

# Catch of the Day

CHOOSING SEAFOOD FOR HEALTHIER OCEANS



BRIAN HALWEIL

# Catch of the Day

CHOOSING SEAFOOD FOR HEALTHIER OCEANS

BRIAN HALWEIL

Lisa Mastny, *Editor*

WORLDWATCH PAPER 172

November 2006

**THE WORLDWATCH INSTITUTE** is an independent research organization that works for an environmentally sustainable and socially just society, in which the needs of all people are met without threatening the health of the natural environment or the well-being of future generations. By providing compelling, accessible, and fact-based analysis of critical global issues, Worldwatch informs people around the world about the complex interactions among people, nature, and economies. Worldwatch focuses on the underlying causes of and practical solutions to the world's problems, in order to inspire people to demand new policies, investment patterns, and lifestyle choices.

**FINANCIAL SUPPORT** for the Institute is provided by the Blue Moon Fund, the Chicago Community Trust, the Energy Future Coalition/Better World Fund, The Ford Foundation, the German Government, the David B. Gold Foundation, The Goldman Environmental Prize/Richard & Rhoda Goldman Fund, the W. K. Kellogg Foundation, the Steven C. Leuthold Family Foundation, the Marianists of the USA, the Noble Venture Fund/Community Foundation Serving Boulder County, the Norwegian Royal Ministry of Foreign Affairs, the V. Kann Rasmussen Foundation, the Rockefeller Brothers Fund, The Shared Earth Foundation, The Shenandoah Foundation, the Taupo Community Fund of the Tides Foundation, the United Nations Population Fund, the Wallace Genetic Foundation, Inc., the Johanette Wallerstein Institute, and the Winslow Foundation. The Institute also receives financial support from many individual donors who share our commitment to a more sustainable society.

**THE WORLDWATCH PAPERS** provide in-depth, quantitative, and qualitative analysis of the major issues affecting prospects for a sustainable society. The Papers are written by members of the Worldwatch Institute research staff or outside specialists and are reviewed by experts unaffiliated with Worldwatch. They have been used as concise and authoritative references by governments, nongovernmental organizations, and educational institutions worldwide. For a partial list of available Worldwatch Papers, go online to [www.worldwatch.org/pubs/paper](http://www.worldwatch.org/pubs/paper).

**REPRINT AND COPYRIGHT INFORMATION** for one-time academic use of this material is available by contacting Customer Service, Copyright Clearance Center, at (978) 750-8400 (phone), or (978) 750-4744 (fax), or writing to CCC, 222 Rosewood Drive, Danvers, MA 01923. Nonacademic and commercial users should contact the Worldwatch Institute's Business Development Department by fax at (202) 296-7365 or by email at [wwpub@worldwatch.org](mailto:wwpub@worldwatch.org).

© Worldwatch Institute, 2006

ISBN 1-878071-80-7

Library of Congress Control Number: 2006935638

♻️ Printed on paper that is 100 percent recycled, 100 percent post-consumer waste, process chlorine free.

---

The views expressed are those of the authors and do not necessarily represent those of the Worldwatch Institute; of its directors, officers, or staff; or of its funding organizations.

## Contents

---

Summary . . . . .	5
New Hope for Old Victims . . . . .	9
The Shifting Baseline . . . . .	15
Making Better Choices . . . . .	22
When the Fisher Is the Eater . . . . .	30
Beyond Fillets . . . . .	37
Beyond Fishing . . . . .	45
Endnotes . . . . .	58
Index . . . . .	71

### *Figures, Tables, and Sidebars*

Figure 1: <i>Top Fish Species Harvested Worldwide, 2003</i> . . . . .	19
Figure 2: <i>World Exports of Fish and Fish Products, 1976–2004</i> . .	19
Figure 3: <i>World Fish Harvest, 1950–2003</i> . . . . .	20
Figure 4: <i>World Fish Harvest Per Person, 1950–2003</i> . . . . .	20
Table 1: <i>Fish Consumption in Top Five Countries or Regions, 1961 and 2003</i> . . . . .	14
Sidebar 1: <i>Some Facts About the World’s Fish</i> . . . . .	18
Sidebar 2: <i>What Aquariums Worldwide Are Doing</i> . . . . .	25
Sidebar 3: <i>What’s a Seafood Lover to Do?</i> . . . . .	29
Sidebar 4: <i>Racing for Fish vs. Sharing the Fish</i> . . . . .	44
Sidebar 5: <i>Proposed Fisheries Policy Reforms</i> . . . . .	53

**Acknowledgements:** Like any research project, this paper depended on the help of many people who gave their time and knowledge. Among those who shared their criticism and insight are Greg Andeck, Bill Ballantine, Julia Baum, Chris Bohm, James Bohnsack, Jennifer Dianto, Junko Edahiro, Rod Fujita, Rebecca Goldberg, Michael Hirshfield, Peter Hoffman, Jim King, Henry Lovejoy, Bill Mott, Ransom Myers, Tim O'Shea, Daniel Pauly, Carl Safina, Bruce Sherman, Kim Tetrault, Peter Tyedmers, and Helene York.

At Worldwatch, Danielle Nierenberg and Gary Gardner provided thoughtful feedback on early drafts of the paper. Intern Dana Artz tracked down important data and conducted numerous interviews, and China Fellow Yingling Liu gathered information from East Asia. Senior Editor Lisa Mastny helped smooth and tighten the language. Behind the scenes, Art Director Lyle Rosbotham made sure the layout and graphics were creative and engaging, while Marketing Director Patricia Shyne and Communications Manager Darcey Rakestraw helped craft the paper's overall message.

**Brian Halweil** is a Senior Researcher at the Worldwatch Institute, where he joined the staff in 1997 as the John Gardner Public Service Fellow from Stanford University. Brian focuses his research on the social and ecological impacts of how we grow food, with particular emphasis on organic farming, biotechnology, hunger, and rural communities. Most recently, he describes the evolving local food movement in his book *Eat Here: Reclaiming Homegrown Pleasures in a Global Supermarket*.

Brian's work has been featured in the international press, and he recently testified before the U.S. Senate Committee on Foreign Relations on the role of biotechnology in combating poverty and hunger in the developing world. Brian has traveled extensively in Mexico, Central America and the Caribbean, and East Africa, learning indigenous farming techniques and promoting sustainable food production. Before coming to Worldwatch, he worked with California farmers interested in reducing their pesticide use and set up a two-acre student-run organic farm on the Stanford campus. Brian writes from Sag Harbor, New York, where he and his wife rake clams and tend a home garden.

---

## SUMMARY

---

**A**t a time when international treaties, restrictive quotas, and global regulation of fleets have proven ineffective in protecting beleaguered fish populations, a surprising ally is emerging to tackle the growing fisheries crisis. Buyers of seafood—including individual consumers, school cafeterias, supermarket chains, and large food processors—are choosing to avoid threatened or problematic species in favor of fish that are caught or raised with less impact on the world's oceans. While some seafood lovers are concerned about guaranteeing the future availability of popular fish, others wish to preserve the quality of today's seafood by knowing more about how and where it is caught. As more of our daily food options originate in factories, fish remains the last wild food we consume in large quantities and one of our few remaining direct connections to the natural world.

Yet even as seafood becomes scarcer, we are eating more of it. Chinese consumers now eat roughly five times as much seafood per capita as they did in 1961, and total fish consumption in China has increased more than tenfold. Over the same period, U.S. seafood consumption jumped 2.5 times. For people living in wealthy nations, seafood is an increasingly popular health food option. With its high levels of fatty acids and trace minerals, nutritionists recognize it as essential to the development and maintenance of good neurological function, not to mention reduced risk of cancer, heart disease, and other debilitating conditions. In poorer nations in Asia, Africa, and Latin America, people are also eating more fish, if

they can afford it. For more than one billion people, mostly in Asia, fish supplies 30 percent of their protein, versus just 6 percent worldwide.

From high-profile celebrity campaigns, to shocking footage of shark finning, to the debut of wallet-sized seafood buying guides, everyday consumers are learning more about the consequences of their seafood purchases. The London-based Marine Stewardship Council, the largest global organization that certifies certain seafood as “sustainable,” has granted its label to 18 fisheries worldwide, including North Sea herring, Australian mackerel, and Baja California red rock lobster, and more than 370 products in nearly 30 nations now carry the group’s “Fish Forever” logo. Meanwhile, certain seafood companies are beginning to base their business on “the story behind the fish”—how it’s raised, caught, and processed—just as many supermarkets and agribusinesses now capitalize on rising interest in organic produce, grass-fed beef, and other “environmentally friendly” food alternatives. Even large chains like Unilever, Wal-Mart, and Red Lobster have made commitments to source their seafood only from intact fish populations or to celebrate the small-scale fishers whose techniques are generally less destructive than industrial fleets.

But this growing movement remains fragile, as the commitments of many participants remain incomplete or lack staying power. For instance, Wal-Mart’s recent pledge to sell only certified sustainable fish in the next 3–5 years involves no commitments with respect to farmed salmon and Asian-farmed shrimp, which constitute the bulk of its seafood sales. And endangered swordfish, Atlantic cod, and Chilean sea bass are making a comeback on restaurant menus as chefs forget past campaigns to protect them.

Such consumer-oriented campaigns to save marine life aren’t new. Previous efforts have been organized in the name of saving whales, seals, dolphins, or other marine species from extinction. Yet most of the fish we eat didn’t seem to warrant the same sort of protection—a throwback to the long-standing view that the oceans are inexhaustible. Today, most of the world’s seafood, from tuna to salmon to bay scallops,

is threatened with extinction. For less-threatened species, like shrimp or farmed salmon, survival isn't so much the issue as how the fish is raised or caught, which can have adverse impacts on the environment or human health. In both cases, seafood eaters are increasingly invited to play a role in turning the situation around.

Some seafood enthusiasts are going beyond simply investigating the origins of their fish to helping in shoreline cleanups, reforesting coastal areas, and raising shellfish to seed wild beds. A public that better understands the state of the world's oceans can be a driving force in helping governments pass legislation to ban destructive fishing, mandate seafood labels that indicate how fish were caught, and create marine preserves where fish can spawn off-limits to fishing. Being a more deliberate seafood eater doesn't mean a spartan existence; in fact, it could be the only guarantee that fresh and healthy fish continues to appear on our tables.

## New Hope for Old Victims

---

**I**t's hard to think of sharks as victims. But that's what they've become. From tiny cigar sharks that fit in the palm of your hand to massive whale sharks that are the largest fish in the sea and can grow to 15 meters long, the more than 350 species of sharks that swim along shores, patrol reefs, and dwell in deep ocean expanses have one thing in common: they are all doomed.<sup>1\*</sup>

A few years ago, Julia Baum, a doctoral student in the Biology Department at Dalhousie University in Halifax, Nova Scotia, started looking at shark catch data from the northwest Atlantic. Tuna and swordfishing boats, which often catch sharks attracted to their bait or to the fish they chase, had kept good track of a range of shark species since the 1980s. "We found a really dramatic decline in just 15 years," says Baum, whose work was later published in *Science*.<sup>2</sup> The study covered a very large area and found losses in all shark species tracked. For some, like hammerheads and threshers that are the victims of both tangling in nets and intentional fishing, the decline was over 80 percent. The least-affected species, like blue sharks, still declined by 50–60 percent.

Colleagues from around the world began to send Baum similar findings. In total, nearly 50 shark species are close to disappearing, according to a recent report by the World Conservation Union (IUCN); that's roughly 14 percent of the global total.<sup>3</sup> One set of reports tracked American long-line tuna

---

\* Units of measure throughout this paper are metric unless common usage dictates otherwise. Endnotes are grouped by section and begin on page 58.

boats working the Gulf of Mexico since the 1950s and found perilous declines—above 90 percent—for three different species of sharks.<sup>4</sup> “Today you would never imagine white tip sharks being caught there,” says Baum, “whereas in the fifties they were a nuisance for the fishers. They were on the surface all around the boat, and captains didn’t think they could do tuna fishing because there were so many sharks. Our thinking about what’s normal can change so fast and with so little knowledge of what it was like.”<sup>5</sup>

Sharks serve as a bellwether for what’s happening to everything else in the sea, from the serial depletion of fish species, to China’s rise as a major global seafood buyer, to the shortcomings of international treaties to protect fish. The meat of sharks wasn’t in wide demand until recently, when shark fin soup, an ancient Chinese dish that can cost \$200 a bowl and was once reserved for the kitchens of the wealthy, became a more common menu item in economically booming China.<sup>6†</sup> Hong Kong is now the hub of a roaring market in shark fins, which can fetch \$700 a kilogram and entice shark hunters from as far away as Ecuador.<sup>7</sup>

Roughly 100 million sharks are caught each year, yielding about 8,000 tons of fins that make it into international trade.<sup>8</sup> The market is supplied by a wasteful and blunt practice driven purely by economics and the space limitations of most fishing boats: since a shark’s fins are far more valuable than its meat, fishers often slice off the fins and toss the dismembered shark back into the water to die. Although several nations have banned such finning, and the trade in several shark species is prohibited under international law, the strong demand for shark products means that both government enforcement and fishers’ compliance are less than perfect.<sup>9</sup>

Moreover, today’s fishing techniques now cover such a wide swath of the world’s oceans that there is little room left for sharks to hide. Add to that the biological reality that these top-level predators aren’t typically hunted in the natural world and give birth to relatively few young, and the emer-

---

† Unless otherwise noted, all dollar figures are in U.S. dollars.

gence of an even higher-level predator—humans—makes the existence of sharks even more precarious. Fortunately, the shark story also offers a glimpse into what could be the most encouraging trend in the world's fisheries: the rise of conscientious seafood buyers.

“Leveraging the influence of businesses and consumers to encourage better management of the resources they utilize is a recent development in fisheries,” says Shelley Clarke of the Wildlife Conservation Society, whose 2002 report on the Asian trade in dried seafood products provided groundbreaking evidence of how sorely underreported the shark fin trade is.<sup>10</sup> Shelley found that the Hong Kong importers, traders, and shopkeepers who move most of the world's shark fins “were primarily pre-occupied with short-term impacts to sales, and none considered stock sustainability to be their concern.” The merchants had little interest in supporting shark conservation as a way to protect their own long-term market. But Shelley also discovered that these sellers often specialize solely in shark fins and a few other dried seafood products, making their businesses particularly vulnerable to faltering consumer demand.

As part of a recent shark awareness campaign, the conservation group WildAid pulled a page from the book of animal rights activists and released several graphic videos of sharks being “finned.” Filmed by undercover investigators who had snuck aboard fishing boats, the videos were later aired on television in Taipei, Hong Kong, and Singapore. The group is also featuring Asian celebrities like basketball star Yao Ming, film director Ang Lee, Singaporean pop star Stefani Sun, and Taiwan's President Chen Shui-bian in public service announcements asking people not to eat shark fin soup. In its outreach, WildAid is publicizing the fact that because sharks feed at the top of the food chain, their flesh (including their fins) can contain levels of mercury up to seven times higher than what is safe to eat—a message that provoked a lawsuit from shark-fin restaurateurs in Thailand who claimed it cut their business in half.<sup>11</sup>

These efforts seem to be paying off. After passenger complaints, both Thai Airways and Singapore Airlines pulled shark

fin soup from their first-class services in 2000.<sup>12</sup> In late 2005, several high-profile institutions in Hong Kong, including Disneyland and Hong Kong University (HKU), stopped serving shark fin soup following protests by animal rights and marine conservation groups.<sup>13</sup> Both institutions also started distributing leaflets about shark conservation to their visitors. “The university hopes not only to encourage all students, staff, and alumni to eschew shark fin dishes at all times, but also to give a lead which others in Hong Kong will follow,” read the HKU statement, signed by vice chancellor Tsui Lap-chee. The decision has already inspired several other Hong Kong universities to consider similar bans, and the major caterers who supply them are taking notice.

Such a consumer-oriented campaign to save marine life isn’t new. Previous campaigns have been organized in the name of saving whales, seals, dolphins, or other marine species from extinction. Most fish that we eat, however, didn’t seem to warrant the same sort of protection—a throwback to the longstanding view that the oceans are inexhaustible. But things have changed. Today, most of the world’s seafood, from tuna to salmon to bay scallops, is threatened with extinction. For less-threatened species, like shrimp or farmed salmon, survival isn’t so much the issue as how the fish is raised or caught, which can have adverse impacts on the environment or human health. In both cases, seafood eaters are increasingly invited to play a role in turning the situation around. The public can step in where fishers, politicians, and regulators have failed to respond despite overwhelming scientific evidence that the world’s fish are in danger.

In the past few years, groups like the Monterey Bay Aquarium in California and the Blue Ocean Institute in New York have begun printing pocket-sized guides to inform people which seafood is the most “ocean friendly.”<sup>14</sup> The guides encourage shoppers to avoid species that are threatened or whose harvest is destructive to marine life (e.g. swordfish and caviar) and to favor those that are most abundant or least problematic to catch (e.g. oysters and farmed trout). Other organizations certify specific fisheries as “sustainable,” so consumers

can seek out seafood carrying this label and fishing communities have an incentive to adopt less-harmful practices. The largest of these certifiers, the London-based Marine Stewardship Council (MSC), has granted its label to 18 fisheries, including North Sea herring, Australian mackerel, and Baja California red rock lobster, and more than 370 seafood products bearing the MSC's blue ecolabel are available in supermarkets and restaurants in nearly 30 nations.<sup>15</sup> Originally a collaboration between the conservation group WWF and Unilever, one of the world's largest seafood companies, the now-independent MSC relies on the motivation of seafood buyers—not just home cooks and individual restaurants, but also large supermarket chains and food corporations—who want to ensure there are still fish to eat in the future.

Certain seafood companies are beginning to base their business on “the story behind the fish”—how it's raised, caught, and processed—just as many supermarkets and agribusinesses now capitalize on rising global interest in organic produce, grass-fed beef, and other “environmentally friendly” food alternatives.<sup>16</sup> Consider EcoFish, a distributor based in the U.S. state of New Hampshire. Founded in 1999 as the only company in the world whose sole mission was to identify and market seafood originating from environmentally sustainable fisheries, EcoFish's products are now found in more than 1,000 stores and 150 restaurants throughout the United States.<sup>17</sup> Another U.S. firm, CleanFish, specializes in finding a market for seafood caught by smaller-scale fishers from around the world, whose artisanal techniques are less likely to harm the marine environment (and the quality of the fish flesh) than large-scale fishing fleets.<sup>18</sup> And it's clear that this interest is growing beyond boutique markets, as Wal-Mart, the world's largest retailer, recently opted to source all of its fresh seafood from MSC-certified sources and to develop new standards for its shrimp, one of the most popular forms of seafood in America.<sup>19</sup>

Consumers today have greater incentive than ever to care about where their seafood comes from. As more of our daily food options originate in factories, not fields, fish remains the last wild food we consume in large quantities. As such, it is one

of our few remaining direct connections to the natural world.

Yet even as seafood becomes scarcer, we are eating more of it. Chinese consumers now eat roughly five times as much seafood per capita as they did in 1961, while total Chinese fish consumption has increased more than tenfold.<sup>20</sup> (See Table 1.) Over the same period, U.S. seafood consumption jumped 2.5 times.<sup>21</sup> For people living in wealthy nations, seafood is an increasingly popular health food option: with its high levels of fatty acids and trace minerals, nutritionists recognize it as essential to the development and maintenance of good neurological function, not to mention reduced risk of cancer, heart disease, and other debilitating conditions.<sup>22</sup> In poorer nations in Asia, Africa, and Latin America, people are also eating more fish, if they can afford it. For more than one billion people, mostly in Asia, fish supplies 30 percent of their protein, versus just 6 percent worldwide.<sup>23</sup>

Some seafood enthusiasts are going beyond simply investigating the origins of their fish. On New York's Long Island, several hundred citizens have been trained as "shellfish gardeners," helping to seed the Peconic Bay with scallops, clams, and oysters.<sup>24</sup> And on Kesenuma Bay in northeastern Japan, one fisherman started a campaign enlisting people to plant trees upstream in the mountain forests whose nutrient-rich runoff feeds the local fishing grounds.<sup>25</sup>

**TABLE 1**

**Fish Consumption in Top Five Countries or Regions, 1961 and 2003**

Country or Region	1961		2003		Increase, 1961–2003	
	Total	Per Capita	Total	Per Capita	Total	Per Capita
	(million tons)	(kilograms)	(million tons)	(kilograms)	(x-fold)	(x-fold)
China	3.2	4.8	33.3	25.4	10.4	5.3
European Union	5.6	17.5	10.0	26.2	1.8	1.5
Japan	4.6	48.8	8.5	66.2	1.8	1.4
United States	2.5	13.1	6.2	21.1	2.5	1.6
India	0.9	1.9	5.1	4.7	5.7	2.5

Source: See Endnote 20 for this section.

A public that better understands the state of the world's oceans can be a driving force in helping governments pass legislation to ban destructive fishing, mandate seafood labels that indicate how fish were caught, and create marine preserves where fish can spawn off-limits to fishing. As we begin to develop more of what Carl Safina of the Blue Ocean Institute calls a "sea ethic," we will start to see the oceans as an ecosystem, and individual fish as essential forms of biodiversity, and to think more about how our own lifestyle choices—the cars we drive, the chemicals we spray on our lawns, where we empty our trash—affect the oceans.<sup>26</sup> Being a more deliberate seafood eater doesn't mean a spartan existence, with long lists of do's and don't's; in fact, it could be the only guarantee that fresh and healthy fish continues to appear on our tables.

## The Shifting Baseline

---

**I**n 1995, Daniel Pauly, a fisheries scientist and head of the Sea Around Us Project at the University of British Columbia, wrote a one-page essay describing just how little we really know about the severity of fishery depletions.<sup>1</sup> He coined the term "shifting baseline" to capture the idea that each generation of fishers and marine scientists assumes that the number of fish in the sea during their lifetimes is the norm, or the baseline. This short-term thinking leads to a form of collective delusion in which analysts tend to ignore historic fish populations that could have been many times as great.<sup>2</sup> "What they learn is what is current in their generation," Pauly concludes. "They don't learn how things compare to the past."<sup>3</sup>

As the baseline shifts, it becomes harder to account for the "creeping disappearance" of species, and experts end up setting false reference points for evaluating economic losses from overfishing or for identifying targets for restoration.<sup>4</sup> Historical accounts of very large fish and large hauls tend to be dismissed as wistful, inaccurate anecdotes. Pauly describes

how in the 1920s, a colleague's grandfather reported annoyance at having bluefin tuna—a species for which no market then existed—entangle themselves in mackerel nets in the North Sea. "This observation," Pauly notes, "is as factual as a temperature record, and one that should be of relevance to those dealing with bluefin tuna, whose range now excludes much, if not all, of the North Sea."<sup>5</sup>

The collective delusion that comes from shifting baselines now engulfs resource analysts, seafood buyers, and fishers everywhere. From giant catfish in the Mekong River to the once-plentiful Atlantic cod, humans have, without exception, followed the same pattern with every major fishery since recordkeeping began. As more vessels work a limited number of fisheries with boats, nets, and lines capable of plumbing ever-deeper waters, roughly two-thirds of the world's major stocks have been fished at or beyond their capacity, and another 10 percent have been harvested so heavily that fish populations will take years to recover.<sup>6</sup> In 2004, marine scientists concluded that industrial fleets had emptied the oceans of at least 90 percent of all large predators—tuna, marlin, swordfish, sharks, cod, halibut, skates, and flounder—in just the past 50 years.<sup>7</sup>

Some researchers suggest that fish found in inland waters are even more threatened than their ocean-dwelling counterparts. Harvest from the world's lakes and rivers has quadrupled since 1950, and the current inland catch is estimated at around 8.7 million tons annually, excluding fish farming and sport fishing.<sup>8</sup> Catches of the legendary Mekong catfish, which can grow to 300 kilograms and nearly three meters in length, have fallen drastically in recent years—from 60 in 1995 to just 4 in 2005—heading toward a season when no fish are caught.<sup>9</sup> Total fish catches continue to rise in developing countries like Bangladesh, Egypt, India, Tanzania, and Uganda—which depend heavily on freshwater species for food and jobs—even as the size and quality of the fish is declining and many indicators reveal ecosystem stress.<sup>10</sup> The pattern of depletion is being repeated around the world, despite widespread differences in the scale, technique, and species of fish caught.<sup>11</sup> (See Sidebar 1, pp. 18–19.)

The world's fish farmers and fishing fleets harvested 132.5 million tons of seafood in 2003 (the latest year for which data are available), slightly below the 2002 record of 133 million tons.<sup>12</sup> (See Figure 3, p. 20.) Still, the harvest is nearly seven times what it was in 1950, giving some sense of the additional demands we are placing on the denizens of the deep. The amount of seafood available for each person on the planet declined slightly in 2003 to 21.0 kilograms, down from a high of 21.5 kilos in 2000.<sup>13</sup> (See Figure 4, p. 20.)

With the depletion of wild fish schools, virtually all of the growth in the global catch today comes from farmed fish. In fact, the gap between wild harvests and fish raised on farms continues to narrow. Since 1997, wild harvests have fallen 13 percent from the peak of roughly 87 million tons, while fish farming's harvest jumped more than 50 percent, from 35.8 million tons to 54.8 million tons, accounting for more than 40 percent of the global fish harvest.<sup>14</sup> By 2020, aquaculture could produce the majority of fish harvested.<sup>15</sup> In China, which raises 70 percent of the world's farmed fish, it already accounts for nearly two-thirds of total fish production.<sup>16</sup> For some species, like salmon, farmed production now surpasses the wild harvest.

Such persistently abundant harvests mask an unprecedented change in fish populations. Today, the threats are not simply to individual species, such as cod, but to the sea urchins, flounder, kelp, and other creatures that coexist with the cod and are being overharvested, stripped out, or otherwise damaged. "Oceanic problems once encountered on a local scale have gone pandemic," says Julia Whitty, who has spent 25 years at sea filming nature documentaries. "And these pandemics now merge to birth new monsters. Tinkering with the atmosphere, we change the ocean's chemistry radically enough to threaten life on earth as we know it.... The coastal nurseries of the seas are being filled, dredged, polluted, and drained; as coral reefs and kelp forests are decimated, and dead zones multiply."<sup>17</sup> In other words, as pollution, climate change, and destructive fishing practices intensify, entire ocean habitats and ecosystems are under threat—and with

**SIDEBAR 1****Some Facts About the World's Fish**

**Most Popular Species.** Of some 30,000 known fish species, only 1,000 or so are eaten by humans, and only a small share of these make up most of the catch. (See Figure 1.) Alaska pollock, Peruvian anchovy, Atlantic bluefin tuna, and Chilean jack mackerel account for roughly 13 percent of the global wild catch (or about 11 million tons). Fewer than 10 species—mainly carp, catfish, tilapia, and salmon—dominate global aquaculture.

**Top Fishing Nations.** Just seven nations—China (47.3 million tons), Peru (6.1 million), India (5.9 million), Indonesia (5.7 million), the United States and Japan (5.5 million each), and Chile (4.2 million)—take in nearly two-thirds of the global catch. Fishers in developing countries catch three out of four wild fish, by weight.

**Top Fish Consumers.** People in the developing world eat most of the world's fish (thanks to the larger populations there), though they eat much less per capita: 14.2 kilos per year, compared with 24 kilos annually in the industrial world.

**Global Fish Trade.** Since 1976, the volume of trade has jumped fourfold to 30 million tons, while the value has jumped ninefold to \$71 billion (in 2005 dollars). (See Figure 2.) Fish processors exported 14 million tons of frozen fish in 2004, over six times more than in 1976, with frozen shrimp and squid experiencing particularly rapid growth.

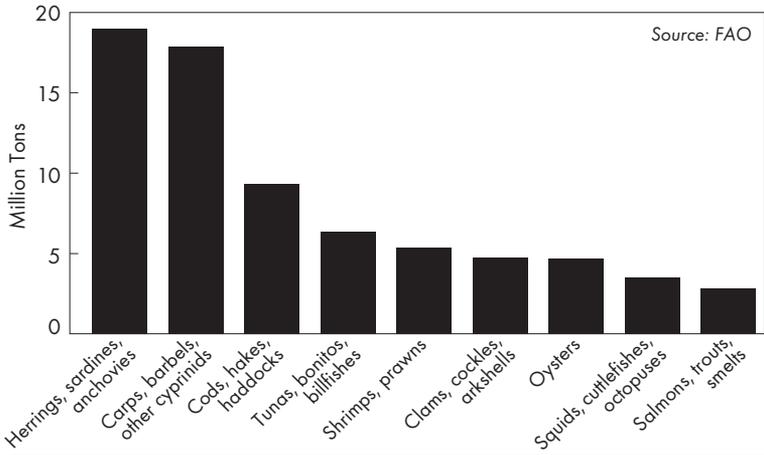
**Marine vs. Inland Catch.** Most of the world's fish comes from marine areas (74 percent), with only about a quarter coming from inland freshwater streams, rivers, and lakes. Of the marine harvest, about 88 percent comes from relatively shallow coastal waters that extend to the outer edge of the continental shelf, less than 120 kilometers from a coastline and no deeper than 200 meters (the most nutrient-rich and productive parts of the oceans). Catch from the "high seas" accounts for the rest, but includes tuna, swordfish, and other higher-value fish.

**Employment.** Fishing employs about 38 million people worldwide, including some 10 million fish farmers. Asia and Africa, where fishing vessels tend to be smaller and more labor intensive, account for 87 percent and 7 percent of this total, respectively. Each year, an estimated 24,000 fishers die in accidents, mostly in developing countries.

**Fleet Size.** The world's fishing fleet numbers some 5.1 million vessels. Most are less than 10 meters in length and lack a motor or deck (i.e., no sheltered area for storage). The largest boats, with a gross tonnage of more than 100 (a measure of volume) and a length exceeding 24

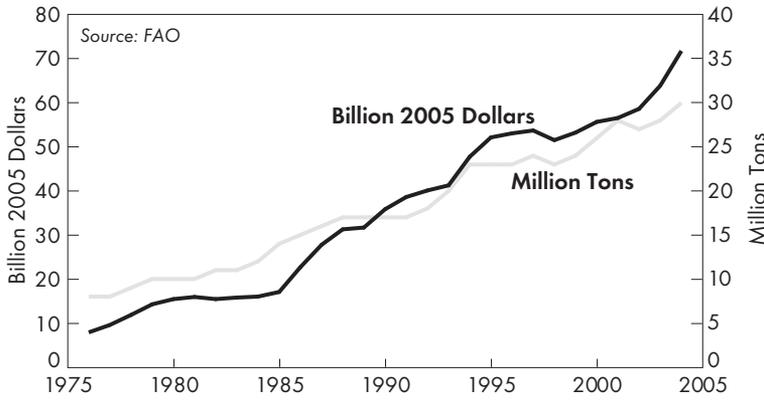
**FIGURE 1**

**Top Fish Species Harvested Worldwide, 2003**



**FIGURE 2**

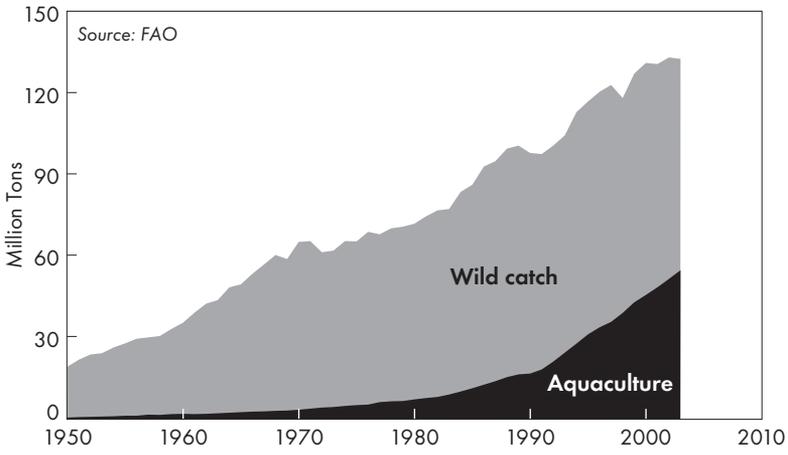
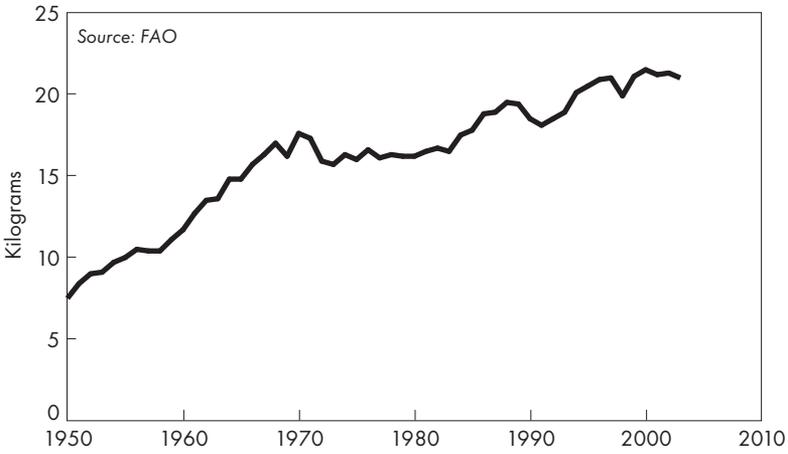
**World Exports of Fish and Fish Products, 1976–2004**



meters, account for some 37,000 vessels, or only about 1 percent of the global fleet.

**Per Capita Catch.** Catch varies greatly depending on fishing technique. In 1995, each of Iceland’s 5,600 fishers produced on average 280 tons of fish, while nearly six million fishers in India produced some 5 million tons.

Source: See Endnote 11 for this section.

**FIGURE 3****World Fish Harvest, 1950–2003****FIGURE 4****World Fish Harvest Per Person, 1950–2003**

them, the most basic functioning of the oceans. Some scientists predict that if current trends continue, the oceans will be reduced to a trawler-scraped wasteland inhabited primarily by sea slime and jellyfish.<sup>18</sup>

The other important difference today is that fishing itself

has changed. For the most advanced fleets on the planet, technology is helping to eliminate the elements of luck and even skill (the finely honed sense for where the fish are) that historically defined fishing. Boats now depend on devices developed for precise military operations, including sonar technology, satellite navigation systems, depth sensors, and detailed maps of the ocean floor. Enormous nets made from synthetic fibers and hauled by massive winches (larger than the boat engines of previous generations) can lift the equivalent of a Volkswagen Beetle from nearly two kilometers down, allowing fishers access to previously inaccessible zones where fish gather and spawn.<sup>19</sup>

Despite this capacity, such massive hauls are becoming fewer and farther between. Fishing is increasingly a game of attrition, as ocean trawlers travel farther and drag their nets over larger areas of the ocean floor to catch smaller fish in sparser schools. And their powerful winches and energy-guzzling refrigeration require far more energy than fishing with a hook and line or a smaller net, making tracking down the larger, more popular, and more lucrative species like tuna or swordfish more energy intensive than catching smaller fish like herring or sardines. (Ironically, many of these smaller fish are fed to livestock, with over 90 percent of their energy content lost in the process.<sup>20</sup>)

In 2000, the world's fishing fleets burned about 43 million tons of fuel to catch 80 million tons of fish.<sup>21</sup> In other words, they use about 12.5 times as much energy to catch fish as the fish provide to those who eat them.<sup>22</sup> (Fishing is still less energy-intensive than raising beef in feedlots or even raising salmon in pens, however.) Such a pattern makes the industry particularly vulnerable to increases in fuel costs. In 2005–06, when global oil prices topped \$70 a barrel, officials from Guyana, Indonesia, Pakistan, Spain, Thailand, and elsewhere reported that large percentages of the fleets remained idle at the dock.<sup>23</sup> Ironically, Dr. Pauly has shown that if global fishing efforts are reduced, stocks may rebound and fewer boats will probably bring in just as many fish. "You could catch the same amount for one-third the energy use," he notes.<sup>24</sup>

Yet there are no signs that commercial fishing companies will voluntarily change their practices, especially as the soaring demand for fish continues to push up its value. Fish prices—especially for prime species such as cod, haddock, and flounder—have risen as much as eight times the consumer price index over the past 20 years.<sup>25</sup> A team at Texas A&M University combed through 40,000 or so restaurant menus (mostly from U.S. coastal cities) dating as far back as the 1850s, and found that as local waters are exhausted, restaurants buy their seafood from farther afield or replace a depleted species with another.<sup>26</sup> The cost of a swordfish meal, about \$7 from the 1920s to the 1950s, rose to \$30–35 by the late 1970s. But the higher prices tempted new suppliers from Australia and the south Atlantic. “The big fishing operations have big incentives to extract even small fish,” says Andrew Rosenberg, fisheries expert at the University of New Hampshire, “and it enables them to invest in even more technology and more powerful boats.”<sup>27</sup>

## Making Better Choices

---

**I**n 1998, a newly formed group called the Blue Ocean Institute developed its landmark color-coded “Guide to Ocean Friendly Seafood.”<sup>1</sup> Using a rainbow of fish categories that faded from bright green (farmed shellfish, Alaska salmon, and other relatively abundant fish caught through safe methods) to red (Chilean sea bass, caviar, bottom-trawled cod, and other products that are endangered or harvested with destructive gear), it was the first in a series of easy-reference seafood guides for shoppers and diners. A long, narrow strip of paper designed to fold up and fit into a wallet, the list was one of the earliest efforts to position commercial fish, generally seen as commodities for eating, as important forms of biodiversity that play key roles in ocean stability. “Now, there are lots of folks doing it,” says Carl Safina, president of Blue Ocean.<sup>2</sup> Two other groups, the Monterey Bay Aquarium and the National Audubon Society, also publish wallet-sized guides

for busy but concerned seafood lovers.<sup>3</sup> “They are still popular,” Safina continues. “We occasionally get orders for several thousand. We got one order recently to give them out as wedding favors.”

Still, the majority of Americans who order fried shrimp for take-out, toss salmon on the grill, or prepare tuna salad for the kids probably haven’t seen the cards. But that may not be important, according to Safina. “There’s a big difference between changing public habits, and scaring big companies into thinking that consumers are really getting concerned about this.”<sup>4</sup>

And in fact, the cards have had an impact, as consumers begin to understand that not all seafood is created equal. A migrating wild salmon caught on a hook and line in Alaska is not the same—in terms of impact on the salmon population, the marine environment, the fishing economy, and the taste of the fish—as a salmon raised on fishmeal and feed in a pen along the coast of Maine. Blue Ocean is trying to expand its audience beyond the usual suspects. For instance, it is developing a Spanish-language guide and Hispanic outreach program to help it reach the fastest-growing minority population in the United States. “The cards aren’t going to save the world,” says Bill Mott, a longtime oceans campaigner who heads The Ocean Project, an international network of aquariums, zoos, museums, and conservation organizations. “But it’s one simple and pretty cost-effective tool.”<sup>5</sup>

Fishers, who know more about species distinctions and the various techniques for catching the fish, have begun to notice the cards as well. For instance, in its first seafood guide, the Blue Ocean Institute granted the Alaskan halibut fishery a green rating, but it gave a neighboring halibut fishery, just across the border in British Columbia, a yellow (“consume with caution”) label. At first, Canadian halibut fishers accused the Institute of nationalism. But because the Alaskan fishers had mandated devices to keep albatrosses and other seabirds from getting tangled in the fish hooks, they had earned the better rating. In response, British Columbia’s fishers asked their government to require the same bird avoidance

devices, which brought a big decrease in the number of birds killed by halibut fishing.<sup>6</sup>

Rising interest in the seafood cards wasn't the first time consumers started being concerned about the seafood they were eating. In the late 1980s, millions of children in the United States and elsewhere signed on to a dolphin-safe tuna campaign that sought to limit the number of dolphins being hooked (and killed) by tuna fishing gear.<sup>7</sup> The high-profile campaign successfully encouraged tuna fishers to replace drift gill nets (which can strangle dolphins) with more selective purse seines and to stop chasing or encircling schools of feeding dolphins as a way to locate the tuna, which greatly reduced their inadvertent catching of dolphins (though these same changes also led to the use of gear more likely to snag sharks).

Unlike the tuna campaign, however, the color-coded cards target all major fish species, and have wider goals. Their intention, according to Safina, has been to help people understand what's happening to the ocean environment, teach them how different fish are caught, and allow them to talk about these issues with friends. "Most people's most direct relationship with the ocean is by eating seafood," he says.<sup>8</sup>

Aquariums around the world are logically concerned about the fate of ocean life as well, and are using their unique educational role to inform schoolchildren and other interested visitors about seafood. Monterey Bay Aquarium has distributed 8 million of its pocket guides (in English and Spanish) through more than 140 partner institutions and businesses, and its program to distribute the guides and accredit local restaurants has been adapted by aquariums in Vancouver, Sarasota, Honolulu, and Seattle.<sup>9</sup> Other aquariums around the world are taking actions from conducting in-house fish conservation and breeding programs to educating restaurants and other local constituencies on more sustainable seafood choices.<sup>10</sup> (See Sidebar 2.)

Separating good fish from bad isn't always easy. Australia, for instance, faces an especially tricky task due to its vast coastline and relatively small but well-dispersed fish populations. According to Chris Bohm, National Fisheries Cam-

paigner for the Australian Marine Conservation Society, which developed its first national seafood guide in 2004, this means a large number of highly specialized fisheries, which often use differing gear types to catch the same fish.<sup>11</sup> (Off southeastern Australia, south of Sydney, a flathead might be scooped up by a trawl that is damaging to reefs, but elsewhere it is caught with a hook and line, which is better for the ocean floor but less beneficial for the sharks that are snagged inadvertently.) In New

## SIDEBAR 2

### What Aquariums Worldwide Are Doing

**China.** The Shanghai Ocean Aquarium has a particular interest in conservation of China's rivers and wild fish populations and has programs to encourage the release and replenishment of sturgeon.

**France.** The National Sea Experience Centre in Boulogne-sur-Mer distributes a "passport" to caring for the marine environment, which includes information about making sustainable seafood choices.

**India.** The Centre for Environment Education in Ahmedabad has launched a sustainable lifestyle campaign that includes a segment on lifestyle choices for ocean conservation.

**Mexico.** Acuario Xcaret, located in a park along Mexico's Caribbean coast, serves only sustainable seafood, raises some fish sustainably on-site, and hopes to begin educating local restaurants and hotels.

**The Netherlands.** The Rotterdam Zoo distributes the North Sea Foundation's card of seafood recommendations, helped develop a cookbook on sustainable seafood by a famous Dutch chef, and engages in discussions with the Dutch fisheries department.

**Portugal.** Oceanário de Lisboa in Lisbon has produced a ruler indicating acceptable minimum fish sizes for consumers purchasing seafood, educates local food businesses on seafood choices, and has organized international meetings on the topic.

**United States.** The South Carolina Aquarium educates a nearby culinary college about sustainable seafood, has encouraged at least 35 local restaurants to refrain from serving three unsustainable species, and promotes the consumption of local sustainable seafood to support coastal fishing communities.

---

Sources: See Endnote 10 for this section.

---

Zealand, meanwhile, the Royal Forest and Bird Protection Society decided to put nothing in the “green” category of its seafood guide because no local fish species are caught in a benign and traceable way, with full knowledge of their interactions with other species, associated bycatch, and consequences for the marine environment.<sup>12</sup> Blue grenadier, a popular fish in both countries, received an orange/amber rating in New Zealand but a green one in Australia. “I’m very nervous about that,” says Bohm. “The reality is that most fisheries don’t meet these criteria. But you’ve got to still give people something to eat or otherwise they’re going to reject this.”

Further complicating matters is the fact that seafood is now a globalized product. The majority of the world’s seafood—nearly 40 percent by weight—is traded across borders, which can make determining how something was caught halfway around the world nearly impossible.<sup>13</sup> In the case of Australia, 60 percent of the seafood people eat is imported.<sup>14</sup> Bohm’s group has suggested that Australians choose local products first, a decision that elicited some flack from seafood distributors and importers. But Bohm argues that choosing local seafood means “we have a better chance of influencing...how fisheries are managed in Australia than fish that are imported.”<sup>15</sup> As the global seafood trade continues to grow, assembling accurate and useful seafood guides will soon require an international network of contributors. Already, both the Monterey Bay Aquarium and Seaweb, a U.S.-based nonprofit that promotes ocean conservation, regularly seek Bohm’s advice on Australian species like barramundi that show up in the American market.

In the absence of better product labeling, seafood guides—no matter how imperfect—may ultimately be the best way to get consumers to choose more wisely. This is particularly true when many seafood labels are vague and confusing. Bohm notes that a typical Australian shopper is likely to encounter as many as 40 different species of so-called “flathead”—a general Australian term for a reptile-like fish that includes sand flathead, tiger flathead, rock flathead, dusky flathead, and yank or blue-spot flathead—a level of vagueness that

conveys little about how the fish was caught. Still, strong response to the guide in Australia (particularly around Easter and Christmas, traditional seafood eating times in this majority-Catholic country) has prompted a second edition with new information on farmed species as well as ratings of the 15 or so most common gear types. Many environmental groups have promoted the guide to their members in an important alliance between groups seeking better government regulation of fishing techniques and those encouraging consumers to push such change via the market. "We hope the guide helps people start thinking of fish as wildlife, that it starts putting some doubt in their mind that fish are in great shape," says Bohm. "People often come to the end of [it] and decide they're going to eat less fish."<sup>16</sup>

This reality might be hard for the fishing industry to swallow. But ultimately, it may not be as important for consumers to eat *less* fish as for them to eat less of certain kinds of fish, and more of others. The good news is that many of the fish species that are most endangered are also the ones that are the most destructive or energy intensive to catch, such as tuna, swordfish, and farmed salmon. In contrast, seafood that is lower on the food chain, including smaller fish like herring and mackerel and shellfish like clams and oysters, is not only less energy intensive, but also in better shape than the large predatory fish that most consumers crave.

"The thing about fish is we need to eat more meat," jokes Peter Hoffman, chef and owner of Savoy, a New York City restaurant known for serving conscientious fare.<sup>17</sup> He means that consuming grass-fed beef or pastured poultry is more sustainable than serving many types of fish. But the comparison goes even further. Speaking at the 2006 Seafood Summit in Seattle, a gathering of conservation groups, fishing organizations, and food conglomerates, Hoffman noted that people today are eating meat with more restraint ("We aren't ordering Porterhouse steaks as often") in part because of what is now known about factory farming. Like factory farming, industrial-scale fishing has become so destructive that it is eroding its ability to exist into the future. "We have aspired to make seafood

cheap and accessible to all," says Hoffman. "We have degraded the taste of seafood so that we only get satisfied if we eat lots of it. We don't need to eat a bucket of scallops, when they're so good. We can be satisfied with a few ounces."<sup>18</sup>

At his own restaurant, Hoffman has tended to emphasize quality over quantity. His portions are often one-third to one-half smaller than the typical seafood serving. And he limits his offerings to fish and shellfish he can trace back to a particular fisher, selecting species that aren't threatened and that are caught with gear that has a minimal impact on the surrounding environment. Recent menu items include pan-roasted skate (a relatively abundant but unpopular fish), local littleneck clams, and shad caught by hand during their annual run up the nearby Hudson River.<sup>19</sup>

Hoffman is also national chair of the Chefs Collaborative, a network of some 1,000 chefs in the United States who have pledged to make responsible choices in their kitchens.<sup>20</sup> Among the group's campaigns are a "sustainable seafood" initiative devoted to educating members about the elements of a sustainable aquatic food system.<sup>21</sup> "It's pretty important, because otherwise, there's not going to be any fish to eat," explains Bruce Sherman, chef at North Pond restaurant in Chicago, who plans to open a sustainable seafood establishment in that city.<sup>22</sup> By using creative flavors and presentation, the Collaborative's members try to educate their staff and customers about the seasonality of various fish, fish to avoid, and underutilized or unfamiliar species.

Sherman and his colleagues are developing a culinary school seafood curriculum for use in the fall of 2006 that includes segments on the differences in quality between wild and farmed fish, on identifying various catch methods, and on the connections between land-based farming and the health of the oceans, as well as a visit from a working fisherman.<sup>23</sup> Chefs Collaborative board member Joe McGarry, a chef with Bon Appétit Management Company in Hillsboro, Oregon, chose to spearhead the initiative after a visit to Western Culinary Institute in Portland two years ago. "The students had a very strong grasp of the ideas of local, seasonal, and organic

as they applied to agriculture,” says McGarry. “But the idea that our oceans do not harbor an endless supply of seafood seemed like a revelation to most. It generated an incredible desire to understand how to incorporate sustainability into a business model, and I realized that we need to fan this flame with every educational tool we have.”<sup>24</sup>

For seafood lovers, favoring certain types of seafood would make a big difference.<sup>25</sup> (See Sidebar 3.) In 2005, Slow Food, an organization with 100,000 members in more than 100 nations that celebrates regional cuisines, distinct crop varieties,

### SIDEBAR 3

#### What’s a Seafood Lover to Do?

**Eat low on the seafood chain.** This means fewer salmon and more clams and squid. Fish lower on the ocean food chain tend to be less endangered, and catching them is less energy intensive. They are also less likely to accumulate mercury and other toxins in their flesh.

**Get to know where your fish comes from and how it’s caught.** Avoid seafood caught using large-scale indiscriminate techniques, such as long-lines (tuna and swordfish) or bottom trawling (shrimp and cod). Seafood guides, like the ones put out by the Monterey Bay Aquarium and the Blue Ocean Institute, often include this information.

**Support small-scale boats and fishers.** Small-scale boats support more people per fish caught than large-scale vessels. They are also more likely to use more selective and less destructive fishing practices.

**Consider what you wash down your drain.** Particularly for people living in coastal areas, much of the water we use in our homes—for showers, sinks, washers, and toilets—ends up in the oceans. Switch to non-toxic, biodegradable cleaners and dispose of paints, used car oil, and other toxins at recycling centers, rather than down the drain.

**Consider the other food you eat.** Runoff from large-scale livestock farms, chemical fertilizers, and pesticides often ends up in the ocean, where it encourages algae blooms that rob other ocean life of oxygen. Animal feedlots also feed livestock large amounts of fishmeal and fish oil, putting additional strain on the oceans. Favoring organically raised food and pasture-raised meats means fewer farms that dump waste into the oceans.

---

*Sources: See Endnote 25 for this section.*

---

and forgotten food traditions, held a meeting called “Slow Fish,” which brought together small-scale fishers, chefs, and seafood companies to discuss how people could continue enjoying seafood without compromising responsibility.<sup>26</sup> The three solutions were to (1) “support small-scale inshore fishing and ancient methods of fishing, processing and preserving, which are sustainable and produce outstanding products that form part of our cultural identity”; (2) to consume fish lower on the food chain, such as the smaller, spinier fish that have long been a base of Mediterranean coastal cuisine (“Consuming these less known but tasty fish relieves the pressure from more popular menu choices”); and (3) “supporting traditional low-impact types of fish farming, such as oyster farming and low-density freshwater pool systems, which produce a tastier product than industrial counterparts.”<sup>27</sup> This last solution might be the real key to attracting the interest of larger seafood companies, says Hoffman, the Chefs Collaborative chair. “People ultimately can taste the difference. If you can tie it in with quality, that’s the real selling point.”<sup>28</sup>

## **When the Fisher Is the Eater**

---

**I**n much of the world, the people who catch the fish are the same ones who consume it. Roughly one billion people in Africa and Asia depend on seafood as their main source of protein.<sup>1</sup> For many of them, who are too poor to purchase fish, the main seafood choice is not whether it’s red- or green-coded, but whether there’s any to catch at all. In such cases, the collapse of a fish population eliminates both a livelihood and a direct source of sustenance.

As wealthy nations find their own waters emptied of fish, they are turning increasingly to fisheries in Africa and Asia. At best, this can mean new and lucrative export markets for many developing nations, particularly if domestic fishing fleets harvest, process, and market the fish.<sup>2</sup> For 14 African countries, including most of the coastal nations of West Africa,

fish comprise over 25 percent of agricultural exports.<sup>3</sup> “The fish trade helps poor countries shore up their food security situation,” explains Grimur Valdimarsson, director of the Fisheries Industry Division at the United Nations Food and Agriculture Organization (FAO).<sup>4</sup> But, he notes, “increasing international demand can at times result in excessive fishing pressure, leading to over-fishing and the wasteful use of stocks.”

Consider the fisheries in Lake Victoria in East Africa. The 69,000-square kilometer lake was transformed in the 1960s with the introduction of the Nile perch to serve both growing local demand and export markets.<sup>5</sup> In the following three decades, fish production increased fivefold. Fishers’ incomes rose as they joined the crews of large fishing vessels—some foreign owned—that supplied the perch to processing factories. But traditional trading and fish processing disappeared and thousands of women lost their incomes, with negative consequences for the nutrition and health of their children. In the 1990s, greatly reduced fish intakes were recorded among the poor, as the most commonly consumed, low-value, and small fish species and skeletons from the processing factories were used for fishmeal production instead of local consumption. “Over-fishing...leads to fewer jobs, can increase the cost of fish to the poor that rely on fish for protein, and can reduce an important revenue stream for developing countries,” explains Warren Evans, environment director for the World Bank.<sup>6</sup>

This pattern is most acute in Africa, where nearly 10 million people depend on fishing or on fish farming, processing, or trading.<sup>7</sup> This means that per person, fishing is more important (relatively speaking) in Africa than anywhere else. That would surprise most people. But sub-Saharan Africa also has the unfortunate claim of being the only region where fish consumption per capita is declining as a growing population depends on a dwindling fish supply.<sup>8</sup> With fish providing such a high proportion of the continent’s nutritional needs, many African leaders are realizing that domestic markets must be the priority. West African (and South Asian) nations now exclude foreign fleets from nearby waters entirely, at least on paper. “The first thing is to have policies that get the right bal-

ance between export and national or inter-African distribution of fish,” said Patrick Dugan, deputy director general of the WorldFish Center, part of the World Bank’s network of food research institutes, at the August 2005 “Fish for All” summit in Nigeria.<sup>9</sup>

Dugan noted that while developing countries as a whole continue to be net fish exporters, sub-Saharan Africa’s demand for fish imports is expected to increase ninefold, from 54 billion tons in 1997 to 492 billion tons in 2020.<sup>10</sup> “Policies should ensure that where possible and where appropriate, fish harvested in Africa is made available to the African market. In many cases it is going to benefit the country to export fish, provided that the revenues obtained are invested back into the communities that are dependent on fishing as a resource. But in other cases it is critically important that fish harvested in Africa is distributed to the people who are demanding that fish in Africa.”<sup>11</sup> If local fishers don’t have reliable access or rights to their own fishing grounds, there can be less incentive to invest in protecting them.<sup>12</sup>

In other cases, a strong export market may accelerate the decline of a fish species, threatening local livelihoods. In New Caledonia and the Solomon Islands in the Pacific, harvesting sea cucumbers has been part of the local culture for at least 200 years. Women typically walk the reefs at low tide, gathering the creatures and selling them to raise money for food, medicine, school fees, and other daily needs. Nearly half the families in some villages rely on the sea cucumber fishery. As the “earthworms” of the marine environment, the cucumbers serve an important role in maintaining the health of the nearby reef, sucking up mud and debris, aerating sediments, and recycling nutrients. Their larvae also constitute an important part of the reef food chain.<sup>13</sup>

But a lucrative export market for sea cucumbers (some varieties, like the sandfish, command as much as \$75 per kilogram) has encouraged over-harvesting and illegal catches. The local harvest now stands at less than one-tenth that of the early 1990s. In response, WorldFish is working with the government in the Solomons to give fishing communities clearer

control over the fishery. As a result, islanders are more willing to consider reducing their sea cucumber catches, knowing that what they leave behind will not be taken by somebody else. Fishers and scientists have already noted a decline in illegal harvests.<sup>14</sup>

WorldFish is also experimenting with rebuilding stocks by culturing and releasing juvenile sea cucumbers into the wild. Attempts to grow sandfish with shrimp in earthen ponds have been promising, as the sandfish provide a secondary crop for shrimp farmers, eat waste products from the shrimp, and can be used to replenish wild stocks. In addition, WorldFish is helping islanders obtain better returns for their products in the world market by training them to set up basic processing and brokerage facilities. Alternative livelihood choices are being developed, including seaweed farming and the culture of giant clams and hard corals for the aquarium trade. Already, representatives from the Philippines and Egypt have requested advice and training in sea cucumber rearing to replenish severely overfished stocks.<sup>15</sup>

Many development experts see great potential for fish farming in places where it hasn't necessarily been part of the cultural heritage. For instance, although many African nations depend on seafood, only 3 percent of the continent's fish production is from aquaculture, compared with more than 40 percent worldwide.<sup>16</sup> The U.S. Agency for International Development (USAID) recently launched an integrated agriculture-aquaculture program to introduce the benefits of small-scale fish farming to African nations. In Malawi, one of the world's poorest countries, subsistence farmers often grow everything their family will need during the year on less than one hectare of land. But slash-and-burn cropping has degraded much of the soil and the land.<sup>17</sup>

Under the USAID program, farmers set aside a small amount of their land for fish farming and either dig a pond or build one inside earthen walls. Farm and kitchen wastes, including maize bran, household leftovers, and animal manure, become food for fish species such as tilapia. Compared to traditional crop farms, these integrated systems

increase profits sixfold, and crop yields are 18 percent higher. In a typical situation, farmers produce 1,500 kilograms of fish per hectare a year, providing food for their families as well as a new cash crop. The ponds help farmers cope with drought and enable them to raise crops like cabbage and tomatoes that require irrigation during the dry season. Farmers also grow cash crops like bananas and guava around the banks of the ponds, and the pond sediments make great fertilizers. Research by WorldFish has shown that replacing inorganic fertilizers with the sediments as a top dressing in maize fields can boost productivity, and that in good years farmers need to apply it only once a year (during the wet season) to get the best results. In families that have added aquaculture to their farming operation, child malnutrition has dropped by some 15 percent. “Fish in the pond is like money in the bank,” says Jessie Kaunde, a farmer and widow in Mangwengwe village in southern Malawi. Some 5,000 farmers have adopted the system in Malawi and Zambia.<sup>18</sup>

In many Asian nations, fish farming is a natural addition to existing rice farming operations.<sup>19</sup> This isn’t new. Archeological evidence shows that Chinese farmers have been raising fish in rice paddies for nearly 3,000 years. As in Africa, vegetable scraps and crop residues are fed to fish, which in turn produce waste that is used to fertilize the fields. Farmers can also use fewer pesticides and herbicides, since fish help control pests by consuming the larvae and eating weeds and algae that carry diseases and compete with rice for nutrients. (Fish farming also helps to control malaria, since fish eat mosquito larvae.) Farmers practicing rice-field culture in Bangladesh have managed to reduce their production costs by 10 percent, and the average farm income has increased by 16 percent in just three years, buoyed by sales of fish fry and fingerlings as well as fish that farmers do not eat. One hectare of rice field typically produces between 250 and 1,500 kilograms of fish. Thousands of rural dwellers in Bangladesh have already adopted this form of affordable aquaculture, and projections show that the integrated system could yield an estimated 400,000 tons of fish a year, worth

\$300 million, on 40,000 hectares of land.

On Southeast Asia's "Great Lake," the Tonle Sap in Cambodia, protecting fish supplies means breaking with fishing and forestry customs that have been followed for nearly a century. Long the main source of sustenance and survival for the millions of people that inhabit its shores, the Tonle Sap is only about a meter deep for much of the year. But every summer, as Himalayan snowmelt and monsoon rains swell the Mekong River system, the lake's depth increases by up to nine meters while its surface area expands by a factor of five, to cover 1.3 million hectares. The months of flooding spark a huge boom in the number of fish and aquatic organisms, making the Tonle Sap ecosystem one of the most productive inland fisheries in the world. It provides Cambodia with 200,000 tons of fish each year, or 60 percent of the nation's total catch. And when the flood waters recede, the alluvial soil surrounding the lake is perfect for growing rice, with productivity of up to six times the national average.<sup>20</sup>

By the early 1990s, however, the catch and size of individual fish in the lake had begun to decline. "People were using small-mesh mosquito nets to capture fish, taking too many small juveniles, or carrying out electro-shock fishing with car batteries," explains FAO specialist Patrick Evans, who has worked on the Tonle Sap for a decade. The 100-year-old system of commercial fishing concessions, inherited from colonial times, was suffering from problems of unfair access, corruption, and, occasionally, violent disputes. Beyond overfishing, excessive clearing of the surrounding forests for farming or fuelwood was beginning to reduce the fish harvest, since the hundreds of thousands of hectares of flooded forest provided nutrients, food, and habitat for the fish in the summer months.<sup>21</sup>

In 1997, Cambodian authorities teamed up with the FAO to help villagers organize themselves into local resource management organizations; by 2000, communities controlling about 10,000 hectares were involved. The improved management, combined with a 1997 government ban on brick kilns in the region, stemmed excessive timber harvesting, and much of the cleared flood forest began to grow back. By mid-2005,

some 15 different community-based natural resource organizations had been established in 116 villages around Siem Reap, actively managing 108,000 hectares in and around the lake. A loan from the Asian Development Bank has since funded additional initiatives, including a floating environmental education center that teaches children about the lake's natural resources and the need to manage them responsibly; the creation of 12 protected fish reserves in deep water holes where fish can spawn and grow year-round; and community-led forestry management in upland areas of the watershed.<sup>22</sup>

For fishers in many African and Asian countries, the best way to make their fisheries sustainable is to eliminate illegal fishing from foreign vessels, primarily those from wealthier nations. The FAO estimates that illegal fishing robs sub-Saharan Africa of more than \$1.2 billion annually in stolen fish, unpaid taxes, and lost work.<sup>23</sup> (Ironically, while the best fish are transferred to refrigerated ships bound for Europe, much of the damaged and poor quality catch is either dumped or canned for sale back to African countries.<sup>24</sup>) But since 2000, a partnership between the FAO, the United Kingdom Department for International Development, and 25 West African countries has supported fishermen in the monitoring, control, and surveillance of areas reserved for artisanal fishing.<sup>25</sup> The project includes training as well as supplying equipment so that artisanal fishermen can rapidly communicate information on illegal boats to surveillance headquarters. As a result, in Guinea, between 2000 and 2002, observed incursions by industrial (often foreign) vessels in the artisanal zone dropped from 450 to 81, and the number of disputes at sea dropped from 240 to 35.<sup>26</sup>

In Kenya, where fisheries regulation was inadequate, the government began involving fishing communities in efforts to protect the fish supply. "We had many stakeholder meetings and discussed how best we can run fisheries management so that the resource can last for ever," explains Nancy Gitonga, the country's director of fisheries. "We have agreed on net sizes that can be used, and they have vigilante groups so that if people don't use the right nets they report them and

action is taken.”<sup>27</sup> The primary institution overseeing these activities is the Beach Management Unit (BMU), a group that comprises the fishermen in a village or landing site. Unit members are empowered to regulate their own fisheries, agreeing on the number of people who can fish at a given time and making sure that quality control is observed. The BMU concept has since been adopted in Tanzania and Uganda.<sup>28</sup>

## Beyond Fillets

---

**I**n January 2006, the Seafood Choices Alliance, a global trade association devoted to increasing the supply of “ocean friendly” seafood, organized a seafood summit in Seattle. The meeting brought together a diverse group of people, including those who sell fish (fishers, food companies, restaurant chains), and those who speak for the fish (marine conservation groups). “Here’s the reality,” said Mike Boots, head of the Alliance, in his welcoming speech. “Fish consumption continues to rise. And the number of certified choices is rising rapidly.”<sup>1</sup>

Yet with global demand for seafood outstripping supply, “bad” seafood (fish harvested illegally, destructively, or from endangered populations) is still widely sold. Later at the summit, Andreas Merkl, head of the Sea Change Investment Fund, noted that although the United States is one of the world’s largest seafood importers, it constitutes only a small share of total fish consumption.<sup>2</sup> So even if 10 percent of Americans buy only certified fish, the overall impact on global fisheries is still fairly small. However, Merkl noted, there is tremendous potential in influencing the world’s largest buyers of seafood: the big food distribution companies, restaurants, and supermarkets.

In the United States, Europe, and Japan (the three most lucrative fish markets) about two-thirds of all seafood flows through these large distribution channels.<sup>3</sup> Huge—and increasingly multinational—food companies determine what seafood appears on consumers’ tables, and they are not oblivious to the

state of the world's fish populations. Increasingly, they too are looking to the future and realizing they may have problems meeting growing demand. "They are beginning to understand that the oceans are a living organism that can be harmed," says Carl Safina of the Blue Ocean Institute. "But at the same time, the industry still refers to seafood as 'product,' not as wildlife or part of an ecosystem. They have to get beyond fillets and product, and then they can sell the story to their customers."<sup>4</sup>

Among the first large food purveyors to make the realization that oceans were emptying was Unilever, the Dutch food and consumer products company. In the 1990s, the company, then the world's largest seafood buyer, faced considerable pressure from its customers and from environmental groups to rethink its seafood purchases. But it needed some guidance on which species to avoid and which to favor. Working with WWF, Unilever helped create the Marine Stewardship Council (MSC) in 1997 to certify fish populations as sustainable and to provide direction for the nascent sustainable seafood market. The MSC is now supported by over 100 corporate, environmental, and consumer organizations in more than 20 nations, all of whom have a stake in the future of the global seafood supply.<sup>5</sup> Certified fisheries are rewarded with the right to use the group's "Fish Forever" ecolabel, signifying that their product was caught using environmentally sound, economical, and socially responsible management practices. In 2000, the Western Australian rock lobster became the first fishery certified to the MSC standard. Today, 18 fisheries are certified and another 16 are being assessed.<sup>6</sup>

When a company as large as Unilever changes its purchasing habits, the impact can ripple throughout the fishing industry. One of the world's largest fisheries, the Aleutian Islands pollock fishery in the Bering Sea, was certified to the MSC standard in late 2004.<sup>7</sup> The next year, Unilever introduced certified Alaska pollock in many of its European brands, including offering fish fingers derived from the fish. The company's use of certified pollock increased the share of its European fish products made from MSC-certified fish from 4 percent in 2004 to 46 percent in 2005.<sup>8</sup> In another example, when the MSC cer-

tified longline-caught Pacific cod, a substitute for depleted Atlantic cod, in early 2006, boats rushed to become involved.<sup>9</sup> “We believe the current level of demand will result in an additional 10 to 20 freezer longliners producing MSC-certified Pacific cod over the next year,” said Paul Gilliland, managing director of Bering Select, a Seattle-based seafood company that applied for the accreditation. “Future growth is possible as consumers weigh in at fish counters in key markets.”<sup>10</sup>

For now, the MSC is the only major seafood certifying body, a position that helps make it more recognizable to consumers and food shops, but which could also hinder the growth of labeled seafood. The developing world in particular remains a largely untapped market. Although the MSC has sought to build ties with fishing communities in developing countries for some time, only a few fisheries are nearing approval. In 2004, the first two to undergo full assessment against the MSC standard, the South African hake fishery and the Mexican Baja California spiny lobster fishery, became certified.<sup>11</sup> Part of the problem is that most of the demand for certified seafood is in wealthier settings, and certification represents a cost that many poorer fishing communities cannot bear. It takes time, money, and expertise to complete the paperwork required to prove that a fishery is sustainable.<sup>12</sup>

Among the other developing nations currently engaging with the MSC are Argentina, China, India, Ecuador, the Gambia, Malaysia, Mexico, Papua New Guinea, Tanzania, Thailand, Venezuela, and Vietnam. Yemi Oloruntuyi, who manages the MSC’s developing world fisheries program, notes that the level of awareness of ecolabeled seafood is currently low in developing nations. But she thinks that will change—and it will have to, since three out of four fish on the planet are consumed in the developing world. “The demand for fish in developing countries is rising significantly,” Oloruntuyi explains. “We see the need to develop market presence in some key developing countries like China and India as an important long-term goal.”<sup>13</sup>

Labeling is an important first step to guiding this growing market, but distributors, processors, and other players in

the seafood chain will also need to sign on if “sustainable” fish is to make it into restaurants, supermarkets, and other places where people do most of their eating. “For a long time marine preservation advocacy groups have been doing really good things—creating buying guides and publicizing the phenomenon of overfishing—but consumers never had a good choice at the stores,” says Henry Lovejoy, founder and owner of the New Hampshire-based distributor EcoFish.<sup>14</sup> “The market can drive this faster than any regulations,” explains Tim O’Shea, founder and head of CleanFish, who describes his company as “a champion of artisan producers” devoted to get as much of a return for its fishers as possible.<sup>15</sup>

In contrast to certification through the MSC, a process that typically begins in response to requests from fisheries, EcoFish and CleanFish seek out seafood supplies from around the world and then assess whether they meet certain internal standards. This has allowed the two firms to offer seafood products that aren’t easily certified or that may take years to receive MSC certification, which can be a lengthy and expensive process. For instance, EcoFish’s products include frozen and vacuum-packed fish, as well as pre-made frozen seafood meals. The company recently received an investment grant that it hopes will allow its sales to grow fivefold in the next three years, to \$15–20 million. EcoFish products are now available in 243 branches of Loblaws, Canada’s largest seafood retailer.<sup>16</sup>

For large food companies, their professed “inability” to source sustainable or ocean-friendly fish is becoming a less persuasive excuse. Once one major industry player makes the shift, its competitors often must do the same or risk losing business.<sup>17</sup> For instance, in early 2006, Compass Group USA, one of the largest food service companies in the United States, began to shift its purchases “away from threatened fish species and toward sustainably sourced supplies.”<sup>18</sup> Around the same time, Darden Restaurants, parent company of Red Lobster, the top seafood restaurant chain in the United States with 1,300 locations, also announced plans to certify all of its farm-raised shrimp “to ensure it is grown in a sustainable

way, with minimal impacts on the environment.”<sup>19</sup> And Wal-Mart, the world’s largest retail store and the largest food seller in the United States, has pledged to certify all of its wild-caught and frozen seafood for the North American market as sustainably raised within 3–5 years.<sup>20</sup> “Wal-Mart has huge market clout,” says Rebecca Goldberg, senior scientist at Environmental Defense, which is working with the company on its new sustainability initiative. “The result will almost certainly be improvements in fisheries management as new fisheries work to achieve certification.”<sup>21</sup>

In most cases, companies aren’t taking these steps of their own volition. A combination of environmental, consumer, and public health groups is helping to pressure these businesses and even suggest alternatives to their current seafood sources. The recent Wal-Mart decision, for example, was brokered by Conservation International and WWF. And the Pure Salmon Campaign, a partnership of seafood companies and salmon producers from Canada, Chile, Europe, and the United States, was organized by the Washington, D.C.-based National Environmental Trust to improve the way salmon is raised.<sup>22</sup>

With support from the Packard Foundation, the Monterey Bay Aquarium in California has teamed with Environmental Defense to systematically approach large food companies to alter their practices. (The Aquarium set a good example by reforming the food it serves in its own Portola Cafe and Restaurant on historic Cannery Row, featuring local seafood to the extent possible, favoring fish and shellfish that are lower on the food chain, and complementing these items with organic produce.) “What we’re interested in is not just working with one-off companies, but changing and transforming entire industries,” says Greg Andeck, who coordinates corporate partnerships for Environmental Defense.<sup>23</sup>

As it has done with similar campaigns on forestry products or more efficient cars, Andeck’s group favors very large companies in a given industry, or companies that are particularly influential because of a reputation for innovation. In the case of seafood, Monterey Bay Aquarium and Environmental Defense approached Wegmans, a medium-sized supermarket chain

with 70 stores in the eastern United States, and Bon Appétit, a catering company with more than 400 cafés in 29 states.<sup>24</sup> Both are viewed as trendsetters that have enjoyed growing shares of their respective markets in recent years; Wegmans reports among the highest per-store sales in the industry.

The groups also went after some of the most popular seafood products on the market: farmed shrimp and salmon, both available year-round and less expensive than the wild alternative. Environmental Defense scientists worked with experts in the fish industry and representatives from Wegmans and Bon Appétit to develop a series of standards they felt could significantly reduce the toll of salmon and shrimp farming on the environment, without adding substantially to the cost or logistics of buying the fish. Among the key provisions of the standards were: a low ratio of wild fish consumed to fish produced (1.5 or less); no sourcing of fish feed from species named by fisheries regulators as at risk or threatened; no record of major salmon escapes at production facilities; no stocking of genetically modified fish; limited use of antibiotics and parasiticides (only to treat diagnosed conditions); no use of hormones; and no raising of farmed salmon in migratory corridors of native salmon.<sup>25</sup> The companies' suppliers were ultimately able to switch sources to meet the standards, sending a message throughout the fish farming community that addressing concerns about feed, chemical use, escape, and genetically modified fish could be required for any fish farm that wants to sell to mainstream supermarkets.

By the time the new salmon reached Wegmans, the company had developed an advertising campaign that proclaimed, "there's something special about our fish, ask us why." The product flew off the shelves. When the dust cleared, it was clear the seafood initiative had been the most successful promotion in the store's history. The company has put in a much larger order for next season.<sup>26</sup>

Environmental Defense is now approaching Wal-Mart and Costco, the nation's two largest discount food sellers, to adopt similar standards for salmon. (The group just opened an office in Bentonville, Arkansas, Wal-Mart's hometown.<sup>27</sup>) And it is

finalizing standards for farmed shrimp that will be rolled out at Wegmans and Bon Appétit. "It's an evolving science of aquaculture," says Andeck, noting that there is no widely recognized certifying body for farmed fish.<sup>28</sup> (The industry-organized Global Aquaculture Alliance has emerged to fill this certification gap, though critics have raised questions about the stringency of the group's standards.<sup>29</sup>) But Andeck notes that as larger companies show interest in the standards, there is inevitable pressure to weaken them, since the supply might not be there to meet demand from a store of Wal-Mart's size. For instance, Environmental Defense chose not to push for closed containment aquaculture, a system that often involves raising the fish inland or in some tank that virtually guarantees no coastal pollution and no fish escapes.<sup>30</sup>

Of course, these sorts of corporate and fishing industry initiatives are no substitute for government involvement. For instance, school cafeterias are an important frontier for sustainable seafood, not just because they present a large untapped market, but also because these meals offer an opportunity for children to learn responsible eating habits. In the United Kingdom, Brakes, the nation's largest supplier of food to schools, has begun to offer a wide range of certified sustainable products, from salmon fish fingers to simple hoki fillets.<sup>31</sup> Certain schools have approached Brakes in response to concerns from parents and teachers, but government requirements that school seafood meet certain health and environmental standards would prompt considerably more purchases. "These external forcing strategies are more likely to have an effect on the bottom line than working tirelessly to alter government bureaucracies," says Rod Fujita of Environmental Defense, who worked with fishermen and environmental groups to get the state of California to create a large marine preserve where fishing is restricted.<sup>32</sup> In other words, a change in shopping habits can pull reforms forward, rather than having to push government bodies from behind.

Fishing communities are a growing ally in this movement. Fishers are often the first to know that a given fish supply is endangered. But this doesn't always mean they have incentives

**SIDEBAR 4****Racing for Fish vs. Sharing the Fish****Alaska's Salmon Fishery**

When Alaska became a state in 1959, it inherited a fishery troubled by overharvesting and declining stocks. Since then, the constitution has been rewritten to require that salmon habitat be conserved and protected, and the local fishing industry has worked with the government to rebuild the stock. Before the season opens each year, state biologists now make sure ample numbers of salmon have passed upstream to lay eggs. Regulations strictly limit the number of fishing permits, and gear recommendations are designed to encourage smaller vessels. Since the state assumed management of the fishery in 1959, Alaska's annual salmon harvest has increased from 25 million to 206 million, the third largest catch on record.

**Cape Cod Hookers**

Despite the decline of cod, there are still sizeable quantities of haddock and other fish in the north Atlantic. In 1993, the Cape Cod Commercial Hook Fishermen's Association, a group of traditional fishers with deep knowledge of the sea and its species, decided to distinguish themselves from the larger trawling vessels by promoting "old-fashioned" hook lines. Fish removed from a hook are less likely to get damaged than trawled fish (resulting in superior texture and taste) and undesirable fish are more likely to survive when thrown back in the water. The Cape Cod fishers have contracted with several supermarket chains and seafood distributors, who have found that the "story-driven" fish sell extremely well, despite the higher cost.

**Loch Duart Salmon**

In response to the strong demand for farmed salmon—and rising concerns about related contamination—Loch Duart in Scotland developed detailed protocols for its aquaculture practices. When the farm purchases fish meal, it questions the competing uses for the feed, its cleanliness, and how far it has to travel. It avoids applying chemical antifoulants by using frequent "swimthroughs" whereby fish are shifted from place to place; avoids feed pollution by following certain pools; avoids prophylactic antibiotics by giving the fish more room; and uses only native fish species. Loch Duart salmon fetches the equivalent of \$0.16 more per portion in restaurants, and many European chains that serve it set cards on their tables describing how the fish was raised. CleanFish, a U.S. distributor that sells Loch Duart products, has asked the company to train fish farmers in Maine and Nova Scotia.

---

*Source: See Endnote 33 for this section*

---

to reduce fishing or change their practices. Like a farmer who is so deeply in debt that he can't afford to let his fields go fallow, even though he knows that constant farming will reduce their long-term ability to provide him with a living, fishers know that when the fish are in trouble so are they.

It's not surprising, then, that fishers are using the new-found consumer awareness about the state of the world's fisheries to redefine their own role. In some cases, this means returning to older fishing techniques that are less destructive and help preserve the quality of the seafood. In other cases, fishers are forming cooperatives to collectively manage a given fishery and perhaps even cut down on the total catch. And just as seafood companies are beginning to see fish as a form of wildlife, and not just as a commodity, fishers are making a similar shift in mindset, adopting a marketing strategy that treats the fish as a higher-value product rather than a low-cost raw material for processing. It's a shift from "racing for fish" to "sharing the fish," observes Fujita of Environmental Defense.<sup>33</sup> (See Sidebar 4.)

There is another advantage to the public, since small-scale fisheries also tend to be more efficient and require more workers. A survey from Norway's fishing industry showed that small-scale fisheries employ five times as many people as large-scale fisheries and generate five times as many jobs per unit of landed value. Small-scale fisheries also achieve 150 percent better value for their catch, because 60 percent of the catch of larger vessels is low-value fish for processing fishmeal and oil, while only 15 percent of the small-vessel catch is used this way.<sup>34</sup>

## Beyond Fishing

---

**P**eople don't only influence the oceans when they eat seafood. Years ago, that became clear to a Japanese oyster farmer named Shigeatsu Hatkeyama, who lives along Kesennuma Bay on the northeastern coast of Japan's largest island,

Honshu. He noticed that as more of the forests near his fishing ground were cut down, the shellfish beds he depended on were beginning to suffer. When it rained, instead of the intact forest holding down the soil and allowing the water to percolate slowly to the sea, the water rushed towards the ocean, carrying with it a soup of agricultural chemicals and roadway runoff. To tackle the problem, Hatkeyama organized a group called “Friends of the Oyster-Nurturing Forest” and initiated tree-planting activity.<sup>1</sup>

As Junko Edahiro of Japan for Sustainability explains, the idea was to “grow healthy forests as a water source to nurture abundant marine life.”<sup>2</sup> Hatkeyama and other coastal fishermen began collaborating with residents of the nearby mountains to plant trees in an annual festival that recently celebrated its tenth anniversary. Hatakeyama sometimes invites children living in riparian regions upstream to taste plankton washed with seawater. “Whatever humans put in the water makes its way to the sea and is concentrated in plankton,” he notes. “Only when they taste the plankton collected with a plankton net do children start to make the personal connection with the environment.”

After more than a decade of such activities, upstream residents have become more conscious of their impacts on the water, eels, and seahorses along the coast, and many marine organisms have returned to flourish in the area. Now tree-planting activities inspired by the “The Forest is the Sweetheart of the Sea” concept are spreading across the country. According to Japan’s 11th Fisheries Census of 2003, the number of fishery areas that planted trees that year accounted for nearly 27 percent of the national total.<sup>3</sup>

Japan has a particular interest in thinking broadly about what people can do for the oceans. The Japanese consume nearly 10 million tons of marine products annually, one of the largest per capita shares in the world.<sup>4</sup> Japan once harvested all the fish it needed, with enough left over to export. But recently, it has begun importing about half of its fish, becoming the world’s largest importer of marine products and accounting for about a quarter of the value and more than a

tenth of the volume of global trade in these products.

As Japan's tree-planting campaign illustrates, the connection between what happens on land and at sea can be particularly intimate. Even though the oceans cover more than two-thirds of the planet, they are remarkably sensitive to comparably small amounts of pesticides, fertilizers, nuclear waste, and industrial byproducts. Just as particular fish species are threatened in not just one region, but in many regions, much of the pollution affecting the oceans is global in nature. Oxygen-depleted "dead zones" provoked by nitrogen, phosphorus, and other nutrients from fertilizer, large livestock farms, and septic systems have multiplied in recent decades and now total some 146 worldwide.<sup>5</sup> The most severe such zones exceed 20,000 square kilometers, as in the Bay of Bengal, the Gulf of Mexico, and the Arabian, Baltic, and East China seas—fruitful fishing grounds whose abundance is ironically being reduced because of attempts to increase food production on land.

Around the world, people are beginning to realize that most of our everyday actions—from the chemicals we flush down our drains, to the energy that powers our lights, to how we dispose of our trash—somehow get back to the ocean. Cigarette lighters, plastic bags, toys, diapers, and food packaging have floated to even the most remote corners of the ocean. The United Nations Environment Programme estimates that nearly 18,000 pieces of plastic litter are floating on every square kilometer of the oceans; about 70 percent will eventually sink.<sup>6</sup> Microscopic flecks of plastic sift unseen throughout the marine environment, not only littering beaches and shorelines, but—like fine grains of sand—becoming the beach. Scientists examining plankton samples collected over the past 40 years in shipping lanes between Iceland and Scotland found approximately three times more plastic in the water column in the 1990s compared with the 1960s.<sup>7</sup> Marine conservation groups estimate that more than a million seabirds and 100,000 mammals and sea turtles die globally each year from entanglement in, or ingestion of, plastics.<sup>8</sup>

Even pollution of the atmosphere is taking a toll on

ocean life. Consider mercury. Headlines about high levels of mercury in tuna, swordfish, king mackerel, and other popular fish have frightened consumers to avoid certain types of seafood. But few people realize that mercury is released into the environment from a variety of industrial processes that we rely on in daily life. Mercury enters the atmosphere when coal is burned to make energy; that same mercury settles back down to Earth when it rains and eventually makes its way into rivers, streams, and oceans.<sup>9</sup> Animals high on the food chain carry the most mercury, and many of the fish we eat are close to the top of the marine food chain. Once in our body, mercury attacks the central nervous system, causing such symptoms as memory loss, depression, and blurred vision in adults, and more lasting effects like impaired brain function in infants and children.<sup>10</sup>

Production of chlorine, one of the world's most common chemicals, also uses and disposes of a large amount of mercury. Much of the global chlorine industry has adopted mercury-free processes, but a handful of antiquated factories continue to spew a disproportionate share. As the group Oceana has pointed out, a small number of chlorine plants around the world could be emitting as much mercury as all of the world's coal-fired power plants.<sup>11</sup> (Lack of good record-keeping by the industry prevents an exact estimate.) To address this concern, in 2005 Oceana launched a campaign to encourage the antiquated plants to switch to more modern, mercury-free chlorine production.<sup>12</sup> The group drew on celebrity spokespeople to pressure supermarkets and restaurant chains to post information on mercury content in their seafood sections. Consumers who are more aware of this problem will add momentum to political efforts to clean up mercury in energy generation.

One of the latest forms of ocean "pollution" is global warming. Scientists at the University of Amsterdam recently calculated that warming can interfere with the vital upward movement of nutrients from the deep sea by reducing the mixing of ocean waters. "This generates chaos among the plankton," says Professor Jef Huisman, the lead author of the

study, referring to the foundation of the ocean food chain.<sup>13</sup> Scientists had believed that phytoplankton, which survive best at depths of about 100 meters, were largely stable and immune from the impacts of global warming (typically, the plankton help absorb carbon dioxide and store it in the ocean floor as they die and decompose). But if the nutrient intake of phytoplankton is interrupted by global warming, their ability to act as a buffer against this warming is also affected, creating a possible positive feedback loop. Ironically, so far, the oceans have helped us lessen the impact of our greenhouse gas generation: over the past 200 years, deep ocean waters have absorbed about half the carbon dioxide produced by humans.<sup>14</sup>

Ocean warming will also shift the migration patterns of fish. WWF scientists have suggested that suitable habitat for trout, whitefish, bass, and more than 20 other cool or cold water species in the United States could decline as much as 50 percent due to the effects of global warming.<sup>15</sup> In East Africa's Lake Tanganyika, the world's longest and second-deepest freshwater lake, which supports over 350 fish species and feeds millions of people in Burundi, the Democratic Republic of Congo, Tanzania, and Zambia, scientists have discovered that rising temperatures have affected vital nutrient mixing there as well, possibly contributing to declines in fish populations.<sup>16</sup>

Some of the most pernicious forms of ocean pollution are generated by the people and industries that benefit directly from the pristine nature of the seas. Lax anti-pollution rules in the United States and elsewhere allow the world's growing fleet of more than 200 cruise ships to dump untreated sewage from sinks and showers, and inadequately treated sewage from toilets, into the ocean. Each day, a standard cruise ship generates 95,000 liters of sewage from toilets, 540,000 liters of sewage from sinks, galleys and showers, over six tons of garbage and solid waste, 56 liters of toxic chemicals, and 26,500 liters of oily bilge water.<sup>17</sup> In 2003, Oceana launched a campaign to introduce Clean Cruise Ship legislation in California and, at the U.S. federal level, to prohibit dumping of boat sewage.<sup>18</sup> And after an aggressive 11-

month Oceana campaign aimed at Royal Caribbean, the world's second largest cruise line—which included phone calls, letter-writing, and the creation of a wall of pledges in Miami from people who said they would not cruise with Royal Caribbean until it cleaned up its act—the company agreed to install advanced wastewater treatment technology on all 29 of its ships.<sup>19</sup>

For companies with an explicit eco-sensibility, adopting “ocean-friendly” habits has more obvious advantages. Lindblad Cruises, one of the world's largest ecotourism companies with six ships operating in Alaska, Antarctica, Arctic Norway, Baja California, and the Galapagos, has worked with the Blue Ocean Institute to reform seafood purchasing for its on-board menus.<sup>20</sup> The company decided to avoid purchasing or serving species that are considered overfished or caught using practices with serious negative environmental impacts. Lindblad was the first U.S. signatory to support the Marine Stewardship Council and still purchases from MSC-certified suppliers whenever possible. In 2001, the company decided to remove shrimp from its fleet menus, based on a lack of a supply of verifiably sustainable shrimp that didn't involve destructive shrimp-farming operations or trawling. Officials at the 25-year-old company believe that such conscientiousness explains in part the company's rapid growth (its revenues grew by over 22 percent in 2005) and its ability to attract high-profile partners such as the National Geographic Society.

But average people, perhaps because they care about eating seafood or perhaps because the oceans seem worth protecting, are targeting marine pollution as well. Beginning in 1986, the Ocean Conservancy, a research, education, and advocacy group promoting healthy oceans, has organized shoreline cleanups each fall. Today, “ocean stewards” from nearly 100 countries participate in the International Coastal Cleanup, the world's largest volunteer effort for the marine environment. To date, 6.2 million volunteers have removed nearly 50,000 tons of debris from the world's beaches and waterways.<sup>21</sup> A small number of objects account for a large share of this debris: nearly 60 percent is from recreational activ-

ities, including fishing lines and nets, beach toys, and food wrappers, while 29 percent is cigarette butts and filters.<sup>22</sup> “The information we’ve gathered over the past 20 years shows that marine debris is ultimately a manmade problem, which means it is highly solvable,” says Vickie Matter, director of the International Coastal Cleanup. “The real solution is prevention, and that takes responsible behavior. Raising this awareness is key.”<sup>23</sup>

People who eat from their local waters have a natural reason to be concerned about what goes into it. “Spat” is the term for baby shellfish, but it also stands for the Southold Program in Aquaculture Training (SPAT), an initiative launched in 2000 by Cornell University’s Marine Center on New York’s Long Island to provide additional firepower for local shellfish restoration.<sup>24</sup> For a \$150 start-up fee, community volunteers receive spat and the equipment necessary to raise the creatures in floating cages. They also get an entire year of graduate-level training in the nuances of algae growth, marine ecology, and shellfish dynamics—as well as a chance to restore the popular scallop economy.

Unlike similar programs started in places like eastern Maryland’s Chesapeake Bay, SPAT provides an attractive gastronomic incentive as well: gardeners get to eat half their harvest of fresh, mature shellfish. The other half goes to Cornell University’s marine center and hatchery in Southold, which in turn distributes the mollusks regionwide to bring back the glory of the Peconic Bay, once a center of scallop, oyster, and clam production. There are signs the program is working: in early 2005, baymen, naturalists, and hobby anglers all noticed significantly more baby scallops than in recent years. In 2004, New York’s Suffolk County awarded the marine center a four-year grant of \$1.8 million, enabling “SPATsters” to dramatically expand the capacity of the hatchery and to add a fourth work skiff to seed the bay. Dozens of shoreline communities, from Cape Cod to Chile, hope to replicate the SPAT program.

Even people who haven’t taken courses in marine ecology are showing growing concern about the oceans. The Seafood Choices Alliance, a global trade association devoted

to making “ocean-friendly seafood” more available, has surveyed American and European shoppers about their desire to maintain and improve the health of the world’s oceans, and their interest in choosing seafood that can help accomplish that.<sup>25</sup> Across demographics and across nations, the Alliance found a great deal of concern about the current state of the oceans (85 percent in surveys from the United Kingdom, Spain, and Germany), even if detailed knowledge of fishing techniques and ocean conditions wasn’t widespread. The surveys found that more people are making seafood a staple in their diets as a healthy alternative to meat, that consumers want more information about sustainable seafood on food labels, and that they want the government and retailers to make it easier to buy sustainable seafood. But in contrast to the psychology of most food shopping, where taste and price are the priorities, 79 percent of Europeans report that environmental considerations are the driving factor. And nearly one-third of Europeans have acted on these concerns by avoiding seafood they know is problematic, including certain farmed salmon or tuna that isn’t “dolphin safe.”

Beyond better labeling and sustainable seafood choices, consumers are emerging as an important voice in political decisions that affect the oceans. Whether it’s helping a marine conservation group push through laws that prohibit deep-sea trawling or supporting more restrictive trade in endangered fish species, seafood shoppers can ultimately determine whether a campaign meets success. In the case of legislation that diverges substantially from the status quo, such as eliminating subsidies that encourage overfishing and other fisheries policy reforms (see Sidebar 5), average citizens can be much more receptive than entrenched fishery executives or regulators.<sup>26</sup> “I haven’t normally involved fisheries companies or even fisheries management directly in our campaign,” says Bill Balantine, a marine biologist and grassroots activist, who for nearly 40 years has helped create the world’s largest network of marine preserves in New Zealand. “They’ve been directed at the general public and general voters. We don’t target, we shock them. We’ve done anything we can. You just talk to

**SIDEBAR 5****Proposed Fisheries Policy Reforms**

**Eliminate fisheries and energy subsidies.** Propped up by \$15–20 billion in subsidies each year—whether in the form of low-interest loans, cheap diesel fuel, price supports, or buy-out payments for outdated equipment—global fishing fleets are estimated to be up to 250 percent larger than are needed to catch what the ocean can sustainably produce. As Daniel Pauly of the Sea Around Us Project notes, the public pays for these subsidies with tax dollars and is rewarded with cheaper fish only in the short term. As in agriculture, the wealthiest nations and the largest boats reap most of the benefits: the United States, European Union, and Japan account for between 75 and 85 percent of fisheries subsidies. Payments that encourage the use of less destructive gear, direct marketing to consumers, and ecological fish farming would be better options.

**Establish a global network of marine reserves.** Recent studies have shown that putting just 20–30 percent of the oceans off-limits to fishing would provide sufficient refuges for major fish populations to spawn and reproduce. And while fishermen might lose access to their favorite grounds in the short term, such reserves result in more fish to catch in the long term.

**Eliminate bottom trawling.** Dragging a net across the ocean bottom has been compared to clear-cutting a forest in search of squirrels and chipmunks. Such fishing is energy intensive and destroys habitat that can harbor future populations of fish. Such trawling should be banned from the most sensitive deep sea areas (coral forests) and gradually eliminated in other areas.

**Reduce wasted and illegal catches.** Worldwide, fishers catch an estimated 18–40 million tons of fish and other marine creatures that are discarded, as much as half of all official marine landings. More selective fishing techniques and policy adjustments can help: Canada, Iceland, and Norway, for example, have adopted “no discard” policies, which have created an incentive to minimize bycatch. Existing international fisheries laws would be adequate to reduce illegal fishing if they had sufficient staffing and the support of national governments to enforce them.

**Encourage ecological fish farming.** Large-scale fish farms currently follow the model of land-based industrial farming, raising large numbers of nearly identical species in tight, unsanitary conditions that encourage disease and heavy input use. Raising multiple species together (e.g. salmon and mussels) can reduce pollution, disease, and the need for inputs. Raising herbivorous fish (e.g. tilapia rather than salmon) can reduce aquaculture’s massive use of fishmeal and fish oil.

---

*Sources: See Endnote 26 for this section.*

---

everybody and anybody and keep doing so. In a country the size of New Zealand, this is possible."<sup>27</sup>

Ballantine feels that the oceans hold an almost innate appeal to most people, and that preserving them for future generations is as reasonable for people as buying home insurance. In the case of New Zealand's preserve network, the public ended up pushing fishers, food companies, and politicians to act. Inspired in part by the experience in New Zealand, a similar public outcry pushed the state of Victoria in Australia to set up large numbers of marine preserves. When the state government released scientific recommendations on what share of the waters should be off-limits to fishing and what share should allow some fishing, mining, or other activities, the public response forced the number of areas with full reserves for protection up dramatically, and the areas with all other activities down.<sup>28</sup>

Regulating fish species by species and setting limits on how many can be caught in a given time has proven less and less effective, particularly as fleets reach into areas of the oceans that were once off-limits, are poorly understood, or are difficult to monitor. In contrast to this dominant system of regulation, marine reserves—in which a swath of ocean is made off-limits to any fishing—don't require expensive data collection programs to gain a detailed understanding of the resource. Nature manages itself, and the entire ecosystem gets protection rather than just a single species. Because they tend to target the biggest fish—those most able to reproduce and increase the fish population—marine reserves provide a place for fish to get big, spawn, and yield young fish that migrate out of the preserve. Of course, as marine reserves expert Jim Bohnsack notes, "this is not a panacea for all fisheries problems." Reserves don't work as well for species such as tuna that traverse vast areas of the ocean, and destructive activities that occur outside the preserves remain a concern.<sup>29</sup>

Evidence shows that fish populations recover rapidly in marine reserves, and that nearby fish catches and fish sizes increase dramatically after the reserves are set up. In the north-west Atlantic, two large areas of the Georges Banks that have

been made off-limits to trawling since 1994 have explained partial rehabilitation of the cod population; sea scallop populations adjacent to the closed areas have increased 14-fold.<sup>30</sup> A recent study estimated that establishing reserves for all major fisheries, covering 20–30 percent of the oceans, would cost \$5–19 billion each year and create about one million jobs.<sup>31</sup> (These costs are a small fraction of current government subsidies to fisheries.) Beyond increasing the fish catch, the reserves have other economic benefits, making ideal centers for marine research and tourism, including fish observation, scuba diving, and snorkeling; they also help restore coral reefs, mangroves, and other ocean ecosystems that provide myriad benefits to society. Delegates at both the 2002 World Summit on Sustainable Development and the 2003 World Parks Congress have called for the establishment of a global system of marine protected areas. Yet just 0.5 percent of the world's ocean area is currently protected, compared with 13 percent of the land area.<sup>32</sup>

When the government of California recently set up a 1.5 million hectare no-trawl preserve on its central coast, a broad coalition of citizens organized by several environmental groups helped convince the state of the need for the preserve, after a more insular coalition of recreational fishermen met more resistance.<sup>33</sup> And citizens will continue to ensure that the initiative is successful by purchasing fish caught by the remaining fishers working around the preserve. In this sense, those who organized the preserve are piggybacking on the growing “local food” movement not just as a way to keep money in the local economy, but also to help shoppers understand how their food choices affect the surrounding land and seascape. “We could have just walked away after buying the trawl permits,” says Rod Fujita of Environmental Defense, which purchased all the permits for the area as a way to give fishermen a cash infusion while eliminating the area's most destructive form of fishing. “But we didn't because we wanted to make sure that the victory is durable and that the community didn't fall apart.”<sup>34</sup>

So Environmental Defense and The Nature Conservancy

joined fishers, harbor masters, and restaurant owners from the Central Coast in forming the Fishing Heritage Group. The goal is to shift from a high-volume, low-value endeavor (trawling) to a lower-volume, high-value endeavor (including hook-and-line fishing, fish traps, and other “passive” gear that doesn’t destroy the ocean bottom). Since the mix of fish caught will be different—less rock fish, which is hard to catch without trawls, but more black cod and Dover sole, which don’t dwell in the rocks and can be targeted with traps—the group has joined with fishers to develop a marketing plan to create a demand for the new catch.

One fisherman who has provided inspiration for the group is Mark Tognazzini, a commercial fisher for 35 years. Tognazzini sells some of his catch directly off his boat, notifying customers by e-mail of his “Weekly Specials.” He also features local fish on the menu of Tognazzini’s Dockside Restaurant in Morro Bay, which he runs with his family. If you ask for the special, he’s likely to come to your table with a logbook and look up who caught your fish and where. The restaurant is thriving, and so are the fishers who supply it.<sup>35</sup>

This vision may seem idealistic, but it is becoming reality—and not just in wealthier countries where people are willing to pay more for seafood with a story behind it. In the world’s poorer regions, fishing communities are planting trees in their watersheds, placing spawning grounds off-limits, and clamping down on illegal fishing. These changes will take time. Fortunately, successive episodes of fish depletion throughout history reinforce our faith in the ocean’s ability to recover.

As the editors of the *International Herald Tribune* suggested in a recent editorial, patience may be worthwhile. “For anyone who has ladled a teaspoon of pearly beluga onto a sliver of toast with a smidgen of sour cream and a sprinkling of chopped egg and onion, and followed it with a shot of below-freezing vodka, this is sad news indeed,” the paper lamented, referring to a temporary 2006 ban on caviar trade. “Still, if a few years of gastronomic sacrifice will help Caspian sturgeons multiply and be fruitful again, then we throw our

wholehearted support behind [it]."<sup>36</sup>

Failure to wait it out won't just mean that certain extravagant seafood—sturgeon, tuna, sharks—are eliminated from the beleaguered marine food chain. As fisheries expert Daniel Pauly notes, "It also means that for the top predator in the system—us—there will be less fish of the kind we like to eat."<sup>37</sup>

## Endnotes

---

### New Hope for Old Victims

1. More than 350 species from Julia Baum, Researcher, Dalhousie University, Halifax, Nova Scotia, Canada, discussion with author, 22 June 2006.
2. Baum, discussion with author, op. cit. note 1; Julia K. Baum et al., "Collapse and Conservation of Shark Populations in the Northwest Atlantic," *Science*, 17 January 2003, pp. 389–92.
3. "Nearly 50" reflects the 45 shark species classified as "Critically Endangered," "Endangered," and "Vulnerable," per the World Conservation Union (IUCN), Shark Specialist Group, "IUCN Shark Specialist Group Red List Summary Tables 2000–06," [www.flmnh.ufl.edu/fish/organizations/ssg/RLsummary2006.pdf](http://www.flmnh.ufl.edu/fish/organizations/ssg/RLsummary2006.pdf), updated May 2006.
4. Julia K. Baum and Ransom A. Myers, "Shifting Baselines and the Decline of Pelagic Sharks in the Gulf of Mexico," *Ecology Letters*, Vol. 7 (2004), pp. 135–45.
5. Baum, op. cit. note 1.
6. Increased demand from Hank Pellissier, "Shark Fin Soup: An Eco-Catastrophe?" *San Francisco Chronicle*, 20 January 2003; \$200 a bowl from Juan Forero and Alyssa Lau, "Hidden Cost of Shark Fin Soup: Its Source May Vanish," *New York Times*, 5 January 2006.
7. Price of \$700 per kilogram and Ecuador from Forero and Lau, op. cit. note 6.
8. Roughly 100 million from IUCN, "Threatened Shark Species Receive International Focus," press release (Queensland, Australia: 6 March 2003); 8,000 tons from Bijal P. Trivedi, "Shark-Soup Boom Spurs Conservationist DNA Study," *National Geographic Today*, 17 September 2002.
9. Susie Watts, "Shark Finning: Unrecorded Wastage on a Global Scale" (San Francisco: WildAid and Co-Habitat, September 2003).
10. Shelley Clarke, "Trade in Asian Dried Seafood: Characterization, Estimation and Implications for Conservation," Working Paper No. 22 (San Francisco: Wildlife Conservation Society, December 2002).
11. WildAid, communication with Dana Artz, Worldwatch Institute, 16 August 2006; Pellissier, op. cit. note 6; David Barboza, "Waiter, There's a Celebrity in My Shark Fin Soup," *New York Times*, 13 August 2006. See also WildAid Shark Campaign, at [www.wildaid.org](http://www.wildaid.org).
12. Thai Airways International Public Company Limited, "THAI Cancels

Shark Fin Soup Service on Board," press release (Bangkok: 2000); Maria Cheng, "More Than We Can Chew: Environment Groups Are Trying to Change Hong Kong's Destructive Eating Habits. Can They Pull It Off?" *Asiaweek*, 27 October 2000.

**13.** The Walt Disney Company, *Enviroport 2005* (Burbank, CA: 2005); Doug Crets and Mimi Lau, "HKU Bans Shark Fin Dishes," *The Standard* (Hong Kong), 3 November 2005.

**14.** Monterey Bay Aquarium Seafood Watch Program Web site, [www.mbayaq.org/cr/seafoodwatch.asp](http://www.mbayaq.org/cr/seafoodwatch.asp), viewed 18 September 2006; Blue Ocean Institute, "Guide to Ocean Friendly Seafood," [www.blueocean.org/Seafood](http://www.blueocean.org/Seafood), viewed 18 September 2006.

**15.** Marine Stewardship Council, "History of MSC" and "About MSC," at [www.msc.org](http://www.msc.org), updated 14 September 2006.

**16.** Kate Moser, "Sustainable Seafood Casts a Wider Net," *Christian Science Monitor*, 3 April 2006.

**17.** Henry Lovejoy, President and Founder, EcoFish, Dover, NH, discussion with author, 21 August 2006. See also EcoFish Web site, [www.ecofish.com](http://www.ecofish.com).

**18.** Tim O'Shea, Chairman and CEO, CleanFish, San Francisco, CA, discussion with author, 4 September 2006. See also CleanFish Web site, [www.cleanfish.com](http://www.cleanfish.com).

**19.** Wal-Mart Stores, Inc., "Wal-Mart Stores, Inc. Introduces New Label to Distinguish Sustainable Seafood," press release (Bentonville, AR: 31 August 2006); Wal-Mart Stores, Inc., "New Certification for Wal-Mart Shrimp Another Example of Environmental Leadership," press release (Bentonville, AR: 17 November 2005).

**20.** Data and Table 1 from United Nations Food and Agriculture Organization (FAO), FAOSTAT Statistical Database, [faostat.fao.org](http://faostat.fao.org), updated 15 September 2006.

**21.** Ibid.

**22.** Nanna Roos et al., "Fish and Health," in Corinna Hawkes and Marie T. Ruel, eds., *Understanding the Links Between Agriculture and Health for Food, Agriculture, and the Environment*, 2020 Focus No. 13 (Washington, DC: International Food Policy Research Institute (IFPRI), May 2006).

**23.** Thirty percent from Meryl Williams, "The Transition in the Contribution of Living Aquatic Resources to Food Security," Food, Agriculture, and the Environment Discussion Paper 13 (Washington, DC: IFPRI, 1996); six percent from FAO, op. cit. note 20.

**24.** Brian Halweil, "Salty Saviors," *Orion*, July/August 2005.

25. Junko Edahiro, Co-Chief Executive, Japan for Sustainability, Tokyo, Japan, e-mail to author, 23 July 2006.

26. Carl Safina, "Launching a Sea Ethic," *Wild Earth*, Winter 2002–2003, pp. 2–5.

## The Shifting Baseline

1. Daniel Pauly, "Anecdotes and the Shifting Baseline Syndrome of Fisheries," *TREE*, October 1995, p. 430.

2. Daniel Pauly, Director, Fisheries Centre, University of British Columbia, Vancouver, Canada, discussion with author, 10 April 2006.

3. Ibid.

4. Pauly, op. cit. note 1.

5. Ibid.

6. Two-thirds and 10 percent from United Nations Food and Agriculture Organization (FAO), *The State of World Fisheries and Aquaculture* (Rome: 2004), p. 32.

7. Ransom A. Myers and Boris Worm, "Rapid Worldwide Depletion of Predatory Fish Communities," *Nature*, 15 May 2003, pp. 280–83.

8. J. David Allan et al., "Overfishing of Inland Waters," *BioScience*, December 2005, pp. 1041–51.

9. Mekong catfish from James Owen, "Overfishing is Emptying World's Rivers, Lakes, Experts Warn," *National Geographic News*, 1 December 2005.

10. Allan et al., op. cit. note 8.

11. Sidebar 1 is based on the following sources: 30,000 from Ian Payne, "Fish and Biodiversity," Biodiversity Brief 11 (Brussels: Biodiversity in Development Project, The World Conservation Union (IUCN), the United Kingdom Department for International Development, and the European Commission, undated); wild catch, aquaculture species and Figure 1 from FAO, "Capture Production 1950–2003," FISHSTAT Statistical Database, [www.fao.org/fi/statist/fisoft/FISHPLUS.asp](http://www.fao.org/fi/statist/fisoft/FISHPLUS.asp), updated March 2005; top fishing nations, consumption in developing and industrial worlds, seafood trade, inland versus marine catch, and Figure 2 from FAO, FAOSTAT Statistical Database, [faostat.fao.org](http://faostat.fao.org), updated 15 September 2006; share from coastal waters from Yumiko Kura et al., "Fishing for Answers: Making Sense of the Global Fish Crisis" (Washington, DC: World Resources Institute, 2004), p. 16; employment and world fishing fleet from FAO, op. cit. note 6, pp. 22, 24; largest boats and catch per fisher from FAO, *The State of World Fisheries and Aquaculture* (Rome: 1998), at [www.fao.org/docrep/W9900E/w9900e04.htm](http://www.fao.org/docrep/W9900E/w9900e04.htm); accidents from Katharine Houreld, "African Nations Battle 'Pirate' Fishers for Shrinking Resources,"

*Christian Science Monitor*, 21 June 2006.

**12.** Total harvest and Figure 3 from FAO, FAOSTAT Statistical Database, op. cit. note 11.

**13.** Per capita harvest and Figure 4 from *ibid*, and from U.S. Bureau of the Census, *International Data Base*, electronic database (Suitland, MD: updated August 2005).

**14.** FAO, FAOSTAT Statistical Database, op. cit. note 11; aquaculture statistics from Sara Montanaro, Fishery Information, Data and Statistics Unit (FIDI), FAO, Rome, e-mail to author, 7 January 2005.

**15.** WorldFish Center and International Food Policy Research Institute, "Poor Countries to Dominate Fish Industry in 2020," press release (Washington, DC: 2 October 2003).

**16.** FAO, *State of World Aquaculture 2006* (Rome: 2006).

**17.** Julia Whitty, "The Fate of the Ocean," *Mother Jones*, April/May 2006.

**18.** Daniel Pauly and Jay Maclean, *In a Perfect Ocean* (Washington, DC: Island Press, 2006), p. 56; Naomi Lubick, "The Rise of Slime," *California Wild* (California Academy of Sciences), Winter 2004, p. 1.

**19.** For a great history of fishing technology, see Dietrich Sahrhage and Johannes Lundbeck, *A History of Fishing* (Berlin: Springer-Verlag, 1992).

**20.** Pauly and Maclean, op. cit. note 18, p. 41.

**21.** Cornelia Dean, "Fishing Industry's Fuel Efficiency Gets Worse as Ocean Stocks Get Thinner," *New York Times*, 20 December 2005.

**22.** Peter H. Tyedmers et al., "Fueling Global Fishing Fleets," *AMBIO: A Journal of the Human Environment*, December 2005, pp. 635–38.

**23.** Peter H. Tyedmers, Dalhousie University, Halifax, Nova Scotia, Canada, discussion with author, 3 July 2006; "Guyana Deep-sea Fishermen Suspend Operations Due to High Fuel Costs," *Associated Press*, 9 January 2005; "Gov't Considering Subsidy on Diesel Sales to Fishermen," *Daily Times* (Pakistan), 12 February 2006; "Fishermen Seek Subsidised Diesel," *The Hindustan*, 9 July 2005; "Spanish Fishermen Keep Up Protests Against Fuel Prices," *Newsfromrussia.com*, 26 October 2005.

**24.** Pauly quotation from Dean, op. cit. note 21.

**25.** Eight times from Pauly and Maclean, op. cit. note 18, pp. 37–38.

**26.** "When Lobster Was Fertilizer," *The Economist*, 27 October 2005; Census of Marine Life, "Restaurant Seafood Prices Since 1850s Help Plot Marine Har-

vests Through History,” press release (Kolding, Denmark: 24–27 October 2005).

27. Rosenberg quotation from D.L. Parsell, “High-Tech Fishing Is Emptying Deep Seas, Scientists Warn,” *National Geographic News*, 26 February 2002.

## **Making Better Choices**

1. Blue Ocean Institute, “Guide to Ocean Friendly Seafood,” [www.blueocean.org/Seafood](http://www.blueocean.org/Seafood), viewed 18 September 2006.

2. Carl Safina, President, Blue Ocean Institute, Cold Spring Harbor, NY, discussion with author, 15 June 2006.

3. Monterey Bay Aquarium Seafood Watch Program Web site, [www.mbayaq.org/cr/seafoodwatch.asp](http://www.mbayaq.org/cr/seafoodwatch.asp), viewed 18 September 2006; National Audubon Society, Living Oceans, “Seafood Lover’s Guide,” <http://seafood.audubon.org>, viewed 18 September 2006.

4. Safina, op. cit. note 2.

5. Ibid; Bill Mott, Director, The Ocean Project, Providence, RI, discussion with author, 17 August 2006.

6. Safina, op. cit. note 2.

7. Yumiko Kura et al., “Fishing for Answers: Making Sense of the Global Fish Crisis” (Washington, DC: World Resources Institute, 2004), pp. 61–62; Earth Island Institute, “Questions and Answers About Earth Island Institute’s Dolphin Safe Tuna Program” (Washington, DC: May 2002), at [www.earthisland.org/immmp/EII\\_Q\\_&\\_A\\_Dol\\_Safe\\_12-01.html](http://www.earthisland.org/immmp/EII_Q_&_A_Dol_Safe_12-01.html).

8. Safina, op. cit. note 2.

9. Jennifer Dianto, Seafood Watch Program Manager, Monterey Bay Aquarium, Monterey, California, “Meeting Notes for the Seafood Awareness Projects Luncheon,” prepared for the 6th International Aquarium Congress” (Monterey, CA: 8 December 2004).

10. Ibid.

11. Chris Bohm, National Fisheries Campaigner, Australian Marine Conservation Society (AMCS), Manly, Queensland, Australia, discussion with author, 16 August 2006. For more information, see [www.amcs.org.au](http://www.amcs.org.au).

12. New Zealand Royal Forest and Bird Protection Society, “Best Fish Guide,” [www.forestandbird.org.nz/bestfishguide/index.asp](http://www.forestandbird.org.nz/bestfishguide/index.asp), viewed 18 September 2006.

13. Share of seafood traded from United Nations Food and Agriculture Organization (FAO), "The International Fish Trade and World Fisheries," fact sheet (Rome: May 2006).
14. Bohm, *op. cit.* note 11.
15. *Ibid.*
16. *Ibid.*
17. Peter Hoffman, Chef, Savoy, New York, NY, presentation at Seafood Summit 2006, "Sustainability and the Future of Seafood," Seattle, WA, 29–31 January 2006.
18. *Ibid.*
19. *Ibid.* See also Savoy Web site, at [www.savoynyc.com](http://www.savoynyc.com).
20. Chefs Collaborative Web site, at [www.chefscollaborative.org](http://www.chefscollaborative.org).
21. Chefs Collaborative, "Seafood Solutions," [www.chefscollaborative.org/index.php?name=Seafood](http://www.chefscollaborative.org/index.php?name=Seafood), viewed 18 September 2006.
22. Bruce Sherman, Executive Chef and Partner, North Pond, Chicago, IL, communication with author, 5 June 2006.
23. Chefs Collaborative, "Chefs Collaborative Enters the Classroom: Sustainable Seafood Curriculum Arms Future Chefs with Tools for Responsible Decision Making," press release (Boston, MA: 29 August 2006).
24. McGarry quotation from *ibid.*
25. Sidebar 3 is based on the following sources: energy use and employment for different types of fish from Daniel Pauly and Jay Maclean, *In a Perfect Ocean* (Washington, DC: Island Press, 2006), pp. 41, 73; pollution on land spilling into oceans from J. Michael Beman, Kevin R. Arrigo, and Pamela A. Matson, "Agricultural Runoff Fuels Large Phytoplankton Blooms in Vulnerable Areas of the Ocean," *Nature*, 10 March 2005, pp. 211–14.
26. Slow Food International Web site, at [www.slowfood.com](http://www.slowfood.com); Slow Fish, "The Return of Slow Fish: Sustainable Seafood Salone Back in Genoa," press release (Bra, Italy: Slow Food International, 2005). See also Slow Fish Web site, at [www.slowfish.it](http://www.slowfish.it).
27. Sarah Weiner, "Slow Food and Fishing," *The Slow Food Companion* (Bra, Italy: 2005), p. 33.
28. Hoffman, *op. cit.* note 17.

## When the Fisher Is the Eater

1. Meryl Williams, "The Transition in the Contribution of Living Aquatic Resources to Food Security," Food, Agriculture, and the Environment Discussion Paper 13 (Washington, DC: International Food Policy Research Institute (IFPRI), 1996).
2. Ernest Harsch, "Africa Starts a Fishing 'Revolution,'" *Africa Renewal*, April 2006, p. 9.
3. "Fish, Lovely Fish... Who Will Buy?" in "Focus on... Fisheries in Africa," *New Agriculturalist On-line*, 1 November 2005.
4. Valdimarsson quotation from United Nations Food and Agriculture Organization (FAO), "Fish Exports by Developing Countries Help Combat Hunger, But Better Management Needed," press release (Rome: 30 May 2006).
5. Nanna Roos et al., "Fish and Health," in Corinna Hawkes and Marie T. Ruel, eds., *Understanding the Links Between Agriculture and Health for Food, Agriculture, and the Environment*, 2020 Focus No. 13 (Washington, DC: IFPRI, May 2006).
6. Evans quotation from "Crisis? What Crisis?" in "Focus on... Fisheries in Africa," *New Agriculturalist On-line*, 1 November 2005.
7. Ibid.
8. Ibid.
9. Dugan quotation from "Fish, Lovely Fish... Who Will Buy?" op. cit. note 3.
10. Ibid.
11. Ibid.
12. For information on the benefits of access and rights, see FAO, op. cit. note 4; Edward H. Allison and Marie-Caroline Badjeck, "Fisheries Co-Management in Inland Waters: A Review of International Experience" (Rome and London: FAO and UK Department for International Development, March 2004).
13. WorldFish Center, "South Seas Treasures," [www.worldfishcenter.org/cms/list\\_article.aspx?catID=32&ddlID=84](http://www.worldfishcenter.org/cms/list_article.aspx?catID=32&ddlID=84), viewed 4 September 2006.
14. Ibid.
15. Ibid.
16. "Crisis? What Crisis?" op. cit. note 6.
17. WorldFish Center, "Waste Not Want Not: Spreading Affordable Inte-

grated Agriculture-Aquaculture in Malawi, Sub-Saharan Africa," [www.worldfishcenter.org/cms/list\\_article.aspx?catID=32&ddlID=77](http://www.worldfishcenter.org/cms/list_article.aspx?catID=32&ddlID=77), viewed 4 September 2006.

**18.** Program description and Kaunde quotation from *ibid.*

**19.** WorldFish Center, "Rice-Fish Culture: A Recipe for Higher Production," [www.worldfishcenter.org/cms/list\\_article.aspx?catID=32&ddlID=78](http://www.worldfishcenter.org/cms/list_article.aspx?catID=32&ddlID=78), viewed 4 September 2006.

**20.** Patrick T. Evans et al., "Flood Forests, Fish, and Fishing Villages: Tonle Sap, Cambodia," a collaborative study by the FAO, Siem Reap, and Asia Forest Network (Bohol, Philippines: Asia Forest Network, 2004); FAO, "For Cambodia's 'Great Lake' and the Millions Who Depend on It, A New Lease on Life," press release (Rome: 21 September 2005).

**21.** *Ibid.*

**22.** *Ibid.*

**23.** Katharine Houreld, "African Nations Battle 'Pirate' Fishers for Shrinking Resources," *Christian Science Monitor*, 21 June 2006.

**24.** *Ibid.*

**25.** Sustainable Fisheries Livelihoods Programme (SFLP) Web site, at [www.sflp.org](http://www.sflp.org).

**26.** SFLP in West Africa, "Connecting Fisheries and African Development" (Rome: undated document), available at [www.sflp.org](http://www.sflp.org).

**27.** Gitonga quotation from "Fisheries Management—A New Approach Needed," in "Focus on... Fisheries in Africa," *New Agriculturalist On-line*, 1 November 2005.

**28.** *Ibid.*

## **Beyond Fillets**

**1.** Mike Boots, Director, Seafood Choices Alliance, Silver Spring, MD, presentation at Seafood Summit 2006, "Sustainability and the Future of Seafood," Seattle, WA, 29–31 January 2006.

**2.** Andreas Merkl, Chairman, Sea Change Investment Fund, San Francisco, CA, presentation at Seafood Summit 2006, "Sustainability and the Future of Seafood," Seattle, WA, 29–31 January 2006.

**3.** Seafood Choices Alliance, "Constant Cravings: The European Consumer and Sustainable Seafood Choices" (Washington, DC: 14 December 2005).

4. Carl Safina, President, Blue Ocean Institute, Cold Spring Harbor, NY, discussion with author, 15 June 2006.
5. Marine Stewardship Council (MSC) Web site, at [www.msc.org](http://www.msc.org).
6. Jessica Wenban-Smith, Communications Manager, MSC, London, United Kingdom, e-mail to author, 12 January 2005.
7. MSC, "BSAI Alaska Pollock Fishery Certified to MSC Standard," press release (London: 30 September 2004).
8. Unilever, "2005 Unilever Environmental and Social Report" (Rotterdam: 2005), p. 13, available at [www.unilever.com/Images/Environmental%20and%20social%20report\\_bkmks\\_tcm13-39279.pdf](http://www.unilever.com/Images/Environmental%20and%20social%20report_bkmks_tcm13-39279.pdf).
9. MSC, "First Cod Fishery Receives MSC Environmental Certificate," press release (London: 10 February 2006).
10. Gilliland quotation from *ibid.*
11. MSC, "Protecting Fisheries, Improving Livelihoods: MSC Developing World Fisheries Programme" (London: undated), available at [www.msc.org/assets/docs/Resources/DWP\\_6pp\\_final.pdf](http://www.msc.org/assets/docs/Resources/DWP_6pp_final.pdf).
12. Oluyemisi Oloruntuyi, Programme Manager, Developing World Fisheries, MSC, London, discussion with Dana Artz, Worldwatch Institute, 8 August 2006.
13. *Ibid.*
14. Henry Lovejoy, President and Founder, EcoFish, Dover, NH, communication with Dana Artz, Worldwatch Institute, 12 May 2006.
15. Tim O'Shea, Chairman and CEO, CleanFish, San Francisco, CA, discussion with author, 1 September 2006.
16. Lovejoy, *op. cit.* note 14.
17. "Buyers Navigate Sustainable Seafood," *SeaFood Business*, October 2004, pp. 22-23.
18. Compass Group, "Compass Group Announces Landmark Policy to Purchase Sustainable Seafood," press release (Charlotte, NC: 14 February 2006).
19. Kate Moser, "Sustainable Seafood Casts a Wider Net," *Christian Science Monitor*, 3 April 2006.
20. Wal-Mart Stores, Inc., "Wal-Mart Stores, Inc. Introduces New Label to Distinguish Sustainable Seafood," press release (Bentonville, AR: 31 August 2006).

21. Rebecca Goldberg, Senior Scientist, Environmental Defense, Washington, DC, discussion with author, 13 January 2006.
22. Pure Salmon Campaign Web site, at [www.puresalmon.org](http://www.puresalmon.org).
23. Greg Andeck, Program Coordinator, Corporate Partnerships, Environmental Defense, discussion with author, 21 August 2006.
24. Wegmans Food Markets Web site, at [www.wegmans.com](http://www.wegmans.com); Bon Appétit Management Company Web site, at [www.bamco.com](http://www.bamco.com).
25. Andeck, op. cit. note 23; Environmental Defense, "Bon Appétit Management Company/Wegmans Food Markets, Farmed Salmon Purchasing Policy" (Washington, DC: March 2006), available at [www.environmentaldefense.org/documents/5117\\_FarmedSalmonPolicy2006.pdf](http://www.environmentaldefense.org/documents/5117_FarmedSalmonPolicy2006.pdf); Environmental Defense, "New Farmed Salmon Standards Adopted by Wegmans and Bon Appétit," press release (Washington, DC: 13 March 2006).
26. Andeck, op. cit. note 23.
27. Environmental Defense, "Environmental Defense Will Add Staff Position in Bentonville, Arkansas," press release (Washington, DC: 12 July 2006).
28. Andeck, op. cit. note 23.
29. Global Aquaculture Alliance Web site, at [www.gaalliance.org](http://www.gaalliance.org).
30. Andeck, op. cit. note 23.
31. MSC, "Brain Food: Brakes Joins Marine Stewardship Council in Pioneering Sustainable Fish on School Menus," press release (London: 1 December 2005).
32. Rod Fujita, Scientist, Environmental Defense, Oakland, CA, discussion with author, 24 July 2006.
33. Ibid. Sidebar 4 is based on the following sources: "Third Largest Harvest on Record for Alaskan Salmon - Exceeds 200 Million Fish," [Fishupdate.com](http://Fishupdate.com), 1 November 2005; Doug Woodby et al., "Commercial Fisheries of Alaska," Special Publication No. 05-09 (Anchorage, AK: Alaska Department of Fish and Game, June 2005); Nick Joy, Managing Director, Loch Duart Ltd., Scourie, Lairg, Sutherland, Scotland, UK presentation at Seafood Summit 2006, "Sustainability and the Future of Seafood," Seattle, WA, 29–31 January 2006.
34. Daniel Pauly and Jay Maclean, *In a Perfect Ocean* (Washington, DC: Island Press, 2006), p. 72.

## **Beyond Fishing**

1. Junko Edahiro, Co-Chief Executive, Japan for Sustainability, Tokyo, Japan,

discussion with author, 11 September 2006. For more information, see [www.japanfs.org/index.html](http://www.japanfs.org/index.html).

2. Ibid.

3. Ibid.

4. Ibid.

5. J. Michael Beman, Kevin R. Arrigo, and Pamela A. Matson, "Agricultural Runoff Fuels Large Phytoplankton Blooms in Vulnerable Areas of the Ocean," *Nature*, 10 March 2005, pp. 211–14.

6. Kristina M. Gjerde, *Ecosystems and Biodiversity in Deep Waters and High Seas*, United Nations Environment Programme Regional Seas Report and Studies No. 178 (Nairobi: 2006), p. 29. Source states that 46,000 pieces of litter are on the surface of every square mile of ocean.

7. James Owen, "Oceans Awash With Microscopic Plastic, Scientists Say," *National Geographic News*, 6 May 2004; Richard C. Thompson et al., "Lost at Sea: Where Is All the Plastic?" *Science*, 7 May 2004, p. 838.

8. Owen, op. cit. note 7.

9. Mayra Quirindongo et al., "Lost and Found: Missing Mercury from Chemical Plants Pollutes Air and Water" (New York: Natural Resources Defense Council, April 2006).

10. Edward Groth, "Risks and Benefits of Fish Consumption: Yes, Mercury is a Problem" (Washington, DC: Oceana and Mercury Policy Project, December 2005).

11. Dawn Winalski, Sandra Mayson, and Jacqueline Savitz, "Poison Plants: Chlorine Factories Are a Major Global Source of Mercury" (Washington, DC: Oceana, January 2005).

12. For more information, see Oceana, "Stop Seafood Contamination," [www.oceana.org/index.php?id=90&no\\_cache=1](http://www.oceana.org/index.php?id=90&no_cache=1).

13. Jef Huisman et al., "Reduced Mixing Generates Oscillations and Chaos in the Oceanic Deep Chlorophyll Maximum," *Nature*, 19 January 2006, pp. 322–25; Huisman quote from Steve Connor, "Warmer Seas Will Wipe Out Plankton, Source of Ocean Life," *The Independent* (UK), 19 January 2006.

14. The Royal Society, "Cuts in Carbon Dioxide Emissions Vital to Stem Rising Acidity of Oceans," press release (London: 30 June 2005).

15. Stacey Combes, "Are We Putting Our Fish in Hot Water? Global Warming and the World's Fisheries" (Gland, Switzerland: WWF, July 2005).

16. "Like Fish Out of Water: The Impact of Climate Change on Fisheries," in "Focus on... Fisheries in Africa," *New Agriculturalist On-line*, 1 November 2005.
17. Oceana, "Needless Cruise Pollution: Passengers Want Sewage Dumping Stopped" (Washington, DC: 2003).
18. Oceana, "Stop Cruise Ship Pollution," [www.oceana.org/index.php?id=91](http://www.oceana.org/index.php?id=91).
19. Oceana, "Royal Caribbean Campaign Victory" [www.oceana.org/index.php?id=801](http://www.oceana.org/index.php?id=801), dated 4 May 2004.
20. Lindblad Expeditions Web site, [www.expeditions.com](http://www.expeditions.com).
21. The Ocean Conservancy, "The Ocean Conservancy Announces Results of the International Coastal Cleanup; Next Cleanup Set For September," press release (Washington, DC: 20 July 2006).
22. The Ocean Conservancy, "The International Coastal Cleanup: A Legacy of Cleaner Oceans" (Washington, DC: 2006), at [www.oceanconservancy.org/site/DocServer/oc\\_cleanup\\_05.pdf?docID=1841](http://www.oceanconservancy.org/site/DocServer/oc_cleanup_05.pdf?docID=1841).
23. Matter quote from The Ocean Conservancy, op. cit. note 21.
24. Brian Halweil, "Salty Saviors," *Orion*, July/August 2005.
25. Seafood Choices Alliance, "Constant Cravings: The European Consumer and Sustainable Seafood Choices" (Washington, DC: 14 December 2005).
26. Sidebar 5 is based on the following sources: subsidies from Daniel Pauly and Jay Maclean, *In a Perfect Ocean* (Washington, DC: Island Press, 2006), p. 68; WWF, "Turning the Tide on Fishing Subsidies: Can the World Trade Organization Play a Positive Role?" (Washington, DC: 2002), p. 3; Anthony Cox and Carl-Christian Schmidt, "Subsidies in the OECD Fisheries Sector: A Review of Recent Analysis and Future Directions," background paper prepared for the FAO Expert Consultation on Identifying, Assessing and Reporting on Subsidies in the Fishing Industry, Rome, 3–6 December 2002 (Paris: Fisheries Division, OECD Directorate of Agriculture, Food and Fisheries, 2002), p. 27; marine reserves from bycatch from Pauly and Maclean, op. cit. this note, p. 31; marine preserves from Andrew Balmford et al., "The Worldwide Costs of Marine Protected Areas," *Proceedings of the National Academy of Sciences*, 29 June 2004, pp. 9694–97; bottom trawling from Santi Roberts et al., "Deep Sea Life: On the Edge of the Abyss" (Washington, DC: Oceana, 2005); no discard policy, international law, and aquaculture from Yumiko Kura et al., "Fishing for Answers: Making Sense of the Global Fish Crisis" (Washington, DC: World Resources Institute, 2004), pp. 64–65, 108–09, and 43–58. For a good summary of priorities, see idem, pp. 101–10.
27. Bill Ballantine, Leigh Marine Laboratory, University of Auckland, Auck-

land, New Zealand, discussion with author, 17 and 18 August 2006.

**28.** Ibid.

**29.** James A. Bohnsack, Southeast Fisheries Science Center, University of Miami, Miami, FL, discussion with author, 15 May 2006; James A. Bohnsack, "Marine Reserves: They Enhance Fisheries, Reduce Conflicts, and Protect Resources," *Oceanus*, Vol. 36, No. 3 (1993).

**30.** Bohnsack, "Marine Reserves...", op. cit. note 29; Pauly and Maclean, op. cit. note 26, p. 100.

**31.** Balmford et al., op. cit. note 26.

**32.** WWF International, "Marine Protected Areas: Providing a Future for Fish and People" (Gland, Switzerland: WWF Global Marine Programme, 2005).

**33.** Jon Christensen, "Unlikely Partners Create Plan to Save Ocean Habitat Along With Fishing," *New York Times*, 8 August 2006.

**34.** Rod Fujita, Scientist, Environmental Defense, Oakland, CA, discussion with author, 24 July 2006.

**35.** Rasa Gustaitis, "On the Morro Bay Waterfront: Reinventing a Local Fishery," *California Coast & Ocean*, Autumn 2005.

**36.** "A Gastronomic Sacrifice," *International Herald Tribune*, 19 April 2006.

**37.** Pauly and Maclean, op. cit. note 26, p. xx.

## Index

- A**ctivism, 11–13, 15, 22–24, 52  
 Acuario Xcaret, 25  
 Africa, 18, 30–32  
 air pollution, 47–48  
 Alaska, 23–24, 38, 44  
 anchovies, 18, 19  
 Andeck, Greg, 41, 43  
 antibiotics, 42  
 aquaculture  
   ecological, 33–35, 53  
   harvest volume, 17, 20  
   shellfish restoration, 51  
   standards, 42–44  
 aquariums, 12, 22–25, 41  
 Arabian Sea, 47  
 Argentina, 39  
 arkshells, 19  
 Asia, 6, 14, 18, 30  
 Asian Development Bank, 36  
 Australia, 24–27, 54  
 Australian Marine Conservation Society, 25
- B**allantine, Bill, 52, 54  
 Baltic Sea, 47  
 Bangladesh, 16, 34–35  
 barbels, 19  
 Baum, Julia, 9  
 Bay of Bengal, 47  
 Beach Management Units, 37  
 beef, 27  
 Bering Select, 39  
 billfish, 19  
 bird avoidance devices, 23–24  
 blue grenadier, 26  
 Blue Ocean Institute, 12, 15, 22–23, 38, 50  
 Bohm, Chris, 24–27  
 Bohnsack, Jim, 54  
 Bon Appétit, 28, 42, 43  
 bonito, 19  
 Boots, Mike, 37  
 Brakes, 43  
 British Columbia, 23–24
- C**alifornia, 43, 55–56  
 Cambodia, 35–36  
 Canada, 23–24, 41, 53  
 Cape Cod Commercial Hook Fishermen's Association, 44  
 carbon dioxide absorption, 49  
 carp, 18, 19  
 catfish, 16, 18  
 caviar, 12  
 Centre for Environment Education (Ahmedabad), 25  
 certifications of sustainability, 6, 12–13, 38–43  
 Chefs Collaborative, 28, 30  
 Chile, 18, 41  
 China  
   fish consumption, 5, 14  
   fish production, 17, 18  
   seafood certification, 39  
   Shanghai Ocean Aquarium, 25  
 chlorine production, and mercury pollution, 48  
 clams, 19, 27, 33  
 Clarke, Shelley, 11  
 CleanFish, 13, 40, 44  
 coal burning, and mercury pollution, 48  
 cockles, 19  
 cod  
   black, 56  
   harvest size, 19  
   Pacific, 39  
   prices, 22  
   rehabilitation, 55  
   as threatened predator, 16  
   trawling and, 29  
 Compass Group USA, 40  
 Conservation International, 41  
 consumer guides/guidelines, *see* seafood guides/guidelines  
 coral reefs, 55  
 Costco, 42  
 cruise ship pollution, 49  
 culinary school seafood curriculum, 28–29  
 cuttlefish, 19  
 cyprinids, 19

- D**arden Restaurants, 40  
 dead zones, ocean, 47  
 deforestation/reforestation, 35–36, 46  
 developing countries, 18, 32, 39, *see also* Africa; Asia; *specific countries*  
 Disneyland (Hong Kong), 12  
 dolphin-safe tuna campaign, 24, 52  
 Dugan, Patrick, 32
- E**ast China Sea, 47  
 EcoFish, 13, 40  
 ecosystem destruction, 17, 20  
 Ecuador, 39  
 Edahiro, Junko, 46  
 education, 24, 28, 36  
 Egypt, 16, 33  
 energy consumption, of fishing, 21  
 energy subsidies, for fishing, 53  
 Environmental Defense, 41–43, 55–56  
 European Union, 14, 37, 53  
 Evans, Patrick, 35  
 Evans, Warren, 31
- F**ertilizers, 47  
 fish consumers, and conservation, 5, 11–13, 15, 52, *see also* seafood guides/guidelines  
 fish consumption  
   by country, 14, 18, 37  
   China, 5  
   Japan, 46  
   per capita, 31  
   species rank, 18  
   United States, 5  
 fisheries, sustainable, *see* sustainable fisheries initiatives  
 fisheries depletion, 9–10, 15–16  
 fisheries regulation, 36–37, 44, 52–55  
 fishers, small- vs. large-scale, 29, 30, 45  
 fish exports/imports, 18, 31–33, 46–47  
 fish farming, *see* aquaculture  
 fish feed standards, 42, 44  
 Fish for All summit, 32  
 fish harvests, *see also* aquaculture  
   decline, 21, 31, 35  
   inland vs. marine, 16, 18  
   Lake Victoria, 31  
   per capita, 19, 20  
   wild vs. farmed, 17, 20  
 fishing employment, 18  
 fishing fleet size, 18  
 Fishing Heritage Group, 56  
 fishing nations, ranked, 18  
 fishing techniques/technology, 21, 53  
 fish migration, 49  
 fish prices, 22  
 flatheads, 26  
 flounder, 16, 17  
 France, 25  
 Friends of the Oyster-Nurturing Forest, 46  
 Fujita, Rod, 43, 45, 55
- G**ambia, 39  
 genetically modified fish, 42  
 Georges Bank, 54  
 Gilliland, Paul, 39  
 Gitonga, Nancy, 36  
 Global Aquaculture Alliance, 43  
 global warming, 48–49  
 Goldberg, Rebecca, 41  
 Guinea, 36  
 Gulf of Mexico, 10, 47  
 Guyana, 21
- H**addock, 19, 44  
 hake, 19, 39  
 halibut, 16, 23–24  
 Hatkeyama, Shigeatsu, 45  
 herring, 13, 19, 27  
 Hoffman, Peter, 27–28, 30  
 Hong Kong University, 12  
 Honshu (Japan), 46  
 hook lines, 44  
 hormones, 42  
 Huisman, Jef, 48
- I**celand, 53  
 illegal fishing, 36–37  
 India, 14, 16, 18, 25, 39  
 Indonesia, 18, 21

inland fisheries, 16, 18  
 International Coastal Cleanup,  
 50–51

## Japan

fish consumption, 14  
 fish distribution, 37  
 fisheries subsidies, 53  
 fish harvest size, 18, 46–47  
 watershed reforestation, 14,  
 45–46

Japan for Sustainability, 46

**K**aunde, Jessie, 34

kelp, 17

Kenya, 36

**L**abeling, fish, 52

Lake Victoria, 31

Lindblad Cruises, 50

Loblaws, 40

lobster, 13, 38, 39

Loch Duart (Scotland), 44

long-line fishing, 29

Lovejoy, Henry, 40

**M**ackerel, 13, 18, 27, 48

Maine, 44

malaria control, 34

Malawi, 33, 34

Malaysia, 39

mangroves, 55

marine mammals, 47

marine reserves, 15, 52–55

Marine Stewardship Council (MSC),  
 6, 13, 38–40, 50

marlin, 16

Matter, Vickie, 51

McGarry, Joe, 28–29

Mekong River, 35–36

mercury, 11, 29, 48

Merkel, Andreas, 37

Mexico, 25, 39

Monterey Bay Aquarium, 12, 22–24,  
 26, 41

Mott, Bill, 23

**N**ational Audubon Society, 22–23

National Environmental Trust, 41

National Sea Experience Centre, 25

Netherlands, 25

nets, drift gill, 24

New Caledonia, 32

New York, 14, 51

New Zealand, 25–26, 52, 54

North Sea, 16

Norway, 45, 53

Nova Scotia, 44

nutrient mixing, 48, 49

**O**ceana, 48, 49–50

Oceanário de Lisboa, 25

Ocean Conservancy, The, 50

Ocean Project, The, 23

ocean warming, 48–49

ocean water mixing, 48

octopus, 19

Oloruntuyi, Yemi, 39

O'Shea, Tim, 40

oysters, 12, 19, 27

**P**ackard Foundation, 41

Pakistan, 21

Papua New Guinea, 39

parasiticides, 42

Pauly, Daniel, 15–16, 21, 53, 57

Peconic Bay (NY), 51

perch, Nile, 31

Peru, 18

pesticides, 47

Philippines, 33

plankton, 48–49

plastic litter, 47

policy reform proposals, 53

pollock, 18, 38

Portola Cafe and Restaurant, 41

Portugal, 25

poultry, 27

prawns, 19

predators, 10–11, 16, 27

public service announcements, 11

Pure Salmon Campaign, 41

purse seines, 24

**R**ed Lobster, 6, 40

reforestation/deforestation, 35–36, 46

resource management

organizations, 35–36

- restaurant menus, 22
- restaurants, 24, 25, 28, 37, 40, 56
- rice farming, 34
- Rosenberg, Andrew, 22
- Rotterdam Zoo, 25
- Royal Caribbean cruise ships, 50
- Royal Forest and Bird Protection Society, 26
- S**afina, Carl, 15, 22–24, 38
- salmon
  - endangered, 12
  - farmed, 17, 18, 27, 42, 53
  - fishery regulation, 44
  - harvest size, 19
- sandfish, 33
- sardines, 19
- Savoy, 27
- scallops, 51, 55
- school cafeterias, 43
- Scotland, 44
- Sea Around Us Project, 15, 53
- seabirds, 47
- Sea Change Investment Fund, 37
- sea cucumbers, 32–33
- seafood certification, 6, 12–13, 38–43
- Seafood Choices Alliance, 37
- seafood consumption, *see* fish consumption
- seafood guides/guidelines, 12–13, 22–27, 29–30
- seafood retailers/distributors
  - Brakes, 43
  - Compass Group USA, 40
  - conservation awareness, 13, 37
  - Costco, 42
  - Darden Restaurants, 40
  - Loblaws, 40
  - Unilever, 38
  - Wal-Mart, 41
  - Wegmans, 41–43
- Seafood Summit, 28
- sea turtles, 47
- sea urchins, 17
- seaweed farming, 33
- shark fin soup, 10–12
- sharks, 9–12, 16
- shellfish, 14, 27
- Sherman, Bruce, 28
- shoreline cleanups, 50–51
- shrimp, 19, 29, 40, 42, 43, 50
- Siem Reap (Cambodia), 36
- Singapore Airlines, 11
- skates, 16
- Slow Fish meeting, 30
- Slow Food, 29–30
- smelt, 19
- sole, 56
- Solomon Islands, 32–33
- South Carolina Aquarium, 25
- Southold Program in Aquaculture Training (SPAT), 51
- Spain, 21
- squid, 19
- sturgeon, 25
- subsidies, 53
- sustainable fisheries initiatives
  - aquarium-sponsored projects, 25
  - Chefs Collaborative, 28
  - consumer receptivity, 52
  - dolphin-safe tuna campaign, 24
  - Environmental Defense, 41
  - Japan for Sustainability, 46
  - Pure Salmon Campaign, 41
  - seafood certification, 6, 12–13, 38–39
  - Wal-Mart, 6, 13, 41
  - Wegmans, 42, 43
- swordfish, 12, 16, 22, 27, 29, 48
- T**anganyika, Lake, 49
- Tanzania, 16, 37, 39
- Thai Airways, 11
- Thailand, 21, 39
- The Nature Conservancy, 55–56
- tilapia, 18, 33, 53
- Tognazzini, Mark, 56
- Tognazzini's Dockside Restaurant, 56
- Tonle Sap (Cambodia), 35–36
- trawling, 20, 44, 53, 55, 56
- trout, 12, 19
- Tsui Lap-Chee, 12
- tuna
  - destructiveness of harvest, 24, 27, 29
  - harvest size, 19
  - mercury levels, 48

popularity, 18  
species decline, 16

**U**ganda, 16, 37  
Unilever, 6, 13, 38  
United Kingdom, 43  
United Nations Food and  
Agriculture Organization  
(FAO), 31  
United States, *see also specific states*  
catch size, 18  
fish consumption, 14  
fish distribution, 37  
fisheries subsidies, 53  
University of British Columbia, 15  
U.S. Agency for International  
Development (USAID), 33

**V**aldimarsson, Grimur, 31  
Venezuela, 39  
Victoria (Australia), 54  
Vietnam, 39

**W**al-Mart, 6, 13, 41, 42  
wastewater treatment, 50  
water pollution, 29, 47–51  
Wegmans, 41–42, 43  
Whitty, Julia, 17  
WildAid, 11  
wild fish harvests, 17–21  
Wildlife Conservation Society, 11  
World Bank, 31, 32  
World Conservation Union  
(IUCN), 9  
WorldFish Center, 32–33  
World Parks Congress, 55  
World Summit on Sustainable  
Development, 55  
WWF, 13, 38, 41

**Z**ambia, 34