The Conflict with Lobstering, and Why Whales Are Critical to Ocean Health and the Gulf of Maine

by Toby Stephenson

INTRODUCTION

Lobstering has been a part of the Maine culture and identity for more than a century, shaping our heritage , language, and maritime history. The Gulf of Maine provides 93 percent of US lobster landings,[1] and lobstering contributed nearly $1 billion to the state's economy in 2018 (Waterman 2022). The health of the Gulf of Maine's ecosystem, however, touches more than just the productivity of its commercial fisheries. Figures range, but at least 44 percent of Maine's population lives along the coast (Maine Audubon 2006), and according to a 2012 study, the state receives over $14 billion dollars each year from its natural resources (including the ocean, but excluding products like lobster that are already accounted for in the marketplace).[2] While economic importance of lobster is unquestioned by our political leaders, who have come out in force against recent restrictions proposed by the National Oceanic and Atmospheric Administration to protect whales in the Gulf of Maine, it is not a zero-sum game between whales and the lobster fishery. Whales play a vital and under-appreciated role in maintaining the health of the entire Gulf of Maine ecosystem, and mitigating threats to whales will have benefits that reach all corners of the food web, from plankton to baitfish to lobster and far beyond. In this commentary, I examine the conflict between Maine's lobster industry and whales and discuss reasons why we should be concerned about and try to protect whales and the overall health of the Gulf of Maine ecosystem.

Commercial harvesting of lobster in Maine began in the early 1820s, with the development of lobster smacks (Acheson and Acheson 2020). Over time, the fishery expanded from a coastal fishery to one that reaches more than 50 miles offshore, and the number of fishing lines connecting bottom traps to surface buoys increased extensively since the early days of subsistence harvesting. This growth has created tension between lobstermen and regulators responsible for maintaining natural resources. The demand for bait complicates the issue (Stoll et al. 2022) as herring stocks have crashed (ASMFC 2019) and competition for the resource has increased. All the while the Gulf of Maine is warming at unprecedented levels (Pershing et al. 2021; Seidov et al. 2021), and the entire ecology of the Gulf is facing unprecedented and potentially devastating changes. A reduction in whale populations will only exacerbate problems with the overall health of the Gulf of Maine ecosystem because whales recycle nutrients, such as iron and nitrogen, from the bottom of the ocean to the surface as they feed, digest, then move the matter into the upper water column where it fertilizes the oceans (Roman and McCarthy 2010; Roman et al. 2014).

THE CONFLICT

The struggle between lobstermen and whales has played out in the courts (*Strahan vs Linnon, 1994; Me. Lobstermen's Ass'n v. Nat'l Marine Fisheries Serv., No. 22-5238* [D.C. Cir. Jun. 16, 2023]), at public forums, and on the water since the mid-1990s when laws first requiring fishing rope modifications were adopted to protect endangered whales. While the fishing conflict has primarily centered around the endangered North Atlantic right whale (E*ubalaena glacialis*), other species of whales, seals, and sea turtles suffer the consequences of commercial activities. The lobster fishery is by no means the only threat to these animals—ship strikes account for at least half of known fatalities to whales—but the fishery has drawn attention as it has the most to lose if vertical fishing lines become restricted.

Lobstering is an owner-operated fishery, and the boat captain is the only individual who holds the fishing license. This prevents monopolies, whereby an individual owns numerous licenses and boats, which would lead to greater profits for fewer people, but it also places the cost of any gear modification on the shoulders of individual fisherman. The recent proposed gear modifications that were struck down by a federal court could have cost as much as $15 million across the industry (Oliver 2020). In addition to the cost, the proposed gear modifications raised concerns over safety risks from having more traps per buoy. As a result, lobstermen are fighting for their industry through rallies, signs, and lobbying for support from Maine's political leaders (Bever 2019; King et al. 2021; Office of Governor 2020). While our courts have gone back and forth in upholding or denying regulations on the lobster fishery from the National Oceanic and Atmospheric Administration (NOAA), the most recent ruling requires NOAA to reassess the risk to right whales anew, allowing six years before new regulations must be in place. This reprieve was well received by lobstermen and their supporters, but offers little comfort to those concerned with the future of our oceans and the survival of right whales.

WARMING WATERS

While fishing and shipping industries affects the lives of existing whales, human influence on climate change and the ocean environment is exacting an even greater, and possibly irreversible, toll on future whale populations. Warming ocean temperatures are causing biological shifts in ocean productivity (Saba et al. 2016), leading to major shifts from the bottom of the food chain to the top. This change is most evident in copepods—the smallest animal plankton (zooplankton), which fits into just about every marine animal's food web.

In the Gulf of Maine, *Calanus finmarchicus* is the sole food for North Atlantic right whales, and this copepod, which only reaches 2 to 4 millimeters in length, is diminishing in size and caloric value (Wilson et al. 2016). *Calanus finmarchicus* feeds primarily on diatoms, an even smaller single-cell algae (phytoplankton) that abounds in the waters of all oceans. During the winter months when temperatures and sunlight diminish and the phytoplankton dies off, copepods enter a state of suspended development called diapause. Diapause is essential to copepods as it allows them to pause metabolic processes and preserve important fats for early spring when the diatoms begin to multiply and bloom as sunlight increases. At this time, copepods can draw upon their fat reserve and begin foraging ahead of their reproductive stages. However, when winter ocean temperatures do not get cold enough, diapause is shortened, and copepods metabolize more energy, consuming the fat stores intended for their spring energy needs (Wilson et al. 2016). This reduction in diapause means *C. finmarchicus* in the Gulf of Maine are smaller and thus less valuable to right whales. As a result, many right whales that used to feed in the Gulf of Maine and Bay of Fundy have begun to feed during the summer months in the Gulf of St. Lawrence, a body of water to the north of Nova Scotia and New Brunswick, Canada (Meyer-Gutbrod et al. 2021).

The transition of right whales into the Gulf of St. Lawrence happened over the course of more than a decade, but it was not the only change in biological presence in the Gulf of Maine. Observations in the Downeast region have shown both humpback whales (*Megaptera novaeangliae*) and fin whales (*Balaenoptera physalus*) virtually disappeared between the years 2015 and 2021. And while there has been an uptick in sightings over the 2022 and 2023 summer feeding season of humpbacks, most animals observed appear to be passing through while seeking better foraging grounds, rather than residing in a region for months. At this time, it appears the days when individual whales would spend the entire summer feeding between Mount Desert Rock and the Inner Schoodic Ridges, south and southeast of Acadia National Park are gone (Nielsen 2023).

PLANKTON, EGGS, AND RECRUITMENT

Calanus finmarchicus is not only a primary food for the North Atlantic right whale, but also an important food for larval North Atlantic herring (*Clupea harengus*). Herring, in turn, is an important baitfish for the lobster fishery. As herring catches have declined, in part due to low quotas since 2019, lobster fishermen need to seek alternative bait sources. In Atlantic Canada, herring biomass declined by roughly 50 percent between 1995 and 2015 (Wilson et al. 2016). Furthermore, overall fitness of herring appears to have been declining since the mid-1960s, accelerating into further decline in the 1990s, and only moderately improving to unhealthy. Much of this decline is due to commercial harvesting, but given the highly complex variability in herring abundance based on numerous environmental factors, including ocean temperature, spawning success, and highly volatile predation pressure (e.g., seals, seabirds, tuna, sharks, and whales), in addition to a biased target size of larger fish by commercial harvesters, total stock stability has become threatened (Boyce et al. 2019).

Furthermore, warming waters have an imbalanced impact on herring spawning. While warm waters reduce spring herring-egg recruitment, it has a much lower effect on fall herring-egg recruitment (Boyce et al. 2019), which appears to go up. This imbalance can mislead policymakers into thinking rising temperatures do not always result in a lower spawning stock biomass and is therefore not a serious concern. Egg fecundity in warmer waters is, however, quite low, causing a latent response that leads to lower recruitment of spawning stock biomass several years down the road when the surviving herring reach harvestable size (Burbank et al. 2022). It turns out egg fecundity in herring has been in decline since the 1970s (Barrett et al. 2022), and fecundity of egg and larval success may be directly related to copepod abundance. A 2017 study in Norwegian waters showed a direct correlation to long-term recruitment success when there is a higher abundance of zooplankton (dos Santos Schmidt et al. 2017). The Department of Fisheries and Oceans in Canada is now using copepod abundance as a reliable predictor for long-term herring recruitment estimates (Turcotte 2022).

THE KRILL SURPLUS HYPOTHESIS

In the latter half of the 20th century, when most whaling was nearing its end in the Southern Ocean, it was a common belief that zooplankton, mainly the krill species Euphausia superba, would begin to thrive as their main predators were removed from the ocean. A British Antarctic Survey published data in 1977 estimating that 150 metric tons of surplus krill would be available annually for seals, penguins, and other marine animals due to whale absence, and that populations of these fauna would experience a notable increase (Laws 1977). Current methods at that time were limited to known stomach contents of whales from whaling data and estimates of the caloric needs of mammals based on animals much smaller than baleen whales. These limited predictions proved incorrect, and beliefs that seal and penguin predators would thrive with newly available prey were wrong. Instead, the lack of whales resulted in a population stagnation, or in some cases a decline in seal and seabird populations (Lee et al. 2010). A recent study by Savoca et al. (2021), using bio-loggers, drones, more informed prey consumption calculations, and more precise models of feeding regions by species, finds that the 1977 study was off by more than threefold. These findings profoundly change our understanding of the effect of prey consumption by whales and the resulting growth of life in the water. Instead of a krill surplus from whale reduction, we experienced the krill paradox in which krill abundance declined.

THE WHALE PUMP

As is often the case, predicting nature is a humbling experience. All too often we impress ourselves with sophisticated modeling techniques that later send us back to the drawing board scratching our heads. But the scientific process does not promise answers, it merely provides a method to continuously make corrections based on new data and always leaves open the option for refinement. Just as medicine develops new treatments for well-known ailments to replace old methods, we now understand the consumption of zooplankton is not the end of a life cycle; it is merely a stage in an ever-revolving process of nutrient cycling and transport where whales are the primary vector.

Iron is a relatively rare element that is crucial to the biological process of photosynthesis in phytoplankton. Iron in the form of dust may be carried over oceans by wind blowing off mountains and across high plateaus, and volcanic eruptions can also release iron into the atmosphere. As rivers course over land, they carry and distribute iron into coastal waters, and hydrothermal vents release iron into the deep ocean. Because iron tends to settle and phytoplankton consume free iron in the upper water column, deep waters have much higher concentrations than surface waters. So, in the photic zone, where most ocean life exists, iron is sparse and in high demand (Boyd and Ellwood 2010). Much of the iron consumed by phytoplankton ends up in the bodies of zooplankton. Whales play an important role in redistributing that iron by consuming copepods, krill, and the fish that feed on them and releasing the iron they ingested at the surface, where whales inevitably go to breathe, in the form of feces and urea (Roman and McCarthy 2010).

Nitrogen is also a critical element to ocean fertilization. It is estimated that whales deliver 23 metric tons of nitrogen to the surface of the Gulf of Maine annually (Roman and McCarthy 2010) through defecation. This process provides more nitrogen than all the rivers that flow in the Gulf of Maine and is a critical volume of nutrients for phytoplankton production. While the nutrients from the whale pump do not solve the diapause problem in copepods, they do affect the number of phytoplankton available for copepods and are critical to the lifecycle of larval herring, whales, and the health of other fisheries in the Gulf.

CONCLUSION

Right whale mortality is exceeding their biological growth rate due to entanglements in fishing gear, ship strikes, and a low birth rate as a result of a poor diet. They are expected to go extinct within the next few decades if these threats are not mitigated (Pettis et al. 2020). This extinction would be a major defeat to wildlife management and has already begun to reveal the weaknesses in the Endangered Species and Marine Mammal Protection Acts. While fewer whales in the Gulf of Maine may simplify the management problem for lobstermen, it poses a threat to their fishery. Marine ecosystems are vastly complex systems with annual, decadal, and longer cycles that affect all marine species, including the Atlantic herring. Whales are not only barometers of ocean health, they are drivers of ocean biomass with their constant movement through the water column and daily dietary functions. Through the digestion of animal plankton and the transportation of nutrients from the bottom to the surface, whales fertilize the water and redistribute needed nutrients that propagate plant plankton growth at immense levels not fully appreciated until recently. Their absence does not bode well for the future of the Gulf of Maine and instead reveals its fragility.

Policymakers are the arbiters of how natural resources are used and conserved for long-term environmental and economic health. If they choose to act on popular demands over science, data, and observed trends, I believe they risk a legacy of failure. The signs of a sick ocean are clearly visible, and to those who are studying the data and watching the trends, it is reminiscent of the 1990s, when climate change and the greenhouse effect were often ridiculed or ignored. These signs can hardly be more evident, especially for the fishermen who witnessed the collapse of the Long Island Sound lobster fishery in 1999 (Balcom and Howell 2006). Though it may not be evident to the fishermen experiencing high landings in the northeastern Gulf of Maine (Goode et al. 2019), those who are studying the nuanced complexity of long-term oceanographic patterns are alarmed by the declining health of the Gulf of Maine. As a commercial mariner, I admire and respect the Maine lobster industry for its unprecedented management and stewardship of the resource, which has led to a successful fishery. But I believe it's important that we adopt a broad view that considers the complexity of our ocean ecosystem and learn to appreciate there are more elements to our economy than lobster landings. While the industry is unquestionably an important component of our economy, so is the existence and abundance of whales, seals, tuna, cod, herring, and everything else in the Gulf of Maine. We must act conservatively and prevent the next great disaster and preserve this precious resource.

NOTES

1. https://www.fisheries.noaa.gov/species/american-lobster
2. https://www.manomet.org/publication/manomet-study-maine-receives-14-billion-in-economic-benefits-from-natural-environment/

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