

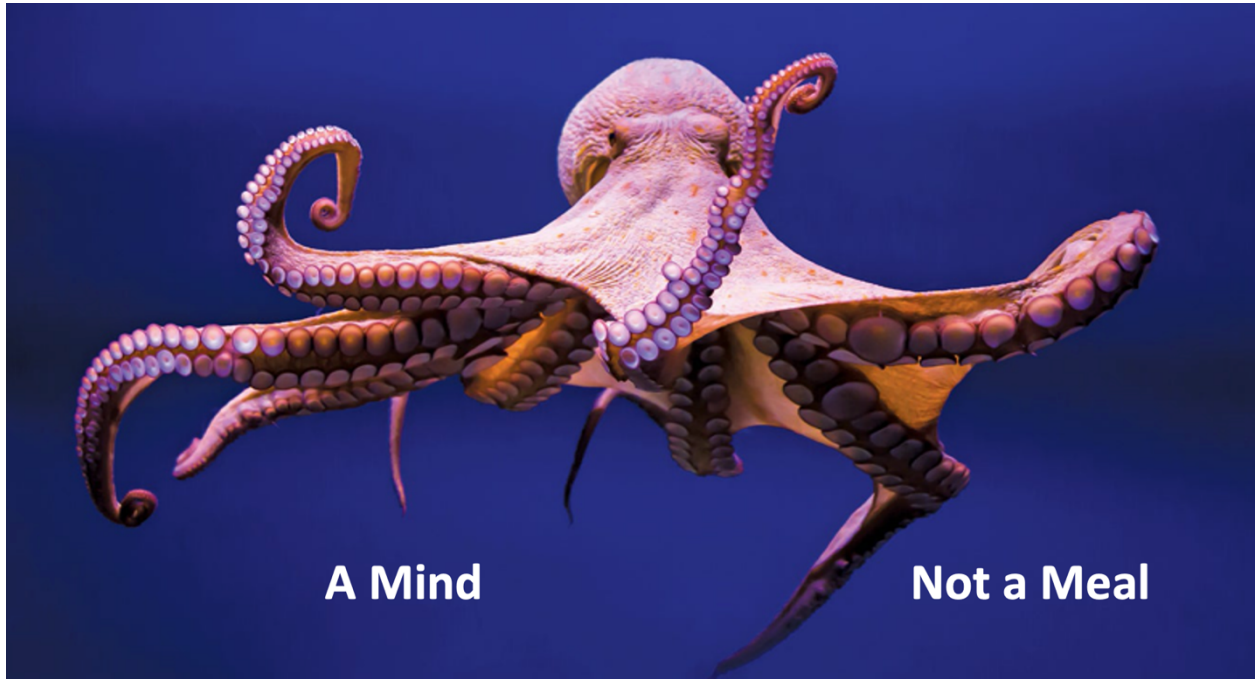
Appendix 4

A Mind not a Meal: The Two-Faced Dilemma of the Octopus in Contemporary Conservation

Paul Greenberg



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A Mind not a Meal

The Two-Faced Dilemma of the Octopus in Contemporary Conservation

by Paul Greenberg

Part I Reconsidering the Octopus

Over the course of the last two centuries, intellectuals of note have made the case for rescuing particular marine animals from the condemning label “fish” or even worse “seafood”. Melville gave the whale personality and memory in *Moby Dick* even though cetaceans were perceived at the time to be mainly industrial sources of oil and bone. D. Graham Burnett in his history of the era, *Trying Leviathan*, points out that even the prevailing legal opinion of Melville’s day held that a whale was a fish¹. More recently Carl Safina in *Song for the Blue Ocean*² drew attention to the exceptional nature of bluefin tuna, alerting readers outside marine science to that fish’s astounding ability to navigate over thousands of miles and heat its blood 20 degrees above ambient. Mark Kurlansky in his bestseller *Cod* (1998)³ while not exactly attempting to build empathy for the book’s eponymous fish, built bridges to a large popular audience by recounting the squandering of the codfish’s natural abundance and comparing it with the more commonly known story of the destruction of the American bison. David Foster Wallace in his widely read essay *Consider the Lobster*⁴ presented the scientific evidence around that crustacean’s possible sensitivity to pain and disturbingly reintroduced to the culinary world the shocking concept that an animal might prefer *not* to be boiled alive.

But the default for modern humans is to view any animal that inhabits the sea as an item for the supermarket rather than as a sentience responding to and interacting with a complex ecosystem. Think of the word “seafood” itself. How many genera and species are described by these two dismissive syllables? Equivalent in other cultures are no less vague or misleading. In

French, Italian, and German seafood is *fruit de mer/frutti di mare/Meeresfrüchte* “sea fruit.” Most Slavic languages, meanwhile, call the many creatures of the oceans *dari mor’e* “gifts of the sea”⁵ and in their utilitarian way the Soviets tagged ocean animals blanketly as морепродукты – sea products. All these expressions imply that the ocean’s denizens are vegetative, arbitrary, and free of charge. So-called vegetarians, indignant over the suffering of farmed cows and chickens, frequently include wild fish and shellfish in their diets. Kosher laws that mandate the merciful slaughter of mammals and birds do not apply to fish.

It is in this context that we must view the challenges involved in rescuing a new marine species or category of species from thoughtless consumption. The tidal pull of “seafood” for the general public should never be underestimated. Given the choice between saving something and eating something from the sea, people will generally prefer to eat it.

So it is with the 300+ described species comprising the family Octopodidae. As scientific evidence for these creatures’ unique sentience has steadily built from the Victorian period to the present era so too has their capture killing and consumption. In 1980 just before wide-scale re-appraisal of octopus intelligence made its rise in public discourse the world harvest of all species of Octopodidae was 179000 metric tons per year. By 2014 after octopus YouTube videos and other cultural memes had started to achieve a certain kind of fame across the internet harvests had nearly doubled to 355000 metric tons. Today the internationalization of previously local dishes that favor octopus as an ingredient are further pressuring Octopodidae. Hawaiian poke and Spanish-style tapas as well as the continued growth in popularity of sushi implies that growth in landings will continue apace. The 2020 hit documentary *My Octopus Teacher* may have brought the octopus’s special intimacy to a large new audience but a 2019 YouTube video called Mukbang Twin Roozi Family in which a pair of tween Korean girls plays with and then devours

an octopus has received 221 million views to date--more than any other octopus video on the platform. In fact, across YouTube octopus videos that feature a harassment of a live animal followed by its dismemberment and consumption by a teenager or 20-something human far outrank any videos concerning intelligence escape or mimicry (see appendix 2). These videos loosely fall into a genre of video called “Mukbang” first popularized in South Korea. The word mukbang (먹방) meokbang) being a neologism formed from the Korean words for “eating” (먹는; meongneun) and “broadcast” (방송; bangsong). A literal English translation might be “EatCast.”⁶

There are also, unfortunately, certain physiological characteristics specific to octopuses that make them an object of consideration for both fishing and cultivation. Octopuses are efficient at converting their food into protein. They have short lives that encourage fast growth—a trait conservation organizations zero in on when determining whether a “seafood” is “sustainable.”⁷ Octopuses have no bones which translates into minimal time on the processing line. In many ways they appear to be an easy way to increase protein in a protein-desperate 21st century. But as the Alaska-based octopus researcher David Scheel pointed out to me, “nobody knows how many species there are. There is terrible tracking of what’s actually being harvested and no ability for fishers to know what they’re catching. The taxonomic science is a mess. This is not a criticism of taxonomists. Octopus are tough to differentiate. External appearance changes constantly. What criteria can you use to categorize them?”

Assessments of octopus fisheries are similarly messy. The Monterey Bay Aquarium’s Seafood Watch Program labels most fisheries for octopus as either overfished or experiencing over fishing. But in truth Seafood Watch’s assessment is even more ominous. For at the present moment, according to Monterey Bay, more than two thirds of octopus fisheries around the world

haven't even been assessed. Those who study the fishing industry know that a lack of assessment more often than not is a precursor to that fishery's being later declared overexploited.⁸

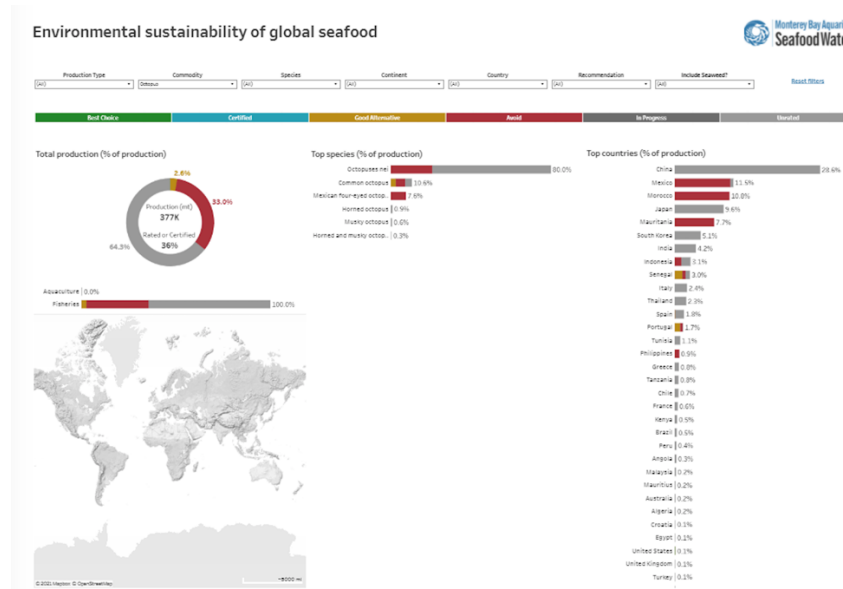


Figure 1, screenshot from Monterey Bay Aquarium Seafood Watch's summary assessment of world octopus fisheries

Meanwhile the results of research into octopuses' sentience has started to move out of the laboratory and into the realm of legal protection. The European Union, Canada and the United Kingdom have all placed octopus under the umbrella of welfare laws that blunt to some degree the extent to which these animals may be subject to suffering during scientific testing and entertainment display.⁹

This then is the octopus's particular dilemma in 2021. As behavioral research speeds ahead showing more and more convincingly that this family of invertebrates possesses awareness, agency, and a unique take on what we are just now cautiously labelling consciousness, exploitation threatens to erase whole swaths of individuals whose lives we have scarcely come to know. The larger Pacific striped octopus off Brazil, for example, was described in a lone research paper in the 1970s as having atypical behavior for the family, mating for life

and spawning and surviving rather than abruptly perishing after reproducing as most octopus species are known to do. But when more ambitious researchers finally went back to see if the data gathered was correct, the species, highly localized off Brazil, had vanished, evidently from overfishing. The species reappeared again in the mid 2010s but without adequate assessments of the species lifecycle and biomass it is nearly impossible to determine whether the next overfishing event could lead to the species' eventual extirpation¹⁰.

How then can we help public knowledge outpace public consumption before these kind of vanishings become more common and, perhaps permanent? How can we build a case for the octopus as a mind and not a meal? A look into the steps that have rescued these animals from underwater obscurity to date suggest a strategy, that, like the octopus itself, follows unusual and unexpected pathways. A distributed intelligent strategy to help society embrace the unique distributed intelligence of the octopus and other cephalopods.

From Monster to Mind

The last three thousand years have seen the octopus make a tortured journey from misunderstood monster to emerging mind in a one-step-forward-two-steps back kind of way. The steps back, usually arising from taxonomic confusions that plague these animals to the present day. Much of what follows is drawn from Stefan A. Gawronski's wide-ranging and deeply researched dissertation "Sympathy for the Devilfish."¹¹ Gawronski notes that Aristotle labeled octopuses' inherent curiosity toward man as "stupidity" assuming that the trusting tentacle they often extended to humans in the water proved their ignorance of an obvious threat. Pliny the Elder, in an early, oft-repeated mistake conflated octopus with giant squid that would on

occasion wash ashore along the Mediterranean. Pliny misinterpreted these strandings, suggesting that octopus were dangerous monsters that could pursue their victims all the way onto land.

The Aristotelean/Plinian “stupid/brute” view of octopus stayed oddly persistent up until the late 18th century. It is only as various lines of research start to coalesce around a theory of evolution that a certain duality starts to arise; a duality which Gawronski calls a “divide between morphology and mythology.” The naturalist Pierre Dénys de Montfort did much to expand knowledge about octopus and other mollusks in *Histoire Naturelle Générale et Particulière des Mollusques* in 1802 and 1806. But his later work used interviews with seamen as primary sources resulting again in the mistake of conflating octopus with giant squid (octopus, according to de Montfort were responsible for sinking an entire fleet of British ships). Victor Hugo turned de Montfort’s “nonfiction” into outright fiction in an international bestseller known in English as *Toilers of the Sea* (1866) and Jules Verne further captured interest in cephalopods with his 1870 *20,000 Leagues Under the Sea*.

But parallel to an emerging literary tradition around cephalopods was also a technological innovation that served to cement octopus in popular culture. In the 1840s England abolished the Medieval era glass tax, clearing the way for the possibility of creating glass-constructed aquariums. In 1853 The Crystal Palace aquarium was opened in London followed by other major aquaria in Paris (1867) and Berlin (1869). Crystal Palace began displaying a live octopus in 1871 drawing enormous crowds and fueling a trend that the press labeled “cephalomania”. The Victorian naturalist Henry Lee who worked out of Brighton aquarium wryly declared in 1875 that “an aquarium without an octopus is like a plum-pudding without plums”¹². But in addition to the monster-hyping, cephalomania was fed by moments of perplexing octopus mischief. The octopus at the Brighton Aquarium achieved national fame when it was discovered to be sneaking

from tank-to-tank after hours and stealing fish from other exhibits. When it died (or rather was eaten by a dogfish shark in its home tank) letters of mourning poured into local newspapers.

And even as the general public feared the myth that octopus left untended could grow to tremendous proportions and attack their keepers, aquaria also became houses for quiet, measured observations that began to point science in a distinctly different direction. The most significant step in this direction was the 1872 founding of the Stazione Zoologica Anton Dohrn in Naples. The Stazione for the first time combined a public facing aquarium with a rigorous research institution. The arrival in 1891 of Jakob Johann von Uexküll marks the emergence of serious work on the octopus brain. Von Uexküll investigated the nervous system of *Eledone moschata*, and, by, as Gawronski notes, “systematically extirpating segments of its brain, and recording the resultant behavior”. In this way he “divided the brain into centers for eating, centers for grasping and so on.” He performed experiments on octopus arms, and found they were capable of coordinated actions after having been severed from the body and concluded, the distributed nervous system of the octopus contains both a ‘higher’ animal and a ‘lower’ one.” Von Uexküll’s students carried on his line of research at the Stazione into the 1970s. Researchers conducted brain vivisections that for all their brutality slowly came to map the octopus nervous system; a feat that was achieved in 1971.

Along with the mapping of what researchers were finding to be a markedly complex nervous system, behaviorists were doing a similar charting of how octopuses worked in the world. With the work of P.B. Dews in the 1950s a mind starts to reveal itself. As a research subject, octopus quickly showed that they viewed the world very differently from their vertebrate examiners. Dews in 1959 did some of the first learning and reinforcement experiments on octopuses convincing two octopuses named Albert and Betram to pull a lever to get food. But as

the philosopher Peter Godfrey-Smith points out in his 2016 “Other Minds: The Octopus, The Sea and the Deep Origins of Consciousness” some of the research subjects adapted to the new and unusual circumstance of lab confinement “to turn the apparatus around them to their own octopodean purposes.” The octopus Dews christened “Charles” broke the experiment’s lever, stole a light bulb, and squirted at researchers in act of seeming revenge.¹³ Paralleling academic work on the octopus more popular nonfiction started to attract an audience most notably Frank W. Lane’s *Kingdom of the Octopus* (1960).

Behavioral experiments combined with the now more complete development of evolutionary taxonomy and phylogenetics allowed for scientists to begin to grasp what a unique challenge to human exclusivity on intelligence the octopus represented. Scientists came to understand that the point at which the octopus evolutionary tree branched away from that of humans and, indeed all of vertebrate life, necessitated that they develop an alternate route to sentience. The possibility of communication between, say, dolphins and humans seemed plausible due to obvious parallels in physiology. A dolphin and a human are both bilaterally symmetric organized around a large brain and a spinal column. A human brain looks like a dolphin brain. Dolphins exhibit traits of selfhood as *we* understand it to be (mirror recognition, active social behavior, individual “personalities” to name a few).

Precursors to octopuses meanwhile, separated from the vertebrate evolutionary line some 600 million years ago which means that consciousness and agency in this range of animals was invented independently of vertebrates. As Godfrey-Smith puts it “if we can make *contact* with cephalopods as sentient beings, it is not because of a shared history, not because of kinship, but because evolution built minds twice over. This is probably the closest we will come to meeting an intelligent alien.”¹⁴

A Second “Cephalomania”: Distributed Intelligence and a New Intelligence to Media Distribution

Several important pieces of traditional octopus-focused popular culture in the last few years have certainly raised the octopus’s profile, most notably Sy Montgomery’s *The Soul of the Octopus*¹⁵ and the above cited *Other Minds*. But what seems to truly trigger empathy for cephalopods in humans is the opportunity to experience a direct gaze with these creatures. The 2020 surprise hit documentary *My Octopus Teacher*¹⁶ in which a diver comes to build a relationship with an octopus in the South African kelp forest is laced with moments of eye-to-eye contact between the eponymous teacher and the film’s human narrator. Godfrey-Smith in *Other Minds*, was drawn to his subject not through previous reading of literature but after a close, eye-to-eye encounter with a cuttlefish off the coast of Australia. It is this notion of an engaged gaze that links the Victorian era cephalomania with the 21st century equivalent. Just as the emergence of aquarium technology offered the public an opportunity to lock eyes with the octopus so too did the emergence of compact digital video recorders and internet streaming technology give computer users a chance to look at cephalopods intimately.

In addition, just as the octopus was, via the neurological mapping done in the 60s and 70s, realized to be built around a distributed intelligence model where each appendage works semi-independently to help the octopus interact with the world, so too have human information gathering systems over the last four decades gradually migrated from a top-down mode to a decentralized model for both computing and media distribution. As many an author or filmmaker will confirm, traditional modes of reaching audience will only take you so far today. To truly

penetrate and shift consciousness toward a given idea, distributed networks are the mode of choice.

Fortunately for the octopus three important technological leaps have paralleled in time the next step in popularizing octopuses' unique intelligence. The first development was public access to the internet itself. Built on a model that directly counters the network television or wire service model, multiple nodes (indeed billions of them) can now contribute to a hive mind of knowledge and information. Much like the way each octopus tentacle contributes to a collective sense of perception so too does the internet reflect a matrix of points of view. The first steps in popularization of the internet track closely in time with the octopus' migration from strictly academic publications to more speculative ideas around what the octopus mind might be capable of doing. In 1992 Jennifer Mather published *Underestimating the Octopus*, a chapter in a larger work on human/animal relationships that bridged academic research with public curiosity.¹⁷ In 1992 Graziano and Scotto published "Observational Learning in Octopus Vulgaris" and in 1993 Mather went further to suggest octopuses had individual personalities.¹⁸ A year later, in 1994, Mosaic Netscape 0.9, the first widely available web browser, appeared.

The second important development was the rapid acceleration in availability of consumer grade video cameras. The GoPro camera (analogue, 2002, digital, 2006) followed by the iPhone (2007) enabled amateur videographers to capture octopus in their natural environment or during random actions of escape.

The third and perhaps most important step was the creation of YouTube. Launched in 2005 this largely decentralized video distribution engine allowed GoPro users to upload what had become a steady stream of remarkable octopus behavioral moments. David Gallo's popular

“Underwater Astonishments” 2007 TED talk brought all of these different elements together into a video that has been viewed more than 16 million times to date.

It’s not that internet expansion directly caused the investigation of octopus research but distributed conveyance undoubtedly drew attention to distributed intelligence. Furthermore, because computer science helped the idea of decentralized intelligence become widely accepted, what had previously been perhaps only a theoretical concept of another kind of consciousness was now being demonstrated in vivo. The octopus *could* be intelligent because we humans had started to build a mind thrice over (to repurpose Godfrey-Smith’s words). And this thrice-built artificial mind was in a way closer to an octopus’s than to a human’s.

Part II Octopus Opportunities

Achieving Octopus Consciousness for the Conscious Octopus

With pathways now firmly established for sharing octopus “moments” with the general public, and with a growing interest in the octopus’s unique take on intelligence the time appears to be ripe to build on that enthusiasm to create awareness around particular threats, not only to octopuses themselves, but to the environments and ecosystems that support them. Exactly which threats represent the most urgent is the subject for future research. But a very rough mapping of areas along which research and activism could be pursued follows below.

Octopus and Data Poor Fisheries

Data poor fisheries are one of the most important yet most overlooked aspects of marine conservation. As I noted in the introduction to this essay, not knowing something about an active fishery is more often than not a precursor to discovering the fishery in question to be overfished. At present a large portion of the world’s fisheries have yet to be assessed and a much larger share are data poor. Without proper fisheries management data and, particularly historical baselines, there is no way for managers to a) design and execute effective long term management goals and b) rebuild toward an accurate historical baseline. You cannot restore what you cannot remember. Researchers interviewed for this paper all agreed that octopuses represent a particularly data poor set of fisheries. They further emphasized that along with catch data gathering and analyses there is an urgent need for *basic taxonomy* so that every existence and range of species is more firmly established. But in addition, octopuses could also serve as a stand in meme for the need to

address the data-poor fishery problem overall. Data-poor fisheries are a distinctly unsexy and hard-to-grasp concept for those not engaged with fisheries science. The charismatic octopus as spokes-creature for this problem could perhaps spur a way in for educators to draw the general public more directly to solving this nettling fisheries dilemma.

Octopus and Marine Protected Areas

Even though octopus are fast growing and quick to reproduce, they are vulnerable to overfishing. Research of artisan fishing communities has shown that in spite of their intelligence, they are relatively easy to capture and can quickly be overexploited. At the same time, because they are quick to reproduce they respond well to conservation measures and can quickly prove the efficacy of even limited shielding from fishing pressure. David Scheel referenced a trial conducted in Madagascar by the nonprofit Blue Ventures, documented that the introduction of rotational closures in octopus fishing grounds resulted in a net increase in abundance and overall catch for rural communities who depended on octopus for both subsistence and income. Thus, once again the octopus can be a “poster-child” opportunity. Quick rebounding from fishing closures are something of a holy grail for those trying to enforce, maintain and promote marine protected areas. With the 30 by 30 goal declared by the United Nations (30 percent of the ocean protected by 2030) an octopus meme-ed initiative could help shepherd in this larger movement.

In addition, with some caveats, it can also be cautiously asserted that there is a synecdochal relationship between octopus abundance and healthy benthic habitat. Again, the paucity of data makes one cautious of generalizing across octopus taxa, but generally speaking there does seem to be among octopuses a preference for bottom with rugosity and adequate

cover. These habitats are subject to damage by bottom trawling throughout the world and on reefs to dynamite fishing in unregulated coastal areas of the world. Saving “octopus homes” could therefore be another meme for gathering conservation momentum. The fact that octopuses are not particularly migratory further solidifies the concept of the importance of protecting underwater “homes.”

Octopus and Water Quality

Octopus are notably sensitive to anthropogenic pollution. As Barrett Christie, the octopus curator at the Maritime Aquarium in Norwalk, Connecticut told me, water that passes the EPA standard for drinkability could be a hundred times over the level that would generate mortality in octopuses. In a liver like organ called the hepatopancreas, octopus accrete and then fail to discharge heavy metals such as chromium and lead. Octopus therefore have the potential to be canary-in-the-coal mine ambassadors for protecting coastal watersheds. This is particularly notable since the majority of octopus species tend to be in coastal waters ranging from shore to the continental shelf--precisely those areas that humans have greatest agency over and greatest need to protect.

Octopus also can play this same canary-in-a-coal mine role in the popular mind with respect to ocean acidification. Octopus like all mollusks are particularly affected by even subtle changes in pH. Ocean acidification, one of the more unseen byproducts of the burning of fossil fuels could potentially profoundly affect octopus populations worldwide. This would at first seem counter-intuitive since octopus unlike other mollusks don't form a hard shell (a trait that has found to be strongly affected by ocean acidification since small changes in pH are used to

regulate the deposit of calcium). But octopus do use small amounts of calcium carbonate in their macular system which allows them to sense gravity. That plus an extremely thin cell-width skin that is stretched over the octopuses color generating chromatophores adds to these creatures susceptibility to chemical changes in the ocean. It should be noted that the largest and most charismatic octopus species, the Giant Pacific Octopus (GPO) are endemic to the Pacific northwest, a region where acidification is already affecting shellfish growers. The GPO could therefore be a vehicle for research and public information/awareness campaigns a poster child of sorts for activism to work against ocean acidification.

Octopus and Aquaculture

As Jacquet et al. have pointed out,¹⁹ octopus also have a role to play in advocating against the expansion of aquaculture or at least against the expansion of ecologically unsound practices. For half a century now, aquaculture has expanding rapidly going from 10 million metric tons in 1987 to 80 million tons by 2017²⁰. The most harmful portions of that expansion have revolved around the growth in the farming of carnivorous fish and shellfish. Salmon aquaculture, for example, has gone from a near negligible portion of the overall amount of salmon consumed pre-World War II to the point where now farmed salmon, primarily of a single species (*Salmo salar*) rival the catch of all six species of wild salmon combined.²¹ This is particularly impactful to marine ecosystems since, by and large, carnivorous fish require more pounds of wild fish per unit of edible flesh produced.

In this respect the octopus represent a dangerous next step for aquaculture. As I and others have written, aquaculture profits depend on the efficiency of the animals they grow and

the degree of human care those animals require. On both scores octopus species highlight the inadequacies of the aquaculture sector. Not only are octopuses dependent on large amounts of ecologically expensive protein in their diet, they also are known to produce inordinate amounts of waste relative to their size and mass. This provides two considerable hurdles that have interesting ecological parallels. Since the protein component in aquaculture is primarily generated through the harvesting of forage fish like Peruvian anchoveta (a segment of global fisheries of which the public remains largely unaware) highlighting the high protein demand of octopuses could potentially point an awareness finger at the reduction industry which today claims about ¼ by mass of all fish and shellfish extracted from the sea on a regular basis²².

Nitric waste from octopus also presents a conservation tether to the water quality issues raised elsewhere in the aquaculture sector. Similar to CAFOs on land, fish farms present challenges to the surrounding environment in the form of excretion. For this reason many have argued in recent years for the sequestering of farmed salmon to inland tank-based facilities. But in order for that to be a viable form of production, recirculating farms have to come to manage a closed system and incorporate expensive waste filtration techniques into their systems. Octopus with their voluminous excretions tax even the best-managed aquarium facilities and thus would allow another vector for explaining to the public the dangers in continue to pursue the development of carnivorous finfish and invertebrate aquaculture.

Octopus on the Spectrum

Octopus draw a unique audience in the form of people who, for whatever reason feel intellectually misunderstood. Octopuses tend to disguise, resist socialization, escape, and take

fundamentally different pathways to discover and explore their environment. Their uniqueness therefore is potentially an opportunity to build empathy among aspects of society that might not typically embrace conservation goals. These parallels curiously circle back to the tech sector where more than a few individuals of financial and organizational prominence self-identify as “being on the spectrum.” It therefore seems not implausible for the conservation community to build bridges to the tech sector via the octopus. One could hope that in the future a large tech company might even take on the octopus as a corporate symbol and activist cause. But as the internet pioneer Vint Cerf noted to me in an interview²³, the fact that octopuses are still plagued by a false history as being grasping, all-consuming monsters may give pause to any global corporation that seeks to identify with them.

Octopus and the Fleeting World

A last possible intellectual liaison that can be made among fields could possibly be mined by octopuses’ surprisingly short lifespans. Octopus of different species seldom live more than two years, prompting many animal behaviorists to wonder why the animal has invested so much energy in learning and memory and a large neural network. These systems are energetically expensive to build and maintain and it would seem to fly in the face of evolutionary logic. Octopus highlight the fleeting nature of existence, the value of the individual moment, and the imperative to make the most of the little time we have on earth.

Appendix 1: Timeline of Octopus Understanding/Research/Popularization

c. 350 BC: Aristotle describes octopus as 'a stupid creature, for it will approach a man's hand if it be lowered in the water'.

c. 77 AD: Pliny in his *Historia naturalis* notes of the octopus that: "there is not an animal in existence, that is more dangerous for its powers of destroying a human being when in the water. Embracing his body, it counteracts his struggles, and draws him under with its feelers and its numerous suckers, when, as often is the case, it happens to make an attack upon a shipwrecked mariner or a child.

77-1700s: Plinian and Aristotelian modes of perceptions persist.

1802 and 1806 Denys-Montfort writes *Histoire naturelle generale et particuliere des Mollusques* using science-based observations of octopus physiology and behaviors.

1840s: England abolishes the glass tax which opens the way for the creation of public aquaria. Widening network of railways gives public greater access to coastal environment.

1853: London's Crystal Palace Aquarium founded starting the Victorian era aquarium craze

1866: Victor Hugo publishes *Les Travailleurs de la mer (The Toilers of the Sea)* that is the *Jaws* of its time launching the "cephalomania" craze in Europe. Hugo's wife, writing from Paris, tells her sister Julie: "Everything here has become octopusied"

1869: Berlin Aquarium opens and the future founder of Stazione Zoologica in Naples Anton Dohrn visits.

1870: Jules Verne's *20,000 Leagues Under the Sea* is published and the book's description of giant squid further fuels cephalomania

1871: Crystal Palace Aquarium acquires an octopus

1872: Stazione Zoologica Anton Dohrn founded in Naples. The Stazione for the first time combines a public facing aquarium with a rigorous research institution.

1873: Henry Lee, curator of the Brighton Aquarium, describes incidences of an octopus escaping its tank and eating fish from other exhibits attracting public interest.

1875: Henry Lee publishes *The Octopus or, The Devil-fish of Fiction and Fact* – a treatise meant to be a correction of the myths propagated by Hugo and others.

1891: Jakob Johann von Uexküll arrives at Stazione Zoologica and begins the most ambitious program of octopus research to date.

1892 and 1894: von Uexküll investigates the nervous system of *Eledone moschata*,

systematically extirpating segments of its brain, and recording the resultant behaviour. In this way he 'divided the brain into centers for eating, centers for grasping and so on.' He performs experiments on octopus arms, and finds they are capable of coordinated actions after having been severed from the body concluding In other words, the distributed nervous system of the octopus contains both a 'higher' animal and a 'lower' one."

1947-1971: Boycott, Young, and Wells, continue von Uexküll research on octopus at the Stazione Zoologica. 1971 Young publishes *The Anatomy of the Nervous System of Octopus vulgaris*). Young notes "Since it responds so consistently to the presence of prey, the animal is readily trained. It is also tolerant of surgery and survives the removal of the greater part of its brain. This makes the octopus an ideal animal with which to test directly the relation between the various parts of the brain and the various kinds of perception and learning."

1960: Frank W. Lane writes the popular book *Kingdom of the Octopus*

1964: Zachary Young publishes *A Model of the Brain*, systematically mapping the functions of the octopus nervous system, primarily by "surgically removing bits", seeing what functions changed and then documenting exactly what was removed microscopically"

1972: Martin John Wells publishes, *Octopus: physiology and behavior of an advanced invertebrate* (New York: Chapman / Hall, 1978), 271.

1992: Fiorito, Graziano, and Pietro Scotto publish "Observational Learning in Octopus Vulgaris."

1992: Jennifer Mather publishes Underestimating the octopus in *The Inevitable bond: examining scientist-animal interactions*, edited by Hank Davis and Dianne Balfour. Cambridge: Cambridge University Press, 1992.

2004: James Wood and Roland Anderson conduct an interspecific evaluation of octopus escape behavior. In their published results, they cite the assessment of I. Gleadall, who remarked that "warm water species like *O. vulgaris* are veritable hyperactive Houdinis!"

2005: YouTube founded

2006: First GoPro digital camera released

2007: David Gallo's popular "Underwater Astonishments" TED Talk produced/posted

2013: Amodio, Piero, and Graziano Fiorito. "Observational and Other Types of Learning in Octopus." In *Invertebrate Learning and Memory*, edited by Randolph Menzel and Paul Benjamin. San Diego, The Netherlands: Elsevier Science & Technology

2015: Sy Montgomery publishes the bestselling *Soul of an Octopus*

2016: Peter Godfrey-Smith publishes the bestselling *Other Minds* which makes use of the behavioral research to date.

2017: Marini, Gaia, Fabio De Sio, Giovanna Ponte, and Graziano Fiorito. “Behavioral Analysis of Learning and Memory in Cephalopods.” In *Learning Theory and Behavior*, edited by R Menzel, 2nd ed., 1:441–62. *Learning and Memory: A Comprehensive Reference*. Oxford: Academic Press, 2017. includes a section on the history of the octopus in neuro- and behavioral science.

2020: Netflix releases Pippa Ehrlich and James Reed’s documentary film *My Octopus Teacher* which becomes an international hit.

Appendix 2: The Octopus on The Web

A thorough, verified analysis of online traffic for octopus-related internet content is beyond the scope of the present paper. When an inquiry was made of ChartBeat, an internet traffic survey company with which I've worked in the past Chartbeat replied "Unfortunately, our data isn't currently set up for us to be able to pull this analysis without a good amount of work on our team's end and we don't have the bandwidth in the near future to do so."

But to get a very surface level understanding of what videos and themes garner the most attention I did several simple searches with different criteria on YouTube and ranked them by view number. A distinct viewer preference for eating octopus (usually live, usually after some degree of harassment) can be seen across the board. The top "eating octopus" video has over 211 million views to date whereas the top "octopus intelligence" video has about a tenth of that. A simple search for just "octopus" meanwhile tends to produce a hash of things ranging from a King Kong vs. a giant squid video to an extremely popular (82 million views) video of octopus squishy toys being shredding by a machine.

The search ranks are below.

Search query: "Eating octopus"

Mukbang TwinRoozi Family

221,232,843 views

May 29, 2019

<https://www.youtube.com/watch?v=DLolStukgG8>

Giant Octopus Spicy Noodle Mukbang

74,365,396 views

Jul 23, 2020

<https://www.youtube.com/watch?v=VehKdqQ2Y6k>

ENG Mukbang Octopus Noodles

55,444,270 views

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Largest Octopus VS Ssoyoung

48,412,309 views

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Octopus Steals Crab from Fisherman | Super Smart Animals | BBC Earth

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True Facts About The Octopus

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A Sneaky Coconut Octopus Uses Tools to Snatch a Crab

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Octopus Escape!

15,190,109 views

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Octopuses are the World’s Greatest Escape Artists (Ft. PhilosophyTube)

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Unbelievable Octopus camouflage itself in Coral reef

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Most intelligent Mimic Octopus in the world

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Octopus Family Shredded! Sharks and Squishy Things Destroyed! What's Inside Slime Animals!

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Kong: Skull Island (2017) - Kong vs. Giant Squid Scene (3/10) | Movieclips

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Octopus Caught While Kayak Fishing

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Notes/References

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- ² Carl Safina, *Song for the Blue Ocean* (New York, Henry Holt and Company, 1999), 3-109
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- ⁵ In the United Kingdom the word “seafood” tends to refer to mollusks and crustaceans, whereas in the US it is more embracing of all marine and aquatic food. French, Italian, German and Russian equivalents similarly apply more to mollusks and crustaceans than to bony fish but the terms are vague and certainly embracing of the octopus.
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- ⁸ In correspondence with Monterey Bay Aquarium Seafood Watch program dated June 2, 2021, researchers conveyed “We only have about a third of global volume [of octopus] rated at this point, but at least within those fisheries it’s pretty clear that environmental performance is poor. The overall red in these fisheries is typically driven by stock status and risk of overfishing (Criterion 1) and the ineffectiveness of management. Impacts on other species can sometimes be a problem too, depending on the gear used.”
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- ¹⁰ David Scheel, a professor of Marine Biology who studies cephalopods at Alaska Pacific University wrote in a July 21, 2021 email: “The larger Pacific striped octopus was described as ‘common’ in the 1970s and caught by commercial fish trawlers. After Rodaniche’s observations in the 1970s, it looks like there was a gap until 2012 before reports of another aggregation reached the scientific world.” The story is summarized in: Caldwell, R.L., Ross, R., Rodaniche, A., and Huffard, C.L. (2015) Behavior and Body Patterns of the Larger Pacific Striped Octopus. *PloS one* 10(8), e0134152”
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