Are Jellyfish Actually Apex Predators? The Potential of a Jellyfish-Dominated Ocean Ecosystem

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Are Jellyfish Actually Apex Predators?

*The Potential of a Jellyfish-Dominated Ocean Ecosystem*

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In the last two decades, jellyfish have been grabbing headlines. The increasing size and duration of jellyfish blooms (large aggregations of jellyfish usually for mating) have been closing beaches, wreaking havoc on fisheries, clogging industrial water intakes, and even shutting down nuclear power plants. In the Philippines, on December 10th, 1999, 50 truckloads of jellyfish that had been sucked into the cooling system of a power plant completely shut down the entire northern Philippines power grid. In 2019, a mass stranding of blue bottle jellyfish invaded Australia’s northeastern shores. This incident left 3,595 people with burning stings and painful welts and caused widespread beach closures. The causes of increasing jellyfish bloom intensity and what it means for ocean ecosystems are far from clear.

It is easy to see the devastating effects of human activity on our oceans as commercial, wild fish populations plunge, the coral bleaching leaves ghostly white graveyards, and eutrophication (excessive richness of nutrients in a body of water, usually due to human activity) creates ‘dead zones.’ There is so much focus on what we are destroying the question of what we have an equal hand in creating is often overlooked. Within nature, present destruction is usually a last act of creation. Each mass extinction event in Earth’s history is later preceded by a period of rapid species diversification as previously filled niches become available. According to some scientists, we are presently in a sixth human-caused mass extinction event. As ecosystems change, jellyfish seem ready to fill in the gaps.

The recent increase in the size and duration of jellyfish blooms is seen as a kind of canary in the coal mine - a symptom of an ocean in distress. However, in this case, the canary is a jellyfish and has caused millions of dollars of commercial damage. Jellyfish have been shown to thrive in many conditions associated with human-driven ecosystem change; lower O2 levels, warmer temperatures, eutrophication, and overfishing have all been associated with increases in jellyfish populations.

Jellyfish have been around for approximately 600 million years and are considered potentially the first ‘multicellular ‘animals.’

Some researchers have started to speculate that the future of our oceans may be jelly-dominated. The theory suggests an alternative second food web called the jelly web or a ‘low energy’ food web constantly operates alongside what we would call the normal/high energy food web and represents a fundamental shift in how energy within an ocean ecosystem flows.

What we typically think of when it comes to the ocean is a high-energy food web. Phytoplankton (tiny photosynthetic organisms) are eaten by copepods (small zooplankton), which are eaten by krill, which are eaten by fish, which sharks, seals, and other high-energy predators eat. Each level of this food web represents larger, more energy-dense organisms. In a jelly web, on the other hand, phytoplankton are still eaten by copepods but are then consumed by jellyfish, and larger jellyfish consume those jellyfish. This web is fascinating because it is, in some ways, upside-down. Jellyfish consume ounce-for-ounce, energy-dense food sources but are a nutrient-poor food choice since they are 98 percent water, leading to a kind of ecological dead end that only supports hunters that exert little energy catching prey. While new research suggests that jellyfish may be an important food source for some penguins, fish, and turtles, it is reasonable to assume they cannot be the primary food source for high-energy predators.

Usually, these two food webs coexist and fluctuate seasonally, but human disturbances push ocean ecosystems toward a jelly web. Whether an ecosystem will be a high-energy web or a jelly food web starts at the very bottom of the food web, with what type of phytoplankton (tiny, microscopic plants) are present. Diatoms are microscopic unicellular algae that create glass-like capsules made of silicate, a naturally occurring mineral in the ocean, and are the basis of a high-energy food web. Flagellates, a different type of phytoplankton, are smaller and make no capsule but have flagella, long, whip-like tails that allow them to swim. Copepods will preferentially consume large diatoms to small diatoms or flagellates. Fed on a diet of large diatoms, copepods will grow larger and become easier prey for higher energy predators like small fish that hunt by sight, which are eaten by larger fish and support a higher energy food web. If copepods eat flagellates and remain smaller, they will be far better prey for jellyfish, which hunt passively, do not rely on sight, and expend little energy on movement - leading to an ecosystem dominated by jellyfish.

Many human activities are promoting conditions more favorable to flagellates and, therefore, jellyfish. Eutrophication, a major type of human pollution mentioned above, has led to excess nutrients, e.g., nitrogen, and low oxygen levels in coastal areas. This excess nitrogen also favors the proliferation of flagellates over diatoms, as the amount of silicate available in the water limits diatom growth. So diatoms do not benefit from the excess of nutrients. Flagellates not only exploit these nutrient pollutants to grow in mass quantities but are far more tolerant of lower oxygen levels as they can propel themselves to more oxygenated water, whereas diatoms generally sink and die. Combined with the fact that jellyfish are also tolerant of oxygen-poor environments, they have been doing exceptionally well in coastal regions, where they are causing the most trouble.

When flagellates bloom, they do so rapidly. This favors jellyfish fish proliferation as the jellyfish life cycle is highly adaptable and can rapidly increase in population to take advantage of these blooms. Other species, like mammals, require regularity of food sources as they have slower, less adaptable life cycles and generally put energy into raising a few offspring rather than putting little energy into raising many offspring. This means that jellyfish populations can rapidly adapt to changing conditions more quickly and take advantage of increasing flagellate blooms.

While this theory is relatively new and still in its scientific infancy, it is well worth considering the future ecosystems human activity in the Anthropocene is creating - and the potentially key role jellyfish will play in that future. Jellyfish have been around for approximately 600 million years and are considered potentially the first multicellular ‘animals,’ mindlessly drifting through the millennia. There is a beautiful irony in jellyfish, a mindlessly floating, gelatious organism, inheriting a world polluted by human’s over productivity. • • •