50 percent within only a few generations.

Clearly, ignoring the consequences of evolution may be costly for fisheries conservation. Managing fisheries from an evolutionary perspective will almost certainly require a variety of strategies. For some fisheries, we may need no-take zones where the full range of sizes and ages of a given species can thrive. For those that target migratory species, setting both maximum and minimum size restrictions—so-called slot limits—might work better.

The most alarming realization is that evolutionary changes may be difficult to undo once they become entrenched. But we owe it to future generations to try.

About the Author

David Conover is Dean of the School of Marine and Atmospheric Sciences at Stony Brook University.

Good Credit Risk

Invest in microcredit schemes for women in poor coastal communities to curtail overfishing

by Amanda Vincent

Overfishing in many of the world's coral reef ecosystems is escalating as coastal populations boom and desperate people go to sea as an occupation of last resort. Conservation groups have tried for years to offset the problem by offering impoverished fishers other means of employment, but most of these efforts fail because of poor social or economic viability. I advocate a different strategy: offering microcredit to women.

Since the 1970s, the Grameen Bank and many of other microfinance institutions have enabled millions of people in developing countries to start self-employment projects without collateral or a verifiable credit history. Most of these initiatives focus on women, in part because women are considered a good credit risk and tend to invest their earnings in their families' well-being. Microfinance schemes in impoverished fishing communities should follow suit.

A woman would apply for a small loan—perhaps as little as US\$20—to invest in an entrepreneurial venture showing clear potential to reduce her family's fishing effort. She might start a shellfish farm, for example, or buy a pig to slaughter and sell. To improve its chances of qualifying, the activity would also need to lessen the family's dependence on fish for food. Unsustainable fishing will continue unless poor coastal communities find alternative sources of dietary protein; most still rely heavily on seafood.

Besides drawing people away from fishing, I predict that a microfinance initiative directed at women would greatly enhance current conservation efforts in at least three key ways. First, such a scheme would allow women with a strong entrepreneurial spirit to develop projects that respect local ideas, skills, conditions, and limitations—giving those activities a better chance for success than the current alternatives, most of which depend on external expertise and ignore the costs incurred by outside organizers.

Second, women with higher economic capacity would have a stronger voice in community affairs. In the fishing communities where I work in the central Philippines, women are seldom consulted in the initial planning meetings regarding local ecosystem management—despite their considerable role in both fishing and conservation. The same is true elsewhere. Women in the Pacific islands have told researchers that they remove half the biomass harvested each year, yet their activities are largely ignored in official fisheries statistics and decision-making. Involving women would generate conservation plans that embrace all fishers instead of men only. Empowering women also tends to build community cohesiveness, which often generates other collective efforts to improve

resource management.

The third and perhaps most-important payoff from a microfinance initiative for women would be a trend toward smaller families. Experience proves that women with greater economic opportunity have fewer children—a major benefit for coastal communities where population growth overwhelms current conservation efforts.

Initiatives to curb the pressures on marine resources for food and livelihoods while still supporting local communities would be a boon for marine conservation. Such change does not, of course, eliminate the need for distant markets to curb seafood consumption, but it is a significant step in the right direction.

About the Author

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Healthy Competition

Tap into the firsthand expertise and ingenuity of fishermen and backyard inventors by Kimberly Davis

The thousands of miles of lines and nets set in the oceans each day catch a staggering number of unwanted creatures, many of which die by the time they are hauled up and discarded overboard. This bycatch, as it is called, poses a major threat to the survival of certain turtles, sharks, and other endangered marine species—and to the long-term sustainability of fisheries.

Fortunately, simple and inexpensive modifications to fishing gear can dramatically reduce bycatch in many fisheries. That is why the World Wildlife Fund launched the International SmartGear Competition in 2004. Our motive is to reward innovative, practical, and cost-effective gear designs that safeguard marine life while enabling fishers to better target their intended catch. We will be announcing this year's US\$30,000 grand-prize-winner and two US\$10,000 runners-up in November.

Running competitions with cash prizes is not the typical work of conservation organizations, but we wanted to try something new. We want to make fishermen and fishery managers stop and say, "I can't believe we didn't think of that years ago." Indeed, the competitions held so far have introduced surprisingly effective yet simple designs.

In 2005 the grand prize went to an idea that reduces the number of sea turtles captured on longlines. Knowing that most turtles are hooked at shallow depths, Steve Beverly of New Caledonia proposed a system for setting baited hooks deeper than 100 meters, thereby minimizing encounters with sea turtles while still catching target fish. Last year's grand-prize winner, Michael Herrmann of the United States, proposed placing magnets on fishing lines to scare away sharks, which are particularly sensitive to magnetic fields.

Clever gear modifications are not the only way the contest is paying off for conservation. The partnerships we fostered to generate sponsorship for the contest are challenging the traditional perceptions that business and conservation don't mix. World Wildlife Fund is working alongside commercial fishing fleets and the world's largest maker of fishing hooks, just to name two.

The competition is open to all—fishermen, professional gear manufacturers, teachers, students, engineers, scientists and backyard inventors. We plan to run it again in 2009, so start working on your entry now.

About the Author

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Gifts for Ancient Mariners

Simple modifications to fishing gear save thousands of turtles and seabirds each year

by Carl Safina

Commercial longline fisheries dangle thousands of baited hooks from a single fishing line tens of miles long and are major killers of both sea turtles and albatrosses. Intending to catch tuna, swordfish, and other fish, longliners hook or tangle some 250,000 turtles accidentally each year, drowning or maiming thousands of them. (All sea turtle species are listed under the U.S. Endangered Species Act as either threatened or endangered.) This practice also kills an estimated 300,000 seabirds each year, pushing numerous albatross populations toward extirpation.

And yet, good news: in important places, simple modifications to fishing gear are dramatically improving the situation. These changes, while covering only part of the ocean, show that we now know what to do. For turtles, merely changing hook styles from J-hooks to circle hooks can reduce turtle take up to 90 percent, depending on a combination of hook size (larger is better), bait (fish rather than squid helps avoid turtles), and turtle species (mortality reduction was greatest for leatherbacks). These changes are becoming mandatory in some U.S. fisheries and are being spread to Latin America by groups such as the Inter-American Tropical Tuna Commission and World Wildlife Fund.

For almost all albatross species, fishing gear represents the most significant source of artificial mortality—drowning on longlines (the birds crowd behind the boat and get hooked before the baits sink out of reach) and colliding with moving trawl-net cables. Once again, easy solutions have proven extremely effective. Tying streamers to the boat scares birds away from lines and cables, and adding weight to longlines makes them sink out of sight faster. Setting the lines after dark also helps. In the past ten years, the number of seabirds killed by longliner fleets in Hawaii, the Falkland Islands, South Georgia, the Southern Ocean, and the Indian Ocean declined by 95 percent or more, thanks to these changes.

Most such mandated improvements apply to U.S. boats, to international fleets operating within the 200-mile zones of the places mentioned above, and to boats operating legally in the Southern Ocean. Market approaches coupled with certification and labeling could help favor seafood from these better-managed fisheries while marginalizing the marketability of seafood caught illegally. Such actions could also pressure boats operating in temperate international waters—especially temperate longline tuna fisheries—to join the program or operate at a disadvantage in the marketplace.

About the Author

Carl Safina is president and cofounder of the Blue Ocean Institute.

Tradable Bycatch Credits

Create new markets that reward careful fishing

by George Sugihara

Traditional bycatch limits have reduced the number of sea turtles, sharks, and other nontarget species that fishing fleets kill accidentally as they pursue their intended bounty. But many experts say such limits are not enough to save the most endangered species. Creating a new economic market around so-called tradable bycatch credits would put a much bigger dent in the problem.

In such a market, any fisher who snares a protected bycatch species must buy credits from fishers who have not. In effect, the aggressive fisher pays a fine to those who are more careful. This economic incentive for individuals to avoid unwanted species is precisely what the current system lacks. When the entire fleet is forced to stop harvesting as soon as it hits the bycatch limit, it makes economic sense for individuals to catch fish as quickly as possible without putting in the extra time and effort to protect other animals. That behavior collides with the good of the group, however, by shutting down the fishery well before it has time to maximize its target catch. Last year, for instance, the Hawaiian swordfish fleet hit its limit on endangered sea turtles and closed after only six weeks, cutting its annual

swordfish season by nearly 90 percent.

A simple solution would be to allocate a limited number of bycatch credits to the fleet each year—let's say 200 to each licensed fisher. If the fine for hooking an endangered sea turtle is 250 credits, every fisher who does so must buy 50 additional credits from fishers who have not. As the season progresses and more turtles are caught, credits become scarce, and so their price on the open market should rise—further increasing the incentive to avoid turtles. Because catching fewer turtles helps the fishery stay open longer, the fleet's earnings go up.

Another facet of a tradable credits scheme could assist conservation of overexploited swordfish populations. Once the annual supply of bycatch credits is allocated to the fleet, individual fishers can choose to sell their credits to outside parties at a substantial premium. The opportunity to buy those credits—in other words, paying fishers to reduce fishing—not only eases pressures on swordfish and turtle stocks but also serves as a market-based subsidy that can dramatically increase gross revenues to the industry and reduce risk during bad seasons.

Almost any fishery that monitors its bycatch can benefit from this kind of system, which is modeled after tradable emissions credits that have successfully reduced pollution in the manufacturing and energy industry. In more ways than one, tradable bycatch credits are a good example of how well-structured markets can align individual utility with the collective good—and promote conservation goals at the same time.

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Running on Empty

Eliminate fuel subsidies to reduce destructive bottom trawling on the high seas

by Ussif Rashid Sumaila

Marine ecosystems pay a hefty price for getting orange roughy, Greenland halibut, and deepwater shark to our dinner plates. Fishing vessels capture a majority of these and other bottom-dwelling species by dragging huge nets armed with steel plates and heavy rollers across the seabed. These trawlers crush everything in their path and haul up tons of coral and other unwanted bycatch—decimating entire ecosystems in a matter of weeks or months.

Marine conservation organizations have worked for years toward a moratorium on high-seas bottom trawling, to no avail. But my colleagues and I think we have found this industry's Achilles' heel: fuel subsidies. When we recently compiled the first-ever global estimates of subsidies to bottom-trawl fleets operating in the high seas, we found that those investments actually exceed reported profits: subsidies make up about 25 percent of the total landed values from the catch of these fleets, whereas the reported profit per landed value is no more than 10 percent.

Getting rid of all the 12 types of subsidies we identified would mean that these high-seas trawlers, as a group, would operate at such a loss that they would no longer be able to fish. But such sweeping change may not be necessary to close this fishery. These fleets, which travel great distances between fishing grounds and port, are extremely sensitive to fuel price increases. And fuel subsidies alone accounted for just over 50 percent of the total subsidies, or about US\$152 million a year. Conservation groups may best achieve their goals by focusing their efforts on persuading governments to do away with fuel subsidies to these fleets.

Any change that cuts jobs or seems to threaten food security is understandably controversial. But consider how tiny a fraction of the global fishing industry this group represents: out of 3.1 million active fishing vessels worldwide, not more than 200 are bottom-trawling the high seas full-time, researchers estimate. Furthermore, the estimated landed value of this fleet's catch, US\$601 million, represents less than 1 percent of total global marine catch value, and most of it is sold in the European Union, U.S., and Japan—making this fleet a virtual noncontributor to global food security.

Fuel subsidies for the world's leading high-seas bottom-trawling nations Source: Sumaila, U.R., Pauly, D. eds. 2007. Catching more bait: A bottom-up re-estimation of global fisheries subsidies (2nd version). Fisheries Centre Research Reports 14(6):49-53. Fisheries Centre, University of British Columbia, Vancouver.

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Use Your Thumbs

Text messaging is changing the face of marine conservation by Amanda Vincent

Cellular telephones have put the power of instant communication into the hands of people all around the world—even those who have limited access to landlines. We should maximize the marine conservation benefit of this nearly ubiquitous phenomenon by tapping the power of text messaging.

Sending text messages is the most popular means of cell phone communication nearly everywhere outside North America. It is quick, direct, and often much cheaper than calling, and it works well even in remote areas where signals are too weak to transfer the spoken word. Through texting, all manner of conservation advocates can mobilize action, obtain information, and elicit support. Imagine, for example, a global network of hotlines created to react to a wide array of ocean issues, from oil spills to escapes of farmed fish. Citizens and other stakeholders witnessing such events could text an immediate report to the appropriate hotline and demand an official response. People whose cell phones take photographs and record precise geographic coordinates could supplement their words with additional evidence.

Even without formal hotlines, texting can make a difference. In the central Philippines, my colleagues and I have fostered an alliance of nearly 900 fishing families who send text messages to coordinate conservation efforts across a 150-kilometer arc of isolated reef atolls. Using cell phones donated by various Filipino sources, these fishers can alert the provincial environmental management office and local police when they observe illegal dynamite and trawl fishing, which have helped push many of their coastal ecosystems to the brink of collapse. The alliance leaders have also reported rampant violations and bureaucratic inertia to the national media through text messages and have given interviews by return text.

The list of conservation options for texting goes on. Fishers in remote areas of Africa are focusing their fishing efforts by texting buyers or friends to determine whether and where particular species are selling well. In South Africa, consumers can text a special hotline to check whether a tempting seafood dish or a fresh market fish has been deemed environmentally sound. Nongovernmental organizations worldwide can download free cell-phone software to organize their work and contact members, and interested citizens can transfer funds instantly to conservation organizations by ordering a ring tone and wallpaper of an endangered animal.

In the new world of cell phone text messaging, nearly everyone can contribute to good ocean stewardship—and the opportunity is only a few thumb taps away.

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A Separate Peace

Move toward wholesale zoning of the oceans—rather than piecemeal protection schemes

by Tundi Agardy

Most marine conservation is ad hoc, coming together bit by bit as individuals, communities, and institutions respond to a particular need at a particular site—restricting access to a threatened reef tract, for example, or regulating harvest of a depleted fish stock. Although well-intentioned, such responses are usually far too focused to address the multiple threats that simultaneously degrade most of the world's nearshore ecosystems.

We need a radical shift in our management schemes, away from piecemeal regulations and small-scale protected areas toward wholesale zoning of the oceans. That means managing each large geographic region—the Gulf of Maine, say, which covers 275,000 square kilometers from the inland limits of all its watersheds out to the edge of the continental shelf—as a single unit. The result is a regional map in which every space is zoned for a particular use or array of uses—from commercial activities to recreational ones, with strictly protected areas that allow little or no use at all.

As on land, ocean zoning would reduce conflicts among various users by separating incompatible activities; shipping would not occur in designated whale-watching areas, for example. To achieve conservation goals, a zoning plan would also stipulate what levels of use are allowed. Ecologically critical areas—nursery grounds for fisheries and riparian wetland buffers, for instance—would merit the strictest protection. Degraded or relatively unimportant tracts could be “sacrificed” to industrial uses such as ports, wind farms, or oil extraction.

What makes ocean zoning different from and potentially more successful than current conservation efforts is that practitioners wanting to mitigate threats to a given portion of the marine realm can cast a wider net. For instance, if an estuarine nursery habitat is being degraded by diversion of freshwater flowing to that estuary, then a regional zoning plan could influence behavior at upstream farms and hydroelectric plants. Australia's Great Barrier Reef Marine Park, one of the world's largest marine protected areas, has not been as successful as its international reputation suggests, primarily because the original planning did not address high inputs of sediment and agricultural runoff from coastal watersheds.

Inspired by the successes of zoning within marine protected areas, maritime nations such as New Zealand, the United Kingdom, Germany, Belgium, China, and Canada are now experimenting with larger-scale zoning. Nationwide efforts in the U.S. have not yet emerged, but some individual states such as Massachusetts and California are exploring the possibilities of zoning within state waters.

Whatever defines the region, good zoning requires all stakeholders to sit down with the research community and jointly tackle the question of what activities should be allowed where and to what extent. And because the zoning plan is not static, this participatory planning must be ongoing. Be they fishers, politicians, or conservationists, groups who participate will reap the benefits of better conservation while bearing fewer costs. All it takes is visionary leaders who understand the value of ocean zoning and are not afraid to push forward with it.

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