The Catch

Volume 1 Article 15

2013

Economic Efficiency in Fisheries and Aquaculture

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Cover Page Footnote

A longer version of this essay appeared in the International Journal of Transdisciplinary Research 1(1):100-113.

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In October of 2003, Hurricane Juan drove thirty-foot high waves into the seawall guarding Halifax, Nova Scotia, and eighty-mile-an-hour winds toppled giant old oaks across the city's flooded streets. As the storm raged, Peter Tyedmers, an ecological economist at Halifax's Dalhousie University, explained the theory of dissipating structures to me, via a tenuous telephone connection. "As you increase order in a subsystem, it comes at a higher cost to the over-arching system. You see more rapid entropy," said Tyedmers, an expert on energy efficiencies in fisheries and aquaculture. "Higher levels of order are possible, but for shorter duration."

I had long experienced the cycle of dissipating structures, in one fisheries meltdown after another. But when I started out, as a teenager pounding the docks of various East Coast ports in 1976, an infectious optimism masked all concerns about sustainability. The United States had just declared the 200-mile limit, establishing sovereignty over three million square miles of ocean—an area roughly equivalent to the landmass of the lower forty-eight states—and Congress poured millions of dollars into modernizing the fleet. Fishermen did not see themselves increasing the order of a subsystem; they expected to feed the world with the unlimited bounty of the sea. Efficiency, according to the policy makers, amounted to catching more fish faster.

In the late '70s, newly launched stern trawlers, all more than eighty feet long and built of steel, headed to sea equipped with the latest electronic technology. Sonars for finding fish, and Loran-assisted track plotters enabled the boats to tow their nets through the schools repeatedly, with lethal accuracy. New diesels with increased horsepower enabled the boats to tow larger nets, and like many others I gravitated toward the new technology without questioning its efficiency—until the bill arrived.

All the new toys had to be paid for with fish. Rising landings flooded the market and prices dropped, requiring fishermen to further increase landings in order to make the same amount of money. Competition drove the most progressive fishermen to invest in more sophisticated technology: global positioning systems connected to computerized track plotters replaced the old Lorans, and digital sonar displays showed fish more clearly. Every advance led to increased landings and as soon as everyone in the fleet adopted the technology, they required those increased landings just to maintain the status quo.

I experienced an awakening of sorts one bright summer day in 1984, aboard the ninety-foot trawler, *Atlantic Harvester*, out of Rockland, Maine. On a ten-day trip in the Gulf of Maine, out near the Canadian boundary, we caught thousands of pounds of hake, much of it too small for our market. Tow after tow we sorted out the bigger fish and shoveled the small ones over the side, dead. Looking up from my work I saw the bodies of juvenile hake, their bellies to the sun, bladders distended from their mouths, floating all around the boat and out toward the horizon for quite a distance. An airplane, bright red against the blue sky and sea, flew past low enough that when I looked up I saw the insignia of the

Canadian Coast Guard. A helmeted crewman leaned out an opening in the fuselage and looked down at the scene. Years later I met a former pilot of one of those planes and he told me about seeing fishing boats surrounded by dead bycatch.

"Maybe you saw us," I said.

"Who knows, there were so many," he replied.

Standing on deck of the *Atlantic Mariner* in 1984 I started to do the math. The hired captain had to produce something to pay for the trip, loading the boat with small hake at $0.15 a pound; we spent at least the first seven or eight days of our ten days at sea working to cover expenses. In the meantime we killed and discarded as many fish as we caught. But we believed we had no choice; we had to pay for the trip and make a profit anyway we could. We had to maintain our economic sustainability. The sea dotted with dead fish represented an expense, an externality that we would internalize a few years later in the form of empty nets.

I made only one trip on the *Atlantic Mariner*; working more than a week just to pay the fuel bill of an overcapitalized fishing boat may have made sense to some fisheries economists, but it seemed a waste of my time. I went back to the boat I'd worked on the summer before, the *Irene Alton*. Her owner, Bernard Raynes, had built the fifty-seven-foot wooden boat in his backyard. She carried the minimum in technology: an old paper recorder depth sounder, a Loran and a VHF radio. Raynes carried in his head all that he needed to catch fish. He had inherited the accumulated wisdom of eleven generations of his ancestors, all fishing folks in the Gulf of Maine. An image of the seafloor and a map of the currents, formed over the years through the combined observations of those preceding generations, became part of Raynes's own mental landscape.

Working with his father and grandfather from the time he could hold an oar, Raynes had learned, as much as anyone can, the ways of fish and how they moved in the sea and seasons. "You have to learn to think like a fish," he once told me.

At a time when new steel boats entered the fishery off the northeast U.S. at a rate of one every four days, Raynes launched an anachronism. His boat is still working, while the eighty-foot-plus, heavily subsidized fleet has vanished from the nearby Rockland waterfront.

Raynes's boat required basic maintenance, most of which he accomplished with the help of his crew. The work cost him time, not money, and acted as a bonding exercise for all of us. We laughed a lot on the summer days we spent scraping and painting, and paid close attention as Raynes taught us how to splice new shrouds and stays, and build nets. When groundfish landings crashed in the late 1980s and the 1990s, his self-sufficiency paid off.

He continued to fish long after the big fish draggers had all disappeared from the Rockland waterfront, one way or another. The owner of the *Atlantic Mariner*, Lee Riley,

a man I never met, re-rigged her as a purse seiner for herring fishing. The O'Hara fleet, half a dozen ninety-foot steel boats—all built with government subsidies—left for Alaska, where stocks remained healthy enough to support their wasteful mode of fishing. The *Irene Alton,* with her low fixed and operating costs, survived and in 2006 the thirty-year-old boat continued to fish. Unfortunately the infrastructure that enabled her to take on ice and offload fish vanished. She survived due to her efficiency, only to become functionally obsolete due to the breakdown of the supporting infrastructure. I left Bernard in the late '80s, and moved to an isolated stretch of the coast of Maine, where I began an experiment in efficiency.

Like Raynes, I built my own boat, but lacking his history and confidence in what the stocks could support, I built a sixteen-foot dory, a lovely little craft that I rowed along the open shore searching in the intertidal zone for periwinkles, "wrinkles," and later, sea urchins.

From 1988 to 1991 I had the wrinkles all to myself. On spring tides I could earn $120 in six hours. The rest of the time I worked in my garden, cut wood, and read. Wendell Berry's book of essays, "The Unsettling of America," and Masunobu Fukuoka's, "One Straw Revolution," which awakened me to definitions of efficiency that made more sense to me than what I had seen in industrial fisheries. Both writers advocated more human effort and less purchased inputs in food production. I learned that a human working by hand in a garden gets about 10 calories back for every one invested. Petroleum-driven machines reverse the ratio: for every ten calories invested, with a tractor or roto-tiller, the garden returns one. I assumed that by rowing I would get the same sort of calorie for calorie return ratio in my fishing as I did in my garden. Following Raynes's example I kept my fishing expenses low by relying more on my senses and accumulated knowledge than on technology.

One afternoon as I rowed past a new fiberglass lobster boat anchored in the harbor, the captain hollered over, "Why don't you put a motor on that thing?"

I dug my oars in and stopped, then pulled quietly into an eddy next to his boat.

"I want my money in my pocket," I told him. "A motor costs $1,000 for something decent; then I have to register my boat, there's another twenty bucks every year; plus gas and all that. Adds up to a lot of goddamn wrinkles, and what's it going to save me? A two mile row with the tide in my favor. You go ten miles offshore, I guess you need an engine, but for what I'm doing it makes no sense."

More than a decade later I read a book by an eco-economist named Kozo Mayumi, in which he explained what I instinctively knew: that there were two types of efficiency. One measured work accomplished in relation to energy used, the other looked at production in terms of speed. As an example Mayumi noted that cars had an ideal economical speed in terms of gas consumption and distance covered, but most people used more gas than necessary in order to get to their destinations faster. "Such drivers prefer efficiency in terms of speed of the car to efficiency in terms of gas consumption,"

wrote Mayumi.

Indeed as declining fisheries forced more fishermen to turn to wrinkle-picking, they arrived with outboard motors, which needed to be paid for with wrinkles. The new entrants to wrinkle-picking thought less about efficiency or sustainability than I did. They took the small with the big, they took every wrinkle they could find, and before long the wrinkles had been picked so hard that we went from 250 pounds on a good day, to fifty, with the bulk of the money from the harvest gone to the Honda outboard dealer, and the local gas station.

I did not need the terminology of ecological economics to understand that the fallacy that efficiency is defined by speed, and not energy conservation, spread from the industrial trawlers to the smallest of small scale fisheries, helped deplete both. That fallacy continues to contribute to the destruction of every resource-based industry it comes into contact with.

One day, rowing home into Haycocks Harbor, a crew of wrinkle pickers raced past me in their outboard skiff. A young boy sat on one of its thwarts and watched me as they roared by. He had a curious, almost sad look on his face, and I like to think that he realized in seeing me there as a contradiction to everything he had been told, that there are other ways of fishing that make sense—and maybe he wished he was in my boat.