

Changing Livelihoods: Marine Economies Then and Now

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Any seagoing experience involves change. High winds and head tides can quickly become sunny skies and fair seas. Change affects not just the voyage, but also the maritime economies related to it. Human innovation creates new industries, like offshore wind or cruise ship tourism, to create livelihoods and produce goods and services for the society at large. This issue of *Mainsheet* sees today's ocean economy changing in ways that empower economic activities and cause social changes, both good and bad. By looking back, we can also look forward to understanding how marine economies affect national and global development.

Change can be powered by new technologies. Even if endorsed by markets, new ways of doing things face scrutiny in terms of social acceptance, which determines whether a new technology will have a lasting role in society. One need only look at public opinion moving away from fossil fuels and offshore oil due to oil spills and carbon dioxide in the atmosphere to see how the public and government can question past practices. It is in this interplay of technology-based economic development and social impacts that authors in this issue insightfully probe past and present across multiple disciplines.

Economists recognize the marine economy as a relationship between ocean-based industries and the resources of marine ecosystems.¹ Industries include oil extraction, shipping, and tourism. Ecosystems naturally produce goods and services that society relies upon such as water supply, carbon storage, and nutrient cycling. Interestingly, these concepts have been previewed in US discussions as national policy has evolved. Ecosystem-based management proposes that relationships among all ecosystem components including all species and their environments be included.² Some have extended this idea by speaking of ecosystem services—or those direct and indirect contributions of nature to human well-being which, in turn, makes them amenable to economic valuation.³ For example, fish harvest, flood control, and carbon sequestration supplied by healthy natural systems all can have economic values.

With this background it's fair to ask, what sectors of economic activity are defined as coastal or marine? What insights can we gain from the past to better understand technology change and other catalysts for economic development? The next section overviews the marine economy and presents its status in the US. Then each of the primary sectors are discussed. They include ports and shipping, energy, tourism, fisheries, and government, as well as finance and related activities. Many of these sectors are explored further through articles in this issue of *Mainsheet*.

Marine economies

Marine economies include industries based in the ocean or on the coast and the associated government activities and services. Four observations emerge from considering this plethora of activities. First, there is enormous variation in which specific activities are included in a named sector of the marine economy. Not only the nature of the activities, but also the geographic boundaries within which they occur, pose definitional challenges. Without a common taxonomy, analysis across articles remains difficult.

Second, the amounts of dollars or jobs attributed to a named sector differ, often considerably, due to analytical approaches and specific activities included in a sector. The importance of industries that occur on land and sea like construction or national defense requires some judgment about how much of the sector relates to each. An individual sector can rank differently in magnitude of dollars or jobs. Fisheries, for example, rank low in dollar value but are by far the highest in terms of livelihoods.

Third, marine economies have been presented using a variety of metrics. Reports include contribution to gross domestic product (GDP) and value added as well as others. GDP is defined as the total annual market value of goods and services for a nation. Value added consists of the gross output of an industry minus its intermediate inputs. Applying a clearly defined metric across all activities allows the magnitudes of the different sectors to be compared. And if all nations were to adopt the same measures, global assessments of the marine economy would become more readily available.

Finally, there are parts of the marine economy that are still being defined and enumerated. Principal among them are ecosystem services⁴ and the dimensions of the blue economy, a term introduced in 2012 but still interpreted in many ways. A UN explanation of the blue economy focuses on the

sustainability of use and collaboration across borders and sectors through partnerships.⁵

In the US, for example, the ocean economy spans activities on the coasts of the Great Lakes and the ocean states and extends seaward to the limit of the Exclusive Economic Zone (EEZ).⁶ The industries included take place in the region, use inputs from the marine environment, produce a good or service used in the marine environment, or rely on proximity to the coast to exist. When ranked by GDP, the combination of national defense and public administration are the largest contributors in the US. The sectors that follow in descending order of magnitude are tourism and recreation, offshore minerals, transportation and warehousing, and living resources. Following up but with ever-smaller contributions are research and education, coastal utilities, ship and boat building, construction, and, finally, professional and technical services. Identifying industries and their magnitudes provides one way to sort the large number of maritime activities that affect our lives.

In the sections that follow, an expanded description of the present marine economy introduces articles in this issue of *Mainsheet*.

Ports and shipping

Today's globalized world owes much of its origin to innovations in marine transportation. A first step in understanding how marine transportation affected the origins of globalization is to establish a definition and a way to measure the change. Kevin O'Rourke defines globalization as integration of international commodity markets.⁷ Globalization can be observed as early as ancient China or Rome. But by considering the core of globalization as substantial trade, the nineteenth century becomes an inflection point. The nineteenth century was marked by growing use of steamships, the reduction of trading monopolies, and international price convergence for commodities. With that in mind,



Figure 1. Containership *Elizabethport*. Originally built as a tanker, the vessel was converted to be one of the early containerships. It is shown here heading into San Francisco in 1962. The new containerships of 2024 have increased their capacity twenty-nine-fold compared with these early vessels. Photograph of *Elizabethport*, Mystic Seaport Museum, 2024.⁶⁶

Antoni Estevadeordal et al. followed world trade volumes from 1800 to 1914 and found a twentyfold increase.⁸ Up until 1914 the productivity advances in shipping reduced cost, but with other sectors booming after that date, shipping cartels, protection for domestic fleets, and increased labor costs, the cost for transportation went up. The period 1914–39 saw higher transportation costs and abandonment of the gold standard. Globalization of trade declined, a possibility that is before us again today. In today's marine economy some see the cost of operating a vessel being lowered by reducing or eliminating crews on ships.⁹ Many believe reducing onboard crew size to zero is technologically possible, but social barriers to such a change remain substantial.

Over time not only have crew sizes been in play but also the number of passengers accommodated have changed. With steam, the capacity of ships increased, along with the need to fill them, in some cases with passengers. James Boyd explains this in "Nineteenth-Century Passenger Agents within the Local and Global Commerce of Maritime Mobility." He lays out the mix of forces

creating a network of emigration agents in both countries of origin and destination. The creation of this associated industry, facilitating the movement of people in an increasingly globalized setting, promoted financial success for the new steamships.

Similarly, containerships of the last century relied upon shore-based changes in cargo handling and truck/rail transportation. Originating in the 1950s, containers represent a major technological change in the means of handling formerly break-bulk cargoes and a major force in the globalization of today. While containerization began in the 1950s, it was only in the mid-1980s, when the cost of fuel fell, that ocean transportation costs also retreated.¹⁰ Growth from that point onward has been substantial. In 2022, maritime commerce, incorporating ports and shipping, handled over 12 billion tons of cargo that included over 852 million twenty-foot equivalent units (TEU).¹¹ A TEU is twenty feet long by eight feet wide and usually eight and a half feet tall. In their forty-feet-long version they are commonly seen on highways throughout the world.



Figure 2. Jackup rigs for offshore oil. Rigs like these, which are currently out of service, are in diminishing demand as drilling moves into waters deeper than the capabilities of this oil drilling platform. Photograph by Galen Crout on Unsplash

Energy

The well-known energy transition from sail to steam fundamentally changed marine transportation and society at large. Subsequently, when oil became the preferred energy source, the sea became not only a place where fuel was consumed aboard vessels, but also a source of oil and gas from under the sea.

Producing oil and gas from beneath the sea began as conventional oil drilling equipment moved seaward on timber pile platforms from the shores of southern California prior to World War II.¹² After the war, steel pile platforms, often at quite a distance from shore, were utilized off of Louisiana. Technological evolution not only in the platforms but also in associated equipment to find, drill, and produce oil and gas allowed access to deeper waters and new oil fields. When the combination of oil prices and the geological certainty of large oil deposits can be met with appropriate technology, the market draws capital in, and new, ever-deeper fields are exploited, assuming the government supports the enterprise through leasing and other policies. In the current decade, depths of

over 3,500 meters or nearly 12,000 feet of water are within the capabilities of existing drill ships that have replaced jackup rigs suitable for shallower waters. For now, the drilling of these ultradeep wells can be profitable.

However, declining prices, oil spills, and international commitments to reduce fossil fuel consumption¹³ have many anticipating a decline of subsea oil production in future years. The Deepwater Horizon oil spill in April 2010 released over 210 million gallons of oil into the Gulf of Mexico with consequences for the environment, livelihoods, and US oil policy.¹⁴ Additionally, since the US historically participated in the Paris Climate Agreement, it sought to reduce fossil fuel combustion to half as much as was used in 2005 by 2030, with perhaps half that goal already achieved.¹⁵ To the extent that developed nations continue and other nations follow, a new energy transition will proceed with renewables added to the energy mix.

The much earlier energy transition to steamships created the need for refueling stations and the coal-carrying ships or colliers to supply them. Steven Woods examines this issue in “The Collier

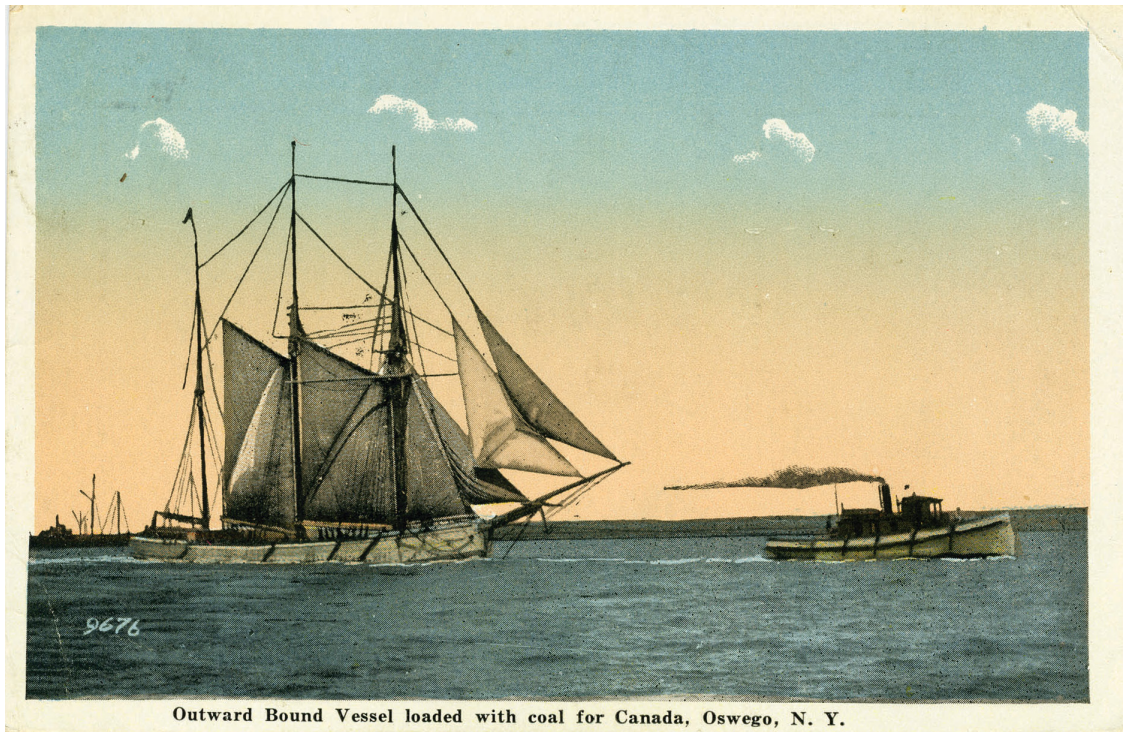


Figure 3. Sail to steam. Powering ships and developing economies on the Great Lakes and beyond required ready supplies of coal, more profitably distributed by windjammers that were often assisted by steam tugs to aid vessel movements near ports. "Outward Bound Vessel loaded with coal for Canada, Oswego, N.Y.," postcard, Mystic Seaport Museum, 2014.49.2461. Gift of Monika and Steven Lang, 2014

Problem: Toward a Definition and Application."

As he shows, the new technology, steam, required the old technology, sailing ships, to function. Wind power, it turns out, was often more efficient for carrying coal to refueling stations. Similar problems may beset some of our current energy transitions.

Beyond the technological complexities of an energy transition, the social dimensions exert significant influence on its acceptance. Shannon Howley and Emma Korein, in "Social Perceptions of Offshore Wind Energy through the Lens of Acceptance and Justice" recognize the social ties that individuals and communities have to ocean areas that are rapidly industrializing for wind energy production. The initiation of offshore wind as an industry dates to 1991 in Denmark,¹⁶ and it contributes a small but rapidly growing part of the marine economies in Europe and China. However,



Figure 4. Wind turbines. Current offshore wind towers are comfortably taller than the Statue of Liberty and have blade sweep diameters of almost three times the wingspan of the largest commercial airplane. Photograph by Bruno Figueiredo on Unsplash



Figure 5. The birth of beach resorts in France and elsewhere drew artists and the wealthy, presaging the development of the tourism industry. Claude Monet, *Garden at Sainte-Adresse*, 1867. Image copyright © The Metropolitan Museum of Art. Image source: Art Resource, NY

people whose livelihoods are in fishing or tourism, or who value species affected by wind and oppose certain inevitable space conflicts, can perceive the new technology negatively. By looking at social dimensions and hence license to operate, Howley and Korein provide the background for understanding the values in play when offshore wind industrializes ocean spaces.

Tourism

Coastal and marine tourism includes recreation and leisure activities adjacent to or on marine waters. Sea-based activities such as surfing, diving, boating, recreational fishing, wildlife observation, and cruises, as well as land-based sports, hiking, beaching, touring, and coastal heritage are included. Some assess coastal and marine tourism as around half of the global tourism industry, which, in 2023, employed 330 million people globally, according to

the World Travel & Tourism Council as noted by the High Level Panel.¹⁷ Tourism includes both leisure travel and some business operations and comes with social consequences, positive and negative.¹⁸

One of the threads of the origins of this globally important industry may be found in Hawai'i. Mallory Huard explains this in "Neither Missionaries nor Sailors: How Maritime Women Shaped US Imperialism in Nineteenth-Century Hawai'i." Wives of whaling captains exposed to mid-nineteenth-century Hawai'i reflected on a society that operated in ways very different from their own. Hundreds or perhaps a couple of thousand visitors followed their early lead and made it to Hawai'i in the late 1880s.¹⁹ By steam, the passage from the mainland averaged seven days in the 1880s or half the average for sail earlier in the century. Air travel ultimately reduced it to hours.



Figure 6. Air travel expansion of tourism. With flying boats, airlines opened travel possibilities to remote locations and, after the transition to jet travel, ushered in the era of mass tourism. *Hawaii by flying clipper*—Pan American Airways System. Color lithograph, ca. 1938. Courtesy the Library of Congress, <https://www.loc.gov/item/95503069/>

By the late nineteenth century, tourism included those with sufficient wealth to recreate continuously and those whose time at the shore remained limited. For the former, grand tours of Europe²⁰ or extended time at the great Eastern resorts of the US²¹ were commonplace.

Others found the seaside through camp meetings for religious purposes in the mid to late nineteenth century or at coastal amusement parks like Coney Island, New York.²² Availability of steamboats and trolleys made daytrips from center cities to cooler coastal locations possible for the amusement parks, which featured technical innovations like electric light bulbs, Ferris wheels, and roller coasters. By the 1920s, not only had vacations become common for factory workers, but an increasing number of US companies offered vacations with pay.²³ As paid vacations became more common throughout the world, they opened the door for package tours and mass tourism, which was augmented by jet airplanes, computerized systems for booking at international hotel chains, and even individual residences through Airbnb. For those traveling to Hawai'i, Pan Am Clippers, introduced in 1936, had become modern jet air-

planes which opened the islands to over 10 million visitors in 2019.²⁴ Ultimately, the most impactful manifestation of marine mass tourism, the cruise industry, boasted 31.7 million passengers in 2023.²⁵

A recent literature review shows most analyses find the economic benefits of tourism income are not widely shared within communities and come at a cost to the environment.²⁶ Furthermore, for many, sustained growth and sustainability through tourism are questionable at best. For these reasons differing styles of development would be far more desirable. One response, ecotourism, posits an orientation toward sustainable outcomes as the most responsible way to proceed.²⁷ One might envision the community taking the lead rather than the tour operator, and the experience becoming far more educational. However, at present these possibilities appear more rhetorical than real,²⁸ and many destinations continue to follow a pattern of growth and decline shaped by the wants of travelers and the responses of destinations to them.²⁹

Fisheries

The single most important global maritime industry in terms of jobs and livelihoods is fisheries,



Figure 7. Fishing vessel *Roann*. A diesel engine, winch, and net, among other changes, made this vessel very capable while she continued to utilize two masts and a sea-kindly hull reminiscent of her sail-powered predecessors like the *L. A. Dunton*, also at Mystic. *Roann*, by Arthur Moniz, graphite and watercolor. Mystic Seaport Museum, 2018.²⁹

which includes companion activities in aquaculture. Small-scale fisheries, as a distinct class, operate through activities where involvement is varied, catch is hard to tally, and value can be measured in sustenance, cultural affect, and market value. These small-scale fisheries likely provide livelihoods for a total of 491.7 million people or almost 6.6 percent of the world population.³⁰ This astounding statistic grows from a careful consideration of the operation and characteristics of fishing equipment and the recognition that participation includes full- and part-time employment in harvest along with pre and post activities, subsistence work, and livelihoods that are dependent on them.

Global-scale fisheries can be tallied when employment, harvest, and value in a currency are reported by individual nations to the Food and Agriculture Association (FAO), but these reports do not fully consider the small-scale activities mentioned above. The international tally of individual country reports by the FAO finds that 34 million individuals are involved in capture fisheries and

22 million in aquaculture, to which they add an additional 6 million unspecified workers for a total of 61.8 million.³¹ In 2022, the international trade in fisheries and aquaculture products, estimated by compiling country reports, totaled 4.9 million vessels and amounted to \$195 billion in value.³²

Technologies related to different stages of fisheries are well represented at the Mystic Seaport Museum. There, one can see the *L. A. Dunton*, a sail-powered vessel, and *Roann*, an engine-powered vessel. The former utilized hook-and-line technology to capture fish while the latter harvested by pulling a net. *Roann* represents a big change from sail to diesel power that occurred in the last century. Fishing, always a dangerous occupation, became safer and more efficient with the new technology, and vessels operated further offshore in deeper waters.

Government and Finance

Recent analysis of the US marine economy of 2022 identifies two sectors that were not previously

tabulated. The first sector, government, includes the navy, coast guard, and regulatory units of federal government such as parts of the Environmental Protection Agency and the Department of the Interior, as well as other agencies, and has an estimated total of 724,000 part- and full-time jobs.³³ Through naval activity, governments around the world have always had a prominent role. In this issue of *Mainsheet*, Sofia Zepeda provides a historical look at the British government's role in providing security for a nation at war. In "Bread and Sympathy: British Sailors' Wives' Survival Strategies, 1793–1815," we see that impressment and high costs of staples forced major social instabilities manifested by riots at home. The social impacts of an empire are observed not just overseas but also very much at home.

The second newly tabulated sector in the US is a composite of finance, insurance, real estate, rental, and leasing.³⁴ Finance and insurance include securities, insurance carriers, financial vehicles, and credit systems related to coastal and marine activities. Real estate in various forms and services is also a part of this sector. As seas rise and storm damage increases, both real estate values and insurance costs will be affected.

Looking globally, the finance sector can include both philanthropic and development assistance funding³⁵ to expedite conservation and fisheries management as well as to respond to climate change. When governmental support lags, funding may flow from philanthropic sources or the private sector.³⁶ By its nature, the former does not require a return on investment whereas the latter does. Hence, private finance through debt, equity, or other means is a small but emerging sector.

Future

Expectations for the future of the marine economy remain strong. Further, growth can be expected in activities that, in most instances, have been practiced for decades but remain small. Not all techni-

cal possibilities turn out to be profitable or do so very quickly. For example, scientists have considered the extraction of gold from sea water for over a century. It's certainly possible, but techniques identified so far cost several times the value of the gold that would be obtained.

As the Organization for Economic Cooperation and Development noted in its global assessment, expectations run high for offshore wind and other forms of renewable ocean energy, marine aquaculture, deep sea mining, oil extraction, marine biotechnology, high-tech products such as safety and surveillance, and others such as carbon capture or desalination.³⁷ Furthermore, the social and natural conditions surrounding people's uses of the coast and the sea continue to change with rising seas, increased naval tensions, globalization, and demands for food from the sea, making the creation of new ventures and jobs ever more likely. From 2021 to 2022 the US marine economy employment increased by 113,000 part- and full-time jobs, resulting in a new total of 2.4 million people employed.³⁸ In this setting, the environmental and social impacts of a growing economy require enhanced vigilance lest the gained income results in a diminished quality of life.

Understanding the marine economy and managing it not just for profit but, rather, for benefits across society more broadly remains a substantial challenge. Opportunities abound to fine-tune marine economies to meet broad social needs, and our contributors to this issue have very ably looked at the past, distant and recent, to better equip us to move forward.

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