



Ethical Challenges in Mariculture: Adopting a Feminist Blue Humanities Approach

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Abstract

As mariculture—the cultivation of aquatic organisms in marine environment—intensifies to meet the demands of sustainable blue growth and national policies, novel ethical challenges will arise. In the context of ethics, primary concerns over aquaculture and mariculture tend to stay within differing value-based perspectives focused on benefits to human and non-human subjects, specifically animal welfare and animal rights. Nonetheless, the burgeoning field of feminist blue humanities provides ethical considerations that extend beyond animal subjects (including humans), often because of its concerns with new materialist, posthumanist, and other relations-based theories. This article examines feminist blue humanities and the contributions it may bring to understanding contemporary and future ethical challenges posed by mariculture and its intensification, especially the cultivation of low-trophic organisms. By offering an overview of feminist blue humanities, this article explores some of its particularities by drawing out three major ethical concerns facing contemporary mariculture, specifically material reconfigurations, radical alteration of the lives of low-trophic species through industrialization and increases in maricultural waste products.

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Mariculture and Ethics

The promise of mariculture—the cultivation of aquatic organisms in marine environments—points to a secure food future, sustainable growth and blue economy, and climate-mitigating endeavor. Specifically, by 2050, human pressure on the environment from food production is estimated to increase by 50–92% without mitigation (Springmann et al., 2018), which fuels the perceived need to produce more food in the seas rather than land. Thus, ramping up the cultivation of sea organisms to meet global food supplies represents collective hopes in achieving blue growth, a sustainable and climate-neutral society (Campanati et al., 2022), and more sustainable and just forms of nourishment (Bennett et al., 2021). Hence, mariculture appears as the means to increase food production, provide nutrient dense foodstuffs, fight climate change, and create more sustainable food cultures (Schubel & Thompson, 2019; Troell et al., 2022). If true, cultivating larger amounts and more species of sea organisms may provide more sustainable nourishment than traditional fishing or even land-based agriculture has achieved.

Over four decades, mariculture has increased dramatically, growing faster than other food production sectors (FAO, 2018, 3, 17, 176). Indeed, continued growth has led to a record 214 million tonnes of aquatic animals and algae production in 2020 (FAO, 2022, xvi). As this sector grows, however, it requires more nutrient inputs. While much of these nutrient sources—including both animals and plants—for maricultural production come from land-based sources, researchers aim to generate these nutrient inputs through aquatic products, such as microbial seaweeds used in feed (FAO, 2018, 147). This unprecedented turn to close “the number of trophic transfers in the seafood chain”—such as relying on and producing more aquatic plants and low-trophic organisms (i.e., species such as bivalves that occupy the ‘lowest’ positions in the food web) to feed fish and humans—may help solve a future-looming food crisis through a significant reshaping of cultures, economies, and forms of consumption (Olsen, 2015, 2; FAO, 2022, vi).

As a result, novel ethical challenges continue to arise as mariculture grows, consumption of aquatic products rise, investment in mariculture as a solution to food security and environmental sustainability increases, and its environmental impacts ramp up (FAO, 2022, xvi-xvii). Indeed, mariculture will undoubtedly have a larger ecological impact, leading to challenges facing social/environmental justice, including the marginalization of women and indigenous peoples (Bennett et al., 2021, 2023) and to increases in forms of oceanic degradation. Additionally, such intensification will change the sea, the lives of marine creatures, and the lives of those that buy, sell, grow, or consume them in ways that cannot be fully predicted. Hence, society will need ethical frameworks that can cope with the modification of aquatic ecosystems and the ways that the seas and its creatures adapt and react. Different ethical perspectives have much to offer in these scenarios. That said, as social science and humanities scholars have begun to operate under the burgeoning fields of blue humanities (Mentz, 2023) and/or critical ocean studies (DeLoughrey, 2019), new or innovative perspectives or values may begin to emerge that can be of assistance in thinking specifically with mariculture.

This article therefore presents some ways how a feminist blue humanities approach may enliven ethical thinking surrounding maricultural intensification and innovation. To do so, I point to existing ethical concerns related to aquaculture, specifically animal welfare and rights. From this, I highlight three ethical concerns emerging from feminist blue humanities scholarship—related to ontology/matter, critical post-humanisms, and intersectionality—that can invigorate and extend the discussion on welfare and rights. Presenting these three concerns is not necessarily exhaustive nor does it suggest that feminist blue humanities scholarship operates under any single ethical framework. However, these concerns help demonstrate how feminist blue humanities approaches may address existing or expose novel ethical challenges in sea farming and contribute to policy or educational initiatives that help to ensure mariculture is practiced in ways that do not recreate negative environmental impacts or injustice.

Maricultural Ethics Focuses on Welfare and Rights

As mariculture intensifies and ramps up in scale, an increasing number of ethical challenges and implications will need to be addressed. Much work has been done on the more general issue of aquaculture—raising aquatic organisms in fresh or saltwater—with special attention towards fish and fish farming (Grigorakis, 2010, 347; Olesen et al., 2011; Bovenkerk & Meijboom, 2012). Books such as *Fish Welfare* and *The Welfare of Fish* stress the more general conditions for understanding the well-being of fish, with some attention given over to serious concerns related to intensive fish farming (Branson, 2008; Kristiansen et al., 2020, vi). Additionally, animal ethicists Bernice Bovenkerk and Franck Meijboom, for instance, provide a clear overview of four different ethical perspectives on fish, specifically “utilitarian, rights based, relational, and virtue ethical animal ethics theories” (Bovenkerk & Meijboom, 2020, 19). Importantly, they point to the ethical dilemmas of killing fish and domestication that focusing on welfare cannot adequately address (Bovenkerk & Meijboom, 2020, 30–34). These important works aside, more attention to the ethical circumstances surrounding finfish but also other species in mariculture, specifically low-trophic species, is required as mariculture incorporates these organisms into their production cycles and industrializes the production of these lives at larger scales than before.

In many ways, the scholarly work on fish sets the stage for ethical reflections on other marine organisms involved in mariculture. Interestingly, scholarly work on marine vertebrates tend to focus on the welfare of select taxonomic orders or species. For instance, research has shown that sea turtles raised at the Cayman Turtle Farm (now called the Cayman Turtle Centre) evidenced “problematic physical and behavioral stress” to such an extent (Arena et al., 2014) that the operations of the farm and its supposed benefit to wild turtle populations were called into question (D’Cruze et al., 2015). Additional attention has been given to the welfare of different phyla or classes, such as invertebrates, through a focus on animal sentience (Mikhalevich & Powell, 2020). For instance, scholars have turned towards considering the welfare of some oceanic organisms, including cephalopods and crustaceans, with some attention to specific species (Crook, 2021; Mather, 2022; Crump et al., 2022; Pedrazzani et

al., 2023). Additional work has commenced on more ethical relations to echinoderms in respect to harvesting wild populations and their use in research (Micael et al., 2016; Crespi-Abril & Rubilar, 2023) as well as mollusks in the context of certification (Boyd et al., 2005). And, even if bivalves appear to be one of the most sustainable food sources in mariculture (Jacquet, 2017), little is still known regarding which species, including those cultivated, are most vulnerable to extinction (Huang et al., 2023). Regarding the plight of seaweed, ethical frameworks focused on the welfare of macro- or microalgae remain rather limited. This is not unexpected, considering that the sentience of fish and their ability to experience pain are still called into question (Wadiwel, 2016). Such ethical reflections might be justified, however, considering the recent concerns over plant sentience and consciousness—though these debates typically occur in respect to vascular as opposed to non-vascular (aquatic) plants (Hall, 2011; Chamovitz, 2020). What limits these discussions, however, is the tendency to stick with such organisms as bounded subject's or individuals. For instance, sentience does not necessarily capture organisms' interests (Rodogno, 2010) nor account for feminist posthuman calls for “a material, trans-corporeal ethics [that] would turn from the disembodied values and ideals of bounded individuals toward an attention to situated, evolving practices that have far-reaching and often unforeseen consequences for multiple peoples, species, and ecologies” (Alaimo, 2008, p. 253).

Though ethical reflections related to aquaculture tend to focus on animal welfare and rights, they also raise ethical challenges on related topics specific to aquaculture practices, including sustainability, environmental, toxicological, or health-related issues. For instance, an intensification of aquaculture could achieve similar benefits as agricultural intensification—such as poverty reduction, increased food availability, reductions in habitat loss, and increased human life expectancy—which addresses ethical concerns related to food access and equity (for humans). As noble as these efforts are, such potential ethical wins for humanity have been understood to outweigh the immediate costs to the lives and habitats of sea-dwelling organisms (Asche, 2008, 533). From this perspective, such results conform to value-laden hierarchies in which human interests tend to trump those of other species. Yet, a feminist blue humanities approach would counter such a Machiavellian logic where the potential human benefits justify the intensification of mariculture. Such ethical hierarchies would rather be understood as connected to the “phallogocentrism” operating at the core of Western society and which often serves as part of the justification for treating animals as less than human (Irigaray, 1985; Baumeister, 2017). As important as these considerations are, a feminist blue humanities approach has potential to explore existing ethical challenges in mariculture from less anthropocentric, androcentric, and species-specific positions, raising additional ethical concerns for consideration.

Beyond Welfare and Rights: Feminist Blue Humanities Perspectives

Research within blue humanities are well-situated to theorize and analyse the ethical challenges facing ocean farms and the wider context of coastal nourishing. Working at the intersections of various fields and approaches—such as environmental ethics, political ecology, posthumanism, feminist and queer theory, environmental

humanities, marine artistic research, and STS—scholars generate knowledge regarding practical and speculative reimaginings of ethical human to non-human relationships. Generally speaking, this “belated recognition of the close relationship between modern western culture and the sea” represents a trend of inquiry by the social sciences and humanities regarding the maritime, which exposes the historicity, cultural values, symbolism, imaginations, politics, stories, representations of the seas over time as well as the human quest for dominance over them (Gillis, 2013, 12). Of note, such studies have capacity to “reckon with epistemological problems of scale, onto-epistemologies of rapidly altering and utterly entangled lifeworlds, and the urgency of extinction” (Alaimo, 2019, p. 431).

Ontologies and Materiality

Blue humanities scholarship that draws on feminist critical perspectives has much to offer regarding ethical reflections on mariculture. First, a feminist blue humanities approach considers ontology and materiality as a “seabed” upon which critical analysis rests. Drawing on new materialist inquiry, such as the work of cultural theorist Jane Bennett and science and technologies studies scholar Karen Barad, feminist blue humanities tend to take matter seriously, seeking to understand the multiple ways that different physical features co-produce relations, values, and meanings. Barad, for instance, argues for an “ethico-onto-epistemology,” which accounts for human knowledge and situated forms of being because of “ontological entanglement,” that is, knowing and being are mutually implicated with physical matter and making worlds (Barad, 2003, 829; Barad, 2007). Hence, thinking from and with the seas become an imperative ethical position. More specifically, geographers Kimberly Peters and Philip Steinberg argue that oceans’ material dynamism and “continual reformation” in a voluminous space can “reinvigorate, redirect, and reshape debates that are all too often restricted by terrestrial limits” (Steinberg & Peters, 2015, 2019, 293). For instance, in my own work, I point to the material changes taking place in the oceans which then get labelled as various kinds of marine degradation. From this I demonstrate how physical changes in the oceans that do not conform to human expectations about them prompt the need for continued valuation that often reinforces normative ethical frameworks (Peterson, 2024a).

Indeed, a terrestrial bias (Jue, 2020) or land/sea binary (Braverman, 2022) are increasingly seen as undesirable. Rather, ethical thinking and practice with oceanic place and its organisms must be situated in volumetric depth and get ‘submerged’. In other words, the spaces and organisms co-opted through maricultural practices cannot be fully accounted for ethically if engaged with from *terra firme* alone (Ingersoll, 2016); and oceanic space cannot be totalized as it consists of multiple materials and these materials can transform (e.g., water to ice), highlighting serious challenges to prior assumptions (Steinberg et al., 2020).

These scholars point to the significant role that the physical characteristics of organisms and their environments play in respect to how they get valued and discussed. They additionally point to the need for alternative perspectives that ebb and flow, bob, sink, swim, or drift to help bridge the gap between land and sea and foster multispecies kinship. Adopting such perspectives can better expose how and why

society values some species or places over others, allowing for other potential socio-ecological values to come to the fore and for additional negotiations to come to fruition between different visions for what nature is, ought to be, and about to become.

Multispecies and Critical Posthumanisms

Moreover, within the blue humanities, inquiry into human relationships to aquatic organisms has grown substantially, with a particular focus on relational multispecies and posthuman accounts. Generally, blue humanities research focuses on the cultural value and meanings of complex organisms, including cetaceans (Huggan, 2018; Bastian, 2020) and finfish (Swanson, 2015; Hamada & Wilk, 2018; Telesca, 2020). Nonetheless, scholars' attention has also looked at how oysters contribute to gentrification (Hubbard & Brooks, 2021), how microbial oceans influence our scientific and cultural understanding of the sea (Helmreich, 2023), and how human notions of microalgae develop through social, cultural, and political processes that occur alongside algae and the relationships they perform in their situated environments (Paolisso & Chambers, 2001; Waterton & Tsouvalis, 2015; Peterson, 2022). This focus on low-trophic organisms has potential to facilitate a strong foundation for building ethical principles related to maricultural relations with them.

For example, feminist cultural theorist Stacy Alaimo underscores the marvelous alterity of the oceanic deep, by bringing attention to the organisms inhabiting this space and the ethical implications humans have towards them (2013). Literature studies scholar Clare Brant explores sea squirts through life writing methods. She argues that sea squirt sentience can be explored more aesthetically (rather than scientifically) through (pre)positioning humans and sea squirts “to, for, with, from” each other and points out how many sea squirts and other aquatic organisms are represented” in terrestrial terms and establish[ed] through analogy that it is fine to eat these creatures—whose creature-ness is denied by comparing them to fruits” (2021, p. 127, 138). Feminist philosopher Astrid Schrader tackles the toxic dinoflagellate *Pfiesteria pisciscida*, demonstrating how scientific and cultural beliefs and practices lead to different understanding related to the species (Schrader, 2010, 2012), while I experiment with writing methods for adapting an algal perspective to reframe understandings surrounding *Nodularia spumigena* and how to achieve improved human-algae relations (Peterson, 2024b).

Of particular interest to this theme are feminist studies focusing on aquatic organisms in a maricultural context. However, less studies exist at this intersection. Of note, gender studies scholar Elspeth Probyn explores the creation of an “ethics of food that departs from human anthropomorphic desires,” asking, for instance, “how to eat the ocean well” and answering the question first and foremost from a position that acknowledges “the wonder of the ocean” (Probyn, 2016, 20, 130, 163). Elsewhere, through an exploration of marine foodstuffs, landscape planner Maggie Roe, argues that waterbodies can conceptually be considered similar to “landscape,” which may enliven ethical responses to ecological impacts of ocean resource use (Roe, 2018, 154), providing one instance for the need to conceptualize oceans in less extractive and more relational terms (George & Wiebe, 2020). Such positions highlight ways that challenge discourses of blue transformation, blue economy, and

commodity frontiers that focus on the “extractive possibilities” of low-trophic lives, such as in the use of algal “bits of life” (Smelik & Lykke, 2010) for producing high value products like omega 3s (Braun, 2020). Notably, feminist posthumanities scholars Marietta Radomska and Cecilia Åsberg propose a “low-trophic theory” which approaches oceanic challenges from a stance that considers the “entanglements of consumption, food, violence, environmental adaptability and more-than-human care from the co-existential perspective of multispecies ethics” (Radomska & Åsberg, 2022, 1; Åsberg & Radomska, 2021). From this perspective, low-trophic mariculture and organisms like kelp become places and companions for reimagining the world and society’s place in it (Åsberg, 2020; Åsberg et al., 2020). In sum, these studies point to the urgency in tempering anthropocentric-oriented ethical concerns through a multispecies or critical posthuman account of marine spaces as always-in-the-making.

Intersectional Imbalances

Additionally, gender and feminist scholars, specifically coming from Black feminism and critical race theory, contribute to theorizing about power by providing intersectional lenses that highlight implicit categorizations, such as race, class, ethnicity, etc., that contribute to inequality and injustice (Carbado et al., 2013). Through applying gender and intersectional-oriented frameworks, scholars looking at mariculture illustrate power differentials and hierarchies implicit within fishery cultures, usually highlighting the role of women (Porter, 2012). Unsurprisingly, most research finds that women remain at a disadvantage within aquaculture and mariculture in various parts of the world. For instance, thinking that women are land-bound strengthens roles for men and women in fisheries, preventing equal opportunity and granting women “full rights as fishers” (Alonso-Población & Niehof, 2019, 249). Barriers, such as opportunity costs and outside options, create gender gaps between men and women involved in seaweed farming in Chile (Salazar et al., 2023). Gender stereotypes persist in seaweed cultivation in the Philippines, affecting “roles, wages and decision-making power” (Mengo et al., 2023) as well as the marginalization of persons outside or that flow between traditional sexual and gender binaries (Knott & Gustavsson, 2022; Kenny & Tapu-Qiliho, 2022). Additional categories used in intersectional analyses, such as caste, ethnicity, race, location (Lokuge & Hilhorst, 2017; Galappaththi et al., 2021), further perpetuate sex and gender inequalities in maricultural contexts. Though such scholarship demonstrates clear power imbalances among the different sexual and gendered identities of those involved in mariculture, some positive results can be observed. In Maine, for example, gender balance becomes more equitable as wild fishing industry transitions to mollusk and seaweed aquaculture (McClenachan & Moulton, 2022).

Such intersectional studies display strength in tackling ethical challenges taking place in the social contexts of mariculture. However, intersectional approaches could prove a strong research approach for dealing with socio-ecological relations that also involve the animals and plants farmed in the sea. For instance, the traditional intersectional categories of race, class, and gender can be augmented by applying other categories to specific case studies. Scholarly work in animal studies has long pointed out the domination of animals by humans and has shown how speciesism often jus-

tifies (human-centered ethical) frameworks for dealing with other animals (Horta, 2010). For instance, though focusing on horse and cattle, multispecies ethnographer Andrea Petitt outlines a “multispecies triad” for nuancing how one understands the oppression of species resulting from an assumed “species dyad” between human and a singular non-human species. Importantly, she points out how this approach underscores a need for understanding how humans categorize other animals along intersectional categories, how nonhumans enact power relations, and how nonhumans differentiate relations between other species (2023). By extension, such an approach offers potential for thinking with posthuman conceptions of intersectionality that extend beyond the use of human-centered categories and contribute to non-binary approaches to multispecies intersectional thinking. Utilizing this or similar approaches offers considerable ethical innovations for thinking intersectionally with fish, bivalves, seaweeds, and other low-trophic organisms in entirely new ways.

Ethical Considerations from Feminist Blue Humanities Approaches

Influenced by critical attention to matter, posthumanist imaginaries, and intersectional power differentials, feminist blue humanities scholarship provides innovative perspectives for understanding the ethical implications facing contemporary challenges in mariculture and other aquacultural practices. Specifically, the intensification of mariculture in the coming decades will highlight a need to explore the ethics surrounding the use of ever larger swathes of terrestrial and marine environments for mariculture, including the deep seas. Other environmental challenges, including maricultural discharges, will also need to be addressed as more and more organisms begin to be cultured, fed, and, ultimately, harvested for human uses. These two key issues point to ethical concerns over habitat loss and environmental pollutants (Asche, 2008, 535) while also signaling possibilities for additional ethical challenges connected to labour, biopower, diets, companionship and more.

From Land to Sea and Sea to Land

Novel ideas and technological advancements have led to traditional agricultural crops being moved from land to underwater environments and marine creatures to be moved and cultivated upon earth. For instance, mariculture no longer just involves aquatic organisms. Vegetables typically grown in gardens, including lettuces, beans, cabbage, strawberries, and basil, are now being grown underwater outside Noli, Italy. The company Ocean Reef Group operates 6 plastic clear orbs filled with air, chained to the seabed and floating at different depths. Named “Nemo’s Garden,” these orbs function like diving bells or inverted bowls, trapping air and providing access to people through an entrance on the bottom. The water beneath these domes function as boundaries and doorways, keeping airborne and terrestrial organisms away from these plants while allowing divers to enter the orbs from below to take care of the plants inside (McEachran, 2015). Similarly, marine aquaponics—land-based mariculture—continues to increase in scale, moving marine organisms from the sea to saltwater tanks and reproducing them on land. In Japan, recent investment in recip-

culating aquaculture systems is leading to increases in the total volume of shrimp produced (Waycott, 2021). These systems intend to reduce the environmental impact of shrimp farming along the coasts and assist in the prevention of shrimp diseases but have demonstrated “unidentified factors” not observed in experimental testing that limit the total production volume (Shinji et al., 2019). By moving terrestrial organisms underwater and marine organisms to the land, such practices create new material and multispecies relations in need of ethical reflection and theorization.

Attending to these inversions from feminist blue humanities perspectives underscores a need for considering the ethical implications involved in increasing maricultural areas, whether they be in the sea or on land. Such systems challenge our understanding of mariculture, as technological advances create underwater spaces that may be exploited for raising terrestrial organisms and terrestrial spaces used for exploiting marine organisms. Hence, it highlights the need to combine reflection on ethics related to welfare and rights with that of spatially relevant and land-based ethics (Smith, 2000; Schurr et al., 2023). One key area constitutes the ethical questions that arise through a territorialization of the sea for mariculture. As Nemo’s Garden demonstrates, plants grown underwater may be a viable alternative to crop production on land. By extension, as further inroads into aquatic buildings get developed—such as underwater data centers like Microsoft’s Northern Isles underwater datacenter or semi- or fully-submarine homes like the Floating Seahorse, Jelly-fish 45, or Home—a future in which husbandry, dairy farming, or similar land-based forms of agriculture might be outsourced to the sea become imaginable. The conscription of marine space for mariculture finds echoes in land-pumping projects used for “reclaiming” marshland and, more recently, island construction (Jackson & della Dora, 2009). Such raises ethical questions about using “natural” boundaries for isolating organisms from their respective ecologies where they have evolved. Indeed, adopting a feminist blue humanities lens that refutes the nature/culture dualism would need to query practices of domestication, which have long followed species selection and cultivation of land-based fruits and vegetables. Such practices illustrate and function as a complete scientization of mariculture in which testing and production takes place in the same spaces. They raise a potential need for ethical frames that localize oceans and oceanic cultures, such as through indigenous oceanic feminisms (Bardwell-Jones et al., 2022). Also, they put in stark relief the ethical questions concerning what sort of environs become permissible or allowable in the production of such organisms for human consumption. To what extent ought marine environments be engineered? How are its boundaries enacted and policed? What human and nonhuman practices produce such spaces?

To some degree, these practices subvert a “natural” order, moving terrestrial organisms underwater and marine organisms onto land. These practices completely displace organisms from their habitats by creating a heavily controlled, artificial space in which almost all aspects of the species’ environs can be manipulated. Thus, one must think with what kinds of material and cultural displacements occur when moving species across the land/ocean divide. Feminist posthumanist, multispecies, and indigenous thinking will ask what ensuing relations come into practice as a result. Thus, it will be of supreme importance to attend to practices of control in mariculture as well as any unintended consequences. Nature is not static, so how can scale in

mariculture be achieved without replicating similar eco-calaminities on selected harvest species, such as dilemmas created by competing agricultural interests in harvesting shrimp versus bananas (Colburn, 1997) or the introduction of ‘alien’ organisms (Castellanos-Galindo et al., 2018; Rech et al., 2018). Attention might best be given over to how oceanic organisms “think” and practices of care that sustain their worlds, not just ours (Todd, 2018).

Industrialization of Low-Trophic Species

As mariculture intensifies and growth scales globally, sea farmers and their businesses diversify their products by capturing, reproducing, feeding, and harvesting organisms that have not been farmed previously. With interests in materiality and multispecies and posthuman relations, feminist blue humanities provide a lens that seeks to minimize harm across living organisms whose lives are imbricated in each other’s and the places they inhabit. Like calls for “welfare biology” (Soryl et al., 2021), perspectives in feminist blue humanities stress the need for a more holistic understanding of welfare that extends to a broader principle of mutual, albeit “awkward” networks of flourishing (Ginn et al., 2014). Awkwardness in the maricultural sector could be described differently, but one key area amounts to the decision for which species to cultivate. For instance, consuming animals, and which ones, constitutes a choice, with some choices serving certain ethical values (e.g., sustainability) rather than others (Worster, 1994, 10; Jacquet, 2017). Furthermore, as mariculture represents solutions to looming food crises and sustainable growth, increasing reliance upon this sector is subject to increasing pressure to continue unjust colonial legacies and “reinforce settler-colonial structures of dispossession” (Evans, 2022).

Additionally, a key area for study entails thinking with how practices of industrialization shape the cultures of those species now being raised (and those in the future) in maricultural webs of production. From a feminist blue humanities perspective, the lived experiences and worlds of organisms are at stake. For instance, commodifying new species will inevitably alter their lives in significant ways. Consider the life and death of low-trophic species such as the sea cucumber. Cultivating sea cucumbers historically has occurred through ranching due to difficulties in controlling sea cucumber reproduction. Existing methods in sea cucumber production typically induce sexual reproduction by subjecting them to “heat shock treatment” and/or drying them out slightly before squirting them with powerful jets of sea water. These methods work for only some species. Other species—including *Thelenota ananas* (prickly redfish) and *Stichopus chloronotus* (greenfish)—can reproduce asexually through transverse fission, which essentially means they pull themselves apart into two halves that will grow into two fully formed adults. Inducing these species to reproduce asexually involves putting a rubber band around their body for 1–2 weeks. Obviously, such practices call into question the need to understand their ethical implications in terms of altering reproductive cycles, considerations of suffering/pain, and other typical animal welfare concerns, such as discussed in rearing land-based farm animals (Marie, 2006; Tovar & Giraldo, 2006; Averós et al., 2013). Being given the ability to reproduce at least once during its lifetime would typically be

seen as addressing animal welfare, but queer and trans- feminist thinking could also help to complicate such human-centered normativities (Boast, 2022; Subramaniam & Bartlett, 2023). Additionally, the moment of death has been understood as a limit by which an organism's life might be subjected to "foregone opportunities." Hence, if farmed sea cucumbers have not had experiences that would matter to them during life, death can be seen as a form of harm (DeGrazia, 2002). However, assuming that what matters to sea life can be achieved in all circumstances during an organism's life negates that what matters changes when maricultural and farmed organisms get subjected to different regimes of governance and capitalist geographies. In other words, foregone opportunities already begin to accrue during commodification. By attending to the lives and spaces of sea cucumbers and for other organisms, solidarity and care can take root as central ethical concerns (Probyn & Johnston 2020). Feminist blue humanities can also provide opportunities for considering what matters to such organisms that go beyond life processes through speculative imaginings, anti-reductionist forms of representation and decentering human histories (Haraway, 2013; Plumwood, 2007; Peterson, 2024b). By first reconfiguring relations to the seas and its inhabitants, such as through Siwá feminisms (Leonard, 2022), different ethical best practices can come to fruition.

Last, multispecies and intersectional approaches will be much valued as many mariculture systems adapt and continue to utilize integrated multi-trophic systems (see Soto, 2009). Indeed, thinking alongside marine species through an intersectional lens has possibility for directing ethical scholarship and publics towards increased forms of ethical idealism and a less "anthropocentric ecological outlook," which has potential for improving sustainable use of aquatic resources, including marine life (Chen, 2023, 90–92). Such approaches can aid in understanding different worldviews that explore "fishscapes"—defined as cosmopolitan, multispecies-based imaginaries of fish (Santha, 2023)—and other webs of interspecies relations from multiple anthropogenic perspectives and worldviews. They can also allow for the consideration of animal identities being constructed through additional intersectional categories that have yet to be applied, such as 'seafood' or 'meat' or 'diet' or the literal and metaphorical food package labels that inform consumers about maricultural products (Gora, 2022).

Maricultural Wastes

The potential benefits of mariculture notwithstanding, increases in the scale of maricultural production will lead to more waste and other environmental harms. Already, in an Anthropocene epoch, human-level impact on the seas continue to increase. Differing forms of marine pollution—from ocean acidification to microplastics to cultural eutrophication and more—point to oceans in peril. Not only do these changes represent fundamental challenges to marine environments but also to mariculture. Additionally, as mariculture increases in scale, its operations will increase in their capacity to contribute to oceanic waste. A recent article in *The Guardian* on off-shore fish farms positions this "next frontier" between the gains of food production and "wild west" of environmental pollution (Kassam, 2022). Key among such issues includes "mariculture wastewater" produced through residual feed and excrement

(Zheng et al., 2022). Yet, pollution is not just confined to fish farms. For instance, researchers look for novel ways to utilize increasing amounts of shell waste from mollusk farming (Jović et al., 2019). Also, the expansion of kelp production in Europe poses environmental risks, including the absorption of light, nutrients, carbon, and kinetic energy; the introduction of artificial materials; potential increases in noise; releases in dissolved and particulate matter; changes to habitat and their use by pests, diseases, or non-native species; and altering reproduction (Campbell et al., 2019). Many do not fully understand what impacts a large-scale industrialized mariculture will have on the organisms it raises, grows, and processes nor on the environment, such as on the welfare of non-farmed aquatic wildlife (Soryl et al., 2021). The environmental effects of intensified mariculture require further research to understand its potential hazards as well as its ethical implications.

One approach to marine pollution, rooted in feminist materialist and multispecies thinking, argues for acknowledging pollution because of “ecological defiance” by which biophysical processes and nonhuman organisms respond to human-driven material manipulations in unexpected ways (Peterson, 2020). Acknowledging such dynamisms and their limits, “will be necessary to design robust monitoring procedures, especially given a number of site specific ‘positive’ and ‘negative’ changes are likely to occur simultaneously in cultivation areas” (Campbell et al., 2019, 17). Paying attention to environmental responses to pollution and for whom these responses matter, will highlight specific socio-natural values around which ethical concerns must be addressed. For instance, ‘harmful’ algal blooms modify aquatic spaces in ways that are of no concern to the shipping industry, even though shipping exhaust contributes to the overall nutrient loading of waterbodies through atmospheric deposition. In other words, addressing ethics in relation to sea farming wastes and pollutants necessitate grappling with multiple ontologies, disparate values, and visions. By taking on a more ‘oceanic’ lens, maricultural wastes may be constructed in entirely different ways and which do not rely upon normative perceptions of marine environments rooted in Western scientific notions. A feminist blue humanities approach would stress the need for ethical approaches that do not try and save the oceans and oceanic life from pollutants but that rather try and develop ethics around social and cultural waste-making practices. In this way, wastes from maricultural need to be understood outside of ethical approaches that seek to diminish wastes out of an urge to ‘purify’ the process (Shotwell, 2016).

Last, as mentioned previously, maricultural waste must be understood holistically. As waste studies scholarship clearly articulates, waste is unavoidable (Thompson, 2017). Since wastes will be produced, particularly in the neo-capitalist economic framework in which mariculture is being developed, ethical tradeoffs must take place as some lives and places will benefit at the expense of others. Hence, feminist thinking that engages with material and more-than-human relations insists on figuring out “how to be more accountable to the exclusions that are inevitably fostered by any course of action (or indeed inaction)” (Giraud, 2019, p. 182). Thinking in this way prompts questions related to ethical conundrums such as the bio- and necropolitics of converting animal and plant life into feed or in using larger areas of the seas to cultivate certain organisms over others. Furthermore, it invites thinking on how bod-

ies, human or otherwise, are put at risk and how they endanger others, habitats, and ecosystems (Alaimo, 2016 p. 127).

Conclusion

Feminist blue humanities expands who and what belongs in decisions regarding what counts in ethical and moral deliberations. Addressing mariculture, feminist perspectives rooted in materiality, multispecies attentions, and intersectional approaches have much to offer for thinking through, with, and about ethical imperatives that arise as mariculture continues to increase in importance—economically, socially, and environmentally.

Feminist blue humanities scholarship can aid ethical issues related to mariculture through its insistence on utilizing *multiple* ethical frameworks, whether they be utilitarian-, rights-, relational-, or virtue-based. Of note, feminist blue humanities approaches can add to ethical concerns related to animal welfare and rights in a maricultural context. In one respect, feminist blue humanities highlight how values extend beyond the dualisms of nature/culture and land/sea. Achieving sustainable and equitable food systems might be considered an ethical win, but feminist blue humanities notes that these systems must be undergirded by potentially uneasy relations regarding the questions for whom and through which biophysical processes or qualities.

Thus, the possible impacts of reshaping human relationships to the seas around mariculture may entail more than what is hoped for by society as well as unexpected impacts upon the sea creatures affected by it. Thus, current research on ethics related to farming oceanic organisms—specifically low trophic species—can benefit from inquiry that focuses on how mariculture affects the lives of cultivated sea organisms, the places that cultivate them, and those who (will) use/eat them. It also directs our attention to thinking about ethics of place and matter, suggesting that spatial, temporal, and material relations must also be considered when applying policies and regulations that intend to improve ethical practices in the maricultural industry. Ethical frameworks must account for not only the lives of aquatic species and their welfare and rights but also the newly created relations and worlds that they are brought into through ongoing and emerging maricultural practices and ecological responses.

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