

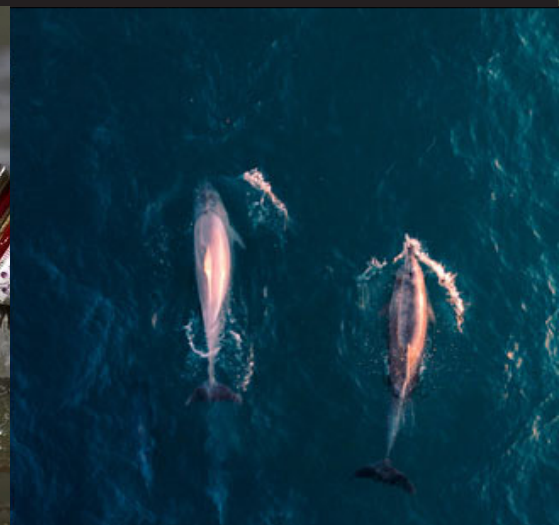
WORLD OCEAN JOURNAL

WORLD OCEAN OBSERVATORY

VOLUME 6, 2019



AQUA / TERRA: REFLECTIONS ON THE WORLD OCEAN





Since 2008, WORLD OCEAN RADIO has been engaging in dialogue about ocean issues, suggesting solutions, and championing for the change required to conserve and sustain natural resources for the benefit of all. The sea connects all things.

I never saw the ocean until I was fully grown...

I had only read about the ocean as a place for adventure up until my father took me to Gloucester, Massachusetts as a young man and I first saw the sea. Something shifted inside of me then, undefined perhaps at the time, but real and transformational and subsequently at the center of my personal and professional life ever since.

It was not just the beauty of this place along the Atlantic, but also the expression of energy and the power of change. Everywhere I looked on that day I saw movement and light, and connection to places and peoples, to mysterious natural systems, and to external and internal meanings that subsequently have shaped my thoughts and actions. I was standing on the beach looking out to a limitless horizon; I was standing on the intersection of space and time; I was standing on the edge of the world, looking forward.

My lifelong career as a novelist, teacher, environmentalist, maritime museum director, communicator, and ocean advocate began there and then.

The reflections gathered here in this sixth volume of the *World Ocean Journal* are taken from the more than 530 transcripts for our weekly

audio feature, *World Ocean Radio*. Some of the essays are journalism; some are opinion; others are my fraught attempts at poetry; all are derived from the wide, deep, and dynamic source that is the ocean, the sea that connects all things.

Never has the ocean been more important than it is today — as the source for food, fresh water, security, trade, peace, and survival. We are all standing alongshore, on that critical edge, shaping the future.

Hold fast.
Lean forward.



PETER NEILL is founder and director of the World Ocean Observatory and is author of *The Once and Future Ocean: Notes Toward a New Hydraulic Society*, published in 2016. He is also the host of *World Ocean Radio* upon which this volume is inspired.

IN THIS ISSUE



WORLD OCEAN JOURNAL is a publication of the World Ocean Observatory, a digital magazine on ocean culture and solutions to today's ocean issues. Each volume includes essays, interviews, art, exhibits, and performances profiling the vital impacts of the ocean on our lives. This and future editions focus on a particular theme.

WORLD OCEAN OBSERVATORY is a major utility for ocean communication as a means to advance public awareness and political will, and is dedicated to providing information and education about the health of the ocean. It is our belief that the sea connects all things. Contact us at director@thew2o.net.

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1. What Does Fracking Have To Do With The Ocean?

From lethal emissions to the exploitation and toxicity of fresh water resources, hydrofracking is a big deal for the ocean.

2. Hydropower

There are strategies at play to improve dam operations, reduce environmental impacts, and embrace new technologies in hydropower development.

3. Ocean-Based Renewable Energy

Wave and tidal power could eventually become a significant contributor to the growing alternative sources of renewables.

4. A Danger of Dams

Dams built in earthquake-prone zones pose significant threats to the environment, to social dislocation and can lead to cultural destruction.

5. Wind, Solar and OTEC

Ocean thermal energy conversion may offer a cost-competitive alternative to conventional power technology.





WHAT DOES FRACKING HAVE TO DO WITH THE OCEAN?

Hydraulic fracturing, the process to extract natural gas from heretofore inaccessible reserves in shale deposits, mostly inland, is the energy industry's newest technology for augmenting fossil fuel reserves to meet national and international demand. The process of fracking, reportedly developed by Halliburton and promoted by the predictable corporations and their lobbyists, is seen by some as the financial salvation of the industry and its future supply, and by others as yet another egregious, short-term assault on the nation's environment with serious detrimental consequences for human health.

Fracking is in use in over thirty states in the United States and is also being investigated for use in Africa and elsewhere. It has been utilized for more than ten years in some areas and the outcomes have become better known to neighborhoods, communities, and in the press, fueling what is now a fervid debate about its practice.

What does fracking have to do with the ocean?

First, studies have estimated that 4 to 7 percent of the gas that flows up the wells escapes as methane into the atmosphere.

Multiply that by thousands of projects and you have yet another measurable negative contribution of toxic emissions to deteriorating air quality with further impacts: increased acidification, diminished ozone protection, global warming, and changing climate conditions, the very same factors that we are trying to identify to relieve us of the consequence of our dependence on oil. The water cycle guarantees that much of that consequence finds its way directly and indirectly to the ocean, the marine food chain, the depleted coral reefs, the red tides, the closed beaches. It is only a matter of time before those consequences find their way into our drinking water, our food, and our bodies.

Further, fracking uses enormous amounts of fresh water, some six to eight million gallons per extraction, water that is admixed with chemical additives including diesel fuel, biocides, industrial solvents, hydrochloric acid, and radioactive elements that are intensely harmful to humans at very low levels of exposure. That toxicity is injected into the water table and then must be extracted and stored either deep underground or in effluent evaporation pits lest it contaminate the soil, groundwater, and water supply in the surrounding areas.

Fracking companies are reluctant to reveal either the nature or the amounts of chemicals in detail, certainly not reassuring to those who are already experiencing the results. There are documented examples of violations of the Clean Water Act, EPA regulations, corrupted aquifers, polluted ponds and streams, tap water ignitable at the spigot, localized health problems, and underground reservoirs (where the companies have stored the untreatable waste water) broken open by natural tremors and minor earthquakes.

What is most important to understand here is that all of this tainted water is removed from the finite supply on earth, a supply that is already at the limits of consumption and sustainability.

It becomes stunningly clear when the impacts are scaled up to the reality of demand. Researchers have found that between 2005 and 2009 over 866 millions gallons of freshwater were mixed with some 750 chemicals, including lead and benzene, the full inventory of which is undisclosed by the companies to protect proprietary or trade secrets. Moreover, the present fracking push in Pennsylvania, New Jersey, and New York is focused on the nation's largest unfiltered

fresh water supply, the Delaware River Watershed, serving more than 15 million people in the east coast megalopolis. Remember: that watershed, if poisoned, leads directly to the sea.

What is astonishing about this is that we have done it all before. The past 50 years have revealed where the trade-offs lie. It is not new news. We have polluted the earth; we have polluted the air; and now, we are repeating exactly the same rationale to justify this initiative and polluting our water, fresh and salt. It makes no sense. But the farmers are selling their land to the highest bidder, moving on to somewhere. The politicians are selling our resources to the largest unaccountable contributor. Are we just to let it happen, helpless, disinterested, and accepting of the consequences?

I keep thinking of Rachael Carson's seminal works *Silent Spring* and *The Sea Around Us*. She sounded the clarion call for earth and ocean decades ago. We listened but we did not hear. And so it goes, beyond pathos.





HYDROPOWER

In the past decade, dams have been targeted as outdated, inefficient energy providers with serious impacts for the immediate and downstream environments. Of the 79,000 dams in the national inventory, some 925 have been removed in the last 100 years.

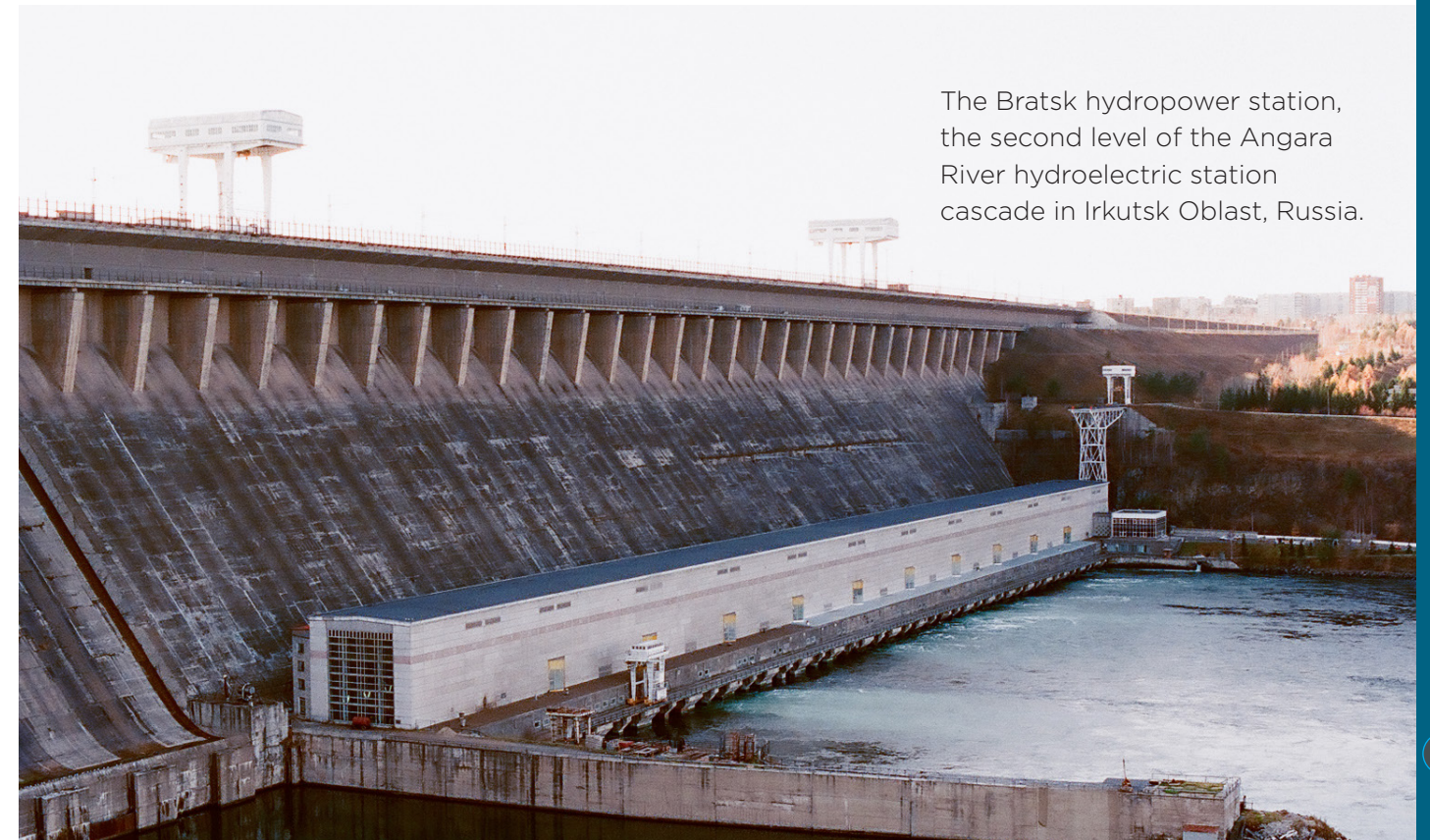
Hydropower is frequently mentioned in conversations about renewable energy generation in the 21st century. We have on *World Ocean Radio* reported on various ocean technologies involving exploitation of water movement such as waves and tides to harness natural capacity not reliant on fossil fuels. Dams have historically served such a function, from small stream diversion for irrigation to massive structures that have re-engineered a regional landscape to generate serious power capacity distributed nationwide. The United States Army Corps of Engineers lists over 79,000 dams in its national inventory. Some 2,540 dams are regulated as certified energy providers by the Federal Energy Regulatory Commission.

Over the past decade, however, environmentalists have targeted dams as outmoded, inefficient energy providers with serious impacts on water flow, surrounding and downstream environments, species migration and spawning, sediment collection, algae blooms, and other damage

to the natural process. Dams have taken on the identity of plaque in the arteries, unhealthy intrusions into the water circulatory system that can take on crisis proportion, even deadly consequences. American Rivers (americanrivers.org) and other such conservation organizations have taken up the strategy to remove these outdated impediments; some 925 dams have been removed from the inventory over the past 100 years, with recent successes increasing public pressure for more.

Those successes have had some very positive and immediate results. In some instances, the return of ocean fish to freshwater spawning ground, inhibited by the dam, has been observed in less than a month. Fish such as alewives, historically essential to the ocean food chain and heretofore threatened, have shown almost instant response to the restoration of the natural passage where once a dam intervened, a natural renewal so essential to their health and proliferation.

But what about the dams remaining? American Rivers suggests six strategies to improve dam operations and to mitigate the economic and environmental impacts, to reconcile the needs of energy suppliers, rate-payers, natural species, and community interests: 1) increase efficiency by retrofitting and improving dams, many of which were constructed 50, even 100 years ago; 2) consider adding capacity to certain existing dams; 3) uphold environmental safeguards; 4) hold hydropower developers responsible for dam safety; 5) design new dams for defined lifetimes; and 6) evaluate dams for production outcome, not size. The Low Impact Hydropower Institute is a new organization dedicated to reducing impact of retrofits and new construction through market incentives and a certification process that evaluates river flows, water quality, fish passage and protection, watershed protection, threatened and endangered species protection, cultural resource protection, recreation, and facilities recommended for removal --



The Bratsk hydropower station, the second level of the Angara River hydroelectric station cascade in Irkutsk Oblast, Russia.

standards for public validation of best hydro-practice.

The primary strategy seems mostly about dam removal or modification to acceptable performance of existing installations. New dam construction does not seem to have much of a constituency, projects being inhibited by permitting and regulatory applications and community activists. And frankly, dam removal has its own environmental downsides including removal of flat water reservoir, local wetlands drainage, resultant habitat modification, sediment release, increased stream turbidity, distribution of accumulated toxins downstream, temperature and water quality issues--negatives hopefully to be overcome by restoration of the long-term natural process.

There are some very interesting new technologies in development for hydro-power: enhanced turbines, for example, generating more energy from the same volume, and small generators built with stock parts and installed in descending sequence in unexpected places like irrigation canals, locks, outlet pipes, storm drains, and existing dams or sites with smaller falls, less than 30 feet from one pool to the next – all resulting in much reduced manufacturing cost, installation cost, operating cost, and environmental impact. The scale of this micro-hydro approach is well suited to developing nations and new installations. Another imaginative example is pumped storage, a system that cycles and recycles a fixed volume of water to gravity fall through a series of miniature blade assemblies to

generate enough energy to drive a pumped return cycle and generate surplus electricity for cumulative contribution to the grid and can be built anywhere where there is an appropriate water source. One might even go so far as to imagine such a closed system for a positive re-use of “fracked” or “black” water left over from other environmentally degrading systems. Now wouldn't that be something?





OCEAN-BASED RENEWABLE ENERGY

In the past decade, dams have been targeted as outdated, inefficient energy providers with serious impacts for the immediate and downstream environments. Of the 79,000 dams in the United States national inventory, some 925 have been removed in the last one hundred years.

Attempts have been made to harness the enormous energy potential of moving ocean water for decades. As far back as the mid-11th century, people were making the logical extension from exploiting energy in running rivers, streams, and canals. Early attempts to harness the kinetic energy contained in moving seawater were focused on estuaries, where both river hydrology and tides influence the water movement. But wave energy can be harnessed, in theory, anywhere where there are predictable waves, including in areas far offshore. The first commercial scale wave-to-energy plant was commissioned for the Isle of Islay, Scotland in 2000.

But ocean energy technology has been historically hindered by the engineering and operational challenges, the availability and low cost of oil and gas, and the resultant low purchase rates and lack of government and public interest. With oil supplies at or near peak, and the price at record highs, renewable energy from ocean-based systems has seen new interest and new investment.

For example, Oceanlinx, a company formerly known as Energetech, has developed wave energy projects in three areas of Australia (New South Wales, Victoria, and Tasmania), in two sites in the U.S.

(Rhode Island and Hawaii), in South Africa, in Mexico, and in the United Kingdom. These wave energy devices follow a very simple principle.

Water inside a chamber, open on the bottom, rises and falls as waves pass through, compressing and displacing the air inside which then drives a turbine. Wave energy is converted to mechanical energy that drives an electric generator. In some units, the turbine is driven on both the upward and the downward movement of water in the chamber.

The Oceanlinx turbine has variable pitch blades that produce maximum energy efficiency – each unit can produce enough energy to power 1,500 homes and can save thousands of tons of CO₂ and SO₃ emissions annually. Other units rely on what is known as heaving buoy technology, which captures the kinetic energy in the orbital motion of surface waves. And tapering channels funnel waves into natural or artificial channels, filling an elevated reservoir which then allows water to flow back to the sea past turbines that capture and convert the energy.

Tidal energy also has great potential as a renewable energy source, and has the advantage over waves of high predictability. Tides are caused by the gravitational pull

of the moon and sun and their effects on the rotating Earth. In near shore areas, the differential between low and high tide (both of which occur twice a day) can approach 15 meters. However, there are a limited number of areas around the world where tidal range and topographic conditions allow the practical utilization of tidal energy. According to the Department of Energy, only about 20 locations in the United States have good inlets and a large enough tidal range (at least 3 meters) to produce energy economically.

Most tidal energy plants use a dam, known as a barrage, which spans a narrow bay or inlet. Sluice gates on the barrage allow the tidal basin to fill on the incoming high tide and empty through the turbine system on the outgoing, or ebb tide. As in wave energy systems, there are units that generate electricity on both the incoming and outgoing tides. The La Rance Station in France began making electricity by harnessing kinetic energy of tides in 1966 and now produces enough energy to power 240,000 homes (240MW/year – or about 1/5th the power generated by a nuclear power plant.) According to an article in the *Financial Times*, total wave and tidal power could eventually exceed 2 trillion watts of annual electrical energy generation, a significant contribution to the spectrum of alternatives sources.





A DANGER OF DAMS

A 2015 report by author Isabel Hilton revealed sobering facts about the Rasuwaghadi Dam in Nepal and its ilk: projects fueled by central governments, unlimited finance and cheap labor that can and do have catastrophic results for the environment and can lead to social dislocation and cultural destruction.

One of the greatest expressions of engineering hubris has been the construction of ever-larger dams to transform the energy of free-flowing rivers into massive reservoirs of water for controlled release and hydro-generated energy. In the United States, and in Egypt, India, China and beyond, enormous dams in remote places have become symbols of national pride and emerging

economy designed to bring energy to distant cities and growing urban populations and industrial enterprise.

The construction of these dams required equally enormous investment of capital and labor, financed, supervised, and subsequently managed primarily by central governments or their specially designated authorities. In

1957, the historian Karl Wittvogel published *Oriental Despotism*, a survey of the reliance of ancient society on the control of water, examples again in the Middle East, India, and China, of similar engineering projects where dams, reservoirs, canals, and distribution systems facilitated the growth and sustenance of sustainable societies on a scale far greater and more successful as a result of abundant

water and its provenance. Such projects could only be managed by a power great enough to command the financial resources and the slave labor required to build such cities. To construct modern dams requires equally authoritative regimes – either by legislative decree or dictatorial fiat. The Aswan Dam in Egypt, the engineered river linkage projects in India, and the Three Gorges Dam and north-south canal water transport systems in China are all examples of a similar pattern: central government, unlimited finance, cheap labor, and no fear of opposition or consequence of environmental damage, social dislocation, and the cultural destruction that follows.

Nepal was devastated by a major earthquake in 2015 that left many thousands dead, many more thousands unrecovered, and the country bereft of the resources required to respond or to restore their way of life.

Isabel Hilton, in an excellent report for *The New Yorker Magazine*, reveals a chilling sidebar to the larger earthquake story, the rescue by helicopter of 280 Chinese workers from the construction site of the hydropower dam on the Tishuli River, some 86 miles from Kathmandu, and 40 miles from the quake’s epicenter. The 350 Nepalese workers were left to fend for themselves. According to the Three Gorges Corporation, the construction company owned by the Chinese government, the dam was “severely damaged.”

“The Rasuwaghadi dam,” reports Ms. Hilton, “is one of three contracts won in the area by the Three Gorges Corporation, and one of thirteen planned along this stretch of the river. The company, which has been repeatedly implicated in corruption in China, has also won the contract to build the controversial seven-hundred-and-fifty megawatt West Seti dam, which, at US\$1.6 billion, will be Nepal’s biggest-ever foreign investment.”

What does it mean that the Rasuwaghadi Dam was “severely damaged?” What would be the catastrophic downstream destruction if an aftershock or larger quake caused the dam to collapse? Here is the most disturbing paragraph in Ms. Hilton’s report:

“Geologists argue that the risks of building dams in earthquake zones go well beyond an earthquake-induced collapse...But the most fiercely debated risk, since the 7.9-magnitude Sichuan earthquake in 2008, which killed seventy thousand people and left nearly twenty thousand missing, is that of ‘reservoir-induced seismicity’ – the theory that the weight of water behind a dam, coupled with the seeping of water into the fissures in rocks below, can produce shearing stress strong enough to worsen, or trigger an earthquake.” What I think this suggests is that the first tremor can create further tremor within the water reserve and the underlying geology so as to amplify

the quake into reverberation increasing the probability of collapse.

Yes, Nepal needs this energy for its own security, development, and financial stability. But what is really being wrought here? These mega-projects – and there are many more of them – are fed mostly by glacial melt, a phenomenon put in question by the already evident effect of global warming on the glacier as source. Thus, these dams may be over-engineered for a future inadequate supply or under-engineered for the risk of an earthquake zone.

Water is power, physical and political, with inherent force not always acquiescent to our ambitions and prideful dreams. We attempt to master it at our peril.

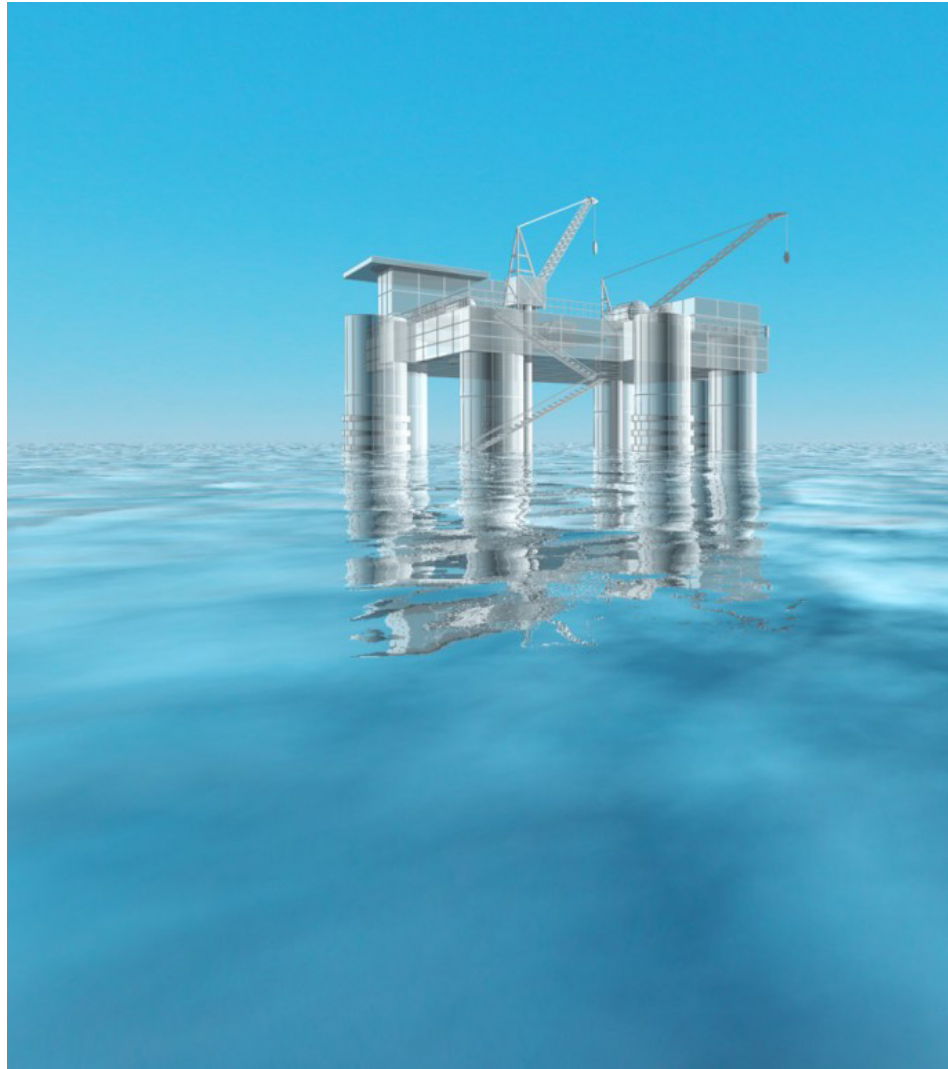


Rasuwaghadi dam, Nepal



WIND, SOLAR AND OTEC

World Ocean Radio follows the progress of all the major developing ocean-related alternative energy technologies including wind, wave, tidal, and solar. One of our favorites has been ocean thermal energy conversion (OTEC) whose approaches and multiple applications make this a fascinating alternative energy for the future.



When considering alternatives to non-renewable fossil fuels, we are all aware of the potential for wind and solar energy generation. We have seen the many large windmills in the hills of Europe and the United States. And yet the oceans provide not only vast amounts of space and sufficient sunlight and wind – but also provide these as a commons property that can in theory be more easily accessed than private property to meet the public good. Of all the energy alternatives, these are the most advanced.

Offshore wind farms are common in some parts of the world, such as Northern Europe. Oceanic wind is a preferred alternative to other forms of energy generation in areas where land is in short supply, and where coastal winds are sustained and strong. Denmark has led the effort in harnessing sea wind, and constructed the first offshore wind farm in 1991 off the Port of Vineby. By 2008, 89% of Denmark's

electricity supply was provided by wind power. The Netherlands have constructed many alongshore projects, and the United Kingdom opened its first offshore wind farm in 2000 in Northumberland, and has followed Denmark's lead with expanded wind farms and feasibility studies for new areas.

The oceans are also the world's largest solar collector: one square mile contains more energy potential than 7,000 barrels of oil. Solar arrays with unfettered access to sunlight can be installed in virtually any coastal area sheltered from excessive wind or waves. Currently most offshore solar plants are used to power oil platforms and in situ research equipment, but new visionary options are under development.

The oceans can also be harnessed for energy by using the temperature differential of surface and deep waters to drive energy – a process called ocean thermal energy conversion or OTEC. The differential exists because the sun warms the surface layers of the ocean, especially in the tropics, while deep waters stay cool. In order for the technology to be able to capture the thermal energy, this temperature differential must be more than 25 degrees Celsius.

Using the temperature of water to make energy dates back to 1881, when a French Engineer named Jacques D'Arsonval first thought of using ocean thermal energy gradients. His student, Georges Claude, built the first OTEC plant in Cuba in 1930, producing 22

kilowatts of electricity with a low-pressure turbine. The best known and largest scale pilot effort to harness ocean thermal energy was constructed in Hawaii in 1974; it was a technological success but the cost was non-competitive when compared to the very inexpensive price of oil at the time. As a result, enthusiasm for the technology waned.

Three types of systems are used to convert ocean thermal energy to electrical energy. Closed cycle systems use the warm surface water to vaporize a low-boiling point fluid such as ammonia. As the vapor boils and expands, it drives a turbine, which then activates a generator to produce electricity. Open cycle systems operate at low pressure and actually boil the seawater, which produces steam to drive the turbine/generator. Hybrid systems use elements of each, in an attempt to improve conversion efficiencies.

Although the temperature differential between surface waters and the deep ocean is significant in almost all parts of the globe, there are constraints to being able to harness this potential energy. Main among them is having deep cold water in close proximity to warm surface waters. Tropical island nations in the Pacific Ocean that have narrow continental shelves are particularly suited. According to NASA, some 98 tropical countries could benefit from the technology. OTEC also has spin-off benefits, including air conditioning, chilled-soil agriculture, aquaculture, and desalination. And, OTEC also may

one day provide a means to mine ocean water for valuable trace elements.

Thermal energy conversion has great potential, but enormous challenges remain. The technology is still very inefficient and piping large volumes across great depths of ocean (a kilometer or more) is a major engineering feat. Yet some energy experts believe OTEC could produce billions of watts of electrical power, and is now cost-competitive with conventional power technologies.



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1. Who Is Thinking Ahead About Climate?

Two stand-out organizations are taking climate science seriously and moving responsibly forward.

2. A Climate Change Refugee

A man from the small island nation of Kiribati has claimed refugee status from the impacts of climate change.

3. Climate Insurance in a Changing World

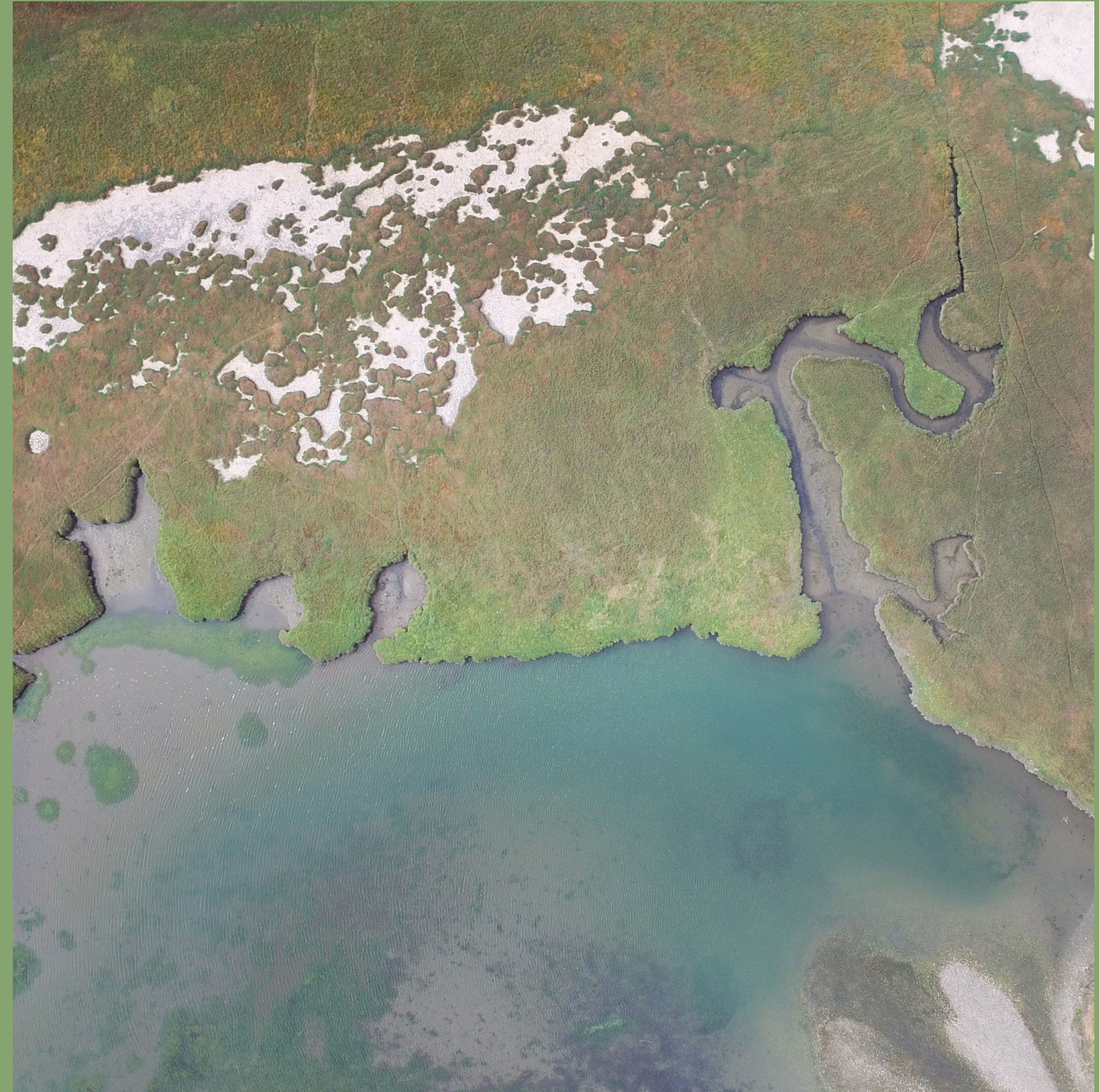
Insurance companies must adapt as a risk management tool for the world's most vulnerable.

4. Climate Risk Management

There has never been a more important time for a climate risk management plan.

5. Ocean Acidification

The changing pH in the water column has devastating impacts on the marine food chain, species migration and reproduction. Here are twenty facts about acidification.





WHO IS THINKING AHEAD ABOUT CLIMATE?

Two organizations are standing out as taking climate science seriously and developing climate solutions and strategies for the future

As evidence of climate change mounts, it is further affirmed in the dramatic news and images of melting Arctic ice; increasing droughts; floods; fires; extreme weather; and warming sea temperatures that are negatively affecting fish migration patterns, the life cycle of certain marine species, algae blooms, and shellfish sustainability.

Who is out there thinking ahead about climate? Are there serious folks pursuing strategies based on climate models and predictions in spite of the silence? Are there organizations beyond the scientists and their research models strategizing about how changing climate conditions will impact their purpose?

Here are two:

First, the United States Navy. In May 2009, the Chief of Naval Operations created Task Force Climate Change (TFCC) that, according to the announcement, was intended “to address the naval implications of a changing Arctic and global environment, to make recommendations to

Navy leadership regarding policy, investment, and action, and to lead public discussion on this serious issue.” Climate change has implications for naval force structure and operations, and the announcement listed these following factors:

1. The changing Arctic;
2. The potential impact of sea level rise on installations and plans;
3. Changing storm patterns and severity;
4. Water and resource challenges;
5. Stress on vulnerable nation states; and
6. Increased humanitarian assistance and disaster response.

A number of scientific *wild cards* must also be considered, such as the impact of ocean acidification on ecosystems, abrupt climate change, and geo-engineering challenges. Courtenay St. John, a spokesperson for the Task Force, said this,

“The Navy cares about climate change because it has implications for its operations and structure. There’s the threat of sea-level rise and increased storm surge to the

Navy’s coastal installations; the potential stresses on water and food resources around the world, which may lead to more international humanitarian and disaster response missions; and the stress on vulnerable nation states and potential national security issues that could arise.”

At a 2014 conference on the ocean and global security, U.S. Secretary of the Navy, Ray Mabus Jr., enumerate specific goals to be achieved by this initiative to include integration of climate science into forward planning and staff training, development of bio-fuels to drive the entire fleet in the next decade independent of foreign controlled oil supply, the construction of new hybrid or all electric ships, evaluation of sea level rise on the more that 740,000 Navy-owned waterfront installations, buildings, and service structures worldwide, and even the relocation of strategic bases from places possibly no longer operationally viable and thus counter-productive to the Navy’s mission.

A second organization thinking ahead about climate is the

International Federation of Red Cross/Red Crescent Societies, the world’s largest humanitarian organization, whose work focuses on four core areas: promoting humanitarian values, disaster response, disaster preparedness, and health and community care worldwide. The Red Cross /Red Crescent is confronted with a sharp increase in weather-related disasters, and has recognized “an urgent need to better manage the rising risk of extreme weather events, including through better early warning, enhanced disaster relief, increased efforts on disaster risk reduction and better and smarter programs in health and care, water and sanitation, food security, and rising concerns

on the potential impact on migration patterns.”

According to the International Federation, “the number of weather-related disasters each year has doubled since the early 1990s. Changing climate coupled with changes in land use and population patterns means more people will be living in locations vulnerable to storms, droughts, floods and other climate risks. The flood-related cholera epidemics in Senegal in 2005, for example, affected more than 30,000 people and killed nearly 500. In 2008 in Bangladesh, Cyclone Sidr forced millions from their homes and killed thousands. Events such as these place an increased burden on governments

and humanitarian organizations, which are responsible for mitigating impacts and saving lives.”

So there you have it: beyond the ideologues, politicians, and deniers, there are these and other organizations out there with future agendas that are taking climate science seriously, for different purposes perhaps, but nonetheless moving responsibly forward through the silence, thinking ahead about climate.





A CLIMATE CHANGE REFUGEE

In 2013 a legal case in New Zealand captured world media attention. An individual named Ioane Teitiota faced deportation to his home in Kiribati, claimed refugee status resulting from the impact of climate change, sea level rise, and extreme weather on his small island nation. Some have predicted that Kiribati will be inundated within decades, forcing the entire national population, some 50,000 people, now inhabiting a narrow island of just six square miles, to seek a new homeland.

The High Court Judge denied Teitiota's claim, dismissing it as "unconvincing" and "novel." Legally unconvincing maybe, the government defenders easily able to find legalistic reasons to discredit the argument. But novel? That is a different matter. The judge should not have been afraid of precedent; after all, lawyers seek and cite precedent all the time. But the implication of a novel standing as a refugee from climate change, the result of deliberate national policies and private actions over which a single citizen or even a small undeveloped country has no control is another matter. Indeed, it is terrifying by its implication.

Beneath any vindication of Mr. Teitiota's claim lies another acceptance: that of responsibility

for the contribution by the developed economies and multi-national corporations to environmental conditions resulting in storm surges, flooding, water contamination, community dislocation, and, in such cases as Kiribati, the probable collapse of a nation. It is facile to deny the link between certain human behaviors, economic policies, corporate actions and changing climate, to ignore the arguments and evidence of responsible science, and to argue that the energy demands of the larger world and its growth and consumption-based economies are far more important than the life of one man, or even one small country. Tell that to the residents of New Orleans post-Katrina, or to the devastated homeowners along the New Jersey and New York shoreline post Sandy or the residents of Dallas post Harvey, and you may find angry pushback from those citizens of the developed world seeking compensation for the destruction not just of property but also of their lives.

These events are not going away. In November 2013, super typhoon Haiyan struck the central Philippines with unprecedented strength, leaving almost 6,000 dead and millions displaced. Entire villages were destroyed, entire livelihoods, entire families – a

tragedy that joins other perhaps lesser events with equal, terminal impact on those affected. But think also what this leaves behind, what faces the survivors in the form of reconstruction of buildings, infrastructure, occupation, food supply, local and regional economy, and the critical water and health needs of the area. Millions are left behind, and why would we not expect them to migrate to higher ground, safer communities, new opportunities for themselves and their families. Many of these will become refugees, not from war and politics, but from the consequence of climate change.

The New Zealand judge cited the United Nations Refugee Convention in his decision, stating that Mr. Teitiota did not meet the "fear of persecution" criterion that is central to the UN definition. But is not fear of persecution by circumstances already demonstrated, or by a high probability of similar destruction, reason enough for seeking an alternative status in a safer place? Especially when the situation is known for both its cause and its inevitable effect and the victims have no defense against the indifference of the perpetrators. And is it only the numbers that matter? Must the destruction be measured only in massive political

disruption? Or gross national product, or vast economic loss, or untenable cost of reconstruction, or numbers of people killed or driven from their homes, never to return? Must it be millions? More? Or does the life of one man stand for us all?

We fight to little end over the stupidest things while we deny responsibility for our own actions and ignore the consequences of climate inaction with righteous indifference. Often, on World Ocean Radio, we mention the question we all ask when faced with these large, disturbing questions is this: *What can I, just one person, do? The issues are so enormous, and my actions so insignificant.*

I give you Ioane Teitiota, whose "unconvincing" and "novel" court case captured the attention of the world. I trust he will appeal, and that the environmental NGOs and legal defense organizations cleave to his argument, and that all of us, in some way, file "friend of the court" opinions that indicate our concern that this matter deserves a different decision as means to address how Teitiota and all other such refugees, now and certainly to come, will be treated and protected legally as a result of our failure to act. COP19 in Warsaw, despite some advances in a tortured process, offered little hope that the issues and disagreement will be resolved with any dispatch.

Thus, the precedent matters, perhaps as means by which those responsible should be held accountable. We know who they are, the arguments they use to evade accountability and governance, and the threat they sustain -- making climate refuges of us all.



Ioane Teitiota from the small island nation of Kiribati in the central Pacific.





CLIMATE INSURANCE IN A CHANGING WORLD

How might we protect against the far-reaching impacts of extreme weather, changing temperatures, sea level rise, and other phenomena that affect everyone, even when no single cause can be identified?

Insurance is prevalent in every aspect of our lives: in our homes, our cars, our health. It is a massive global industry that exists to protect us against risk, against accident, against personal circumstance, against almost every manifestation of human endeavor where there is an opportunity to use an insurance scheme to protect us financially against loss.

In some cases, such as car ownership or business liability, insurance is required by law. There is fire insurance, property and theft insurance, unemployment insurance, mortgage insurance, bankruptcy insurance, crop insurance, flood insurance, marine insurance, and many more such specific coverage types that are financed by premiums paid by individuals and corporations into a collective pool from which claims, as they arise, can be paid. In the meantime, the insurance companies use the aggregated monies for investments, marketing, and dividends to their shareholders. It is a lucrative business, and is often “re-insured,” that is the companies claims covered by yet another company that protects for another premium, against corporate loss.

As we consider the threats we face in our changing world, insurance might be a hopeful

tool or discipline to protect and compensate for events not heretofore covered but potentially devastating to us all – the impact of which extends beyond that of specific events and massive financial and social disruption.

The effects of climate change are being felt everywhere on earth, and nowhere more destructively as in the most vulnerable communities where development and poverty are at the highest. So what about climate insurance? How might we protect against the far-reaching impacts of extreme weather, changing temperatures, sea level rise, and other phenomena that affect everyone even when no single cause can be identified, no accountability possible. If these are defined as acts of God then insurance does not apply. But if these are defined as the result of collective actions, by many entities in many places, how is it possible to insure against the predictable economic consequence and critical social detriment?

The Munich Climate Insurance Initiative (MCII) is a response to the growing realization that insurance-related solutions can play a role in adaptation to climate change, as advocated in the Framework Convention and the Kyoto Protocol. The initiative provides a forum for insurance-

related expertise on climate change impacts. The Initiative also brings together insurers, experts on climate change and adaptation, NGOs and researchers intent on finding effective and fair solutions to the risks posed by climate change, as well as sustainable approaches that create incentive structures for risk and poverty reduction. The Munich Initiative is hosted by the United Nations University Institute for Environment and Human Security and issued its first report in October 2016.

As with all insurance policies, the language is complicated, but the report is based on seven principles that represent a clear bias toward the needs of the poor and a real intent to address comprehensive need-based solutions, reliable coverage, affordability, accessibility

and participation through practical programs and associations, transparency and accountability, sustainability over the longer term, and enabling the environment through capacity, literacy, regulation, partnerships, and technology.

The possible role of insurance represents a positive and optimistic step forward through the adaptation of a conventional tool for risk management to serve those most vulnerable. It is an alternative to the sequential, one-time disaster financing we have seen in the aftermath of tsunami or typhoon or other sudden and new examples of climate-related destructive events. Will insurance find a new and useful form and application? Will it be financed adequately and responsibly to provide the amounts and continuity of funds surely to be

required? Will it be supported by other government programs or private financing schemes that will address the roots causes of poverty in the context of rapidly changing environmental circumstance? Will it lead us to adapt and mitigate climate change otherwise by new values, systems, and behaviors? These are big questions; how do insure they are answered?





CLIMATE RISK MANAGEMENT

Considering the great climate change debate – whether it exists or does not exist as a major threat to our future – I am reminded of the philosopher and inventor, Blaise Pascal’s famous “wager” over the existence of God. “If you believe in God, you can find solace in peace and salvation. If you do not believe in God, why not hedge your bet?”

Climate change suggests a similar dilemma. If you don’t believe it is real and dire, and it proves to be nothing, then doing nothing leaves you home free. But what if you are wrong? What if you do nothing, and thereafter succumb, unprepared, to the devastating consequences that might follow? Why would you not here too hedge your bet and at least consider, maybe even define and prepare for the possibility of the predictable risks?

Not long ago I attended a conference and planning workshop sponsored by the Climate Change Institute at the University of Maine that invited state managers, municipal planners, NGOs and interested citizens to take part in a planning exercise to define possible climate change risks, impacts, and vulnerabilities, and to imagine viable responses, to visualize, design, price, and prioritize implementation of responses should they be required.

It was an exercise in climate risk management, and it was very instructive.

Here is a list of climate change risks: increased average surface temperatures, altered air and ocean currents, extreme weather events, increased precipitation, heat waves and cold snaps, melting sea ice, rising sea level, ocean acidification, algal blooms, invasive species, and more.

Here is a list of climate change impacts: flooding, drought, fires, agricultural failure, food shortage, water shortage, water and well pollution, species loss, economic loss, and more.

Here is a list of vulnerabilities: environmental degradation, critical pollution, lack of technical and scientific expertise, alienation from political power, regional geographical decline in island, coastal, and inland communities, poor governance structures, community disruption, social and psychological decline, and more.

So what about that bet? None of this will matter to you if you do not accept the possibility of any of these risks. But, again, what if you are wrong? Are you willing to ignore even the possibility of these circumstances and trends, and leave us all to fend for ourselves and

defer the consequence of neglect to our children?

In that workshop, we accepted the actuality of climate change, and then examined what would be the impact on our specific communities – alongshore, inland, and in the far north of our state, each with very distinct conditions to be affected differently by such risks. It was revealing and disturbing for certain, but it was also uplifting as we worked as groups of managers and residents from these areas to see what we might do, and might invent to sustain our livelihood and place for the future.

We were not overwhelmed or discouraged, as much as we began to understand the comprehensive impact of what we might face, to analyze its complexity, and to agree on what steps might be taken locally, perhaps with resources already available to us, to meet the challenge. Indeed, there was a palpable communal realization in the room that a group of strangers, with varied qualifications and interests, could come together to solve the problem – once we agreed amongst ourselves that it exists. In those few hours, we transformed plausible scenarios into possible plans of action. In many cases, we understood that certain circumstances already existed, that the risks were already evident,

and that the need for response, regardless of the climate change debate, was a necessary step no matter what.

I have always argued that beyond mitigation and adaptation the real solution to climate change is invention, the cooperative application of knowledge and experience not just to maintain or defend the status quo, but rather to

imagine and create new solutions to the problems to be faced. I felt that power of invention in that place and took home renewed optimism that smart and well-intentioned people can come together to build a sustainable future.

I wonder what Pascal would say?





OCEAN ACIDIFICATION

The changing pH or acid balance in the water column is having devastating impacts on the marine food chain, species migration and reproduction.

One of the most serious, debilitating circumstances affecting the ocean today is acidification, the changing pH or acid balance in the water column with devastating impacts on the marine food chain, species migration and reproduction, and sustainability of habitat. This is a global situation, mostly invisible, and demanding of immediate action.

What follows is quoted from a fact sheet on Ocean Acidification: “20 Facts About Ocean Acidification” prepared by the U.S. OCB Sub-Committee on Ocean Acidification in partnership with other international research organizations. It is reported here in full because of the clarity of the presentation and the urgency for public awareness about this issue.

1. Ocean acidification is a progressive increase in the acidity of the ocean over an extended period, typically decades or longer, which is caused primarily by uptake of carbon dioxide (CO₂) from the atmosphere. It can also be caused or enhanced by other chemical additions or subtractions from the ocean. Acidification can be more severe in areas where human

activities and impacts (such as acid rain and nutrient runoff) further increase acidity.

2. Ocean acidification has been well documented with global observations conducted over several decades by hundreds of researchers. It has been definitively attributed to human-generated CO₂ in the atmosphere that has been released primarily by fossil fuel combustion and land use changes.

3. Acidity is the concentration of hydrogen ions (H⁺) in a liquid, and pH is the logarithmic scale on which this concentration is measured. It is important to note that acidity increases as the pH decreases.

4. Average global surface ocean pH has already fallen from a pre-industrial value of 8.2 to 8.1, corresponding to an increase in acidity of about 30%. Values of 7.8–7.9 are expected by 2100, representing a doubling of acidity.

5. The pH of the open-ocean surface layer is unlikely to ever become acidic (i.e. drop below pH 7.0), because sea water is buffered by dissolved salts. The term

“acidification” refers to a pH shift towards the acidic end of the pH scale, similar to the way we describe an increase in temperature from -20°C to -0°C (-4°F to 32°F): it’s still cold, but we say it’s “warming.”

6. Acidification is also changing seawater carbonate chemistry. The concentrations of dissolved CO₂, hydrogen ions, and bicarbonate ions are increasing, and the concentration of carbonate ions (which provide chemical building blocks for marine organisms’ shells and skeletons) is decreasing.

7. Decreases in the availability of carbonate ions force marine organisms to spend more energy building and maintaining their shells or skeletons. For some organisms, spending more energy on shell formation may leave less energy for other biological processes like growing, reproducing or responding to other stresses.

8. Many shell-forming marine organisms are very sensitive to changes in pH and carbonate ion concentrations; conditions predicted for the coming decades may prove very stressful to these organisms. Corals, bivalves, pteropods, and certain

phytoplankton species fall into this group.

9. The biological impacts of acidification will vary, because different groups of marine organisms have a wide range of sensitivities to changing seawater chemistry.

10. Impacts from acidification at any life stage can reduce the ability of a population to grow or to recover from losses due to disturbance or stress, even though news reports have often focused on juvenile forms that are highly vulnerable to acidification.

11. Acidification will not kill all ocean life, but many scientists think we will see changes in the number and abundance of marine organisms. Many marine ecosystems may be populated by different, and potentially fewer,

species in the future. It is unclear whether these biological impacts will be reversible.

12. Areas that will likely be particularly vulnerable to acidification include regions where there is natural upwelling of deep water onto the continental shelves such as the west coast of North America, the oceans near the poles where lower temperatures allow seawater to absorb more CO₂, and coastal regions that receive freshwater discharge.

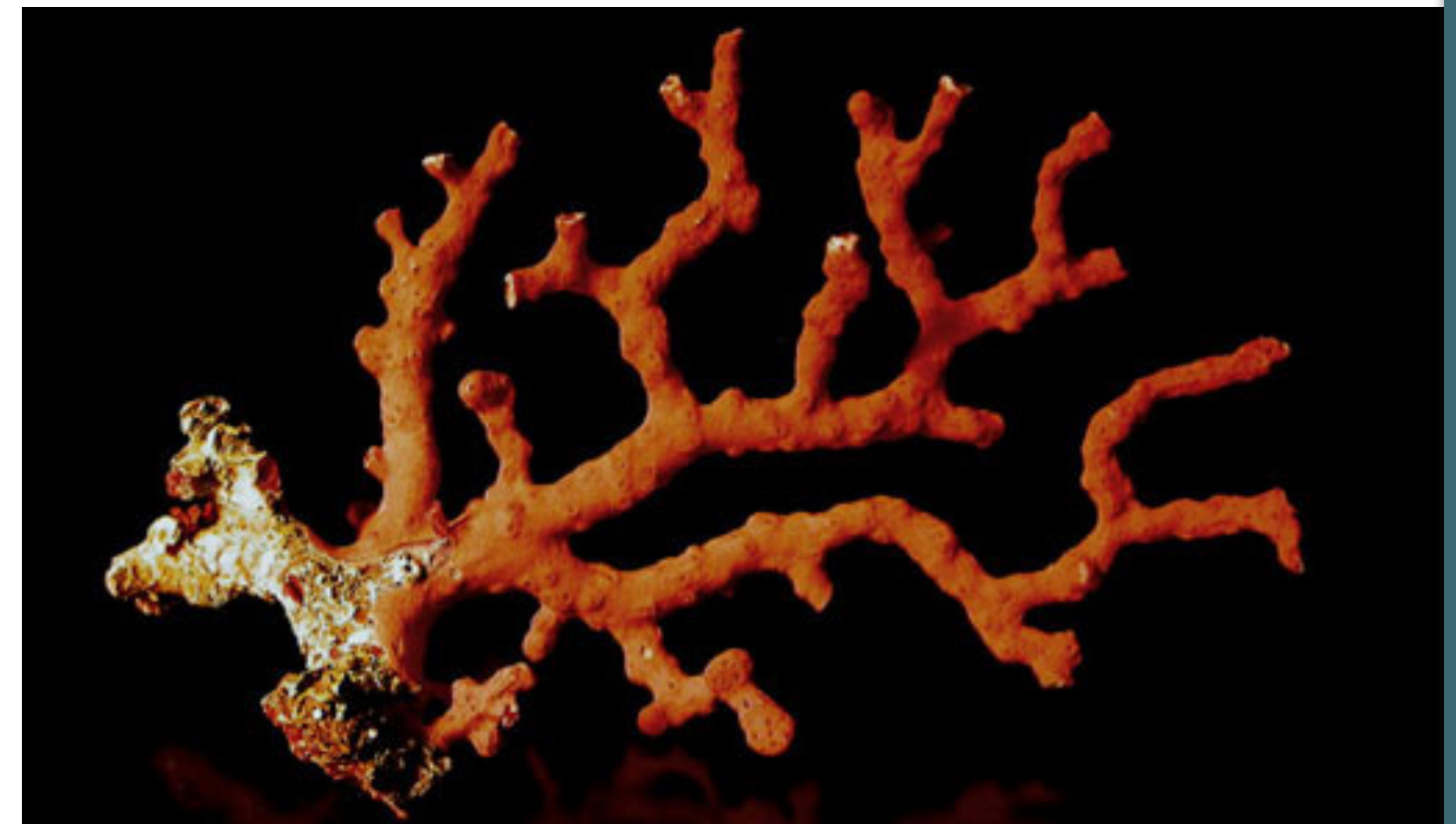
13. Evolutionary adaptation is a slow process, requiring many generations. Ocean acidification is occurring at a rapid pace compared to the speed of reproduction of some organisms. However, organisms have demonstrated an incredible ability to adapt to a wide range of environmental conditions,

including reduced pH; the role of evolution in ocean acidification responses is being studied.

14. Long-term pH decline could exceed the tolerance limits of marine species that live in coastal waters, even though they may have evolved strategies to deal with fluctuating pH on short time scales typical of coastal environments.

15. The current rate of acidification may be unprecedented in Earth’s history; it is estimated to be 10 to 100 times faster than any time in the past 50 million years. During a much slower acidification event that occurred 55 million years ago, the Paleocene-Eocene

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Thermal Maximum, there was a mass extinction of some marine species, especially deep-sea shelled invertebrates.

16. Full recovery of the oceans will require tens to hundreds of millennia. Over decades to centuries, neither weathering of continental rocks, deep ocean mixing or dissolution of calcium carbonate minerals in marine sediments can occur fast enough to prevent ocean acidification.

17. Geo-engineering proposals that seek just to cool the planet will not address the problem, because they do not tackle its cause: excess atmospheric CO₂. Proposals that capture CO₂ and store it away from seawater will mitigate the effects somewhat, but most such proposals are now only cost- or energy-effective on very small scales. For example, buffering the global ocean with mined calcium carbonate would require an annual application of at least 30 times as much limestone as is mined by humans today.

18. Blue carbon is under investigation as a way of locally offsetting CO₂ levels. CO₂ from the atmosphere or seawater can be captured in salt marshes, mangroves and sea grass meadows as organic material that can be stored for decades. This is called “blue carbon.”

19. Reducing nutrient runoff might offset some of the local changes caused by acidification, and could increase the overall health of marine ecosystems. But this would buy only a little time, because the root cause of the problem is global atmospheric CO₂ emissions.

20. Ocean acidification represents yet another stress on marine environments that may endanger the flow of goods and services to marine-dependent communities.

Humans around the world depend on the ocean for food, water quality, storm buffering, and many other important functions. Disruptions to marine ecosystems can alter these relationships.



In laboratory experiments, this pteropod shell dissolved over the course of 45 days in seawater adjusted to an ocean chemistry projected for the year 2100.

NOAA Environmental Visualization Laboratory (EVL)

“Mother Earth has the following rights: To life, to the diversity of life, to water, to clean air, to equilibrium, to restoration, and to pollution-free living.” So states the Law of Mother Earth, a Bolivian law passed in December 2010 as a binding societal duty. Bolivia is the first country on Earth to give comprehensive legal rights to Mother Nature.

In this episode of World Ocean Radio, first broadcast in October of 2014, we explored the language contained in the legislation and asserted that Bolivia may be inventing a social model that will show how we as a global community might transcend conflict and division toward a harmonious and sustainable future.

THIS WEEK ON WORLD OCEAN RADIO



THE LAW OF MOTHER EARTH

worldoceanobservatory.org/world-ocean-radio



1. Mario Soares

A tribute to Mario Soares of Portugal, a champion for the future of ocean and fresh water resources.

2. Hearts in the Ice

A citizen science adventure of a lifetime: two women, nine months, one trapper's cabin in the high north.

3. The Billion Oyster Project

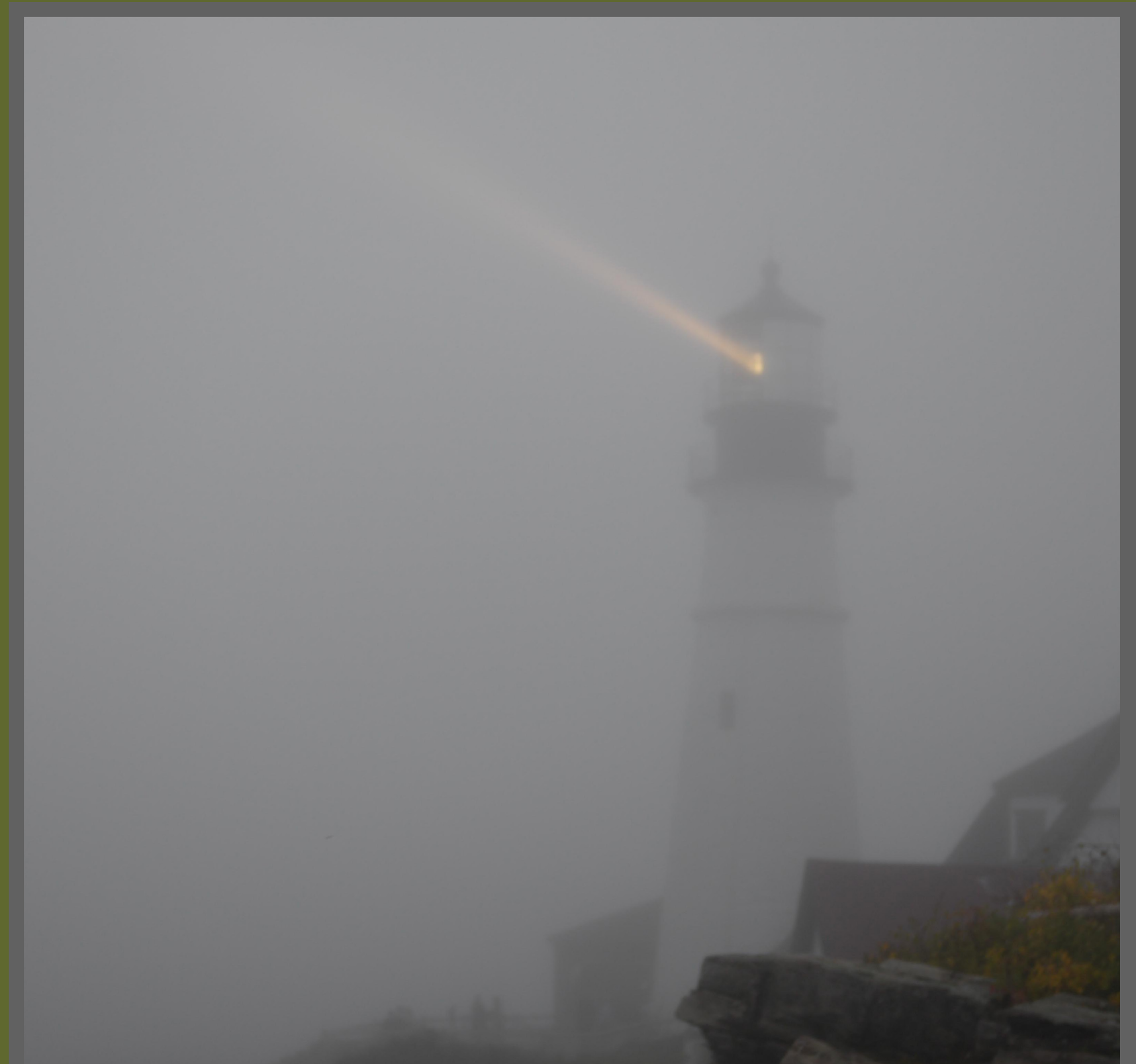
The Harbor School is engaging students hands-on to reconnect New York harbor to the urban watershed.

4. The Legacy of Jacques Cousteau

Jacques Cousteau was a motivating force for his time. How do we generate a comparable force today?

5. The Earth Law Center

Defending the rights of Nature to exist, thrive, evolve and be protected by law.





MARIO SOARES: TRIBUTE TO AN OCEAN EXEMPLAR

Mario Soares, former President of Portugal, socialist, statesman, educator, political prisoner, exile, bibliophile, gourmet, and cultural enthusiast, died this month at the age of 92. Soares was a man of enormous spirit, moral sensibility, verbal persuasiveness, and big ideas. He was a mid-20th century statesman of great imagination, energy, and fervor, although his reputation may have been somewhat limited to Portugal and Europe where he was a continuing political presence long after he left electoral politics.

He stood in courageous opposition to the dictatorial rule of Antonio Salazar, was first arrested at age 19, followed by several further arrests, three-years in prison for his opposition to Portuguese colonial occupation, five years in exile, served as opposition in the legislature, led the bloodless “Carnation Revolution” in 1974--civil unrest characterized by flowers placed in the gun barrels of the military and police--and, in 1976, was the first popularly elected prime minister, thereafter president, of his country in more than 60 years.

What was left out of his NY Times obituary, however, is perhaps his greatest contribution to the 21st century. In 1998, Soares convened two independent groups of

experts, scientists and politicians, independent of the United Nations, to address what he believed were the most compelling questions for the future: the sustainability of the world ocean and the equitable availability and distribution of fresh water to the citizens of the world without which they, and what he knew as civilization, could not survive.

In that year, the Independent Commission of the Future of the Oceans met several times to produce what, in my view, remains still the most prescient statement of policy requirements and recommendations to guide the international community for the preservation of ocean resources, not just species and habitat, but all the ocean connection to climate, food, water, energy, health, trade, transportation, finance, employment, security, policy, governance, coastwise development, and the preservation of cultural traditions and individual freedoms. There have been successive attempts at similar plans but none of them lived up to or sustained their further intention and objectives. The Commission Report was entitled “The Ocean, Our Future;” among its many recommendations was “the creation of a World Ocean Observatory, an online place of exchange for ocean information and educational

services”, of which World Ocean Radio is one part.

The second commission was no less ambitious and effective. Calling itself The Committee for the Global Water Contract, it established a framework for worldwide understanding, access, distribution, and protection of fresh water as “an inalienable individual and collective human right.” The Global Water Contract is based on the premise that “water is a vital good, which belongs to all the inhabitants of the Earth in common. None of them, individually or as a group, can be allowed the right to make it private property. Water is the patrimony of mankind. Individual and collective health depends upon it... There is no production of wealth without access to water. Water is not like any other resource; it is not an exchangeable, marketable commodity.”

The reports were similar in their calls for citizen participation in decision-making at all levels of government; partnership, cooperation and mutual respect for shared needs of a most essential resource; and specific goals and organizational framework for a collective treaty, best management practice, modernization of public, not private, systems, a moratorium on dams, curtailment of industrial waste and other water polluting

activities, and a “manifesto” that can be adopted by individuals, nations, and governments to guide the protection and availability of the finite water on earth for the benefit of a burgeoning population.

What is explicit in both these commission reports and recommendations is the understanding that the ocean and fresh water are one continuous natural system, from mountaintop to abyssal plain, with social, financial, political, and cultural meanings and connections

worldwide. What statesman looks that far into the future? What should be his legacy even beyond flowers in gun barrels and democratic principles? What Soares must be remembered for is his global vision and call for specific international action to address the ocean/water continuum—the single, most important challenge to community survival, peace, and justice in our time. You may now rest, Mr. President, but in your name the rest of us must not.



Mario Soares, former President of Portugal, organized the Independent World Commission on the Oceans to create an agenda for the sustainability of the oceans. The final report, *The Ocean Our Future*, calls for an internet-based ocean observatory to bring together relevant information about the health of the ocean. The World Ocean Observatory is the realization of that recommendation. Soares passed away in January of 2017.





HEARTS IN THE ICE

Two women are currently embarked on an unsupported exploration in the Arctic: 270 days at the Bamsebu trapper's cabin in the high north. Hearts in the Ice is a citizen science initiative that Sunniva Sorby and Hilde Falun Strom undertook in August 2019 as a means to create a global dialogue around the changes in the Polar regions that impact us all.

I am an armchair explorer. Suffice it to say that I have awe and respect for those who attempt to extend our limits and conventions in any direction. As a child, I read fictional and historical adventure, and I marvel still at the accomplishments of those who in the pursuit of knowledge explored the outer reaches of our physical and psychological geography. Survival was not always certain, but its probabilities were always enhanced by knowledge, prior experience, and planning. One such expedition, for which the World Ocean Observatory participates as an advisor and sponsor, is Hearts in the Ice, a project created by two formidable women: Hilde Fåln Strøm from Norway and Sunniva Sorby from Canada who, in 2019, will inhabit the remote, historic trapper's cabin Bamsebu in the High Arctic, at -78°N. in Svalbard, Norway, located 140 km away from the nearest neighbor, not counting the polar bears.

For 9 months beginning in August 2019 Hilde and Sunniva will live at Bamsebu where there is no running water or electricity. 270 days, 90 days of complete darkness, where they will serve as citizen scientists, collecting data for existing research being conducted in the Arctic. The project will serve as a platform for

global dialogue and engagement concerning the changes we are experiencing in the Polar Regions which impact the world and what we all, individually, might be able to do about it. Life at Bamsebu will be broadcast and published via Iridium satellite through social media to scientists, school children, adventurers, and interested citizens from around the world. The World Ocean Observatory will extend their reach through regular updates to our audience through our millions of visitors and followers on social media.

These are two very competent women. Hilde has inhabited the Arctic her entire life. As wife, mother and grandmother, she has lived and worked in Svalbard for 23 years. Suniva's experience has been mostly in the Antarctic. She was a member of the historic first Women's South Pole Expedition in 1992/3, leader of the first Canadian Woman Expedition -- Greenland Crossing in 1999, and leader of the first Canadian Woman Expedition George Island Crossing in 1998. These women are at home on the ice.

During their stay, they will undertake several citizen science research projects:

1. Provide measurements, observations and data to The Norwegian Polar Institute and The Norwegian Meteorological Institute.
2. Analyze the influence that the Gulf Stream has on the west coast of Spitsbergen through The Scripps Institute of Oceanography.
3. Take observations for NASA that will help their satellites better understand how clouds assist in the overall changes in our climate.
4. Collect as much plastic trash as possible from the area and neighboring beaches.
5. Field test cutting edge technology in one of the world's most extreme environments—from solar and wind energy, satellite communication, to electric snowmobiles.
6. Discover how to minimize their carbon footprint in the most demanding conditions as a demonstration of alternative methods and inspiration for others to do the same.

They will do science, live successfully without support, and invite us to into their home and activities in the distant, inaccessible High North. This is a

unique opportunity for all of us to participate and to learn. So, all you armchair explorers, teachers and students, and everyone interested in knowledge and adventure, let's share their experience, send our support, follow the project on heartsintheice.com, on the worldoceanobservatory.org and social media. Join with Hilde and Suniva in a spectacular place apart, in the fullness of wilderness and Nature, and in the spirit of inquiry and inspiration to be found in the ice, in the heart of exploration.



The first all-female overwintering project in Svalbard, Norway will survey rapid climate change escalation. *Hearts In the Ice* project founders Hilde Fåln Strøm and Sunniva Sorby are on a nine month expedition from August 2019 to May 2020 in the High Arctic of Svalbard, Norway.



THE BILLION OYSTER PROJECT

The Billion Oyster Project, a program of the Harbor School on Governors Island in New York City, launched a project to revive the defunct oyster populations through an ambitious goal of restoring no less than one billion oysters to the harbor.

When one thinks of oysters, one may think of Rockefeller and champagne, as a kind of shellfish metaphor for wealth and extravagance. But there was a time, not so long ago, when the oyster was poor man's subsistence food, cheap, available and plentiful, and eaten more often than not because one could not afford anything else. Native peoples thrived on oysters, and working class people ate oysters and crackers by the bucket-load with beer as a cheap repast.

New York Harbor and the surrounding wetlands of New Jersey were once prime ground for oysters and the notorious Fulton Fish Market was piled with many

varieties either local or imported from the waters further north in New England or further south in the Chesapeake Bay. The oyster shells were recycled, gathered and redistributed to coastal areas where the spat or seed took hold and began to grow another oyster in a perpetual natural cycle of sustainable plenty.

But whether as an accompaniment to champagne or beer, the certain supply suddenly dwindled as the coastal, brackish water where the oysters lay became polluted with waste water and chemicals and oil residue and poisons that destroyed the seed grounds and beds, the supply and demand for

a marine food that had suddenly lost its viability and market. The water in New York Harbor and the surrounding rivers and streams was simply filthy; no one would drink it, no one would swim in it, and certainly no one would consume shellfish that had been immersed in its toxic flow. It seemed possible that an ensuing generation might not ever know what an oyster was or its exquisite salty taste.

In the 1970s, when environmental awareness began to take hold in the United States, the public, through legislation like the Clean Air Act or Clean Water Act, demanded a new attitude toward water for drinking and health rather than for industrial use or sanitation. Conservation, management, purification, treatment, legislation, and enforcement – all were applied to raise public awareness, to demand changed behaviors, and to expect some semblance of clarity and cleanliness in their drinking water and watersheds. But no one expected that New York could change, just as no one expected that the smog-infested air of the industrial Midwest could change either – and yet both did as a result of political will and responsive governance.

Today, in New York Harbor, an innovative, theme-based high school, funded by the William and Melissa Gates and other progressive foundations, saw the opportunity to organize its curriculum around maritime history, marine science,

and marine vocational skills as a context for teaching and learning that was authentic, experiential, and inspiring. The school was first hosted in the South Street Seaport Museum in Lower Manhattan, grew and moved to Brooklyn, and then became the central educational activity on Governor's Island, the former U.S. Coast Guard headquarters in New York Harbor. Called The Harbor School, this educational experiment has now proven its value, growing in size and stature, and placing its graduates in jobs, often marine-related, as well as college and the maritime academies in the United States and elsewhere.

As a challenge to its purpose both as an educational and community institution, the Harbor School invented the Billion Oyster Project, an ecosystem services initiative of the New York Harbor Foundation, that would engage its students in a hands-on activity to reconnect the harbor to the 30 million people living within its vast urban watershed. The students would exploit the new cleanliness of the water by reviving the defunct oyster populations through the ambitious goal of restoring no less than one *billion* oysters to the Harbor. And so they have begun through aquaculture study, seeding and growing, restaurant promotions, shell recycling, featured markets, summer camps, fundraising events, and volunteer efforts, involving to date over 3000 students and planting some 16 million oysters for

ecosystem services since the project began in the polluted Gowanus Canal in 2006.

As a community organization, an educational experiment, and an expression of new sustainability-based values that will guarantee restoration and survival of this and other important sources of marine protein, the Harbor School demonstrates how learning can be effective and useful and how "citizens of the ocean" of any age can join together in Nature to build better lives for ourselves and better places to live alongshore.





THE LEGACY OF JACQUES COUSTEAU

Every action in the name of the sustainable ocean counts, but what can we do differently, or more, to inspire the succeeding generation to the recognition and commitment and action that was engendered by the legendary Jacques Cousteau?

Family, colleagues, ocean activists, and even the United States Congress recently celebrated the centennial of the birth of Jacques Cousteau, the French inventor, oceanographer, film-maker, and advocate for the ocean who died in 1997 but left behind a curious legacy of conflicted organizations, competing wives and children, and committed, sometimes disappointed individuals whose knowledge of the ocean and the need for its understanding and care was formed by his television programs, films, and powerful, charming persona.

A few years ago, I had the privilege of attending a reunion of the early members of Team Cousteau -- the writers, filmmakers, and crew of *Calypso*, the converted minesweeper that was the base of operations for the production of "The Undersea World of Jacques Cousteau" that in the 1960's and 70's brought brilliant and alien access to submarine habitats and creatures to millions of armchair

viewers and to a significant number of today's ocean scientists and educators, myself included. The party went through the night, with myriad stories of danger, disorganization, surprise, and fun inspired by the man's determination and spirit. While these veterans had all moved on to very successful careers after and elsewhere, it was clear that those adventures remained at the core of who they were and what they believed in.

After Cousteau's death, things deteriorated. *Calypso* and her wind-powered successor, *Halcyon*, became horror stories of neglect, and The Cousteau Society, once one of the largest environmental organizations worldwide, declined and fragmented. Today, the Cousteau legacy is advanced by a much-diminished Society, split between the United States and France, managed by his widow, Francine, with her son, Pierre-Yves, who are collaborating with the National Geographic Society on ocean conservation films and

mobilization of Scuba divers to be active advocates for the ocean. There is also an announced initiative for a 9 million Euro restoration fund to restore the ships to operating condition. Jean-Michel Cousteau, son of the first wife, is the President of the Ocean Futures Society, an accomplished and successful filmmaker himself, and a peripatetic ocean advocate who recently appeared in Louisiana with football stars Drew Bledsoe and Troy Aikman to endorse *Ozonix*, a non-chemical, large volume oil from water removal system owned by Ecosystem Energy Services in which the two athletes are investors. Jean-Michel's children, Celine and Fabien, are also involved working with their father: moreover, Celine is a spokesperson for the Clean Up the World Campaign, promoting voluntary clean up of local environments; for *Too Precious to Wear*, a coalition of fashion designers advocating against the use of coral for jewelry and home design; and for *La Prairie*, a Swiss cosmetic company with a line of

Advanced Marine biology creams; while Fabien is a founder of *Plant-a-Fish*, an organization working to revive aquatic life around the world -- oysters in New York Harbor, turtles in El Salvador, mangroves in south Florida, and coral in the Maldives.

Not long ago, at a multi-generational family gathering, I asked the 25 or so people around the table if they had heard of Jacques Cousteau. Those over 55 definitely had; the others, mostly teenagers and twenty somethings, definitely had not. This anecdotal measure does nothing to diminish what Cousteau gave to so many, and what his family is continuing to do in his name. But it does put into question the relevance and efficacy of focus more on the man than the message. As a motivating force, Cousteau was undeniable and without equal. Every action in the name of the sustainable ocean counts, but what can we do differently or more to inspire the succeeding generation to the recognition and commitment and action that was engendered by Cousteau? How do we generate a comparable force today? Where is the Cousteau for our time?



Captain Jacques Cousteau
June 11, 1910 - June 25, 1997
Through more than 115 television films and 50 books, Cousteau opened up the world ocean to millions of households worldwide. In recognition that it would take an organized effort to protect the planet, he created The Cousteau Society in 1974. Aboard his former mine-sweeper *Calypso*, Cousteau's adventurer's soul was won over by the ocean and he made it his life's work to share the wonders of the sea to the world.





THE EARTH LAW CENTER

Law brings order to chaos. We have international treaties as agreements between nations. We have legislated statutes that provide structure to civil behavior. We have regulations that counter abuse. We have contracts that define terms of exchange. We have moral laws that are powerful guidelines for human conduct.

Environmental law pertains to all these categories. And we have many organizations, and individuals, to write, analyze, promote, and challenge others, using the law as a fulcrum for innovation, equity, and justice. More and more we see environmental conflicts restoring to litigations and judicial proceedings for resolution. In the laws we must trust if we expect to retain our rights in a civilized society.

What does the word “rights” actually mean? A search through *Black’s Law Dictionary* left me overwhelmed and dissatisfied, proof of my Father’s judgment that his profession was one I had best not pursue. Here is the clearest general definition I could find: “Rights are legal, social, or ethical principles of freedom or entitlement; that is, rights are the fundamental normative rules about what is allowed of people or owed to people, according to some legal system, social convention, or ethical theory.” Note the assignment to people exclusively, a fundamental assertion of humankind as the epicenter of social interaction, all other circumstance excluded. But that social interaction relies on Nature as its source and supply for living: for air, land, and water,

not just as gifts for the taking to exhaustion, but as loans for the sustaining of life and the repaying of that debt so that life may endure.

Thus, today, to defend the rights of Nature is an anomalous and courageous endeavor, out of normative context, demanding that we examine our historical and present values, structures, and behaviors to change them toward a new system of laws that is now essential to human survival. Survival? Yes, it does seem that essential and urgent to me.

The World Ocean Observatory advocates for the conservation of the ocean/freshwater continuum as a scientific, political, financial, cultural, and moral imperative, and one of the best agents for

such purpose is the Earth Law Center, based in New York, which addresses the innovative, revolutionary concept that Nature, as ecosystem, just as people, should have the right to exist, thrive, evolve, and assert accepted rights for protection by law – a right that would accrue to the benefit of everyone on Earth.

Earth Law divides its work between river and land rights and ocean and coastal rights to protect these systems from climate change, contamination, invasive species, destructive exploitations, and detrimental human intervention through various specific strategies in many places around the world. Its programs involve the codifications and declarations of rights, initiatives in the US, Africa, South America, Asia, and elsewhere. Earth Law advocates by educational outreach and training, creating and promoting legal reforms in specific locales and situation, at the United

Nations, and through legal publications and training for young lawyers who are drawn to this necessary transformation of policy, governance, engagement, and protection of Nature. Earth Law has inserted itself into the public dialogue through authoring laws and resolutions in certain communities, amicus briefs and comment letters in national and international cases, speeches and testimony in conferences and public hearings, book chapters and journal articles, educational videos, and the preparation of a new law school textbook to expand “critical analysis of legal solutions to problems that threaten Earth as a human habitat, presenting sources of study that include American and international court cases; International Charters and Declarations; local, national, and international laws; jurisprudence; indigenous peoples’ laws; animal rights; guardianship; and public interest litigation strategy. It is a complicated but very effective

agenda for a small but very successful endeavor.

My personal thoughts on these matters take me to the idealistic notion of “ethos” defined as “the fundamental character or spirit of a culture; the underlying sentiment that informs the beliefs, customs, or practices of a group or society; dominant assumptions of a people or a period.” Is it not then the highest goal for today; to establish a system that affirms the rights of Nature as the core principle in a new global ethos revealed by a fresh expression and application of reformed beliefs, customs, and practices that must become the dominant assumption of our time?



Lighthouse Projects

are initiatives that document and renew local knowledge, skills, and values associated with the marine environment. These initiatives, achieved by small organizations and individuals worldwide, show great variety. From conservation and cleanup to mangrove restoration to small island nations, all rely upon community participation, exchange between generations, and the synergies among science, humanities, arts, social advancement, and sustainable development.

We have many examples of lighthouse projects on our website (worldoceanobservatory.org/lighthouse-projects) and many other examples can be found by visiting the UNESCO (United Nations Educational, Scientific & Cultural Organization) website: en.unesco.org.



1. The Polar Code

Preparing for increased maritime traffic and the risks involved for a highly vulnerable natural ecosystem.

2. Three Arctic Roads

Linking the Arctic's indigenous peoples to economic opportunity and affordable goods and resources.

3. Russia and the Arctic

Russian involvement and investment in the Arctic continues to grow at a fast pace. What are the consequences for the region?

4. A Letter from Nunavut

Premier Taptuna of the Arctic territory of Nunavut directed an open letter to the candidates of the 2015 Canadian election.

5. The Ongoing Race for Arctic Oil

Governments around the world are doubling down on the search for oil, even as the world appears ready to move on.





THE POLAR CODE AND THE FUTURE OF THE ARCTIC

According to its mission statement, the International Maritime Organization is “a specialized agency of the United Nations and the global standard-setting authority for the safety, security and environmental performance of international shipping. Its main role is to create a regulatory framework for the shipping industry that is fair and effective, universally adopted and universally implemented.

Shipping is a truly international industry, and it can only operate effectively if the regulations and standards are themselves agreed, adopted and implemented on an international basis. And IMO is the forum at which this process takes place.

IMO measures cover all aspects of international shipping – including ship design, construction, equipment, manning, operation and disposal – to ensure that this vital sector for remains safe, environmentally sound, energy efficient and secure.”

When faced with any management challenge, it seems a good thing to define goals and objectives, organize and clarify procedures, and begin to design the specific steps to be taken, anticipating the

questions, providing the answers, and putting forward the regulations and reviews for implementation of response. We often complain of such structures as they are typically embodied in vast, often faceless bureaucracies, dense manuals of requirements, rules for inspections and evaluations, additions and revisions, often seemingly tyrannical even when realized and justified for the public good. When we think of “Brussels” or “the Beltway” we think of such agencies and sometimes recoil.

But in fact such responses are the inevitable complicated and specifically detailed requirements necessary to deal with equally complicated and specifically detailed circumstances. Let me give you one example, the recently released IMO text for a new Polar Code to govern all aspects of shipping in the Arctic and Antarctic regions, a situation rapidly changing as a result of melting sea-ice and the potential opening for polar waters to increasing maritime exploitation and endeavor. The purpose of the Code “is to provide for safe ship operation and the protection of the polar environment by addressing risks present in polar waters and not adequately mitigated by other instruments of the Organization.”

It is an astonishing document. The Contents include Polar Water Operational Manual, Ship Structure, Subdivision and Stability, Watertight and Weather tight Integrity, Machinery Installations, Fire Safety and Protection, Life-Saving Appliances and Arrangement, Safety of Navigation, Communication, Voyage Planning, Manning and Training, Prevention of Pollution by Oil, Control of Pollution by Noxious Liquids in Bulk, Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form, Prevention of Pollution by Sewage from Ships, Prevention of Pollution by Garbage from Ships, and various sections and appendices providing additional guidance for the implementation of these various standards and requirements. Each of these chapters is further detailed down to minute specifications, planning documents, inspections, and licensing enforcement.

In a Preamble, the Code acknowledges various limitations: for example, “that the polar water impose additional navigational demands beyond those normally encountered...in many areas chart coverage may not currently be adequate for coastal navigation” or “that coastal communities in the Arctic could be...vulnerable

to human activities, such as ship operation.” In effect, the document addresses the most basic technical engineering standards to diminish risk of accident for ship operation in an uncharted navigational area and a highly vulnerable human and natural ecosystem but requires no capacity for rescue or environmental response to error, accident, or disaster. I cannot argue with the purpose of the Code, its thoroughness, or specific recommendations (down to pocket knives and extra batteries in the survival kits); it is all good, prescient, and actuarially responsible albeit theoretically in advance of what may be increased ship operations in polar waters to come.

But it seems to me fundamentally lacking by not also requiring the operational preparedness demanded by the possible failure of the Code to anticipate all risk taken by ships in these waters at all. Should we really allow vessels passage into water that has no comprehensive navigational aid based on fully surveyed channels? Should we allow such passages with no equally detailed system for emergency response? Should we allow for any risk of pollution by oil, sewage, or other noxious substances with no established capacity or plan in place for immediate reaction, access to an accident site, systematic cleanup material pre-placed,



mitigation technology available and appropriate to severe polar conditions, assignment and acceptance of responsibility clearly stated, adequate and comprehensive insurance, environmental protection bond or other financial guarantees secured, defined legal obligations of ship operators, and judicial procedures and jurisdictions established to adjudicate the inevitable liability disputes? Should not these questions be asked and answered before a single

ship, meeting the Polar Code or otherwise, operates in polar waters? Is the IMO the agency for such deliberation? If not, who is?





THREE ARCTIC ROADS

Since 1974, two roads have been carved from the Arctic landscape: the first to connect oil fields in the north to consumers in the south; and the second, opened this year, to connect Inuvik to Tuktoyaktuk. This second project, more of a local endeavor, links the land's indigenous peoples to economic opportunity and affordable goods and resources.

The Arctic is distant and impenetrable. Its place in the world, like its sister pole to the South, is to be apart. The people who, uniquely, inhabit the north have long lived within parameters of separation, from a world history that has unfolded manically below them, a stasis frozen in time and indifferent to the noise of civilization. In that vast silence, over centuries, they have adapted and devised a wisdom of how to live in harsh places. Theirs in an inner-directed society, based on survival; with animals enduring there alongside, providing, through perseverance and good hunting, food, water, energy, clothing, medicine, and other materials by which to shelter and thrive.

A 2017 report on transportation prepared by the Inuit Circumpolar Council of Canada is entitled *The Sea is our Highway* and argues unequivocally “that life in the Arctic is dependent on movement, freedom that enables inhabitants to move and exploit the richness to sustain generations. No one can argue that it was, and remains,

nothing but a hard life, but it was their life celebrated by achievement and rich cultural traditions passed through generations. In essence, the sea ice was the first Arctic road down which this history travelled.

The larger world found the place apart nonetheless – the arrival of explorers and scientists who appropriated their findings for themselves in the form of knowledge exported to the lecture halls and natural history museum of Europe and the United States. These were followed by the exploiters, looking for wealth as gold or oil or fish, indifferent to social consequence in the intruded places.

The 1974 construction of the Alaskan Dalton Highway that connected the oil fields of the Arctic to the processing and consuming machines to the south was a transformative moment. The engineering perseverance of building such a link across such a vast and unwelcoming landscape was well-compensated by the facility that followed:

tanker trucks, and pipelines, that descended from the north to the big consuming engine to the south, crossing and disrupting habitats, animal migration routes, and the stability of indigenous society. As with the Caribbean and Africa, these were de facto connections of colonization, designed to take away the spoils while bringing new values, co-opted governance, disease, drugs, alcohol, marginalization, broken communities, and disrupted traditions. All and all, this second road seems in retrospect much like a one-way street.

This year, a third road was completed by virtue of a 128-kilometer extension between Inuvik, an administration hub and largest town in Canada's Western Arctic, that reaches Tuktoyaktuk, a small village of 900 on the shore of the Bering Sea. But this one is perhaps different. According to *Cyropolitics*, a very informative series of blog entries by Mia Bennett, an author and dedicated Arctic observer, that through her conversations with the residents

of these towns, “it became clear that the...highway is, at its heart, a local project. The new link... is a result of years of tireless, strategic lobby by members of the Inuvailuit community, one of the indigenous peoples living on the lands that the highway cuts across.” She suggests “their project was really about building a road between two communities in order to provide much-needed jobs, stimulate economic activity, and hopefully lower the prices of things like groceries and fuel.” The distinction here is that, while the funds and intentions might be defined by distant government aspirations, the actual road was supported, built, and used for the benefit of

the people who actually live in the region. But here's a cautionary note: with the possibility, yet again, of permitting oil drilling in the Arctic Ocean, we are faced with these constructs as “roads to resources” and all the good, and bad, that has been shown to entail. The saddest aspect of this story of Arctic roads is the present day rapid melting of the sea ice, the first road that connects across the Arctic in multiple directions and multi-layered dimensions of meaning. No matter the success of roads two and three, if the first road is gone, how much will be lost, and how can those people survive in a place now again apart?



Crews work on the Tuktoyaktuk end of the Inuvik to Tuk all-weather road. Credit: James MacKenzie, Dept of Transportation (Transport Canada)



RUSSIA AND THE ARCTIC

Russia's history in the Arctic and their present and future interests are centered primarily on the extraction of oil and mineral resources and they show little concern for the negative outcomes from increased exploitative activity.



KAMAL, a Russian Arktika-class nuclear-powered icebreaker operated by Atomflot.

It is often difficult to envision the harsh realities of certain actions. Sea level rise, for example, remains a theoretical consequence, visualized by popular films or animations, but hard to perceive and understand just looking at the coming and goings of the tide.

But there is one phenomenon that is definitely visible, measurable and tragically illustrative of how our behavior on land can have catastrophic results in the ocean: the dead zone, large coastal areas that are so polluted, so starved of oxygen that they can no longer sustain any marine life. A study published in the journal *Science* documented more than 400 such hypoxic dead zones, a number that has doubled every ten years since the 1960's.

The cause of this phenomenon is primarily nitrogen-rich nutrients from crop fertilizers that by way of run-off into streams and rivers ultimately end up in coastal waters. Scientists attribute dead zones to a process that begins when nitrogen from agricultural run-off and sewage stimulates the growth of photosynthetic plankton which decays and sinks to the bottom where they are decomposed by microbes that consume large amounts of oxygen. As oxygen levels drop, most animals that live on the bottom cannot survive. Thus, according to study principal author, Dr. Robert J. Diaz from the Virginia Institute of Marine

Science at the College of William and Mary, "dead zones tend to occur in areas that are historically prime fishing grounds. Seasonally, low oxygen levels wipe out fish, shrimp, crustaceans, and the smaller organisms on which they feed, in the bottom waters in places like the Gulf of Mexico, Chesapeake Bay, and the Baltic Sea. Among other places where dead zones have grown in recent years are coastal China and the Kattegat Sea, where the Norway lobster fishery has collapsed. The zones have also cropped up unexpectedly in pockets off the coast of South Carolina and the Pacific Northwest. The dead zone in the Gulf of Mexico in summer 2008 covered a swath nearly the size of Massachusetts.

What possibly can be done? According to marine ecologist Robert Howarth of Cornell University, the best way to reverse the phenomenon in the Gulf would be to incentivize the farmers in the upper part of the United States to plant crops like winter wheat, rather than leaving their fields fallow after the fall harvest. Much of the nitrogenous fertilizer that would normally get washed into waterways by spring thaws would instead be absorbed into winter grain crops, a measure, if uniformly implemented, that could all but eliminate the Gulf dead zone, a major first step toward regeneration of degraded marine life. Simple? Only if local agricultural interests

can be made to see that such an effort benefits not only them but also other interests beyond their own, to understand that their collective action will also affect the lives and livelihoods of farmers of the sea hundreds of miles south of the American heartland and change what otherwise will continue to poison the bountiful ocean.





A LETTER FROM NUNAVUT

In advance of the 2015 election in Canada, Premier Taptuna of the Arctic territory Nunavut wrote an open letter to the candidates. In it, he asked each to outline their vision for the future of the Arctic.

In October 2015, Peter Taptuna, the Premier of Nunavut, the northeastern territory that borders the Canadian Arctic, wrote an open letter to the four candidates in the forthcoming Federal elections. The letter posed questions in six major areas of interest:

1. What will your party do to ensure Nunavut's economic development continues to grow and this growth benefits the people of Nunavut in a sustainable and environmentally friendly manner?
2. What are your party's priorities and plans to address our infrastructure deficit?
3. Is your party prepared to work with the Government of Nunavut to develop a long-term plan that will address and fund Nunavut's housing needs?
4. Does your party support a devolution agreement with Nunavut?
5. Does your party support a

strengthened language services agreement with Nunavut and the resources to enable a successful heritage center?

6. Is your party committed to developing a strategic climate change plan for the Arctic? Will you ensure that the three territories are involved and have real input in such a plan? When would you, as leader, begin and have such a plan in place?

The letter was written, no doubt, to publicize the long and unresolved discussion between the Harper government and the indigenous peoples of Canada, to put the candidates on the spot regarding the future, and to perhaps influence a vote that at the time seemed likely to favor the Conservatives whose policies, focused mostly on Canadian sovereignty in the region, in conflict with Russia and the United States, and an industrial development of the Arctic to include road-building, oil and gas extraction, increasing fishing, and the opening of shipping lanes across the Northwest Passage.

Harper's slogan regarding the Arctic was "Use it, or lose it," thus I suspect Premier Taptuna was not optimistic that his questions would affect the election or change the debate, or even generate a response.

But, change did occur, radical change with the stunning election of Trudeau who had clearly advocated against the Harper emphasis on tar sands energy and pipelines and was apparently more sympathetic about the Nunavut issues raised. Trudeau has now been in office a few short months, and the specific plans he may have for the Arctic are not yet forthcoming.

Taptuna's letter, however, revealed that his concerns for the people he represents, for those who have lived for generations in the hard and remote places of the Arctic, are directed toward development that is environmentally sustainable and benefits residents in the context of local employment and business opportunities, not federal royalties or corporate profits.

image credit
Social Economy Hub | Nunavut
Summit on the Social Economy



Taptuna writes of an "infrastructure deficit" -- outmoded and inefficient power generation, lack of runways for air access, and no fiber optic connection to link these communities through the Internet to the rest of the world. He points further to a crises in sub-standard and limited housing, inadequate water and sewage services, and basic educational programs that do not come close to the communities' needs. He calls for a Nunavut-based university to provide higher education and vocational training. He points to the decline in funding to support Inuktitut, the indigenous language of the Inuit who comprise 85% of Nunavut population. He argues for a place to store, display, and interpret indigenous art and historical artifacts, a heritage center

comparable to those that have been built and are government-subsidized in every other part of Canada.

Nunavut is also the only territory in Canada that does not control Crown lands and natural resources, and thus has no say in policy and decisions made regarding transfer, licenses, royalties, and other benefits derived from this exploitation by others. A devolution agreement, creating a structure whereby the Nunavut government can participate in the development decisions has been under consideration for some time, but negotiations were suspended pending the outcome of the election.

All these questions and uncertainties pertain directly to similar questions regarding Arctic resources and populations all across the north—Canadian and otherwise. These are global ocean issues, and the old parameters, along with the old perpetrators, may no longer be appropriate and useful. It may be that now, at long last, Premier Taptuna's letter from Nunavut merits a differently articulated response.





THE ONGOING RACE FOR ARCTIC OIL

The pursuit for oil continues, even as many alternatives emerge and investments are displaced.

Oil, and the spoils of oil, are an ongoing siren song of temptation, and, even with all the accidents, resultant pollution, environmental damage, and impact of foreign investment on local economies, the pursuit continues. Oil remains an enormous percentage of financial return for governments and corporations in Saudi Arabia,

Russia, the United Kingdom, Norway, and the United States, where the critical supply remains at the heart of economic viability and growth. For years, oil in the Gulf of Mexico and Alaskan waters has dictated tax policy, local development, and regulatory controls, accidents and spills notwithstanding, even as the

global market price declines and alternative energy technologies emerge to displace new investments and future returns.

Paradox abounds. Saudi Arabia announces a major new strategy to switch energy generation from oil to solar. Norway announces major social programs, new technologies, and other investment strategies looking beyond oil dependence. The United States vacillates from administration to administration, from subsidy and support for sun and wind energy innovation to a return to the old drill-baby drill sale of new licenses even in places where the practicality for drilling as already proven unfeasible and dangerous. Russian continues its own independent reliance on oil and gas as its major economic export even as geo-political leverage of that strategy declines.

In a recent article in *Ocean News & Technology*, a headline questions: "Is America Losing Out in Race for Arctic Oil?" The article describes the position of then-US Secretary of State Rex Tillerson, the former Chairman of Exxon-Mobil, quoting this statement:

"The Arctic is important today and it's going to be increasingly important in the future, particularly those waterways opened up. I can tell you that the U.S. is behind... all the other Arctic nations. The Russians have made it a strategy priority."

This statement echoes from decades past – the same indiscriminate focus on economic competition and strategic geo-political positioning, even as Tillerson's own government cuts from the budget supportive services, icebreaker construction, regulatory controls, safety standards, and other political agreements. And then there is the specter of the Chinese.

As technology advances, some of it is corrupted to serve this retro-spectral vision. Big data, machine learning, cloud computing, financed to private shareholder advantage at public taxpayer expense, is turned backward toward the search for new reservoirs of oil and gas in a complex calculation of who has the biggest reserves, who is going to control a world economy based on a bankrupt paradigm of growth at any cost until all the value is gone. Algorithms suddenly inform decision-making; automation removes the danger of the loss of human life in one of the most dangerous occupations on earth, regardless of the consequence of technical failure.

The capacity to respond and clean-up after accidents remains no more fully developed that it was before. The impact on local communities becomes greater with the loss of jobs and lesser as funds for social programs remain unavailable, allocated elsewhere. And so we enter another circle down, and down again into the fossil fuel whirlpool, one turn further toward

loss of control over any aspect of the destructive outcome with no concern for the future. It is at tragic entropic gyre without prescience or conscience.

These events are difficult and energy consuming to resist and counter. In autocracies such as Saudi Arabia and Russia, there is little room to oppose. In the European nations, there is political push-back. In the United States, the opposition is galvanized to fight in the courts of law and public opinion.

What a waste of human energy that is, when all that resource and resourcefulness could be invested in the clean technology that is to come, inevitably as the market rejects the illogic of vested interest and fear of change and adopts process and politics that leaves old world values, structures, and behaviors behind.



I GO DOWN TO THE SHORE

MARY OLIVER

I go down to the shore in the morning
and depending on the hour the waves
are rolling in or moving out,
and I say, oh, I am miserable,
what shall—
what should I do? And the sea says
in its lovely voice:
Excuse me, I have work to do.

Mary Oliver, *A Thousand Mornings*

Penguin Books, September, 2013

In “A Thousand Mornings” Mary Oliver visited the imagery that defined her life’s work, transporting readers to the marshland and coastline of her beloved home in Provincetown, Massachusetts. Oliver’s writings are open to the teachings contained in the smallest of moments, and explore the mysteries of our daily experience.

Mary Oliver, American poet and Pulitzer prize-winner, whose odes to nature brought her critical acclaim, died at home in Florida in January 2019.

1. Where Does the Water Come From?

The ocean lies at both ends of the water cycle, and its protection is essential for our very survival.

2. Water Security

With the water cycle interrupted on every level, what response is required to sustain life on Earth?

3. Water, Water Everywhere

Solutions to the global water crisis lie at the local level with small, incremental action.

4. War and Water

Wars waged around the world typically occur in the watershed, where true security lies.

5. Virtual Water

There are myriad ways that water consumption and use go unseen in our daily lives.





WHERE DOES THE WATER COME FROM?

It seems such a simple question, and the answer is known from our earliest science lessons when we are introduced to the water cycle and the global circulation system that is so essential to our well-being now and forevermore. Water evaporates from the ocean reservoir, captured in clouds and fog and rain, from which it descends to become ground water, seeping into the underground aquifer, or surface water distributed by lakes and streams. Some of the water is captured in ice as glaciers and high mountain peaks; some is retained deep in the earth, some perhaps pre-historic in its deposit, but there for now beyond our eager, sometimes desperate, digging and drilling.

All of it is finite in volume.

We know this cycle, and if we think about it at all, it becomes easy to understand the idea that the ocean where 97% of that volume is contained is the alpha and omega, the mouth and tail from this circle of sustenance. It becomes easy to see the “edge” of the ocean not at the boardwalk and beach, but rather at the distant snow-capped range where begins the long, convoluted flow of water down and across the land until it reaches its

ocean origin...and the cycle begins again.

Essential to the sustainable ocean, then, is the protection and conservation of this fluid passage, the global hydraulics that can be compared to the circulation of blood through our bodies, themselves made substantially of water. Each of us is an ocean, with a comparable circulation, and a reliance on a healthy environment to sustain it. Extend the metaphor: if we treat those bodies with indifference, pollute them with excess and poisons, then we can expect them to succumb to obesity, disease, and collapse. If you think of yourself as the ocean, your family as the ocean, your community as the ocean, your nation as an ocean, then perhaps you will take the necessary steps to sustain the health of each of these many seas.

So, too, with the earth, and we return again to the geography of our living; the ocean, as I choose to define it, as a vast global system of interacting, infused water that extends from mountain-top to abyssal plain and connects us all – physically, financially, politically, socially, and spiritually.

I belabor this point because it

lies at the core of any strategy for change. It establishes the context for every decision that follows – the choice to conserve hillsides and watersheds, lakes, ponds, and rivers; the planning for different settlement and systems, for new construction and re-construction; the promulgation of new standards for economic development; the recognition of natural capital and new economic models as significant elements in the pricing of goods and services and the calculation of our gross national product; the re-engineering of the coastal zone; and the definition of new policies to maintain the quality of our air and water, to manage responsibly our ocean resources, and to govern the open ocean under an egalitarian and equitable set of international treaties and agreements that benefit us all.

I belabor this point because that without our understanding of this absolute, this measurable, undeniable fact of life, all our efforts may be for naught, all our strategies may be half-baked, all of our results inadequate. We cannot build a new society, hydraulic or otherwise, if we build it on a weak and corrupted foundation. We cannot change behaviors if we do not accept and assert new

core values. This clear and present understanding of the wisdom of Nature and the knowledge revealed can guide and protect us in our first steps toward sustainable practice and global renewal.

Where does water come from? That’s one question, and we know the answer, but here’s another, more difficult one: what will we do, who will we be, when that water has come...and gone?





WATER SECURITY

The crisis of water is an indisputable one, as evidenced by a public increasingly aware of the urgency of ocean and fresh water issues. With the water cycle interrupted on every level, what response is required to sustain life on Earth?

There are interesting signs that the public is awakening to the urgency of ocean and fresh water issues, to understanding the crisis of supply, degradation, and governance that has long been the purpose of World Ocean Radio and many other organizations concerned with these urgent challenges to our environment.

One such sign is the more and more frequent use of the word “security” in the context of water and ocean, a term that adds a peculiar emphasis that puts the issue to the front of the line, asserts a gravitas that must be addressed, and implies consequence more threatening and real than reports of climate change, glacier melt, sea

level rise, acidification, depletion of fish stocks, indifference to extant policy, failed enforcement of legislated regulation, and confused or insufficient governance. While we have been talking about these conditions for years, it has been difficult to penetrate public awareness in any meaningful dimension, the message lost in

the cacophony of contradiction, disaster, and diverting entertainment.

From the beginning, the World Ocean Observatory has declared its primary mission “to expand public awareness of the implication of the ocean for the future of human survival.” Survival – a stark term, a precise term, an urgent word that states the truth as life or death. On many occasions, that mission statement has been challenged as too extreme, too dire, too alarmist. I have always rebutted those comments as purposeful denial of overwhelming incidence and evidence, naïve response to the depth of crises known, unrealistic understanding of the extent and consequence of our indifference, and fearful unwillingness to accept and implement the change required to sustain the earth and to survive.

A stunning example may be found in a recent short article generated by ClimateWire and re-posted by Scientific American that points to the area around Lijiang, Yunnan Province, China, typically a heavy rainfall district, but where over the past four years precipitation has dropped by 70% to drought conditions that have already critically diminished agricultural and hydro-electric production, the productivity of local wells and aquifer, and, yes, the survivability of a provincial population of some 45 million that has grown 12% and quadrupled economic output per capita since 2000. In the face of that growth, according to the article, available water resources per capita have dropped by half.

“Yunnan is known as Asia’s water tower because many important domestic and international rivers start from here,” explains Duan Changqun, an ecologist at Yunnan University. “Drought means less water flows in the downstream, sending a blow to the ecosystem of other parts of China as well as South Asian countries.”

It is a vicious cycle: atmospheric circulation change affects rainfall, creates drought, hydro-electrical distribution locally and regionally, collapses the freshwater fish stocks, negates the \$1.8 billion tourist industry and limits household water supply in the capital, Kunming, to four hours a day. Local media at \$4.2 billion has estimated the economic loss since the drought began in 2009. Add to that the retreat of the local glaciers, 70% of which are predicted to disappear by 2050 due to increased average temperature, and the extreme pollution of the remaining water by unregulated waste disposal, sewage, and fertilizer and manufacturing run-off, you have a truly toxic recipe that does not bode well for security or survival.

To solve the problem, the article suggests the Yunnan government is introducing water-saving technologies and proposes to construct “new water reserves of 3 billion cubic meters, a 30% increase in capacity, at untold cost, but it does not indicate from where than water will come.

So, this is an example of the water cycle interrupted at every turn: reduced glacial supply, no re-

generating rain, diminished aquifer, dry rivers, polluted reserves, collapsed economy, and catastrophic local and downstream consequences beyond provincial borders to other regions, other nations, to the coast and, finally, the ocean. It is a case of “hydraulic society” destroyed at every level by a conspiracy of human causes, all the essential value of water and its distributive, generative power dried up, poisoned, insufficient -- depriving individuals, businesses, communities, regions, nations, inter-nations of water, the most essential element of human life. And Lijiang is not the only example to hand. It is a matter of survival. And when you consider all this, add it all up and confront the integrated reality, IN-security is the word that comes to mind, and that does not bode well for anyone.





WATER, WATER EVERYWHERE...

The need for equitable and sustainable water practices and distribution is dire. Here we offer some solutions to the global water crisis--small, incremental local actions that will collectively make a difference.

We live in a water world, dependent on rainfall, groundwater circulating over land and through streams and rivers, and the aquifer beneath our feet. As we have mentioned many times before on World Ocean Radio, water is the most precious commodity on earth in that its supply is finite and limited in distribution, and it is required to survive in the same amount by every one of us every day, rich or poor, wherever we may be. Some would argue that water is a basic human right and we should establish policy and practice for its universal guarantee.

Thus, we rely on water as an essential component of health and well-being, a resource under constant threat by over-consumption, toxins and pollutants, and waste from industrial and agricultural production, sewage treatment, fracking, fertilizer runoff, emissions, chemical and other manufacturing, and the many other technologies that we have invented to support a developing world populated by some 7 billion worldwide, a number that is projected to grow by another 2 billion by 2030 – a date that is just not that far away.

We will only be able to feed this new world, not to mention the

millions today who already go hungry, if we cannot increase agricultural yields significantly and sustainably. Globally, rain-fed agriculture is practiced on 80% of cultivated land and supplies more than 60% of the world's food. According to Aquastat, the United Nations Food and Agricultural Organization's comprehensive website documenting water demand and use by country, "with so much of the Earth's water being used for agriculture, it's clear that an improvement of water management becomes key..."

Add to this situation climate change, increasing incidence and intensity of drought, extreme weather, depleted local water sources, corrupted water systems, and other factors contributing to soil infertility and erosion, reliance on more efficient irrigation and more sophisticated water management becomes more than imperative.

FAO cites a stunning example of the consequences of irresponsible irrigation practice in the Aral Sea, an environmental tragedy, when water from the Sea was withdrawn to irrigate cotton, reducing the annual flow by almost 85%. As a result, to paraphrase the FAO Report, sea level fell by 16 meters

between 1981 and 1990; 24 species of fish disappeared; local catch that once totaled over 44,000 tons per year and supported 60,000 jobs literally vanished; and toxic dust salt from the sea bed made the remaining water hazardous to drink; thousands left the area as environmental refugees while those who remained lost their livelihood. The Aral Sea is just one dramatic example of how water management transcends local practice and demands regional, national, and international planning and management of this declining resource if it is to be conserved for use by one, or a few, or all. If there is a single issue for the international community to agree on as an incontrovertible requirement for world peace, it may be this one: equitable and sustainable water practice and distribution regardless of other necessities and needs. Given the already extant examples of water conflict, both inside and outside many nations and regions, such agreement may be long in coming, if at all.

As with so many things these days, the solution may not come from such a grand design, but rather from small, incremental, local actions that will collectively make a difference. For example, farmers that switch from surface flooding to localized irrigation can cut their water use by 30 to 60% and increase yields of most crops by 100 to 400%. I once watched a Chinese farmer transfer a precise number of buckets from a rainwater catchment area onto a field laid

out slightly downhill and furrowed and barriered to distribute the water along efficient pathways to individual plants so that when the last bucket was poured at the top the last plant was fully watered below. It was effective, efficient, elegant, and wise.

In the end, we will turn to the ocean for desalinated water, when the population has grown beyond the projections, even the most enlightened methods of water conservation and use. But there is a critical time now, in between, and we must make the most of it for all the right reasons. We must not be wrong in this lest we find ourselves, too soon, faced with the quandary of *water, water everywhere, and not a drop to drink.*





WAR AND WATER

Each city lost or gained by rival factions caught up in the violence in the Middle East sits on a major river—the Euphrates, the Tigris, or their tributaries. The wars waged are being fought along a watershed. Despite air strikes, conflicting systems of law, and pursuits for oil, what really matters most is water-- that which enables the true security of the region and the world.



Image: The Euphrates River
Credit: NASA | by Robert Simmon, using Landsat data/EarthObservatory

Our time is fraught with war and water. The headlines confirm that for what seems like forever there has been conflict in the Middle East where sectarian rivalries, religious conflicts, the pursuit of oil, and the geo-political collision between economic aspirations and impassioned ideologies . Many thousands have died – children, women, men – in an endless time and place of conflict.

The most recent manifestation is the so-called Islamic State or ISIL, a particularly feral group of Muslim militants with the intent to re-establish the historical caliphate that once extended from the Mediterranean Sea to the Persian Gulf. Suddenly, everything reverts to air strikes, international outrage, and the possible return of boots on the ground.

I have been looking at the maps indicating where so quickly the ISIL forces seem to have taken control and wondering at their length and direction that extends from the northern border between Turkey and Syria southeasterly almost to the limits of Baghdad. The obvious explanation is that the extent of their success mimics the main highway that runs from Aleppo to the capital city. A larger segment of controlled territory is enclosed to the east by a similar route that connects Mosul south to Tikrit, Samarra, and Baghdad where the situation deteriorates into the ambiguity of warfare and shifting political ambitions.

But if you look closely at your atlas map of Syria and Iraq you discover an underlying revelation:

that those cities are placed and those highways run exactly along the course of several major rivers – the Euphrates, Tigris, and their tributaries – that originate in the mountains of eastern Turkey and descend to and past Baghdad where they empty at Basra into what ultimately becomes the Arabian Sea. In the vast, dry, unpopulated expanse of the region, this war is being fought down a watershed.

My map is also marked by numerous three-dot symbols that are used by cartographers to designate significant historical cultural resources, locating places called Zenobia, Dura Europus, Nimrud, and Nineveh, names that speak to the earliest human settlements in what the history books call “the cradle of civilization.”

Those rivers nurtured our beginnings, before Islam and Christianity, before conquest from elsewhere by imperialists following the trade routes to resources and connections beyond. There are other such symbols on my map – miniature drilling rigs signifying the major oil fields that fuel this war and all others – cultural icons of our modern time.

The irony here is that after all the tumult and shouting, after all the air strikes and beheadings, all the assertions of conflicting systems of law, all the moral justifications, the only thing that really matters is the water – to drink, to secure hygiene and health, to irrigate crops, and to sustain the communities regardless of sect or religious belief, to allow the descendants of those who lived in these places centuries before to continue and thrive.

The location of these cities and the caravan or highway routes between them are all testimony to the fact that for all time water has enabled the true security of the region. Take away the slogans and guns from these militants, let the people live, and the water will sustain them.

We speak often in these editions of the healing and unifying nature of water. Below Baghdad, along this same riverine watershed, there lies an enormous lake and swamp system into which all these waters flow, an area that has been home to so-called “marsh Arabs” who had thrived there for a very long time in what were very fertile conditions. In the 1990’s, as a strategic part of an earlier iteration of this present war, the area was drained by canals and dikes to isolate and destroy the residents by removing their shelter and livelihood. It became a desert like elsewhere, devoid of plant life and birds, of shelter and safety until, when through the efforts of a small activist group, the dykes were broken, the waters returned, the marshes filled, and life began there anew. It is a cautionary tale of how we might through the free and unencumbered flow of water build a home without senseless conflict, without terror and its collateral damage.





VIRTUAL WATER

Virtual water is the water we incorporate into our lives each day that is not listed on labels or calculated into price. When you begin to add it all up, the statistics are dizzying. We are in an age of increased demand and diminishing supply, even while energy extraction methods consume, remove, and contaminate billions of gallons of fresh water each year.

As we continue to work toward a fuller understanding of the presence of water in all aspects of our lives, we begin to look deeper into the hydraulic systems beyond the obvious – the ocean, the glaciers, the mountain ranges, streams, lakes, rivers, and wetlands – to the place where water lies hidden, unrecognized for its significance to our health, our diet, and our way of life. Of course, we know that we need – or at least the United Nations has established that we need – a minimum of 40 liters of fresh water per day to sustain our bodies to support physiological systems, hygiene, and the other mechanics of living successfully.

We know our bodies are approximately 65% composed of water, evident in our blood, our organs, our muscles, our respiration, our digestion, and even our tears. The UNESCO Water Civilization Center asserts that an individual will consume some 25,000 liters of fresh water in an average lifetime to “keep the organic structures and biological

functions in good working order.” We know these things, but we don’t always know their true value, until we become dehydrated and these systems begin to slow down and fail.

What we may not know so well is what is called “virtual water,” the water that lies “behind” things, that is used to produce almost everything we incorporate into our daily routines but is not listed on the label or calculated into the price.

The most obvious example is foodstuffs we consume, the amount of water that is used in production cycles to irrigate, wash, clean, and process the products on the supermarket shelves. UNESCO estimates that it takes, for example, 2,500 liters of fresh water to produce a hamburger, 1,000 liters for a liter of milk, 75 liters for a glass of beer, and 70 liters for that apple a day. A kilo of pork takes 4800 liters, of chicken 3700 liters, of citrus fruits 2000 liters. A kilo of coffee requires 21,000 liters, a single cup 150 liters, and that

does not include the steamed milk should you so choose a latte. Virtual water calculation can be applied to so many other things we use. For example, a kilo of cotton requires 19,000 liters of water to produce, a fact that translates into 8,200 liters for a pair of jeans.

Multiply that by all the cotton in all the clothes we wear and you have a virtual cascade. And then there’s energy required for the processing of the food and clothes and all the rest. According to The Energy Collective, all the increase in US energy production in 2010/11 can be allocated to the 27,000 shale gas wells drilled and hydraulically fracked, each requiring some 5 million gallons of water, amounting to some 135 billion gallons of water consumed and removed as result of contamination from the aquifer, the watershed, and availability for additional use. The number is astronomical, and that’s for just one year, in one nation, for one product in the energy mix. Then add the water required for plastic, packaging, chemical production, fertilizer, irrigation, manufacturing,

and all the other processes in our consumption-driven economy and lifestyle, and the number becomes beyond comprehension until, as with our bodies we become dehydrated, deprived of sustaining water, and these systems begin to slow down and fail.

There are so many examples and statistics you can drown in them. Here is one last: think of all the water lost when food is left on the plate, wasted, or processed foods extend beyond the use date and are discarded? We lose not just the water, but also the associated nutrition, the energy consumed to produce, the transportation cost of shipping from here to there, and the deficit subtracted from the global economy forever.

We are at that point, now. We are a planet crying out for water, and we don’t seem to hear the call. We are 7 billion persons on earth, increasing every day, demanding water as a right, as the supply is poisoned, wasted, and withdrawn from the global value calculation. That’s not virtual; that’s real.

We are what we drink, and without water, we are nothing.



How important is the ocean in today's world?

The ocean and humans are inextricably interconnected. Freshwater, food, Earth's oxygen, weather, transportation, energy, human health, and so much more: without the ocean, no human life on the earth would survive. Each week on World Ocean Radio we discuss various topics including ocean education, ocean literacy, scientific discovery, adaptive technologies, the consequences of pollution and industrialization, the latest on ocean policy and climate mitigation, and so much more.

World Ocean Radio is a weekly series of five-minute audio essays on a wide range of ocean issues. Available for web listeners, podcasts, and worldwide distribution through community radio stations and partners. World Ocean Radio offers a unique perspective on important and relevant ocean issues, ready to broadcast immediately. With the support of private and foundation funds, World Ocean Radio is available for syndicated use at no cost to college and community radio stations worldwide.



1. A Trophic Cascade

When top predator populations are removed from the food chain, dramatic changes in the ecosystem occur.

2. Arctic Fisheries Management

Fisheries worldwide are being depleted by overfishing and IUU. As a result, interest in an ever-expanding Arctic is growing exponentially.

3. A Cetacean Protection Challenge

Action to amend and expand the Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act.

4. Fisheries Crime

What efforts are being made to combat unreported fishing loss, and what is the cost to the global economy?

5. Inventing Fish

Introducing catch shares to establish incentives to promote the long-term sustainability of fish stocks, and the concept of 100% of the fish.



Shark fins drying in the sun cover the roof of a factory building in Hong Kong.
Credit: AFP



A TROPHIC CASCADE

Shark, manta ray, totoaba and bahaba are aggressively harvested from the sea for supposed medicinal properties and status. If certain endangered species do in fact contain medicinal value, are there not other, more supportive ways to meet demand without decimating supply?"

A trophic cascade is an ecological phenomenon triggered by the addition or removal of top predators and involving reciprocal changes in the relative populations of predator and prey through a food chain, which often results in dramatic changes in ecosystem structure and nutrient cycling. A recent article by Gwynn Guilford in the April 2013 issue of *The Atlantic* points to fishing practices in China as examples of trophic cascade resulting from the extreme over-harvest of sharks for shark-fin soup, several other species with high value as components in various Chinese elixirs and remedies, and the manta ray, also known for its medicinal qualities.

Shark-finning is of course a well known practice, the cutting of the fin and discarding of the rest, as the key ingredient in a recipe for soup that is especially prized by Chinese gourmets and those wishing to demonstrate their financial standing and

success through the consumption of a very expensive (and not particularly tasty) status dish. There have been several major public campaigns against shark-finning, promoted by active non-governmental organizations that have had some success in limiting the harvest, exposing the harvesters, and shaming the consumers. The *Atlantic* article points to two other examples, the bladders of totoaba fish found in California waters and a similar fish, the bahaba, native to Chinese waters, both believed to promote fertility. A bahaba is reported to have fetched almost \$500,000 on the black market, this for a species listed by the Chinese government as "protected" and thought by others to be nearly extinct. "Like the totoaba bladder and shark fins, gill rakers of manta rays – cartilage that filters the ray's food – are prized for their supposed medicinal properties," writes *The Atlantic*, "so much so that they fetch about \$251 per kilogram. The \$5 million trade in manta ray gill rakers – almost

all of which occurs in Guangzhou, in southern China – has depleted manta populations so severely that they were classified as endangered."

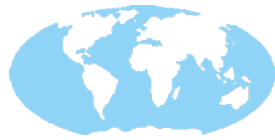
So what about this trophic cascade? What is happening here is that the dramatic removal of large predators at the top of the ocean food chain will have additional impact on the species below. As sharks are killed, their predators flourish and increase, with consequences that change the interaction between lesser species, and that alters the predation pattern and thus the relative population numbers, food chain structure, and ecosystem balance. The change at the top, the sudden disappearance of a major determining force, then results in changes below that further disrupt the existing order of the marine system.

Let's see if I have got this right. It seems silly to say so, but is it not true that this entire process is justified to provide virility/fertility medicines or status symbols

to consumers most probably ignorant of or indifferent to the consequences of their desires? Isn't it ironic that we can harvest one species to extinction in order to foster procreation in another? The Chinese can kill fish, deplete their own waters, waste an astonishing volume of protein, intrude on other nations' sovereignty, destroy coastal livelihoods on distant shores, deprive local tourism and economic development in struggling countries, lie, under-report, or otherwise game the system, ignore international quotas and agreements with impunity, and defy the concept of sustainability as a strategy for the future – all in the name of pleasure. Talk about your trophic cascade!

So who is the top predator here? In this case, it's the Chinese. But there are other examples, other responsible parties; it's any of us who sit at the top of the food chain and are able -- intellectually, financially or morally -- to support a system as absurd as this one. Where is the meaningful social value in this situation? If fish bladders, fins, and gill cartilage really do contain a cure for cancer, are there not other ways to meet the demand without decimating the supply?





ARCTIC FISHERIES MANAGEMENT

Human behavior on land has no more dramatic example of the catastrophic results in the ocean than the dead zone—large coastal areas so polluted by runoff and starved of oxygen that they cannot support marine life.

It is often difficult to envision the harsh realities of certain actions. Sea level rise, for example, remains a theoretical consequence, visualized by popular films or animations, but hard to perceive and understand just looking at the coming and goings of the tide.

But there is one phenomenon that is definitely visible, measurable and tragically illustrative of how our behavior on land can have catastrophic results in the ocean: the dead zone, large coastal areas that are so polluted, so starved of oxygen that they can no longer sustain any marine life. A study published in the journal *Science* documented more than 400 such hypoxic dead zones, a number that has doubled every ten years since the 1960's.

The cause of this phenomenon is primarily nitrogen-rich nutrients from crop fertilizers that by way of run-off into streams and rivers ultimately end up in coastal waters. Scientists attribute dead zones to a process that begins when nitrogen from agricultural run-off and sewage stimulates the growth of photosynthetic plankton which

decays and sinks to the bottom where they are decomposed by microbes that consume large amounts of oxygen. As oxygen levels drop, most animals that live on the bottom cannot survive. Thus, according to study principal author, Dr. Robert J. Diaz from the Virginia Institute of Marine Science at the College of William and Mary, "dead zones tend to occur in areas that are historically prime fishing grounds. Seasonally, low oxygen levels wipe out fish, shrimp, crustaceans, and the smaller organisms on which they feed, in the bottom waters in places like the Gulf of Mexico, Chesapeake Bay, and the Baltic Sea. Among other places where dead zones have grown in recent years are coastal China and the Kattegat Sea, where the Norway lobster fishery has collapsed. The zones have also cropped up unexpectedly in pockets off the coast of South Carolina and the Pacific Northwest. The dead zone in the Gulf of Mexico in summer 2008 covered a swath nearly the size of Massachusetts.

What possibly can be done?
According to marine ecologist

Robert Howarth of Cornell University, the best way to reverse the phenomenon in the Gulf would be to incentivize the farmers in the upper part of the United States to plant crops like winter wheat, rather than leaving their fields fallow after the fall harvest. Much of the nitrogenous fertilizer that would normally get washed into waterways by spring thaws would instead be absorbed into winter grain crops, a measure, if uniformly implemented, that could all but eliminate the Gulf dead zone, a major first step toward regeneration of degraded marine life. Simple? Only if local agricultural interests can be made to see that such an effort benefits not only them but also other interests beyond their own, to understand that their collective action will also affect the lives and livelihoods of farmers of the sea hundreds of miles south of the American heartland and change what otherwise will continue to poison the bountiful ocean





A CETACEAN PROTECTION CHALLENGE

The Canadian government must amend and expand their June 2019 legislative action--the Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act--to include a global reserve for whales, dolphins, porpoise and other cetaceans in the fertile Hudson Bay near Manitoba where an estimated 60,000 beluga whales migrate each year to feed and mate.

Certain animals capture the public imagination like no others. Whales, porpoises, dolphins – cetaceans are the most evocative of ocean creatures by virtue of their scale, vitality, intelligence, and some innate expression of life to which humans respond with joy and identification expressed in art, myth, and spiritual identification. The Great White Whale dominates the literary history of America; Free Willy galvanizes political opposition to animals in captivity; the aquarium industry capitalizes on exhibitions and shows that turn these animals into entertainment.

This latter situation is immersed in paradox and controversy. Many of us have attended these shows and marveled at the agility and grace of whales and dolphins as they leap for fish through hoops, with twists and turns that delight. Some of us may have swum with dolphins, in simulated habitat, and found their touch and sight amazing as encounter with animals so close, so personal. Some of us may have had such experience in the wild.

Some of us may object, and there has been a movement to prohibit the commercial exploitation of such animals captive in a controlled environment, even as trade goods, grown for sale to a global industry. The animal rights community objects; indigenous people object;

many other individuals object, or at least question the rightness of this all, especially when questioned by their children evermore aware of the issues raised.

In June 2019, the Canadian Parliament amended its Criminal Code, its Fisheries Act, and its Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act, to create offenses respecting any member of the cetacean order – whales, dolphins, and porpoises - in captivity, specifically identifying an offense for “every one who owns, has the custody or controls a cetacean that is kept in captivity, breeds or impregnates a cetacean, or possesses or seeks to obtain reproductive materials of cetaceans, including sperm or an embryo.” There are two categories of exception: first, for animals involved in licensed scientific research, in care or rehabilitation from and injury, or in the best interest of a specific animal’s welfare; and second, for certain operators to continue the otherwise prohibited programs, but only with a license given by the provincial government affirming the letter of the law. The fines for violation can be up to \$200,000.

What is affected here are the aquarium programs, unless grandfathered or excepted, and the

breeding programs, particularly for belugas, that exist to generate animals to be sold for exhibition purposes worldwide, thus accounting for the emphasis on genetic materials, tissue cultures, and the like. This market is indeed global, with the major other suppliers located in Russia where there are “beluga farms” to meet the demand, now eradicated in Canada.

There is a continuing action to be taken in the context of this legislative assertion. If Canada is truly interested in the protection and conservation of cetaceans, especially belugas, it has a powerful opportunity to take one more regenerative step beyond prohibition. In Hudson Bay, near Churchill, Manitoba, an estimated 60,000 beluga whales congregate in the summer, in the local estuaries and adjacent waters, to breed and nourish. I have seen this myself,

and I don’t think I have ever seen such a profusion of a single animal species anywhere else in the world, a glorious reality and symbol of Nature’s fecundity, of wild animals in the wild. In my case, I joined the beluga brotherhood.

If Canada wants truly to protect these animals beyond corrective legislation, then a national, provincial, and indigenous declaration to establish a global reserve for cetaceans in that perfect place where they subsist now, not yet compromised or depleted by the forces that have destroyed such communities in such places before, would be step to take. And that is just what they did, when in August 2019, Canada’s Prime Minister Justin Trudeau announced a plan to create a massive marine protected area, the Nation’s largest, just northeast off Baffin Island, a combined area of some 470,000

square kilometers, for the protection of belugas, narwhals, walrus, seals, polar bears and thousands of other species that depend on year-round polar sea ice, a designation that serves the animals, the provincial communities, the local traditions, and Canada by taking conservation action of exemplary global significance. The Hudson Bay area was not included, but my beluga friends will get the message of protection just next door, and perhaps Trudeau will soon, with an inclusive stroke of the pen, add their area next.





FISHERIES CRIME

Fisheries crime is on the rise and the consequences are dire. In most instances of illegal, unreported and unregulated fishing (IUU), enforcement is a major issue. There are efforts by Interpol and other organizations to combat unreported fishing loss, the cost to the global economy, and the ever-shrinking core group of owners and corporate structures at the heart of this illegal activity.

“World fish stocks are being rapidly depleted, and valuable species are nearing extinction. Because fish are a valuable commodity, the last decade has seen an escalation of transnational and organized criminal networks engaged in fisheries crime.”

So declares the website of the Environmental Crime Program launched by INTERPOL and funded by the Norwegian Ministry of Foreign Affairs, the Norwegian Agency for Development Cooperation, and the Pew Charitable Trust Environment Group. Called “Project Scale,” the initiative is based on the premises that “fisheries crime undermines resource, conservation, threatens food security and livelihoods, destabilizes vulnerable coastal regions and is linked to other serious crimes including money laundering, fraud, human trafficking and drug trafficking.”

Specifically, objectives are intended

to raise awareness of fisheries crime and its consequences, establish National Environmental Security Task Forces to ensure institutionalized cooperation between national agencies and international partners, assess the needs of vulnerable countries, and conduct operations to suppress criminal activity, disrupt trafficking routes and ensure the enforcement of national legislation. In addition to analyzing, planning, training, and generating policy and legal recommendations to address the problem, INTERPOL will actually coordinate and conduct regional or species targeted operations in the most vulnerable regions such as the West African coast. In almost every discussion of illegal, unregulated fishing, enforcement has always seemed the insurmountable issue – the lack of police personnel, customs inspection, forensic and financial expertise, cross-border sharing of information, prosecutorial commitment, and surveillance and arrest capacity

on the open ocean and in the off-loading ports and harbors to manage and combat illegal activity that is demonstrably out of control.

The cost to the global economy of this unreported fishing loss has been estimated at \$23 billion per year. So-called “pirate” fishermen, larger flag of convenience registered vessels, and multi-national corporate interests outside national jurisdictions are responsible for untold hidden profits, evaded taxes and uncollected duties, and other illegal activities as harvesting prohibited species, fishing out of season or without a license, fishing in conservation areas and protected national economic zones, and exceeding national and international quotas established by global management governance associations and bi- and multi-lateral treaties.

This is an effort long overdue. In conversations with fishermen, government officials, and policy-

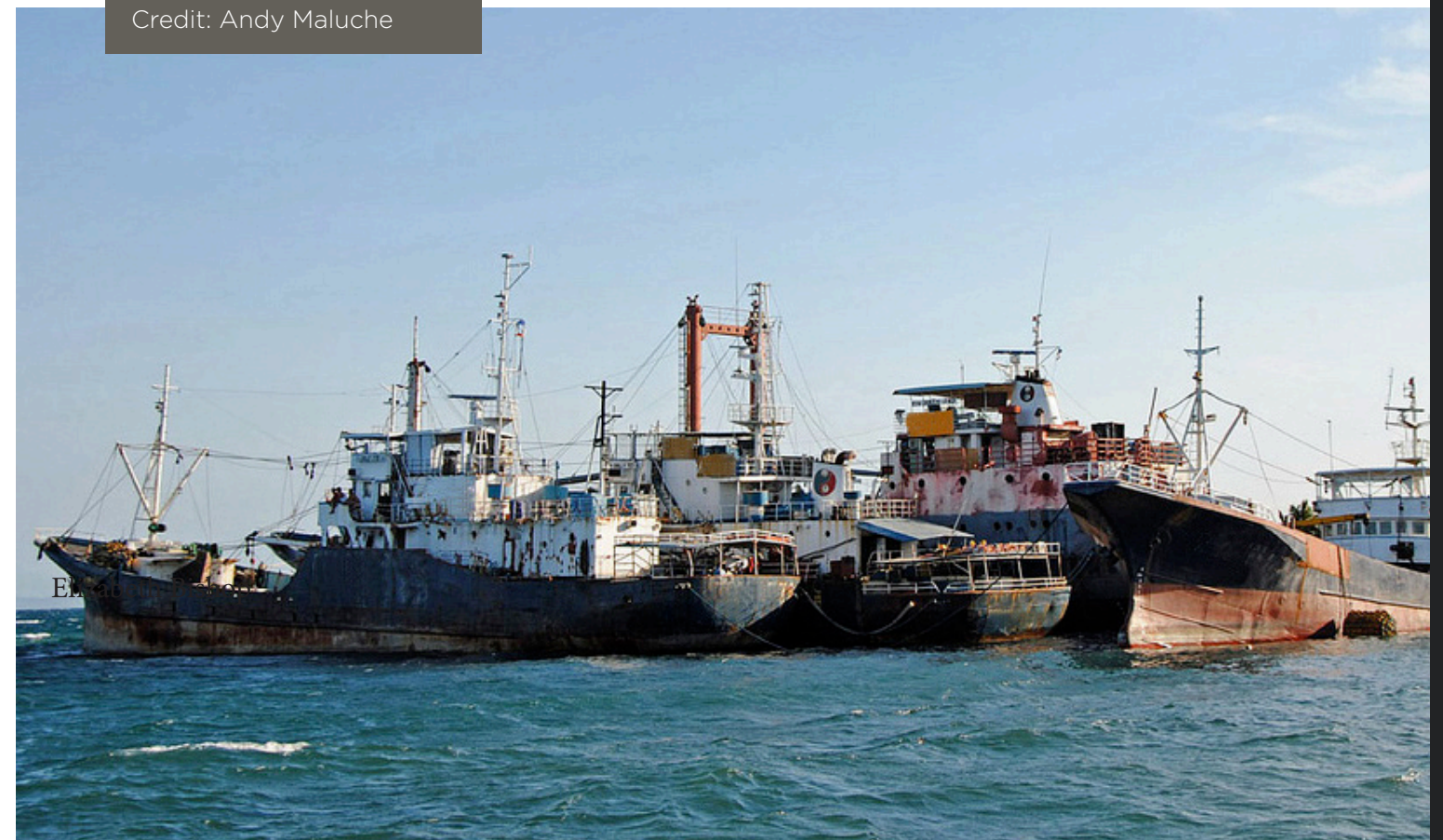
makers, amplified by news reports and UN distress at the level of unregulated fishing worldwide, I have become convinced that the problem, as evidenced by the circumstances described, has at its core a very small group of individuals who through ownership of fishing companies, vessels, inter-locking directorates, foreign flag registration, political influence, and assuredly bribes and pay-offs as a cost of doing business are responsible for the majority of this illegal activity. I make no specific allegation here, but even the simplest investigative effort on the internet begins to reveal contracts, relationships, corporate structures, and offshore registrations, frequent ownership/management changes, corporate

hiring of former regulators, and other behaviors, surely all legal in the overt appearance of things, that suggest a level of manipulation and control that aggregates the power and return from international commercial fishing to an ever-decreasing circle of players. A forensic investigation of these arrangements, at the level of legal and accounting analysis available only to an international law enforcement agency such as INTERPOL, would be a tremendous step forward in understanding how the system works and thus suggesting specific targets for further discovery, surveillance, indictment, prosecution, and trial for those responsible.

What is additionally disturbing about this challenge is the inevitable integration of these profits into the flow of international financial crimes such as money laundering, drug and human trafficking, arms sales, and terrorism. It is not just about fish as food, or preservation of endangered species; it is about the larger morality play that exposes the continuing theft of natural resources in the form water, protein, mineral, and DNA, that continues as a dark and corrosive subversion of the ocean as provider, of marine species as food, of fishing as community subsistence, of national confidence and security, and of the sustainability of what we call civilization.



Photo courtesy of ISSF.
Credit: Andy Maluche



AT THE FISHHOUSES

ELIZABETH BISHOP

Here is a poem by Elizabeth Bishop, published in The New Yorker in 1947. It pertains to the New Year, distills many years of Bishop's seaside meditations, and evokes the clarity of meaning contained in personal encounters with the world ocean.

Although it is a cold evening,
down by one of the fishhouses
an old man sits netting,
his net, in the gloaming almost invisible,
a dark purple-brown,
and his shuttle worn and polished.
The air smells so strong of codfish
it makes one's nose run and one's eyes water.
The five fishhouses have steeply peaked roofs
and narrow, cleated gangplanks slant up
to storerooms in the gables
for the wheelbarrows to be pushed up and down on.
All is silver: the heavy surface of the sea,
swelling slowly as if considering spilling over,
is opaque, but the silver of the benches,
the lobster pots, and masts, scattered
among the wild jagged rocks,
is of an apparent translucence
like the small old buildings with an emerald moss
growing on their shoreward walls.
The big fish tubs are completely lined
with layers of beautiful herring scales
and the wheelbarrows are similarly plastered

with creamy iridescent coats of mail,
with small iridescent flies crawling on them.
Up on the little slope behind the houses,
set in the sparse bright sprinkle of grass,
is an ancient wooden capstan,
cracked, with two long bleached handles
and some melancholy stains, like dried blood,
where the ironwork has rusted.
The old man accepts a Lucky Strike.
He was a friend of my grandfather.
We talk of the decline in the population
and of codfish and herring
while he waits for a herring boat to come in.
There are sequins on his vest and on his hands.
He has scraped the scales, the principal beauty,
from unnumbered fish with that black old knife,
the blade of which is almost worn away.
Down at the water's edge, at the place
where they haul up the boats, up the long ramp
descending into the water, thin silver
tree trunks are laid horizontally
across the gray stones, down and down
at intervals of four or five feet.

Cold dark deep and absolutely clear,
element bearable to no mortal,
to fish and to seals . . . One seal particularly
I have seen here evening after evening.
He was curious about me. He was interested in music;
like me a believer in total immersion,
so I used to sing him Baptist hymns.
I also sang "A Mighty Fortress Is Our God."
He stood up in the water and regarded me
steadily, moving his head a little.
Then he would disappear, then suddenly emerge
almost in the same spot, with a sort of shrug
as if it were against his better judgment.
Cold dark deep and absolutely clear,
the clear gray icy water . . .
Back, behind us,
the dignified tall firs begin.
Bluish, associating with their shadows,
a million Christmas trees stand
waiting for Christmas.
The water seems suspended
above the rounded gray and blue-gray stones.
I have seen it over and over, the same sea, the same,

slightly, indifferently swinging above the stones,
icily free above the stones,
above the stones and then the world.
If you should dip your hand in,
your wrist would ache immediately,
your bones would begin to ache
and your hand would burn
as if the water were a transmutation of fire
that feeds on stones and burns with a dark gray flame.
If you tasted it, it would first taste bitter,
then briny, then surely burn your tongue.
It is like what we imagine knowledge to be:
dark, salt, clear, moving, utterly free,
drawn from the cold hard mouth
of the world, derived from the rocky breasts
forever, flowing and drawn, and since
our knowledge is historical, flowing, and flown.

1. Ocean Dead Zones

The ocean is increasingly plagued by large coastal areas so polluted by runoff and starved of oxygen that they cannot support marine life.

2. A Waste-Free Ocean

We can recover the plastic already in the waste stream by creating incentives, cost benefits and investment opportunities for its capture and reuse.

3. An Epic Flow of Plastic

Looking for the technology, motivation and incentive to clean up the plastic pollution problem plaguing the world ocean.

4. Recycling, Repurposing, Profiting

How do we dispose of toxic waste, plastic packaging, electronics, and other discards of modern society? Where does it all go?

5. Point-Source Solutions

How do we dispose of toxic waste, plastic packaging, electronics, and other discards of modern society? Where does it all go?





OCEAN DEAD ZONES

Human behavior on land has no more dramatic example of the catastrophic results in the ocean than the dead zone—large coastal areas so hypoxic, so polluted by runoff and starved of oxygen, that they cannot support marine life.

It is often difficult to envision the harsh realities of certain actions. Sea level rise, for example, remains a theoretical consequence, visualized by popular films or animations, but hard to perceive and understand just looking at the coming and goings of the tide.

But there is one phenomenon that is definitely visible, measurable and tragically illustrative of how our behavior on land can have catastrophic results in the ocean: the dead zone, large coastal areas that are so polluted, so starved of oxygen that they can no longer sustain any marine life. A study published in the journal *Science* documented more than 400 such hypoxic dead zones, a number that has doubled every ten years since the 1960's.

The cause of this phenomenon is primarily nitrogen-rich nutrients from crop fertilizers that by way of run-off into streams and rivers ultimately end up in coastal waters. Scientists attribute dead zones to a process that begins when nitrogen from agricultural run-off and sewage stimulates the growth of photosynthetic plankton which

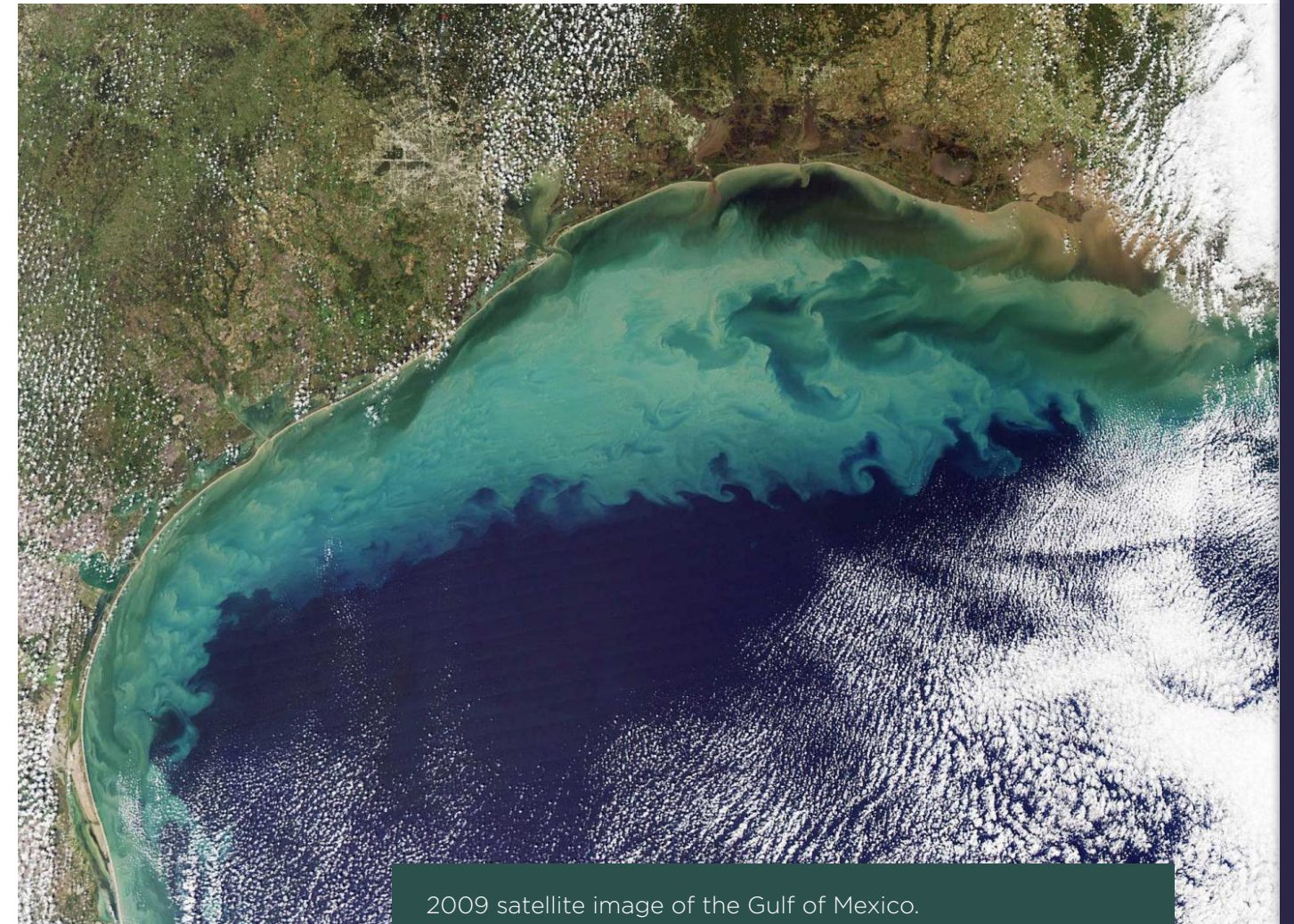
decays and sinks to the bottom where they are decomposed by microbes that consume large amounts of oxygen. As oxygen levels drop, most animals that live on the bottom cannot survive.

Thus, according to the study's principal author, Dr. Robert J. Diaz from the Virginia Institute of Marine Science at the College of William and Mary, "dead zones tend to occur in areas that are historically prime fishing grounds. Seasonally, low oxygen levels wipe out fish, shrimp, crustaceans, and the smaller organisms on which they feed, in the bottom waters in places like the Gulf of Mexico, Chesapeake Bay, and the Baltic Sea. Among other places where dead zones have grown in recent years are coastal China and the Kattegat Sea, where the Norway lobster fishery has collapsed.

The zones have also cropped up unexpectedly in pockets off the coast of South Carolina and the Pacific Northwest. The dead zone in the Gulf of Mexico in summer 2008 covered a swath nearly the size of Massachusetts.

What possibly can be done?

According to marine ecologist Robert Howarth of Cornell University, the best way to reverse the phenomenon in the Gulf would be to incentivize the farmers in the upper part of the United States to plant crops like winter wheat, rather than leaving their fields fallow after the fall harvest. Much of the nitrogenous fertilizer that would normally get washed into waterways by spring thaws would instead be absorbed into winter grain crops, a measure, if uniformly implemented, that could all but eliminate the Gulf dead zone, a major first step toward regeneration of degraded marine life. Simple? Only if local agricultural interests can be made to see that such an effort benefits not only them but also other interests beyond their own, to understand that their collective action will also affect the lives and livelihoods of farmers of the sea hundreds of miles south of the American heartland and change what otherwise will continue to poison the bountiful ocean.



2009 satellite image of the Gulf of Mexico.
Credit: Jeff Schmaltz (NASA Earth Observatory)
[Public domain] via Wikimedia Commons



A WASTE-FREE OCEAN

Of all the types of waste in the marine ecosystem, plastic is perhaps the most ubiquitous: it shows up on beaches, in the stomachs of shore birds, fish and marine mammals as well as in vast, swirling gyres in all of the world's oceans. While recycling technology and acceptance has advanced for glass, metal and paper, only a fraction of the world's plastic is recycled.



Of all the waste deposited in the ocean, perhaps the best known is the plastic debris that shows up on our beaches, in the stomachs of fish and shore birds, in the enormous floating "island" of plastic in the Pacific Ocean, assembled there by the confluence of currents, and by its preposterous scale capturing the imagination of international media and the public. The situation is further exacerbated by the disintegration of plastic waste into microscopic particles that descend in the water column to intrude into the metabolism of marine species with serious implications for reproduction and survival.

Plastic is not the only waste entering the marine ecosystem; human waste, toxic manufacturing by-products, run-off of agricultural fertilizers and pesticide, radioactive material, oil and gas spills, and acid other poisons resulting from the global mass consumption of carbon fuels add to what is the exponentially increasing decline

of the ocean's capacity for future productivity, sustainability, and support for human survival.

The story is not new, and it is getting worse every day. What do we do about it?

We have seen the potential of recycling our waste. Glass bottles, aluminum cans, and certain scrap metals have found an industrial scale technology and financial return, recovering and transforming these discarded products into new ones. Over 70% of newspapers and fiberboard, for example, are recycled and reformed into practical utility and new product.

But not plastic. In 2008, of the 33.6 million tons of post-consumer plastic waste in the United States, less than 15% was recycled or burned for energy; the balance was discarded into stream and rivers, and eventually into the ocean, or was buried in landfills where it will take centuries to decompose, leach chemicals and dies into the groundwater, require some kind of expensive future remediation, and otherwise add insult to injury

and be removed from the "circular" economy that recycling represents.

This is tragic waste of waste. Some 4% of oil consumed annually in the world is used to manufacture plastic, an annual expenditure of resources and energy that ignores the residual value of what has already been expended.

As importantly, that volume is withheld from the myriad alternative re-uses identified – thread, yarn, and fiber for clothing and durable products, injection-molded packaging for meat and vegetables, floor coverings, traffic cones, strapping tape, hoses, trash receptacles, truck cargo liners, clothes hangers, park benches, flower pots and seedling containers, stapler bodies, toys, foam peanuts, composite railroad ties, and aggregates for road surfaces, curbs, and building construction – these things, and many more, otherwise having to be made from new plastic with additional cost.

Because not all plastics are the same, there are different technologies required with varying operational and energy costs. This accounts for the very complicated identification codes found on plastic packaging, signaling the specific sorting required for recycling processes, a differentiation that complicates distribution and transportation, decreases the economic efficiency of any given treatment, and dissuades governments and individuals from investing the time and effort into maximizing the recycling movement. The resultant, less than profitable cost benefit has

been a disincentive to adequate investment, particularly in the US and in less affluent developing nations, and so the plastic accumulates worldwide and the problem compounds itself globally.

Gold, silver, copper, and other precious metals could be recovered from e-waste, the enormous amounts of discarded cell phones, tablets, televisions and computers, other electronic devices, medical instruments, junked cars -- a form of urban mining that can recycle these limited resources and obviate the need for new mining operations, particularly coastwise or in the deep ocean, where other unique marine resources are coincidentally destroyed by a crude, expensive, and unnecessary process.

Plastic recycling should be the same. Even though the unit pricing is radically different (an ounce of gold versus a ton of plastic), the exponential volume and ubiquitous need argues for scaled financial investment and favorable comparable returns. Some government incentives have been created, and some innovative companies have attempted to exemplify the process with success. MBA Polymers, an American company with processing plants in China, Austria, United Kingdom, and the US, won the prestigious 2013 Katerva Award for "accelerating innovation for a sustainable future," by transforming such plastics into a pellet form for use in new products, expending less energy, conserving limited oil supplies, reducing carbon emissions, and reducing the

landfill problem by keeping the plastic in circulation within the production system. Their inability to raise continuing adequate capital for expansion of this endeavor in the US is a sad function of consumption-based conventional thinking, false calculation of corresponding value, and fragmented public concern.

There is hope, however. In Europe, we see the creation of a new organization, The Waste Free Ocean Foundation, dedicated to clean up of marine litter. In the US, we see local communities expanding their recycling efforts; municipalities, even states, prohibiting plastic bags; and grass roots organization boycotting wasteful practice and advocating for new behaviors. Is it possible that through such demands and changes, we might discover that there is enough plastic already extant in this world to meet our needs, and then some? Can we stop just throwing that plastic away? Can we convert that coastal trash and plastic island in the Pacific from a problem to a solution? Can we imagine and sustain a waste free ocean?





AN EPIC FLOW OF PLASTIC

We have such capacity for ingenuity; why do we currently lack the technology, motivation and incentive to clean up the plastic pollution problem plaguing the world ocean?

Recently I saw a social media post on a river, purported to be in the rural Chimaltenango region of Guatemala, that was a constant flow of plastic, waste clogging the stream in a relentless deluge of discarded plastic detritus in what seemed like a never-ending decent to inevitably the ocean. It was so awful it could not be real. Indeed, some questioned its authenticity as some kind of photo-shopped fraud, but a volunteer working for a NGO alongside the riverbed, quickly attested to its reality, not just as a one-time phenomenon, but as a constant, epic flow of plastic. Guatemala is not alone: the vast majority of plastic finding its way into the ocean flows from river systems, coursing through inland agricultural to coastwise urban centers, accumulating and concentrating all along the way.

Unlike other reports of the pervasive polluting impacts of plastic waste worldwide, this one hit me emotionally, viscerally, combining disbelief with anger with outrage that such a condition could be created, tolerated, and left unsolved. It was as if the watershed, the life's blood

of Nature, has been infected by rampant disease that signaled only death, of that river, that place, indeed of the whole world, possessed, inundated, and poisoned by plastic.

That same week a new report was published that revised the estimate of the Great Pacific Garbage Patch, a massive accumulation of plastic cohered by ocean winds and currents into a huge floating island of junk, first estimated to be some 700,000 square kilometers, roughly the area of Texas, now measured at almost twice that size and growing, converted to the astonishing number of 5,800,000 square miles. This not the only such example; lesser gyres are gathering similar concentration in the all the world's oceans: even the Arctic and Antarctic waters are no longer immune.

What is this stuff? The debris inventory is made up of every form of plastic waste – from throwaway bottles and containers, manufacturing by-products, illegal dumping and other detritus discarded by activities on land from harbors and storm drains,

from stationary platforms and shoreline industries, and from ship garbage to enormous abandoned fishing nets and other gear. Plastic straws, cigarette filters, packaging materials, toys and car parts, abrasives in toothpaste and cosmetics, just about everything made of plastic discarded and forgotten in the sea. This mass moves and turns, biodegrades in the sun, and into micro-pellets that descend into the water column as tiny beads to become part of the food chain, mistaken as food, ingested by fish, and ultimately, via harvest and market, into our bodies whether we know it or not. It is insidious and invisible. The negative impact on marine plants and animals is one thing, but suddenly the assault on ourselves is another.

Remember plastic is an oil-based product; it contains all the properties of oil, to include chemicals and other additives that are part of a very much larger problem that affects our way of life additionally as CO2 emissions, persistent organic pollutants, and all the other poisons incorporated in the deleterious cycle of oil.

Not to mention climate change, the most serious global challenge we face in the 21st century. The oil companies depend on our dependence on plastic.

The crisis has been exacerbated by the announcement, that same week, that China was no longer going to accept the world's trash, all the waste from the developed world, particularly the United States, that had been conveniently trans-shipped out of sight, out of mind, across the ocean where it would conveniently disappear. No longer.

All these factors, taken together, must bring this global problem into compelling focus. To be frank, effective response has been

pathetic. There have been constant studies by well-meaning scientists. Some organizations like Project Kaisei and others have addressed the need for political and public awareness. Local activists have made certain progress with deposits on plastic bottles, bans on plastic bags and polystyrene containers.

A young Dutch student, Boyan Slat, has made headlines unveiling a concept to harvest debris using booms and ships, to bring plastic to recycling, re-entering the raw material into the industrial chain of being, possibly for a profit. All celebrated, all good. It has been a trial-and-error process and a sound solution is still to come.

We can recover planes, sunken ships, and bombs from the ocean floor. We can transport goods worldwide 1000 containers at a time. We can build oil-rigs and wind towers. We can dig for sand, uranium, and gold below the bottom of the sea.

We have the ingenuity and capacity. Why don't we have the technology, motivation, financial incentive, political will, and moral commitment to clean up our mess, before in it we all drown?





MODERN DAY WASTE: SOLUTIONS FOR RECYCLING, REPURPOSING AND PROFITING

Waste and the management of it are new challenges in recent decades. How do we dispose of toxic waste, plastic packaging, electronics, and other discards of modern society? Where does it all go? How do we turn bad trash into good cash? Here are some new ideas and efforts to turn waste into profit by recycling and repurposing trash as a means to slow the contribution to the waste stream.



Let's talk about recycling. The idea is certainly not new, in that for millennia humans have maintained and re-used tools and resources as part of an essential economy based on what is available, what is the need, and what is the best way to meet that need without waste. The behavior was reality; there was no choice. But as we multiplied and responded with innovation and technology, we discovered that we could make more than ever before, into goods and necessary services; we could build and earn our way beyond scarcity to a new standard of making, consuming, and living that today is both system and expectation of surplus, even excess.

Waste and its management are the new challenges of this day. How do we dispose of toxic tailings and spoils, plastic containers and packaging, discarded automobiles, old refrigerators,

outmoded televisions, superseded computers, or out-of-fashion smart phones? Where does it all go? Into dumps where we attempt to cover and contain its seepage and deterioration; into the groundwater and watershed and ocean where it does invisible damage to the land and sea and all that lives in it or depends upon it.

Take that to scale and you have poisoned aquifers with water unfit to drink, lakes and streams hostile to native species, an ocean surface pocked with vast clusters of floating debris, and a water column corrupted solution of poisons we cannot see, taste, or feel until we can through algal blooms, dead fish, and sick people.

We recycle what, and how much of this waste? We collect aluminum cans, some glass, paper, and cardboard and a small percentage of the plastic discard, and turn them into similar products for similar uses. We feel good about this. Not everyone does it.

We also have some bright new ideas. For example, we recycle discarded ocean plastic into clothing and soap bottles and surfaces for parking lots; we recycle fishnet and line into carpet tiles, skateboards, and doormats; but when you really consider what percentage of everything we produce and then recycle to be produced again, it must add up to a pittance.

How do we turn bad trash into good cash?

Here are some thoughts:

First, what if we refrain from creating the trash, at all by conserving or using less of the things that enable its making? Use less plastic by not using plastic bags, rejecting plastic packaging, substituting re-useable containers, glass not Tupperware, for just one example. These small individual protests, and many more such similar actions, are easily done now by any of us and our families at home.

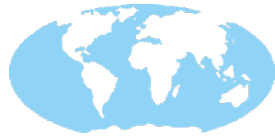
Second, what if we recycle more, by insisting that all plastics be recycled, that all engine oil and fast food frying fat be recycled, that all manufactured items be made of recyclable products or, if not, carry a penalty deposit for the true cost of their safe disposal? What if we held corporations responsible for their industrial waste, enforced, not diluted or contradicted regulations justified by the right of the public to be protected from such pre-meditated impacts on human health? Some of these have been tried and successful, until they are subverted by the narrowest interest that asserts mean shareholder return over basic human rights. These, too, are achievable through political will.

Finally, what if we built a new economy on a recycling ethic, a

price or tax structure built on the inherent value of re-use, the concept that an item is more valuable if it can be used longer or it can be re-used for a process and affirms its economic basis again and again in a cycle of maximum utility and return? What if it costs more, not less, to purchase a non-recyclable item built from a waste-based process? This would not be a new principle on Earth; it too is achievable as the revival of a principled behavior that attacks waste at its irresponsible, anti-social core.

Without substantive recycling, in these ways or others, we perpetuate waste. Waste is excess. Excess is pollution. Pollution dirties our air, corrupts our land, fouls our water, poisons our ocean, and diminishes our future.





POINT-SOURCE SOLUTIONS

Who benefits from current solutions to ocean acidification, CO₂ emissions, and plastic pollution? Might there be simpler ideas that involve investments in green technologies, demand for alternatives, and a shift in attitudes and behaviors away from fossil fuels toward sustainability and solution?

I have a good friend who sends me links to technical ideas directed at fixing major ocean problems such as acidification, plastic trash, and pollutants in our air and sea that represent clear and present danger to global health and security. These ideas are mostly big geo-engineering proposals – iron filings to adjust ocean pH, harvest of the enormous “islands” of plastic bottles and other debris found in the Pacific and most recently in the Caribbean, or huge air handlers to suck in and filter large volumes of air to cleanse them of detrimental emissions, the output of the burning of coal and oil to meet the increasing demand for global energy no matter what the source. Indeed, recent news reports indicate that the use of such fossil fuels continues to reach record levels, indifferent to the rapid shift to less polluting alternatives.

These friendly exchanges ask that I think again about my own ideas about such things, and to articulate the arguments that counter their practicality – mostly the extraordinary demands of scale and capital costs invested in strategies that have no certain outcome and may exacerbate

the problems as much as solve them. It is a good exercise, but it brings me back again and again to our propensity to fix things by actions that do not address the root cause of the problem at hand and may indeed have even worse consequences than the original situation presents.

It is also good to ask who benefits from these ideas? Simply the enthusiastic engineers and inventors and investors who will bet on the next big thing? Or perhaps those with vested interest in the existing system who see any distraction or simplistic hypothetical as a means to prolong the effect, and profits, of the status quo?

What bothers me most about this is the resolve not to address the problem itself at its source.

Over the past two decades we have been well aware of the destructive public health consequences of our dependence on fossil fuels. The debate has been serious and intense, to the point that we have engaged in military adventures to protect or possess oil and gas reserves abroad, advanced technologies such as fracking to

poisonous effect as a means to extend the value of the resources we already have, bend our geopolitical agenda and behavior in support of policies and actions directly against our long-term benefit, and attempt to undermine alternative technologies even when they are proved economical and transformative.

So let's look at what might be a simpler, more direct, point source to solution to some of these issues. With regard to acidification and toxins in air and water, the best possible action would be to regulate or stop such emissions altogether and pursue new, proven technologies such as solar or geothermal energy production that is already providing clean, economical power for many individual homes and factories, some prescient cities, and indeed, some nations. If the United States wanted true energy independence, it would emphasize and incentivize aggressive change over to such technology at every level. As have been suggested, what if we built large-scale solar farms on public lands, using public funds for construction and connection to a new “smart” grid distribution system? Some estimates suggest

that such a strategy would provide every erg of energy required for an expanding US economy with a return on investment that would far exceed the profits of the recalcitrant energy companies fearful of change. What if we just accept that our existing system is strategically bankrupt and financially counter-productive, holding our economy and employment back, and make a revolutionary shift to the future using knowledge and capital readily available if we decide to invest it?

And what about plastics? Well, there may be a short-term benefit in “harvesting” and recycling plastic waste where it is available in large concentration – at sea or at the local dump. What holds us back from that action now? Presumably price. But who benefits

from the need to make more and more plastics? Right, the fossil fuel industry. Some estimates suggest that if we recycled all the plastic on earth today, we would never have to make another piece of plastic again. Or, what if we simply stopped buying plastic containers for our products and water, and used recycled paper containers instead? What's the difference other than a re-allocation of investment to support a better alternative? Indeed, such products exist but are circumscribed in the market because there is no public groundswell for a fresh, less polluting, new employment, practical idea.

Finally, there is the role of the individual as the most common denominator in the market. If

we boycott plastic, shift our investments in regressive product and production, legislate against its use as is being done in many locales, and demand alternatives in all instances against the continuing ill-effect of associated toxic waste and pollutants, we can take back our air and water and health and governance from those who do not have our best interest at heart. We are the ultimate geo-engineers; we are the point men and women; we are the ultimate solution.



1. Fantastic Voyages

The sea has been a source of storytelling and real-time adventure tales since the beginning of narrative fiction.

2. Culture, Connection, and the Trans-Atlantic Slave Trade

Maritime culture and the slave trade have long shaped identity in the United States, as an amalgamation of cultures has formed our settlement, movement and culture.

3. Conrad and the Sea

Observations from the writings of Joseph Conrad, one of the great 20th century authors of sea-based literature.

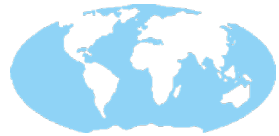
4. Farmers and Fishers

Recent trends point toward a revival of local fishing and agriculture and the ways that we can benefit from investing in the health of our communities.

5. Lost at Sea

Ports and cities along shore have varying ways to honor (or forget) the lives of those who dedicated themselves to seaborne pursuits.





FANTASTIC VOYAGES

The sea has long been a source of storytelling and of real-time adventure tales. The great futuristic tale of our time is “20,000 Leagues Under the Sea” by Jules Verne. It is a story of the submarine vessel Nautilus and her captain, Nemo. In this essay: this and other tales, as well as the evolution of submarine technology and the advent of modern day underwater tools and devices for global ocean research in unexpected places.



The sea has been a tremendous source of storytelling and real-time adventure tales since the beginning of narrative. Almost every culture has its archetypal maritime story – from the Viking Sagas to the Odyssey to the voyages of Sinbad the Sailor. There are stories of sea goddesses that have empowered religious cults and artistic expression – Matsu in China for example, or Mami Wata in Africa. There are sea-based entertainments such as Patrick O’Brian’s *Aubrey-Maturin* series or Herge’s *Tintin* or, more recently, David Misiel’s *2182kHz* or Carstin Jensen’s *We, The Drowned*, both highly recommended stories made more powerfully compelling through their ocean setting.

The great futuristic title, of course, is *20,000 Leagues under the Sea* by Jules Verne, the story of Professor Pierre Aronax, a marine biologist who, with two colleagues, joins an expedition to track down a mysterious sea monster that has been sighted by various ships and damaged an ocean liner. The

monster is, of course, the *Nautilus*, a secret sub-marine vessel of a size never before imagined and sailed by one Captain Nemo, a self-exiled scientist in pursuit of knowledge and independent of the confines of government, politics, and the other restrictions of civilization. Nemo takes Aronax on a fantastic voyage beneath the sea where they visit coral reefs of pure and undiluted beauty, find remnant fleets of ancient wrecks on the ocean floor, and even witness the encrusted architecture of the fabled lost city of Atlantis. These things were in their time of writing the essence of myth or the fabrications of wild imagination. In the end, the intrepid explorers escape, while Nemo and *Nautilus* disappear into the enigma of the Moskstraumen whirlpool off Norway and thence into the annals of literature.

The *Nautilus* pre-visions the submarines we know today, large silent ships with full communities aboard, able to stay submerged for long periods, to visit the bottom of the ocean floor, to transit routinely under polar ice, and to unleash an arsenal of offensive/defensive weaponry of a demonstrative power that not even Verne could invent. Similarly, underwater devices have become important tools for global ocean research, for mapping and data collecting and documenting places and phenomena that have been considered heretofore perfectly inaccessible. There are manned submersibles, deep sea vehicles, and remote-controlled drones that have explored the deepest deep, identified millions of new marine species, and even discovered new ecosystems

and new forms of life – all now universally available to a world audience through underwater digital equipment, television, IMAX films, and real-time streaming into classrooms and onto your desk-top computer or hand-held device almost everywhere.

But what of future ocean voyages?

Well, here’s one that pushes the limits of knowledge, as did Jules Verne. Researchers at the Center for Autonomous Systems at Virginia Tech University in the United States are designing and testing new forms underwater gliders with advanced control technology and neutral buoyancy that will maximize the utility and efficiency of these devices as key tools for underwater exploration in very unexpected places. One fantastic application might take such a glider into space, to the three moons of Jupiter – Ganymede, Callista, and Europa, thought by many scientists today as a possible location for the discovery of extraterrestrial life.

Europa, for example, is described as having an outer surface crust of ice frozen at some minus 160 degrees C, minus 260 degrees F. Many planetary scientists believe that a large layer of liquid water exists the below the ice with a kind of tidal flexing that maintains the heat that enables the existence of this subsurface ocean perhaps 100 kilometers deep. There is much additional speculative research. In a 2001 article, Dirck Schulze-Makuch and Louis N. Irwin of the University of Texas at El Paso suggest that kinetic, magnetic, and thermal energy evident on the

planet may support a unique ecological environment similar to that found as “hydro-thermal vents on our ocean floor.

Various proposals have been put forward to explore these planets in elliptical orbit some 628 to 928 million kilometers from Earth. One such called for nuclear-powered “cyro-bots” that would melt their way through outer ice layer to release “hydro-bots,” autonomous underwater gliders possibly built on the work of the Virginia Tech center and others. In 2012, the European Space Agency selected an orbiter probe expedition to be launched in 2022 in an Ariane 5 rocket to orbit and maneuver around Jupiter and her moons, arriving in 2030 to investigate the subsurface water reservoirs; to conduct topographical, geological and compositional mapping of the surfaces; study of the physical properties of the icy crusts; and to characterize of the internal mass distribution, dynamics and evolution of the interiors. For Europa, the focus will be “on the chemistry essential to life...

Looking forward, far away; maybe we’ll find Captain Nemo already there?





CULTURE, CONNECTION, AND THE TRANS-ATLANTIC SLAVE TRADE

An east coast storm in 2019 unearthed the remains of America's last slave ship in Alabama: the Clotilda. These remains, and the artifacts from another slave ship, the São José-Paquete de Africa, are important symbols of the cultural relationship and interconnected history of the trans-Atlantic slave trade.

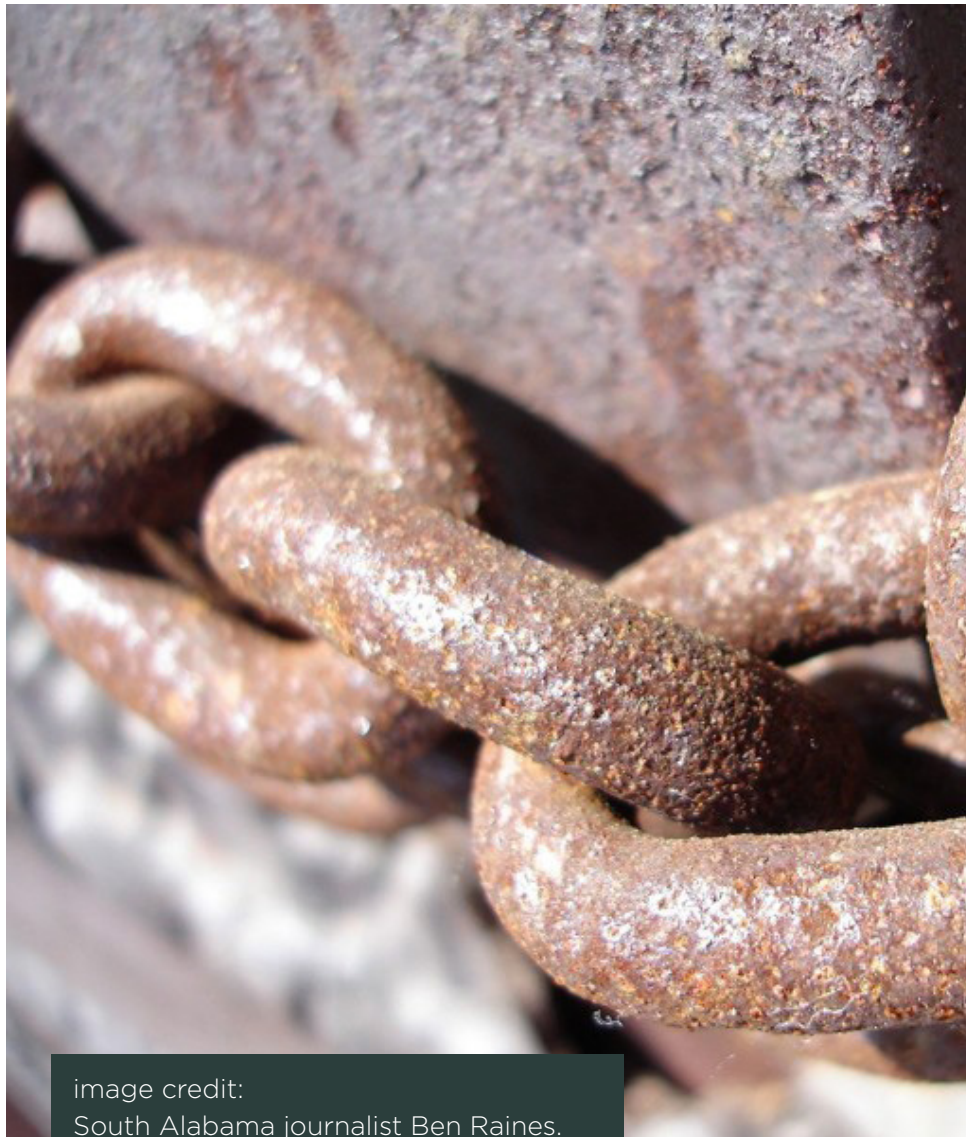


image credit:
South Alabama journalist Ben Raines. Raines is credited with prompting a search for wreckage of what may be the slave ship Clotilda.

There is but one ocean, that is perceived historically as a surface for exploration, transport, and trade, all factors in the making of civilization worldwide. But below that surface lies the detritus of the dangerous endeavor of voyaging, loss by storm, warfare, and ignorance of such a dynamic and challenging environment. That ocean has enabled connection for all time, and has built through the exchange of knowledge, skills, and traditions, a vast contribution to world culture.

One of the most tragic illustrations of this process is the buying and selling of slaves from Africa to the west, South and North America primarily, as cheap, dispensable labor. In the United States, there are three major contributions to our cultural identity: the existing culture of native peoples living here for centuries; the ensuing European culture transferred through waves of immigration from England, Ireland, Scotland, and the continent; and the arrival

of African culture through slaves that changed our nation's patterns of settlement, music and language in powerful, undeniable, positive ways. Indigenous people, European people, African people – we are an amalgam of acculturation that lies at the heart of who we are.

We must never allow that fact, and those memories, to be lost, and to guard against such forgetfulness, we turn to material culture – the objects, sites, and other evidence of such history as our foremost tool for preservation. That commitment, evinced by museums, libraries, archives, cultural sites, and national and international organizations such as UNESCO, is an essential part of an endeavor to conserve and honor this collective past in all its forms and manifestations.

Recently, as reported in the Smithsonian Magazine on-line news, the remains of what is purported to be the last ship to transport African slaves to the United States was revealed following the effect of a powerful storm and flood condition in a muddy riverbank near Mobile, Alabama. Researchers claim that the ship may well be the *Clotilda*, built in the 1850's as a transport for supplies from Cuba, purchased by a local businessman, and, commissioned to purchase 110 slaves in Ouimah, a port town in the present-day African nation of Benin. While slavery was then legal in the state of Alabama, it was in violation of US federal law outlawing the slave trade some 52 years before. If the vessel is indeed

Clotilda, it represents an end, the last shipment of slaves, but also a beginning, the survivors of that ship reported to have formed a nearby community, called Africa Town, in the middle of the American deep south on the verge of the Civil War. Who knows where the ancestors of those slaves are now?

At the 2017 opening of the National Museum of African American History and Culture, as again reported by the Smithsonian, artifacts from another slave ship, the São José-Paquete de Africa, a Portuguese ship wrecked of the coast of Cape Town, South Africa, in 1794 en route to Brazil from Mozambique carrying 400 slaves, were displayed as unique remnants memorializing the maritime aspect of the slave trade, an iron ingot used as ballast and a pulley block, recovered from a 200 year old ship and characterized “as thought to be the first objects ever recovered from a ship wrecked by transporting enslaved people.” The objects were on 10 –year loan to the museum and their conservation had been partially funded by the US Ambassadors Fund for Cultural Preservation, a program of the Cultural Affairs Office of the US Department of State. The grant of \$500,000 had been designated in 2016 by the American Ambassador through the Bureau of Educational and Cultural Affairs as recognition of the importance of these artifacts as symbols of the unifying cultural relationship inherent in the vast interconnected history of the trans-Atlantic slave trade.

There is odd correspondence and symmetry in these examples – Africa and the United States, first and last, as if the story begins and ends, at extremes between which a story in which past, present, and future implication lies. The consequence of the slave trade is with us still; resultant racism is not lost to history, lives still and extends to and resonates with our daily lives and lives to come. The cry that “black lives matter” is an echo of ballast iron and wooden pulley, of the bones of ships lost and found. The continuity of history carries on through cultural preservation; this is how the memory endures.

The U.S. Department of State website and Facebook page related to the U.S. Ambassadors Fund for Cultural Preservation had this statement: “Due to the lapse in appropriations, this Facebook page will not be updated regularly.” That cannot be. Memory cannot be truncated by budget cuts or ideological dis-appropriation. The implications of acculturation cannot be, like the power of an ocean storm, denied. There is wreckage there – disconnection – real, sad, and final.





CONRAD AND THE SEA

Many of literature's great classics are set on the ocean where Nature's beauty and force are bound to the human experience. Here we honor one of the greatest authors of sea-based literature, Joseph Conrad, and share some observations from one of Conrad's most well-known books on the ocean, "The Mirror of the Sea."

Many of literature's great classics are set on the ocean where Nature's beauty and force place humans in a context of survival, of skills put to the test, of confrontation with great questions and moral quandaries that have proved to pertain over time to universal human experience.

Students of western literature are aware of course of *The Odyssey* and *Moby Dick* as powerful, familiar examples. An amazing 1,000 page anthology of great sea stories, edited by H.M. Tomlinson, published in 1937, is described as "an incredible collection of sea stories arranged by setting such as: Ancient Greece, Ancient Rome, Arabia, Persia, Celtic Literature, Great Britain, Canada, Australia, United States, France, Italy, Spain, Portugal, Belgium, Holland, Germany, Poland, Finland, Iceland, Norway, Sweden, Denmark, and Japan."

Thus, the narrative of the sea knows no bounds. Perhaps the greatest such author was Joseph Conrad whose works

include *Lord Jim*, *Heart of Darkness*, *Typhoon*, *Nostramo*, *The Shadow Line*, *The Secret Sharer*, and many other novels and stories set at sea and along the shore. His most direct book on the ocean is entitled *The Mirror of the Sea*, originally published in 1906, and re-issued in 1988 by the small Vermont publisher, The Marboro Press. I urge you to read it.

Describing his purpose in *The Mirror of the Sea*, Conrad writes, "I have attempted here to lay bare with the unreserved of a last hour's confession the terms of my relation with the sea, beginning mysteriously, like any great passion the inscrutable Gods send to mortals..."

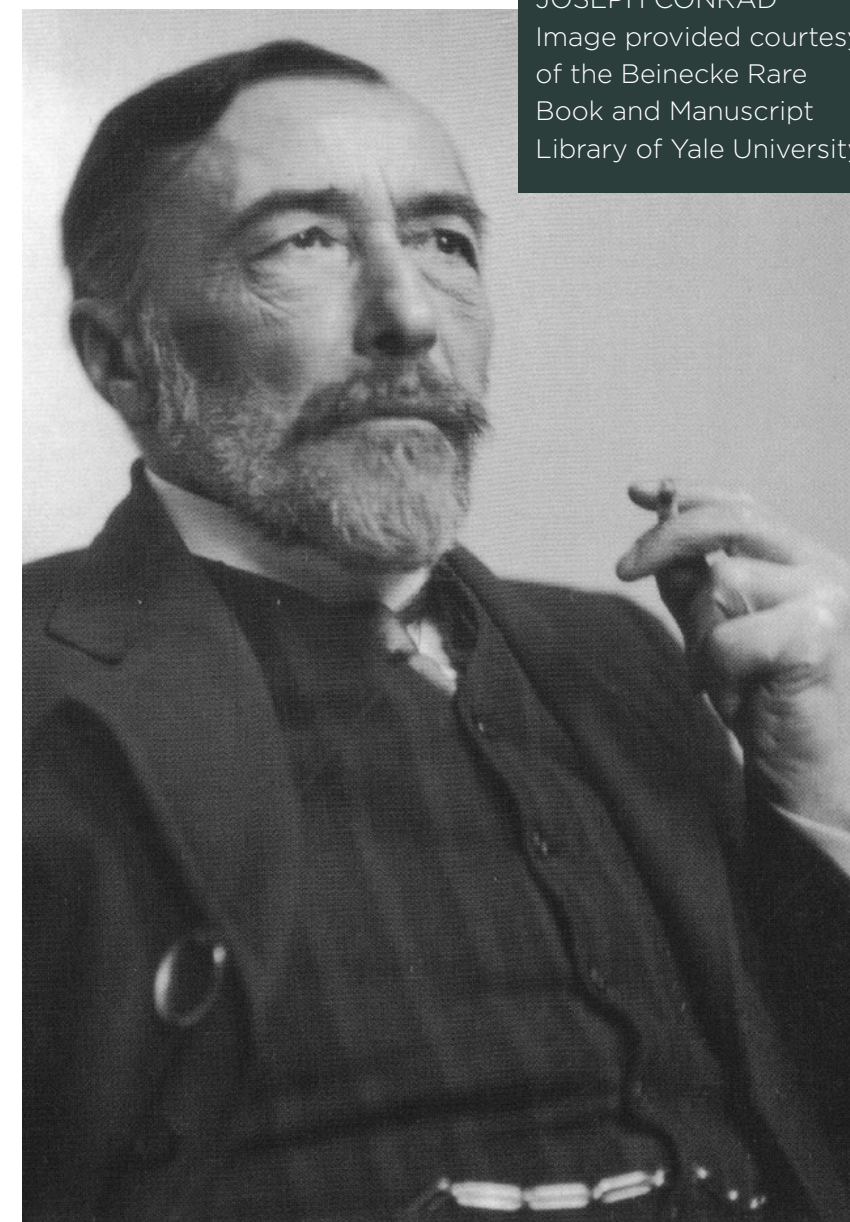
The prose as always is precise, evocative, and dimensional. Here is Conrad writing about the anchor: "For a ship with her sails furled on her squared yards, and reflected from truck to waterline in the smooth gleaming sheet of a landlocked harbor, seems, indeed, to a seaman's eye the most perfect

picture of slumbering repose. The getting of your anchor was a noisy operation on board a merchant ship of yesterday – an inspiring, joyous noise, as if, with the emblem of hope, the ship's company expected to drag up out of the depths, each man all his personal hopes into the reach of a securing hand – the hope of home, the hope of rest, of liberty, of dissipation, of hard pleasure, following the hard endurance of many days between sky and water."

On weather: "The olive hue of hurricane clouds presents an aspect peculiarly appalling. The inky wragged wrack, flying before a nor'west wind, makes you dizzy with its headlong speed that depicts the rush of invisible air. A hard sou'wester startles you with its close horizon and its low grey sky, as if the world were a dungeon wherein there is no rest for body or soul." And here is one of my favorites passages, on work and skill: "Now, the moral side of an industry, productive or unproductive, the redeeming and ideal aspect of this bread-winning, is the attainment

and preservation of the highest possible skill on the part of the craftsmen. Such skill, the skill of technique, is more than honesty, it is something wider embracing honesty and grace and rule in an elevated and clear sentiment, not altogether utilitarian, which may be called the honor of labor. It is made up of accumulated tradition, kept alive by individual pride, rendered exact by professional opinion, and, like the higher arts, it is spurred on and sustained by discriminating praise. This is why the attainment of proficiency, the pushing of your skill with attention to the most delicate shades of excellence, is a matter of vital concern. Efficiency of a practically flawless kind may be reached naturally in the struggle for bread. But there is something beyond – a higher point, a subtle and unmistakable touch of love and pride beyond mere skill, almost an inspiration which gives to all work that finish...which is art."

And one last concluding Conrad observation that relates to our matter to hand: "Water is friendly to man. The ocean, a part of Nature farthest removed in the unchangeableness and majesty of its might from the spirit of mankind, has ever been a friend to the enterprising nations of the earth. And of all the elements this the one to which men have always been prone to trust themselves, as if its immensity held a reward as vast as itself."



JOSEPH CONRAD
Image provided courtesy of the Beinecke Rare Book and Manuscript Library of Yale University.



FARMERS AND FISHERS

Humankind has for centuries been connected to the cycles of the year for sustenance from land and sea and have built our communities and our spiritual and social celebrations around the observations of the seasons and the changing light.

Many years ago during a visit to the National Maritime Museum in Oslo, Norway, in the small boat hall I came across a series of diagrams – circles in an almost mandala form that visualized the cycles of the year, of the harvest on both land and at sea, of the work patterns of men and women, and of the inter-relationship of the generations – grandparents, parents, and children -- to the sustainability of their remote oceanside communities.

These diagrams were an intellectual and emotional revelation, in that they provided me, very much a city boy from America's heartland, extraordinary insight into the patterns and practical collaborations among the inhabitants of coastal communities. For the first time, I appreciated the primarily social organization of such enterprise, the inherent wisdom of experience that determined that success in a challenging

place that demanded the participation of every resident, old and young, in a series of inter-related activities that enabled a healthy, happy, and sustainable livelihood.

Of course, much of this wisdom was based on the observation of

the seasons, the changing of the light, temperature, and resultant practicality for growing things ashore. Each season provided its work-list, tasks that were assigned to the most able and skilled to perform just those things. The men turned and tilled the land, the women planted, every one



harvested, and the additional tasks that transformed this plenty into food for then and the seasons to come was gathered, processed, stored, and even, as seeds, made ready for the repetition of the cycle soon again.

There was also a division of labor related to the sea – gear and boats to be prepared, the fishing itself by crews of men and boys, and the transformation of that harvest into dried fish, export product for trade, and other needs for community life through use of 100% of the fish, even if it was for needles, buttons, thread, health products, and skin for clothing and other uses.

There was also a further circle – of the social and religious celebrations and events associated with each activity and each season. The sum of the circles was a telling portrait of how society can be organized around the plenty that nature so generously will provide for our well-being.

Last week, I received a press release announcing a new partnership of the National Family Farm Coalition and the Northwest Atlantic Marine Alliance, wherein the synergy of activity, needs, and political interests between the two was recognized as common threats facing “land food” and sea food.” The partnership affirmed the similar challenges faced by many family farmers and fishers in recent decades: corporate consolidation of food systems at the expense of small- and mid-scale producers, the decline of rural communities, the reduction of food workers, the destruction of environment, the delimited access to real food, and

collective health. “The expansion of a more sustainable food future is dependent on this declaration of interdependence and solidarity between us,” the release declared, “a vision to unite family farmers, ranchers, and fishers in a collective effort for economic empowerment and food justice.”

At issue here of course is the recurring impact of scale – the growth of food production from artisanal and local to industrial and global. That enormous growth has had astonishing impact on national economies, building an international market for certain foods and grains at the expense of other production, of the land saturated with pesticide and nitrate-based fertilizer, of exhausted and poisoned earth blown and eroded away into our streams where it descends through watersheds to the sea where it subsumes oxygen and biotic life turning large areas of coastal water into a place where no animal, no plant, and ultimately, deprived of associated livelihood, no human can survive.

Perhaps such consequence has convinced us? Perhaps such destruction, now further aggravated by climate change and extreme weather, can be overcome by the diminution of scale, the return to the local, to cooperation among those who live by this small scale production, to the revitalization of land and community by return to sustainable values.

Where I live there is a strong revival of fishing and agriculture. Our fastest growing profession is organic farming, young people returned from the city, educated

and prepared to pursue hard work as a reflection of quality of life, outdoor living not compromised by the demands of consumption, and fueled by the natural energy of earth and ocean. They are becoming much more politically involved, engaging in the determination of policy and direction, and joining together in value-added enterprise, fairs and markets to which so many of us outliers flock for good food, real value, and investment in the health of all aspect of our community.

So, fishers and farmers, unite! Let those circles and cycles of health and vitality return, revitalized, from an exhibit on the museum wall to a regenerative way by we can live, successfully again, together today.





LOST AT SEA

There are many ways that the coastal ports of the United States honor (or forget) those who dedicated their lives to the seaborne pursuits of fishing, boatbuilding, the merchant trades, and international commerce.

Several years ago, I visited Ireland with my son, a musician, and one day we ventured to a small coastal village in search of the grave of a famous Irish traditional singer whose voice and repertoire had shaped my son's first music in a fundamental way. At the local pub, we learned there were five graveyards in the area and we visited them all in our search to pay homage, a lovely walk

alongshore looking out over the sea that seemed as much of the place as was the land itself. We found the stone and, while my son placed a guitar pick in the ground as a respectful tribute, I observed the other stones there, canted by wind and encrusted by the salt air, almost all of which were the final resting place for fishermen, each marked with name, date, and the phrase "lost at sea."

Ironically, all the stones were facing inland, as if the mourners had insisted that this final resting place must turn its back on what took those lives, and so many others, from a community that fished more than it farmed, and by so doing, lost generations of husbands, sons, and brothers to a cold, hard, dangerous, and unforgiving ocean.

Work on or by the sea is challenged

by extremes of weather, wave, wind, and dynamic forces that can equal the wrath of God. Human responses, even in today's most sophisticated technical and engineered world, are limited by the shape and strength of the boat, the durability of the gear, the uncertain availability of the catch, and the weaknesses of the human body and spirit. The graves in that lost cemetery are not unique; indeed they can be found along every coast worldwide shaped by the realities of maritime culture.

And then, there are the unmarked graves of men swept overboard or died and committed to the ocean as their final port of call – without memorial – how many thousands of these are there, dissolved in this history, forgotten?

Gloucester, Massachusetts is a town that has relied on fishing as its primary source of sustenance and survival since its founding. A famous statue stands there, a fisherman looking out to sea; the local churches have stained glass windows commemorative of over 4,000 captains and crew lost at sea since the 19th century. The village houses along the Atlantic shore are known for their widows' walks, on the roof look-outs from which to scan the horizon for the returning sails of whaling ships absent for years at a time, sometimes bringing home sperm-oil and ambergris fortune, oft-times bringing nothing but sadness and loss.

Every major fishing port or coastal

city will have its fisherman's memorial, its monument to lost seamen, its maritime museum documenting the full array of goods and services that contributed so substantially to the early history of the place – not just the fishing, but the boat-building and merchant trade, immigration, emigration, associated international commerce, and the exchange of ideas. Typically, these monuments will stand at the heart of the old port, in the nearby shipyards, or in the old warehouses, markets and exchanges, in the sailor-town neighborhoods that were the physical center and socio-economic heart of these first urban concentrations – in natural harbors or at the confluence of rivers with the sea.

Today more and more people the world over live alongshore – and more are moving there still to relocate to harbor cities with rich regional histories – where the waterfront and port facilities are being modernized to accommodate the old: oil and gas imports, automobiles, and container cargo, with the new: the cruise ship industry, residential development, and recreational use. These cities are proud of their revitalized ocean-related historical architecture, brick and iron buildings adapted to 21st century retail and offices, the atmosphere of the narrow cobbled streets enlivened by brewpubs and restaurants, bike trails and parks. The old fish sheds and docks are mostly gone, the buyers and sellers, product distributors and

processors, lobster boats and draggers displaced and re-located inland to anonymous warehouses serviced by trucks. The loss of the Fulton Fish Market in lower Manhattan in New York and the Tsukiji Market in Tokyo are two of the most egregious examples.

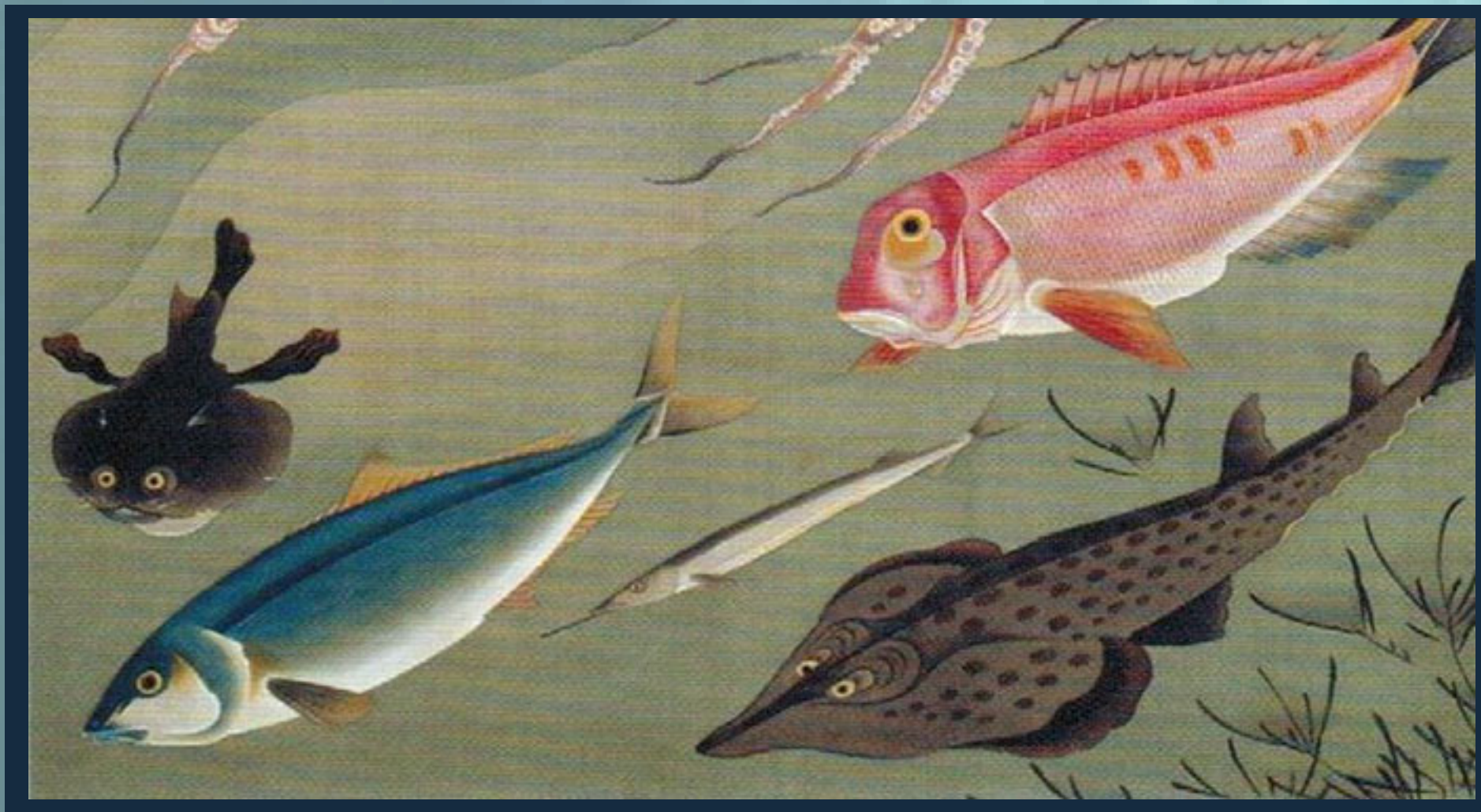
What is left behind? Usually it's a fishermen's memorial, a statue, an empty after-thought of a proud history of ocean enterprise and harvest from the sea. It seems a cruel indifference, to abandon that authenticity, that formative force in the building of community, to permit an insensitive forgetfulness of family, friends, and neighbors gone before, once lost at sea, now lost to memory.



THE FISH

MARIANNE MOORE

Here is a poem first published in 1918, that renders the profusion of undersea life with her characteristic detachment and attentiveness. However precise, the poem is also alert to the less tangible presence of the ocean, its unseen essence of force and motion. Out of the immediacy of the aquatic world emerges a vision of the sea in all its battered, timeless grandeur.



wade
through black jade
Of the crow-blue mussel-shells, one keeps
adjusting the ash heaps;
opening and shutting itself like
an injured fan.
The barnacles which encrust the side
of the wave, cannot hide
there for the submerged shafts of the sun,
split like spun
glass, move themselves with spotlight swiftness
into the crevices—
in and out, illuminating
the turquoise sea
of bodies. The water drives a wedge
of iron through the iron edge
of the cliff; whereupon the stars,
pink rice-grains, ink-
bespattered jelly-fish, crabs like green
lilies, and submarine
toadstools, slide each on the other.
All external
marks of abuse are present on this
defiant edifice—
all the physical features of
accident—lack
of cornice, dynamite grooves, burns, and
hatchet strokes, these things stand
out on it; the chasm-side is dead.
Repeated evidence has proved that it can live
on what can not revive
its youth. The sea grows old in it.

1. The Hard Edge

A history of hard edge coastal management.

2. The Soft Edge

Soft-edged responses to changing climate.

3. The Working Edge

Outlining the economics of settlement by the sea.

4. The Leisure Edge

Taking back the edge as a place for leisure and connection.

5. The Security Edge

Mangroves, beaches, cliffs, bluffs and atolls provide natural places for military and defense installations.





THE HARD EDGE

Hard-edge technology engineers the environment to suit our needs on the industrial scale, to shield us from storm and surge, to make marine transport more effective, and to protect us from the encroachment of water.

Our traditional approach to potential inundation by water has been the hard edge. It represents our cultural assumption that Nature is there to serve our needs and, when necessary, to be engineered to that advantage. You see hard edges everywhere: sea walls; dikes and levees; riprap erosion controls; dams; and canals that artificially connect water bodies for transport by ship, for hydropower, or for redirection away from alternative development.

Indeed, we have created large bureaucracies – water boards and the Army Corps of Engineers in the United States for example – with the mission to protect us from the encroachment of water, to shield ports and harbors against storm and surge, to facilitate the most efficient marine transportation, and to otherwise manage the environment, lakes, inland waterways, and coastwise, to human advantage as defined by the financial exigencies of the time.

The fate of coastal wetlands is another blatant example of hard

over soft. Once massive buffers against storm incursion, wetlands served human needs additionally through complementary cultivation of hay for fodder for salt-water farms. But as those farms gave way to more concentrated settlement and sprawl, the marshes were first ditched to control pesky mosquitoes that annoyed suburban residents, a disruption of the natural arrangement that increased erosion and drained the buffer zone, followed thereafter by hard edges behind which could be deposited dredge spoils, construction debris, and other unnatural material that transformed the soft soil into hard ground on which could be constructed more housing, parking lots, shopping malls, and manufacturing plants – all uses antithetical to Nature’s original intent. You could describe a similar history for the destruction of coastal mangroves in other areas around the world.

Highways are hard edges. In southern New England where I once lived, the major north-south interstate highway that extends from Florida to Maine was built

to follow a coastal route that created a concrete wall between the shore and the entire land mass and marine system upstream to the point that the entire natural watershed was blocked and re-directed to three cement conduits beneath the highway, not only interrupting and concentrating the natural drainage, but also the animal migration and surface water distribution that sustained the historical ecosystem resulting in all sorts of changes, disruptions, and negative environmental consequences to the region.

More modern examples of hard edge thinking also include such things as the Thames Barrier designed to protect London, England, from flooding. According to Wikipedia, the structure is built across a 1,710 foot wide stretch of the Thames, dividing the river into four 200 foot and two 100 foot navigable spans. The floodgates across the openings are circular segments in cross section that operate by rotating, raised to allow under spill for operators to control upstream levels and complete a 180 degree rotation for maintenance. All the gates

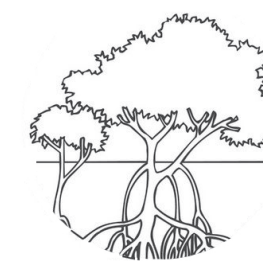
are hollow and made of steel up to 1.6 inches thick. The gates fill with water when submerged and empty as they emerge from the river. The four large central gates are 66 feet high and weigh 3,700 tons. In January 2013 in a letter to the London Times newspaper, a former member of the Thames Barrier Project Management Team, Dr. Richard Bloore, stated that the flood barrier was not designed with increased storm and sea level rise in mind, and called for a new barrier to be looked into immediately.

Finally, the Netherlands has long used the hard edge concept to protect the almost two-thirds of its national territory that is at or below sea level and otherwise susceptible to flooding by three

major rivers: the Rhine, Meuse, and Scheldt. Before 1000 AD, the Dutch began to protect their coastal areas with earthen dykes, followed through the centuries by timber walls, followed by higher structures reinforced by crushed rock and cement, covered over by earth on which sheep continue to graze. But flood control engineering was soon augmented necessarily by the need for increased protection and the Dutch innovated radically with the construction of an enormous barrier system that closed the natural opening to the ocean and transformed the Zuiderzee into the IJsselmeer, literally from a sea to an inland lake. This was followed in the 1990s by the Delta Works, an even larger storm surge

protection system that today, in the face of projected sea level rise, is nonetheless considered inadequate for the future and has sent the Dutch engineers back to the drawing board.

Hard problems, hard thinking, hard edges: might there be another way?



Thames Barrier
London, U.K.



THE SOFT EDGE

How do we protect ourselves and our properties from storm surge and sea level rise? What are the flexible ways to absorb the ocean's powerful force?

Some years ago, a museum exhibit comparing American and Norwegian maritime culture provided an understanding of how one can respond successfully to the challenges of the ocean with two very different solutions. In this case, it was boat construction, the traditional Norwegian boats made with light ribs and planks that flexed and conformed visibly to the shifts in wave and water condition. By contrast, the American boats were built plank on rigid frames and, while these vessels were no less adaptive, or even beautiful, they confronted the ocean differently, rode on the wave not in, to push over or through the water rather than adapt in or to the forces in play.

The contrast may be extended to ideas of how we protect ourselves and property from storm and sea level rise. Last week's edition of World Ocean Radio addressed the concept of hard edges, the use of dikes and sea walls, dams and sea gates as barriers to the ocean, a fortress concept that engineers a didactic structural response to inundation using earthen bulwarks, cement walls, and giant doors that can be closed against the

marauding sea. But what if there is another way?

The obvious alternative is soft edges, more amorphous and flexible ways to absorb rather than divert the ocean's powerful incursions, indeed to let the water in. This of course has been the argument made often by environmentalists when opposing the filling in of wetlands, the destruction of marshes and coastal waterways, and the eradication of mangrove forests that for centuries provided natural protection by embracing the water and its destructive power and keeping it from the higher land beyond.

We have seen the failure of the hard edge way, as storms overwhelm the barriers, destroy the resorts and beachfront homes, and otherwise demonstrate the hydraulic power of the ocean twice, once on the way inland, the other as the water withdraws, doubles down on the destruction, and draws the detritus into the sea. We had only to look at the devastation at Fukushima to witness this two-part threat.

There are slowly emerging examples of soft edge response,

exacerbated now by the undeniable rise in sea level in many places, the consequent frequent flooding, and the unmitigated and very expensive consequence of ever-increasing incident of more powerful storms like Superstorm Sandy in the US. How can we turn these new circumstances to advantage?

In the Netherlands, long the most highly successful practitioners of hard edge strategy, government is now evicting farmers from polders or marshes enclosed by dykes and converted to agriculture to restore those areas as control and containment areas when the other defenses are overwhelmed. According to a recent New York Times report, the Dutch have expanded this concept to a \$3 billion integrated plan to construct and connect flood controls, spillways, polders, smaller dykes, and pumping stations, into a kind of engineered capillary system that can accommodate vast increases in flooding volume as a serious alternative in public investment in additional and very expensive hard edge security.

There are other examples of this evolving thinking. Andrew

Cuomo, the Governor of New York, proposed that coastal properties, susceptible to continuous flooding, be purchased by government, that the owners compensated and relocated, and that the land be designated for public recreation and as natural barriers to future storm events. The cost benefit analysis of the purchase and redefinition of the coastal lands compares advantageously with the financial requirements of just a single storm, not to mention the more to come, as a practical and economical allocation of taxpayer funding. In other countries, private groups, supported by international NGO's, are initiating the restoration and replanting of extensive mangrove forests in coastal areas, again for the same reason, to re-build a natural,

relatively inexpensive system that has proven its effectiveness as both storm and habitat protection, a very different double-down based on knowledge and experience of Nature. In Arcata, California, the city managers have created a wastewater treatment plant that passes effluent through a primary clarifier that separates suspended solids (using a digester to transform into methane and compost for sale), passes the resultant fluids to oxidation ponds and treatment wetlands for additional settling, and then to enhancement and treatment marshes (which also serve as recreation areas), and, ultimately, as clean water into Humboldt Bay – a natural hydraulic process that mimics the natural cycle with

effective result. It is this wisdom that we must look to for instruction lest we drown in our conventional thinking. It is through this learning that we will find our way to new ideas for ocean solutions.





THE WORKING EDGE

The working edge encapsulates various social structures, industries, exchange, trade, globalization and more that were shaped by early settlement near the sea.

When we speak about “the ocean edge” we are discussing that circumferential line that delineates the terrestrial coasts, forming the invisible linear of confrontation and connection between land and sea. We have characterized the identity of those boundaries as “hard” and “soft,” engineered responses and social responses that are at once examples of mitigation of or adaptation to the dynamic circumstance of proximate earth and water.

We can also present the edge thematically, the amalgam of coherent activities that reflect both the reality and symbolic implication of what takes place there. Historically, the distribution of settlement was drawn to natural harbors and shores where fishing and trade could be practiced in support of the people who lived there. This holds true for inland waters as well – the distribution of interior cities in similar location connected up or down stream to the ocean outlets and exchange beyond. The working coast was at first a secure place where a small boat could be dragged a shore, built and repaired, and re-launched as a source of food comparable to the

harvest of the land. I once visited Lan Yu, an island off the south coast of Taiwan. I watch those fishers launch their wooden vessels from the shore, paddle through the waves engineless to sail for several days toward Mindanao and the Philippines, lighting a fire on the bow deck at night to attract the fish toward the light and into the boat. I was there when they returned and was astonished by the minimal catch resulting from such hard work and danger.

As vessels got larger, bigger facilities were required to dock, load, maintain, construct, voyage, and trade – the seemingly simple elements of maritime exchange that linked together eventually all parts of the world as stages of what we now call “globalization.” Those piers and shipyards were alive with work and financial vitality. This enterprise built institutions, organizations, associations, and personal fortunes, and contributed to every aspect of social and political life everywhere on earth where and when people chose to settle by the sea. Breakwaters and cargo handling technology, financial exchanges, banks and trading companies, manufacturing

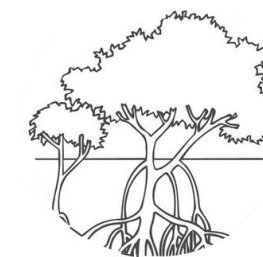
firms, unions, connecting roads and canals, trains, city architecture, churches and cemeteries, civic and social institutions—all these functions and their physical and economic consequences were a direct, progressive reflection of the energy and accomplishment of the working coast. Indeed, the world was parsed and defined by energy generated by the connective power of the ocean.

History brought scale, further exploration, science and invention, confrontation, and imperial expansion to the world, again enabled as response to the value perceived and desired. Expeditions opened the last places; technology enabled us to explore beneath the surface of the sea; iron, steel, and steam transformed ships in size, speed, range, and power. Work, work, work – every aspect of this growth of centuries was powered by the human mind and hand applied to the opportunities offered by the sea and serviced from the land. One can look at the entirety of world history to now and reduce it to one word: maritime – defined as “living or found in or near the ocean.”

The World Ocean Observatory

states as its prime assertion that “The Sea Connects All Things.” But don’t understand that connection as purely geographical, but rather as the unity of effort that is the nature of work and which when applied well to purpose can build a world for the benefit of all mankind. That has not changed. It is applicable and necessary to the future even as work changes and technology creates new vocations. Today, people are migrating from inland to coast; coasts are challenged by

sea level rise and extreme weather; ports can become teleports and cyberports seemingly indifferent to traditional structures. But here is a fact not well known: today, almost all data, financial transactions, internet informational transfer, communications, and more move at light speed as a function of modern work through cables deep on the ocean floor where, invisible, they connect us still through coast to coast, underwater.





THE LEISURE EDGE

We have long enjoyed the ocean edge for leisurely ends: as a place to gather with family and friends to enjoy surf and sand, and to relax in the freedom and solace that being near the ocean provides. What will it take to take back the edge? Those places we treasure for recreation, for coastal protection and for authentic connection to the sea?

The edge where land and sea intersect can be depicted as a place for leisure. We go there for a solitary walk, a romantic walk, the gathering of family, a place for children to play and remember, a rendezvous of friends where we eat and drink and sing songs before an open fire, waves crashing just beyond our line of sight, where we can relax in freedom from our worldly concerns.

The beach has been portrayed culturally in art and literature - seascapes of curving sand, enveloping dunes, waves benign, and men and women in out-of-fashion bathing suits. The primary and secondary dunes that typically separate the beach from land are like protective curtains of privacy, natural grassy barriers that keep the implication of return to work and daily life apart. Long stairs descend, the sting of sand is felt, the smell and sound of the ocean displaces cares and concerns left behind, even for an afternoon.

While beaches were at one time a place for work - harvesting fish and shellfish from alongshore - they have now become a space for leisure, even when they pass before some mighty row of private residences, condominiums, and hotels that in modern times have encroached forward to diminish the border of the regenerative sea.

There is erosion there - not just the inundation by storm waves to undermine the foundations of those intrusive structures - but also by the dissolution of other protections there that have always sheltered land from sea. Beaches are privatized; resorts and clubs claim exclusive lengths of the endless sand; entertainment piers are built as artificial land on which the culture of rides and cotton candy can extend. Suddenly, there is the manufacture for the compulsively active: gas-powered vehicles, small boats, kayaks to rent, surfboards, paddleboards, wind surfers and sail kites. Suddenly there is landside music everywhere, peace and quiet gone, even the crashing surf masked by amplified beats. The shells and driftwood are collected and burnt; the birds fed hotdogs and popcorn, their nesting grounds trampled; the sand and beach grasses clogged with plastic detritus, broken glass, and garbage. Suddenly, what has happened? Suddenly, the openness and tranquility and value of the edge is gone.

We have arrived, invaded and overwhelmed the edge with all our numbers and our beach gear.

I say the beaches belong to everyone, the coast around. Every beach is a reserve, a protected area for natural systems, marine

creatures, sea birds, coastal flora, fauna and people - yes, all the people who will use it sustainably, leave their destructive habits and unrecyclable junk on land already despoiled, and value the edge for all its natural capacity for recreation, renewal, and regeneration. Some states have done so, declared the coast from top to bottom a public amenity. Some cities have done so, building public access and pathways the whole way round in place of exclusive commerce and

industrialization that can be better placed elsewhere. Call me a revolutionary, but I say free the ocean edge, give it back in pure form so we can all enjoy the plentitude it gives to us. Let the kids play and swim without equipment; let them search the tide pools for the critters that live there; let them feel things, like wet and hot, dry and cold. Let them come to the edge in all seasons so they can experience change, feel anger

and solace in the sound of the sea, be by themselves if they want to be, and be together in a place where they can connect authentically, to each other, siblings, parents, even strangers, in a community of pure value, natural structure, and rewarding behavior.

Let's take back the edge!





THE SECURITY EDGE

The ocean edge provides natural security to the land: the barrier effect of mangroves, beaches, cliffs, bluffs, atolls and more, making them suitable places for military and defense installations for the protection of national interests.



What do we make of the security edge? What does the specific configuration of the coast provide to protect us from natural and human interventions?

The most obvious response is of course the barrier effect: the curvature, inclination, geology, and natural configuration provided. Simply by the shape of the land we are protected from strong wind and angry wave. The points of land and sheltered coves, the beach and barrier dunes, the mangrove swamps, the rocky cliffs and bluffs – all these contribute to the security of human settlements there. In many cases, we have exploited those features to site our cities and settlements. We have, for example, extended protections through breakwaters and engineered port facilities or developed certain beaches as resorts and recreational opportunity.

We have also destroyed many of those features – blasted artificial ports, removed and filled the mangroves, dredged the natural river outlets, and created coastal features and constructions that modify and erode rather than sustain the coastal zone. As extreme weather events increase and as the sea level rises, these man-made artificial features are challenged and proven short-sighted with now resultant serious social and economical disruption.

Another important aspect of the security edge is defense against

military attack. Ports become targets; beaches become likely places for attack; bluffs and outcrops become sites for observation and artillery; coastal features become logical places for bunkers, look-out towers, radar placements, and other structures for invasion defense. Historically, one can see the ruins of these installations – old forts overlooking coastal cities with rusting cannon as physical memorials to transformational battles and events. The narrow entrances to the Baltic Sea at Oresund and Mediterranean Sea at Gibraltar are such important historical places, where access was limited, tolls collected, and passage surveyed, even prohibited as an expression of political and economic power and potential.

It is no different today really. The coast is still the only place for naval construction, bases and fleet stations, submarine pens, missile launch sites, and global communications towers and links to orbiting satellites. Key topographical places are often in the news, passages through which concentrated shipping must pass; a global network of narrow ocean places where movement is confined between two coasts and vulnerable to adjacent military surveillance and attack.

We must remember that for all time – from Odysseus to today's tension in the China Sea, the ocean has been vast scape for naval operation, imperial expansion,

offensive and defensive conflict, and the exercise of national interest. Almost all developed nations have some level of a naval fleet to patrol and police their territorial water against smuggling, piracy, and illegal fishing practice. The larger geopolitical players – the United States and Russian Federation, for example – have massive investments in surface and submarine vessels that are constantly at sea as part as a tactical game of influence. Growing economies like China and India are engaged in an expensive expansion of technology and capacity to compete on the world ocean for strategic advantage; another version of the arms race with certain implications for future control of the sea.

All this may seem invisible and disconnected from how we understand and view the edge. But it is real and significant; security is very much part of what is a multi-layered interpretation of what it means to live alongshore where the land meets the sea, a sharp edge that is both useful and dangerous.



con·clu·sion

/kən'klōōZHən/

1. The end or finish of an event or process, especially that which is prepared or carried out by a person.
2. Decision, judgment, or solution which is reachable after having pondered the matter.

The short essays in this volume are nothing more than personal observations, judgements enabled by the privileged opportunity to ponder something as astonishing as our ocean world. This Journal and the texts from World Ocean Radio to come — the reading and listening — are an engagement with what can be legitimately claimed to be a community of millions of *Citizens of the Ocean* worldwide. The purpose is to present ideas, plausible scenarios, and possible solutions as waypoints for collective action and demonstrable change - a true way forward for the benefit of all.

Thank you for being a part. There is no end in sight.



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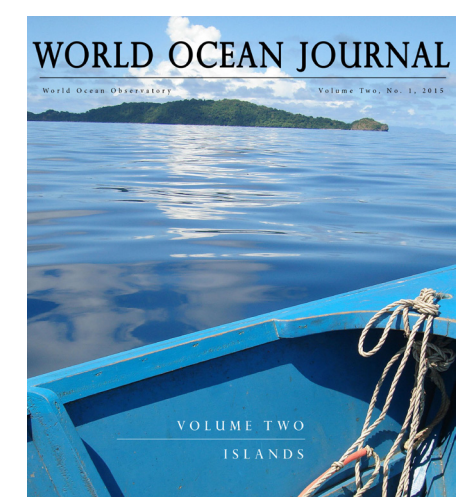
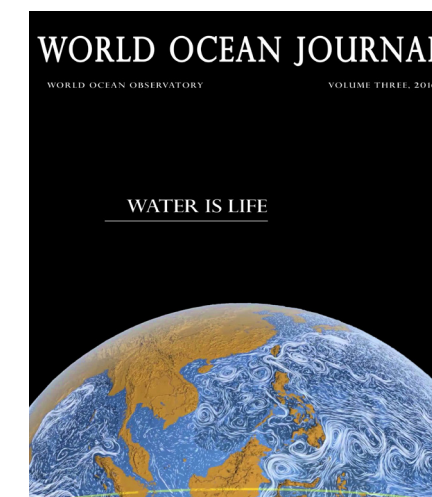
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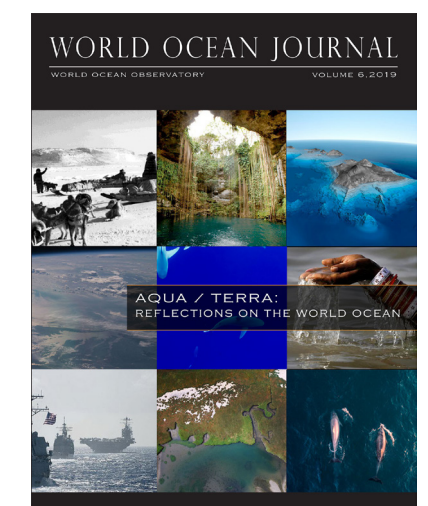
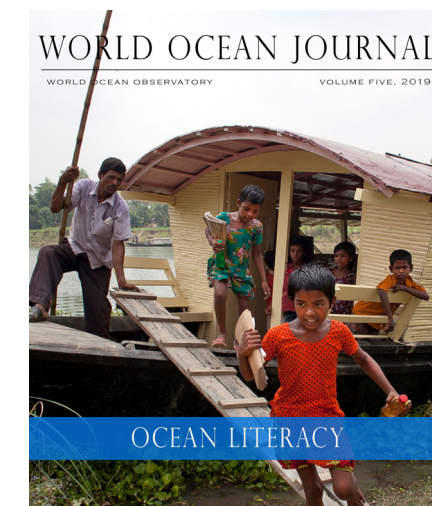
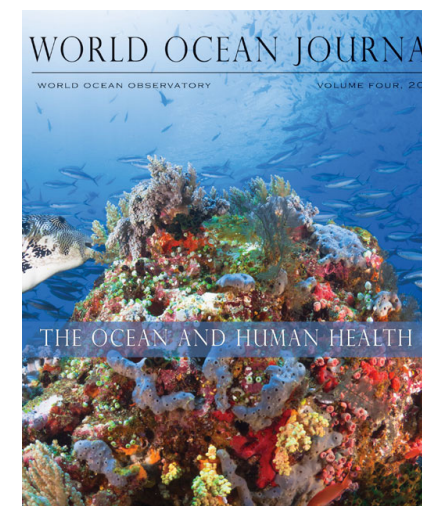
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