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Great the Danger When Unseen; Greater When Lost: An Ecocritical Poetic Study of Marine Micro and Nanoplastic Pollution

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Abstract

Plastic pollution is a global environmental abyss that has attracted the world's attention over the last few decades. The problem began with macroplastics accumulating in the landscape and the seascape. However, the current development of plastic pollution is the fragmentation of macroplastics into unseen micro and nanoplastics, particularly in marine environments. These unseen particles are lost because of their higher mobility in tissues and among creatures consuming them. The study tackles marine micro and nanoplastic pollution in selected blue eco-poems to detect the fate of these elements in aquatic systems and the biological harm accompanying this phenomenon. The chosen poets undermine the myth of nature's self-renewal by exposing the irredeemable outbreak of marine plastic pollution. The study is interdisciplinary as it attempts to unveil the potentiality of poetic writing to absorb scientific knowledge and transfer it to the common reader. Furthermore, the argument endeavors to prove how poetry is capable of altering negative attitudes and raising awareness of such a critical issue threatening the ecosystemic equilibrium of Earth. To accomplish both goals, the investigated poems are analyzed literally and scientifically. Then, the need to initiate genuine reforms to the plastics economy worldwide is aroused. These reforms are inevitable to cure the devastating ecological chaos occurring at an alarming speed. Thus, economics is brought to the stage near the end of the study.

Keywords: Marine plastic pollution, Microplastics, Nanoplastics, Eco-Poetry, Plastics Economy.

Introduction

Plastic is fantastic; it can be made into anything. Since its invention in 1907 by the Belgian-American chemist Leo Baekeland, plastic has been a decisive breakthrough with its use in numberless industries. Rhodes provides a *long* list of *some* plastic products that are crucial in everyday life (2018, 213-16). However, the way humans deal with plastic litter is frustrating. A 2019 study states that of the cumulative production of plastic, "approximately 9 percent has been recycled, 12 percent incinerated, and 79 percent accumulated in landfills or the natural environment" (Almroth & Eggert 2019, 317). Moreover, plastic debris accumulates in the environment for a long time which may outlive successive human generations. Guern reports that the estimated decomposition rates of most plastic debris found on

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coasts are alarming. Foamed plastic cups decompose after 50 years, plastic beverage holders after 400 years, disposable diapers after 450 years, plastic bottles after 450 years, and fishing lines after 600 years (Guern 2020).

Despite the catastrophic repercussions of plastic pollution, it can never be terminated by banning its production and use. Out of this conviction, scientists and environmentalists have sought solutions by suggesting regulations and green alternatives. The three R's hierarchy –reduce, reuse, and recycle– is a popular example of such regulations. On the other hand, oxo-biodegradable plastics, i.e. materials that can biodegrade into natural components, have been introduced as green alternatives to traditional plastics. However, enough testing before introducing alternatives to the market is extremely critical because they can be worse than plastics. Haider et al. affirm that oxo-biodegradable plastics "are often not as 'biodegradable' as they claim to be –it is always a matter of the surrounding environment. Humidity, temperature or concentrations of microorganisms vary in different environments, resulting in different biodegradation rates" (2018, 60). In addition, the Ellen MacArthur Foundation finds oxo-biodegradable plastics misleading for consumers because they merely fragment into small pieces which contribute to microplastic pollution ("Oxo-degradable plastic," 2019). Nonetheless, efforts should continue. Humans' success in addressing ozone depletion anticipates a parallel success with plastics. Referring to marine plastic pollution, Haward states, "An international agreement to address marine plastics could be pursued in a similar manner, but necessarily in a more integrated and broad-based approach than that attempted in the late 1960s. It could be modelled on the successful Montreal Protocol addressing ozone-depleting substances that saw replacement of chlorofluorocarbons and an increasing public awareness of the problem" (2018, 2).

Although land plastic pollution threatens numberless life forms in wild and civil environments, marine plastic pollution is more hazardous. Marine litter "consists of items that have been made or used by people and deliberately discarded into the sea or rivers or on beaches; brought indirectly to the sea with rivers, sewage, storm water or winds; or accidentally lost, including material lost at sea in bad weather" ("Marine Litter"). Marine plastic pollution is more challenging than land plastic pollution for several reasons. First, plastic in the sea has an unpredictable cycle that requires intensive scientific study with a large budget. Second, with the vastness of the waterscape, studying marine plastic pollution becomes problematic. Third, marine environments accelerate the fragmentation of macroplastics leading to a high concentration of micro and nanoplastics, particularly in the five ocean gyres. It is noteworthy that land plastic pollution and marine macroplastic pollution had a fair share of scientific study and media illustration. Therefore, under-analyzed marine micro and nanoplastic pollution will be the focus of the following lines.

The US National Oceanic and Atmospheric Administration defines microplastics as small plastic pieces greater than 100 nm and less than 5 mm long that "easily pass through water filtration systems and end up in the ocean and Great Lakes, posing a potential threat to aquatic life" ("What are Microplastics?"). As for nanoplastics, they are defined as "particles unintentionally produced (i.e. from the degradation and the manufacturing of the plastic objects) and presenting a colloidal behavior, within

the size range from 1 to 1000 nm" (Gigault et al. 2018, 1030). Oceanic nanoplastics are presently catching the attention of scientists because "they have the potential to increase both their environmental uptake and ingestion by living creatures, being far smaller… and in far greater number, hence increasing the overall activity of the plastics on a statistical basis" (Rhodes 2018, 222).

It is estimated that "at least 5.25 trillion plastic particles weighing 268,940 tons are currently floating at sea" with a total floating microplastic load of 35,500 metric tons (Eriksen et al. 2014, 7, 10). In marine environments, microplastics take unexpected pathways. The most startling pathway is their loss: "a tremendous loss of microplastics is observed from the sea surface" mainly due to sinking and degradation into nanoplastics (1, 10). When microplastics sink to seabed sediments, they are entrapped within organisms that "are attracted to consume marine-seasoned plastic debris… coated with a layer of algae" that decompose plastics and release an odor that smells like food (Rhodes 2018, 226). These are a few hypotheses that address the loss of marine micro and nanoplastics; however, scientists deem that "[t]he question 'Where is all the Plastic?' remains unanswered" (Eriksen et al. 2014, 12).

Despite the heavy body of scientific studies on plastics, the plastic dilemma has always been developing more rapidly than scientific research. At first, scientists were taken by plastics' magical properties. But soon, researchers were caught by their slow degradation and accumulation in open environments. These phenomena posed numerous environmental risks like the suffocation of wild and marine creatures by macroplastics. Then, a new problem arose with the formation of oceanic micro and nanoplastics. These tiny particles are presently jeopardizing both sea life and human health. Although the "direct impacts of marine plastics on human health have not been well established," the gradual ingestion and transformation of plastics to humans directly or through food webs are highly anticipated with plastics now unarguably incorporated in ocean food webs (Almroth & Eggert 2019, 320). It is believed that "*the direct ingestion of microplastics by humans via drinking water is a distinct possibility – since 92% of samples taken in the USA and 72% in Europe showed their presence*" (Rhodes, 2018, 207-208, italics original). Furthermore, the "plastics that are ingested by lantern fish become incorporated in the food chain, because they are a principal source of food for tuna and swordfish, which are popular for human consumption" (226).

Literary studies have attempted to keep up with the development of the plastics crisis. Nevertheless, because plastics are faster than humans, eco-poetics tackling micro and nanoplastic pollution are scarce. Therefore, the author employs digital literature which provides up-to-date literary responses to hot issues like that of plastics. Digital literature is defined as a "'work with an important literary aspect that takes advantage of the capabilities and contexts provided by the stand-alone or networked computer'" (Rowland 2021). The coming poetic argument is centered on laughingpoet's "Oceans of Plastic" (2018) and Sam Illingworth's "Plastic Food" (2017). Selected excerpts from other poems are incorporated in the study including Illingworth's "Plastic Snow" (2022), Janey Colbourne's "Living in the Anthropocene" (2018) and "Plasticiser" (2018), poetrygretch's "The Little Mermaid Under the Plastic Sea" (2017), Tom Billsborough's "Sea Pollution" (2016).

With its centeredness on nature abuse in poetic works, the discussion depends on the ecocritical theory as a literary conceptual frame for the argument. Ecocriticism is an interdisciplinary literary school that brings about multiple disciplines to the study of nature literature. With the coinage of Ecocriticism in *The Ecocriticism Reader*, Howarth necessitates the inclusion of various knowledge domains in the ecocritical reading of texts such as natural sciences, geography, social sciences, history, and others (1996, 82-84). For the present study, science, economy, and religion conveniently merge with the eco-poetic argumentations of marine plastic pollution. Land and marine plastic pollution has recently started to occupy ecocritics. Quigley in "Expecting Plastic: Albatrosses and the Discovery of 'Culture'" tackles the visual and affective impact of the images of seabirds encumbered, weakened, and killed by anthropogenic plastic (2019, 394). Along the same lines, De Loughry grapples with the literary temporal and spatial distensions of the polluting effects of plastic in "Polymeric Chains and Petrolic Imaginaries: World Literature, Plastic, and Negative Value" (2019, 179). Serious musings on the topic are traced in *Plastic: An Autobiography* by Allison Cobb (2021) and *Plastic Matter* by Heather Davis (2022).

The academic interest in plastic pollution keeps growing among scholars. Nevertheless, to the author's knowledge, no ecocritical poetic studies have been dedicated to the problematic emergence of micro and nanoplastics in marine environments. Therefore, the study falls into seven sections. It begins by introducing the concept of the Anthropocene Epoch. After that, the myth of oceanic self-renewal is challenged due to the uncontrollable outbreak of marine plastic pollution. Microplastics are detected and found to be breaking up into unseen nanoplastics invading the bodies of sea creatures and humans. Solutions are, eventually, pursued by returning to the source of the problem, the plastics economy. The final section is dedicated to suggestions for further study.

Discussion

The Plastocene

The Anthropocene Epoch describes the most recent period in Earth's history in which the imprints of human activities profoundly impact the climate and versatile ecosystems. Nonetheless, with plastics becoming major players in the systemic alteration of Earth's geology, poet Colbourne had another name in mind for the present age. She announces in "Living in the Anthropocene": "Never mind the Anthropocene, / we are living in the Plastocene" (2018). She travels to the future and sees humans "dig through the dirt, / what will they reveal?" They will reveal "a seam of polypropylene, / strata from the Age of Plastic" (2018). These are "[t]he materials we made for prosperity, / the ones that keep for near eternity."

"Oceans of Plastic" is a poem from the Age of Plastic, the Plastocene. It is written by laughingpoet (this is the pen name s/he uses). S/he introduces him/herself on *All Poetry*, a website publishing poetry, as a retired scientist who likes writing and reading humorous poems, acrylic painting, and writing music. S/he has been affected by the works of Don Marquis, E. E. Cummings, Ogden Nash, Philip Levine, Billy Collins, Charles Bukowski, and Tim Seibles. The scientific background of the poet is clear in the unique style of the poem which can be classified as a scientific poem, a poem tackling scientific theme(s) using

the literary conventions of poetry. Scientific poems mingle two branches of human knowledge, science and poetry, into one body. These poems adapt scientific information to suit the common reader and thus expand the scope of the scientific domain whose data are restricted to scientific circles. The poem under discussion is followed by some references consulted for the scientific facts included in it. Therefore, the poem resembles a reliable academic paper that urges readers to examine its topic deeply.

The poem is written in ten stanzas. Their length is variable, ranging from four to nine lines. The poet employs free verse that suits the scientific nature of the poem. Non-restriction by a definite rhythm or rhyme scheme offers flexibility in expressing scientific and quantitative data. The tone of the poem mixes melancholy with hope. The depressing statistics at the poem's outset are balanced by the second half's hopeful calls for self and communal reform. The poet maintains a minimum use of figures of speech to help the reader focus on the poem's content as a listing of facts not as imaginary hypotheses. The following excerpt is a case in point: "Each year, 20 billion water bottles are pitched. / Only 10% end up being recycled." This technique helps the reader feel the enormity of the plastic pollution problem. When used, figurative depictions are mostly paradoxes and hyperboles; both suit the thematic structure of the poem. In addition, sensual imagery is employed to bring the reader physically into the poem. Lines are neatly composed with orderly grammatical structures and punctuation marks for a clear organization of thoughts. Each idea appears in one complete sentence occupying one or two lines. Periods are consistently inserted to pause and digest every notion before moving to the next.

The poem's value can be summed up in the words of one of the website visitors. Following reading the poem, he comments:

> impressive marriage between poetry and environmental science resulting in investigative essay with analysis and solution in verses, the ultimate solution is likely to include a change in consumers' behavior (as proposed) and a combination of institutional reform, tax (dis)incentives, and law enforcement -- a long, long way to go, with duration likely outweighing the longevity of precious ocean creatures, not that manufacturers of plastic would care, there's a lot of good will (amongst an educated minority), but I'm not optimistic since we're governed by corporates who maximize their profits by externalizing the downside in terms of risk and cost to the suckers, the innocent bystanders[.] (SmilingStocks, 2017)

Myths Undermined

As its title suggests, "Oceans of Plastic" tackles oceanic plastic pollution. The opening stanza criticizes two false myths: the first is the capacity of oceans to absorb whatever is thrown into them due to their vastness; the second is the so-called natural magical powers of oceans to self-renew. "We tend to think of our oceans," the poem goes, "as vast, / nearly unending bodies of water and unfathomably deep, / with an unlimited capacity to absorb and renew" (2018). These erroneous hyperboles are at once interrupted by the conjunction "Yet" which is followed by a horrific image of oceans: "Yet, our oceans are chock full of plastic garbage." The use of the possessive pronoun *our* indicates belongingness and

shared destiny between humans and oceans. This is an efficacious technique to make the reader feel involved and to eliminate the sense of detachment that motivates careless behavior against elements of nature including oceans. The paradox between the former claims and the present state of oceans emphasizes oceanic deterioration with waters filled to overflowing with plastics. This dreary depiction stimulates "solastalgia," a concept denoting the psychological pain or distress caused by the ongoing loss of solace and the sense of desolation in one's home and territory due to the lived experience of negative environmental change (Albrecht, 2019, 38-39). Solastalgia is invoked throughout the poem with multiple scenes of deterioration in waters and on beaches marred and stripped of their former symmetrical charm.

Marine Plastic Pollution Outbreak

laughingpoet in the first stanza of "Oceans of Plastic" utilizes visual imagery to equal plastic particles floating on the water's surface to soup. "Plastic pollution has turned the oceans into a plastic soup," s/he writes (2018). The alliterative plosive consonant /p/ in the line is an abrupt sound that attracts the reader's attention to the catastrophic accumulation of plastics in oceans. The term "plastic soup" is not a metaphorical depiction. It is a scientific term coined by oceanographer and boat captain Charles Moore in 1997. It refers to the plastic litter floating in the oceans and affecting marine life. Rhodes states that "almost a third of the 'plastic soup' that exists in the world's oceans may be due to microplastics" (2018, 223).

The second stanza introduces startling numbers and percentages related to plastics' consumption, recycling, production, and leakage into the waterscape:

> Each year, 20 billion water bottles are pitched.
> Only 10% end up being recycled.
> Of the 260 million tons of plastic produced every year,
> about 10 percent ends up in the ocean.
> Plastic debris makes up 85% of all the water trash.
> Each year, some 4 to 12 million tons of plastic washed offshore,
> enough to cover every foot of coastline on the planet. [2018]

The poet in the first line refers to just one product of plastics, water bottles. The reader, consequently, is motivated to think of hundreds of products that are similarly manufactured in astronomical numbers. A paradox is established between the 20 billion consumed water bottles and the scant 10% of recycling in the following line. These numbers may fail to stir the reader's environmental consciousness; therefore, the third line introduces annual plastic production that comes in millions of tons. When considering the leakage of 10 percent of this enormous production into oceans, the reader realizes the catastrophe. It is noteworthy that there are two *10 percents* in the above stanza. The first is related to recycling; the second concerns plastic litter leakage into oceans. The first is small; the second is grand. These paradoxical implications of the same percentage point to the environmental ambition of the poet to maximize recycling efforts and minimize marine plastic pollutants.

"Plastic debris makes up 85% of all the water trash" is not hyperbole (2018). Around the same time of the poem's publication, the European Commission stated that "[m]ore than 80% of marine litter is plastics" ("Single-use Plastics," 2018). Consequently, the stanza ends with the menacing image of plastic garbage setting forth on its journey toward the deepest reaches of the oceans. There, plastics encounter various destinies: they may be suspended in the water column, sink to the bottom, remain afloat in plastic islands, or circulate endlessly in one of the five oceanic gyres. The amount of these plastics is metaphorically described as being so gigantic that they can cover every foot of the coastline on Earth. Such a repulsive image of plastic trash covering shores alerts the reader. S/he recognizes the naivety of the claim that "whatever we put in our seas / will vanish from sight, with no consequences, / to be swallowed up and forgotten forever" (2018). These lines appear in the third stanza as a restatement of the criticized myths at the beginning of the poem. These images emphasize the fact that there are no waterscape black holes that swallow plastic litter. Water dynamics are continuously at work, and plastics are merely accumulating.

Macroplastics' Fragmentation Jeopardizing Marine Ecosystems and Human Health

Stanzas four, five, and six in laughingpoet's "Oceans of Plastic" are dedicated to macroplastics and how they threaten numberless marine organisms. Undoubtedly, the reader sympathizes with all creatures deprived of healthy habitats invaded by plastics. Many readers will be satisfied by sympathy, and few will consider a concrete reaction. Hence, to intensify the argument, the poet in the seventh stanza employs a popular eco-literary technique that moves the threat from the other to the self to encourage the positive engagement of a broader audience. This technique has been employed by Margaret Atwood in "Frogless" (1998, 324). It begins with the devastation of frogs due to climatic changes, but shortly humans' future generations become vulnerable, too. The poem suggests that both frogs and humans share the same destiny for dwelling on the same planet. Like Atwood, laughingpoet unsettles the reader by proposing that his/her well-being is at risk just like other marine organisms consuming plastics. "We now," the poet declares, "increasingly eat plastic waste in our diets" (2018). At first glance, this statement sounds incomprehensible. How can humans eat a plastic bag or bottle? The answer to this question is instantly given in the line to follow which explains macroplastics' fragmentation. "When plastic begins to break down / through the actions of sunlight and wave action, / microplastics are created, tiny rice sized bits of plastic." There are two types of microplastics: primary and secondary. Primary microplastics or microbeads are mainly used in cosmetic formulations and are introduced directly to the waterscape with runoff (Andrady, 2011, 1600). Secondary microplastics are formed by the "weathering breakdown of meso- and macroplastics debris" because of many reasons like exposure to UV radiation (1600). These tiny particles are the current ghosts threatening all beings including mankind.

Colbourne, poetrygretch, and Billsborough have been haunted by this ghost of microplastics. Using visual, tactile, and gustatory imagery, they translate their worries eco-poetically in "Plasticiser," "The Little Mermaid Under the Plastic Sea," and "Sea Pollution." Colbourne writes about "plastic piling up so thick / in chunks and also finely ground / bound into the very soil" (2018). These finely ground

"microplastics" are "in our food and drink / plasticisers in the milk." Therefore, she warns, "[T]his plastic case may be our doom / enclosing life in a plastic tomb." In the same lines, poetrygretch mingles fantasy with dark reality as he describes the mermaid community undersea alarmed by "[p]lastic [that] will outlive… [them] all" (2017). The catastrophe is reported to their "mighty father / Poseidon." With "A look of anguish," he declares, "We must fear what our eyes cannot see / MICROPLASTICS / Broken down plastic smaller than the grains of sand on our ocean floor." Microplastics, he says, are "[m]agnets for toxic chemicals." "The fish ingest microplastics / We ingest the fish / We eat the consequences of human waste."

Human waste in Billsborough's poem is, likewise, destroying the ocean which is "[t]he very essence / Of our planet's health" (2016). "So," the poet wonders, "why condemn it / To a micro-plastic death?" He writes about how consumers are recklessly

> [f]urring its arteries
> With used cosmetics,
> And other non-essential products,
> Poisoning the bloodstream
> And potentially our brains?

The metaphorical depictions in the lines emphasize that the ocean is a "living soul." Humans stand responsible for its inevitable death due to the hazards of their microplastics. Moreover, humans will be exposed to the repercussions of their misdeeds with the poisoning of their own brains. The image hints at the health risks humans may suffer from with microplastics invading the Earth's bloodstream, the waterscape. The three poets agree that the catastrophic accrual of microplastics will have a ruinous effect on the planet's ecosystemic equilibrium.

The plastics dilemma escalates when the seen becomes unseen, when macroplastics are broken into innumerable microparticles. "51 trillion microplastic particles are now in the seas," laughingpoet remarks (2018). Microplastics put food safety at risk because they have found their way into humans' dietary systems. "Fish and invertebrates gobble up these microplastics / and thus they work their way up the food chain," s/he explains. Numbers continue to play a fundamental role in "Oceans of Plastic," so the poet sums up the whole issue in numbers: "The average person eating seafood swallows / up to 11, 000 pieces of microplastic every year." One year after the poem’s publication, this number multiplies. Through "[e]valuating approximately 15% of Americans' caloric intake," it is estimated that "annual microplastics consumption ranges from 39000 to 52000 particles" (Cox et al., 2019, 7068).

The further fragmentation of microplastics leads to nanoplastics' formation. Therefore, before the presentation of microplastic pollution solutions in laughingpoet's poem, the study will investigate nanoplastic pollution in Illingworth's "Plastic Food." Illingworth is a scientist and poet whose poetic response to nanoplastic pollution is among the very few literary attempts to uncover it. He introduces himself on his blog as an Associate Professor at Edinburgh Napier University in the UK. His research involves using poetry to develop a dialogue between scientists and non-scientists to make the reader think. He explains how every week he finds a new piece of scientific research, reads the journal article

that describes it, and then writes a poem that tries to summarize the research in an accessible and entertaining manner.

"Plastic Food" is a Spenserian stanza comprising nine lines. Eight lines are in iambic pentameter followed by a single alexandrine line in iambic hexameter. The poet employs the regular rhyme scheme *ababbcbcc*. The poem is based on Karin Mattsson et al.'s "Brain Damage and Behavioural Disorders in Fish Induced by Plastic Nanoparticles Delivered Through the Food Chain" (2017). Scientific data are simplified by figurative images. In addition, the poem is followed by a brief prose illustration of the findings of the paper supporting it. The thematic structure of the poem is centered on nanoplastic pollution despite the absence of the term itself from the text. The reader deciphers this information from the scientific explanations after the poem. They are oriented on nanoplastics, their dreadful expansion, and their appalling impact on marine life.

The poem begins with the source of the problem: "The oceans are awash with our debris, / As plastics from our lives flow down the drain / And travel down hewn channels to the sea" (2017). Illingworth refers to oceans crammed with plastic fragments. He clarifies that these plastics are land-based to lay the blame on humans for what is going on in the waters. Like Illingworth, poetrygretch in "The Little Mermaid Under the Plastic Sea" affirms, "The problem is on land / The effect is being felt in the sea" (2017). "More than 80% of MPP [marine plastic pollution]," write scientists Almroth and Eggert, "is land based, thus any effective policy to reduce MPP must target land-based plastic pollution" (2019, 318). Illingworth's use of the verb *flow* in the former lines implies the unnoticed fluid motion of plastic particles as they stealthily travel to contaminate the waterscape. They gain free mobility in the water and are "laced with man-made poisons" (2017). The depiction of nanoplastics as being laced with other poisons is a metaphorical description of the fact that "plastic particles have a greater capacity to absorb toxic chemicals from the environment, particularly when they are present in the oceans" (Rhodes, 2018, 222). A parallel image appears in the middle of "Plastic Snow," another poem by Illingworth, in which he remarks how nanoplastics are

> gently glazed
> by films of filth
> and trade
> and greed. [2022]

His use of visual and gustatory imagery is originally evocative. Moreover, his paradoxical depictions are accurate because these filthy particles appear to sea creatures as delicious as glazed deserts to humans. However, poison and death are trapped inside. These filthy poisonous layers, the alarming rhyming beats suggest, are the outcome of an industrial economy governed by trade and the greed of capitalism.

"Through plankton," the poet remarks in "Plastic Food," "they leach into the food chain, / As fish consume this fouled and tainted meal" (2017). Plankton are usually microscopic organisms eaten by small sea creatures which are in turn eaten by larger predators. This way, plankton incorporate nanoplastics into oceanic food webs. Having consumed a meal laced with poisons, infected plankton turn into a fouled meal to small fish. The plastics pass into the bloodstream of fish and "cross over to their brain, / Affecting

how they move, and eat, and feel." The poet in his summary of Karin Mattsson et al.'s study writes that fish have displayed strange behaviors such as eating slower and being more reluctant to explore their surroundings probably due to brain damage. The poem ends ironically by referring to those who claim that "it is not real." Depending on the scientific body tracing it, nanoplastic pollution is real. Humans who eat infected fish have nanoplastics amassing in their brains and other organs. Illingworth manages to prove Billsborough's earlier fears in "Sea Pollution" when the latter observes that plastics are "potentially ["poisoning"] our brains" (2016). "Plastic Food" lists facts and introduces the problem to the reader without offering any solutions. Therefore, the following section returns to laughingpoet's "Oceans of Plastic" to introduce the poet's proposed solutions to microplastic pollution that may also aid in controlling the outspread of nanoplastics.

Marine Microplastic Pollution Solutions

The seventh stanza of "Oceans of Plastic" is the longest for hosting a detailed argument of microplastics. Through it, laughingpoet succeeds at convincing the reader that s/he is inexorably threatened. Therefore, s/he becomes ready to listen to the list of solutions in the remaining three stanzas. The first step toward concrete solutions, the poet contends, is admitting that humans have no other place than Earth to live on. This fact is implied in the question that begins the eighth stanza: "So, where do we go from here?" (2018). The instant answer that comes to mind is that humans have no other shelter but Earth, so they must act instantly. Some countries that have a well-managed policy regarding plastic waste may feel safe. Nevertheless, "the presence of microplastic particles (MPs) in remote, high mountain regions, without permanent residents and unaffected by sewage discharge, and in nature reserves, indicates they are widely and diffusely distributed" (Rhodes, 2018, 238). It sounds like no one will be safe until all countries admit their shared responsibility in writing the end of plastic pollution.

Despite the urgency of transnational collaboration, self-reform should be the starting point. Individuals should begin with themselves and should not wait for international treaties or governmental regulations. They are the consumers, the active players in the plastics industry who control the production line by the market demand. Accordingly, the poet believes that s/he should begin with himself. "To solve this problem, I resolve / to wean myself off of my plastic addiction" (2018). To illustrate humanity's heavy dependence on plastics, the poet likens him/herself to an addict, and plastics are depicted as drugs. The reader's imagination is necessarily stimulated to think of addiction-related issues like misuse, craving despite negative consequences, compulsive habits, obsession, psychological and physical dependence, loss of control, withdrawal symptoms, and others.

The poet decides to stop "buying plastic bottled water." Plastic bottles are used as a symbol of single-use plastics which constitute a great part of marine plastic pollution. "50 percent of items found in beach surveys are single-use plastic items" (Almroth & Eggert, 2019, 318). In addition to plastic bottles, the poet decides "to avoid using products containing microbeads / including facial scrubs, body washes, and fleece products" (2018). These are just some of many products that can be avoided by consumers in their daily lives to diminish the sources of primary microplastics. Such efforts can minimize the devasting

effects of plastics in the long run because commodities gain their worth with demand. Avoiding such products will make corporate owners change their production course to cope with the consumers' needs.

The poet makes more vows in the ninth stanza to fight over-consumption out of the wise belief that less consumption means less production:

> I resolve to eat out less at restaurants utilizing plastic utensils,
> to buy second-hand plastic products
> rather than encouraging production of more plastics,
> to buy more bulk foods, to use less plastic bags.
> I resolve to do more recycling of my own plastic waste[.]

Then, s/he expands the circle of change in stanza ten to include stores and manufacturers. "I vow to encourage stores and manufacturers / to use and produce more sustainable containers." Manufacturers and stores are key factors in the plastics economy. Manufacturers are the source of the problem; stores are the link between them and consumers. The poet does not explain how s/he is going to encourage manufacturers and stores. Perhaps modifying his/her behavior and that of other consumers will force a change.

Change can also occur through environmental activism that advocates greener commercial activities. Therefore, the poet expresses his/her intention "to support groups that promote environmental causes." In doing so, laughingpoet resembles the Little Mermaid in poetrygretch's poem who determines to "[t]ransform her tail into legs / Transform herself into an environmental activist / Spreading the word about morbidly changing life under the sea" to have a "clean home for all" (2017). Environmental groups restlessly encourage community members to take action and to be positive. "Beat the Microbead" movement is an inspiring example. It started campaigning against the use of microbeads in 2012 by cautioning consumers about their environmental hazards (“Beat,” 2022). Moreover, the campaign calls for collaborating efforts to reach "Zero Plastic Inside" personal care and cosmetics products. By the end of the poem, the poet addresses the reader to handle his/her responsibility. "Finally, I hope you also will please do your own part / to help reduce the scourge of plastic pollution in our oceans" (2018). Through this moving plea, the reader realizes that s/he should be part of the solution because s/he has always been part of the problem.

The Plastics Economy

laughingpoet's discussion of the consumers' role and the gradual procession of solutions to include manufacturers and stores draws attention to the core of the dilemma, the plastics industry. Any solution away from the plastics economy is mostly invalid. "The source of the problem / Becomes the source of the solution," suggests poetrygretch (2017). Plastic production depends on a large-scale industry generating millions of tons of synthetic plastics due to the cheap manufacturing costs. Marine plastic pollution is believed to be "a symptom of an inherently wasteful linear plastic economy" (Forrest et al., 2019, 1). Consequently, present efforts aim to establish a global transformation to a circular economy without waste. Its waste is recycled to feed the industry cyclically. A concrete example is seen in the European Commission's communication to the European Parliament regarding its plan for a circular

economy of plastics with a "smart, innovative, and sustainable plastics industry, where design and production fully respect the needs of reuse, repair, and recycling" ("Single-use Plastics," 2018).

According to Almroth and Eggert, recycling is a fundamental part of a circular economy, but it is "particularly problematic when applied to mixed plastics," so it has a small market (2019, 321). Therefore, they initiated an innovative policy called extended producer responsibility (EPR) (320). EPR "extends a producer's responsibility for a product to the product's postconsumer stage" by requiring the producer with appropriate economic incentives "to finance the collection, recycling, and/or the safe disposal of products" (321). This policy "is used extensively in the European Union," and the rest of the world countries are encouraged to adopt it for a green management of plastics (322). In the same vein, Forrest et al. propose the Contribution which is "a voluntary industry-led contribution" that "facilitate[s] the industry-wide transition from fossil fuels to plastic waste which eventually becomes its sole feedstock" to draw "plastic pollution from the environment back into the economy" (2019, 1, 6-7). The Contribution necessitates worldwide economic support for a circular plastics economy because of key barriers to its realization such as the "inability of circular recycling technologies to compete with the extremely low direct cost of producing FFPs [fossil fuel-derived plastics]" (4). EPR and the Contribution target the producer who undoubtedly keeps an eye on the market demand. Hence, raising awareness to gain public support for creating economic pressure is vital. Eco-literature and eco-poetry, the study affirms, are effective mechanisms in this regard.

The argument so far has unveiled the multidimensionality of the plastics case and the critical demand for an interdisciplinary balanced economic approach. This approach is well-established in Islamic economics. The following section of the study presents a reading through its potentialities and how it can positively affect the world economy. The present global economic system – including that of plastics – is manipulated by capitalism. Its failure to amend its drawbacks has motivated Muslim economists to excavate Islamic economics in search of long-term solutions. The procedure involves studying the economic basics in the Qur'an and the Sunnah as well as the rich socioeconomic history of Islam. Then, current economic models are re-evaluated concerning the findings of this study. Unlike capitalism, which concentrates only on the material dimension of life, Islamic economics is guarded by Islam which is a storehouse of ethics like justice, responsibility, moderation, harm prevention, sacrifice, brotherhood, mercy, compassion, and so forth.

Islamic economics emerged with the establishment of the Islamic State in Medina in the seventh century. It flourished throughout the history of Islam till it witnessed a steep decline by the end of the Islamic Golden Age in the thirteenth century. This decline has been attributed to Muslim economists' abandonment of their essential role in updating the economic system through the lens of Islam to keep up with the goings-on of each era. Consequently, a wide gap has occurred between the frozen pillars of Islamic economics and the current world economy. A sound Muslim society requires continuous cooperation between scholars in all areas of life (including the economy) with Sharia scholars to determine the validity and appropriateness of new knowledge domains to Islamic norms. With the gradual

deterioration of this process and the adoption of cultural and intellectual disciplines that are mostly secular or irreligious, Islam suffered from intellectual stagnation, and Islamic economics was abandoned.

In *An Introduction to Islamic Economics*, Khan juxtaposes capitalism with Islamic economics (1994). The following lines summarize and compare the two economic disciplines as proposed by Khan. The argument introduces valid solutions to the plastic dilemma, the product of capitalism, from the standpoint of Islamic economics. To begin with, capitalism is based on irresponsible economic production by powerful nations and global corporations that are not accountable to anyone in the world (Khan, 1994, 4). In Islam, man is the vicegerent of the Almighty God and is accountable to Him for all his actions on the Day of Judgment (4). This Individual accountability expands to encompass all levels including the international level (101). Therefore, a Supreme Audit Institution of the World should be established to audit the accounts of global corporations by adding at least two more E's –ethics and environment– to the famous three E's –economy, efficiency, and effectiveness– of economic analysis (101).

Production and consumption in the capital system rely on the conventional economic analysis that assumes that human beings are inherently selfish and primarily concerned with deriving maximum utility regardless of repercussions (4). This hypothesis results in the continuance of individual nations and mega-corporations to adopt policies that suit their selfish ends (7). Islam assumes a dual nature of humans; they are selfish and altruistic (5). Selfishness is discouraged and controlled; altruism is encouraged via several means like promoting voluntary work (5). The Islamic view emphasizes that the entire world has been created by the Almighty God for the benefit of all human beings. Thus, all the world's peoples need to consult and cooperate while pursuing economic policies that might adversely affect others (7).

Over-exploitation is attributed to the capitalist economic order in which "progress and material possessions are used synonymously" (5). In Islam, over-exploitation is controlled by the Islamic mindset that treats material possessions as embellishments of life but only secondary to moral and spiritual development which represent the true aim and result of progress (5). Therefore, "a sizable chunk of resources should be spent… on the spiritual training of the people through persuasion, formal education, sound and wholesome public policies, and institutionalization of the moral values of Islam" (91).

The concept of ownership in capitalism suggests the total ownership of human beings to Earth's resource and their absolute right to private ownership. To illustrate, people are free to consume, save, or invest in whatever they own even if it is socially harmful or destructive (6). The Islamic concept of ownership is tightly related to the belief of absolute ownership for the Almighty God and temporal ownership of resources to humans who stand accountable to Him for the proper use of these resources (6). Thus, humans are not free to consume, save, or invest their earnings in any way they like; there are definite moral limits and juristic laws on them (6).

Demand in the capital system is created artificially to keep the system going by resorting to ruthless campaigns of advertisements (8). In contrast, there is a minimal requirement for advertisements in the Islamic economy because its wheel runs by certain mechanisms that transfer sufficient purchasing power from the rich to the poor including zakāh (an obligatory fixed sum paid by Muslims who own a certain minimum of wealth to the poor and the needy), infāq (voluntary spending on one's relations, neighbors,

and other social needs), and the Islamic law of inheritance that disperses wealth on a wide scale (11, 37-39). If needed, advertisements should be free from cheating or gross misstatements (102). Moreover, independent institutions should protect consumers against misinformation and misreporting in advertisements (103-104).

Capitalists encourage consumption "so that a high level of investment is sustained" (15). However, the Islamic ethos encourages a low-consumption economy (15). Individuals in Islam are advised to use resources intensively and to replace them after outliving their utility (15). Besides, the Prophet (peace be upon him) placed a high premium on simple living and discouraged people from luxuries (15). Those who can afford a higher material standard should voluntarily forego some of their comforts and help others improve their economic lot to enjoy a similar lifestyle (16). It is only after most people have acquired a comparable living standard that society as a whole moves to a higher socio-economic level (16). Additionally, Islam "does not approve that people should live beyond their means" (88). It is worth noting that over-consumption is tied to the absence of moderation. Moderation is the mother norm in the Islamic economy as it governs economic behavior on all levels (53). Furthermore, the Arabic translation of the word "economy" is "اقتصاد" which means "moderation." Moderation and economy have always been synonymous in Arabic culture.

"[T]he Western approach to knowledge is chauvinistic" (24). "Islam places a great emphasis on spreading knowledge and sharing it with others" (24). Technology is the product of knowledge that leads to versatile economic problems due to its unplanned introduction to markets. Islamic ethos does not encourage the unplanned introduction of new technology. Moreover, it would urge the industrialists to bear the cost of economic hardships and ecological repercussions created by the introduction of new technology depending on "the general principle that cost and benefit go hand in hand" (9, 98). This concept is similar to Almroth and Eggert's extended producer responsibility initiative.

"Deductive reasoning in economics assumes perfect knowledge of the future by economic agents" (65). The result of the above assumption is that economic agents act confidently depending on imperfect knowledge. Moreover, they react to crises too late to achieve an appropriate recovery due to economic pressures and corporate interests. In Islam, "[p]erfect knowledge of the future is only with Allah and man's knowledge of it can only be partial and imperfect" (65). Thus, economic decisions are taken following tentative intense studies. Hence, Islamic economics expects crises to take place at any stage of the economic process, and it seeks measures to prevent crises before they develop because all players in the economic cycle are accountable (54).

"[T]he entire educational system is geared to the teaching of production skills" (103). Nevertheless, people should be educated in consumption skills like selecting the best buy, the best time of purchase, the method to obtain maximum value out of goods, ordering economical quantity levels, economic purchase outlets, etc. (103). This training should be part of the students' regular education to be "mature" consumers with a reduced tendency to be waylaid by advertisements or marketing campaigns (103). In addition, "neoclassical economists consider information about prices as adequate" (103). Islamic economics demands spreading information that answers many other questions besides prices like: "How

things are being produced, and in which quantities, and at what cost? What is their effect on the environment? What is their effect on human health? How far are the 'advertised' facts true? How far are the 'claims' of the producers correct?" (103).

Finally, Islamic economics has a whole different plan regarding the place of money in life. The five objectives of Islamic Sharia are preserving Muslims' religion, souls, minds, offspring, and money ("The Higher"). Money is among the higher objectives of Islamic jurisprudence; however, it is placed at the end of the list. Additionally, for gaining money, the ends do not justify the means. Each person should give a great deal of care to how money is spent out of the belief that on the Day of Judgment, the Almighty God will ask him/her how s/he gained money and on what it was spent. Thus, the concept of money –which is the undeniable source of all environmental evils– is guarded by morals and gets restrained by an inevitable divine judgment. More detailed studies and discussions of the emerging discipline of Islamic economics are available in many journals like *Islamic Economic Studies*, *International Journal of Islamic Economics and Finance Research*, and *Journal of Islamic Economics*.

Further Study

In addition to the analyzed eco-poems, many others have responded to marine plastic pollution and are worthy of future investigations. Stephen Katona, for instance, in "A World Without Plastic" invites the reader to "ease the world's pain / With a healthy food chain" with "Less chemicals in the sea"; that "Would be healthier for you and me" (2014). He suggests "us[ing] more glass," reusing grocery "bottle[s]" and "container[s]," and taking care of "what you throw away, / Most will be here to stay" (2014). Neil Dufty, on the other hand, portrays the Earth's gloomy future after being crammed with plastic in his satirical "Poem about the Rubbish in Our Oceans." The poem is divided into two sections, "Now" and "Future." The "Now" section consists of two stanzas depicting "the North Pacific Gyre" and its "slowly spinning whirlpool of waste / A 'messpool' of plastic poop" (2014). The "Future" is a bulky prose poem comprising an advertisement for the Plastiglorious Tours Company. The company offers "a once-in-a- / lifetime experience" in "the Fantastic Plastic Tundra Tour across part of the / spellbinding Northern Plastific Ocean. There's solid pristine plastic as far as the eye can / see" (2014). There, visitors can "ride up Tyre Mountain" and "bungie off a massive tyre cliff stopping only centimetres / from the rock-hard plastic icesheet" (2014). Unlike Dufty and his bleak future vision of Earth, Cassidy Claire Johnson in "Plastic" presents a domestic recalling of childhood memories. By referring to thirty plastic items in her childhood room and repeating the word *plastic* forty-six times, the reader realizes how dependable humans have become on plastic. In the poem's finale, Johnson states: "childhood is plastic" (2012). However, concentrating attention reveals that it is not only childhood that is plastic; Earth is sinking into a plastic flood.

Conclusion

The current study aims to bring marine micro and nanoplastic pollution into the spotlight by analyzing it in selected eco-poems. At first, some scientific facts have been explained regarding plastic

litter's chaotic disposal, slow decomposition, and final fragmentation into unseen particles in open environments. Then, the study moves to representing this issue in blue eco-poetics. Colbourne admits in "Living in the Anthropocene" that humans are now living in the Plastocene era considering the devastating accumulation of plastics in the Earth's strata. laughingpoet's "Oceans of Plastic" accompanies the reader on a journey into oceans that are disappointingly packed with microplastics. Microplastics are in continuous motion among sea creatures; they become a real threat to marine life and human health. Oceans, laughingpoet suggests, can no longer absorb these colossal amounts of pollutants, and their magical self-renewal is a myth. This myth targets the continuity of the plastics industry and the wild capitalistic economy guided only by profit. Marine microplastics are further investigated in Colbourne's "Plasticiser," poetrygretch's "The Little Mermaid Under the Plastic Sea," and Billsborough's "Sea Pollution." The poets affirm the irredeemable repercussions of the uncontrollable spread of microplastics among ecosystems and the responsibility of humans for the destruction of Earth’s balanced nature.

Nanoplastic pollution is traced in Illingworth's "Plastic Food" which introduces a skillful poetic reproduction of scientific data to raise the reader's awareness. Unseen poisonous nanoplastics, Illingworth affirms, are lost when ingested by marine creatures and thus become incorporated into food webs. Illingworth proposes no solutions to the catastrophic development of nanoplastic pollution. Therefore, the discussion returns once again to the finale of laughingpoet's poem with its list of solutions to microplastic pollution. Though focusing on microplastics, these valuable solutions can be starting points for controlling nanoplastic pollution. The poet recommends transnational collaboration that should coincide with self-reform and environmental activism. The poem hints at the inevitability of reforming the plastics economy for being the source of the problem. Therefore, the study presents the economic initiatives of EPR and the Contribution that target altering the world economy from a linear to a circular economy. Islamic economics is, likewise, introduced as an interdisciplinary economic domain suitable for the interrelated issues involved in the plastics dilemma.

The argument has been eye-opening and traumatic. This is the principal aim of conducting this study. Ecocritical readings of the current degradation of ecosystems are meant to lead readers of literature to an unwavering awareness that urges them to modify their destructive policies on Earth. Therefore, the author highly recommends ecocritics to further investigate the issue of plastic pollution on all levels and in all literary genres. In doing so, they will revolutionize the public to defend all helpless creatures. They are being taken advantage of for the prosperity of a few individuals of one species, *Homo sapiens*. The discussion succeeds in uncovering the ugly face of plastic and adds new insights for the readers. Economists are fighting to seize the utmost gains from the plastics economy. World peoples should fight back by cutting down on consumption and propagating wiser policies.

عظيمُ الخطر عندما لا يرى... أعظم عندما يضيع: دراسة شعرية من منظور النقد البيئي للتلوث البحري البلاستيكي المجهري والنانوي

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الملخص

يُعد التلوث البلاستيكي هاوية بيئيّة عالميّة جذبت انتباه العالم قبل بضعة عقود، إذ بدأت المشكلة مع تراكم المواد البلاستيكية براً وبحراً. وبعدها تطورت مشكلة التلوث البلاستيكي بسبب تفتت المواد البلاستيكيّة الكبيرة إلى مواد بلاستيكيّة مجهريّة ونانويّة الحجم لا ترى بالعين المجردة، وبخاصة في البيئات البحرية، وتُفقد هذه الجسيمات غير المرئيّة بسبب حركتها العالية في الأنسجة وبين الكائنات التي تتغذى عليها. وتتناول الدراسة الحاليّة التلوث البحري البلاستيكي المجهري والنانوي في قصائد بيئيّة تم اختيارها للكشف عن مصير تلك العناصر في الأنظمة المائيّة، وكذلك الضرر البيولوجي الذي يصاحب هذه الظاهرة، وقد قوّض الشعراء المختارون أسطورة التجديد الذاتي للطبيعة من خلال الكشف عن تفشي التلوث البلاستيكي البحري الذي يصعب علاجه، جمعت الدراسة بين فروع تخصصات علميّة مختلفة، حيث تحاول الكشف عن إمكانيّات الكتابة الشعريّة لاستيعاب المعرفة العلميّة ونقلها إلى القارئ العادي، علاوة على ذلك، تسعى الدراسة إلى إثبات قدرة الشعر على رفع مستوى الوعي بمثل هذه القضية الحرجة التي تهدد التوازن البيئي للأرض. ولتحقيق كلا الهدفين، تم تحليل القصائد المدروسة تحليلاً أدبيًا وعلميًا. وخلال ذلك تَبرُز الحاجة إلى الشروع في إصلاحات حقيقيّة لاقتصاد البلاستيك في جميع أنحاء العالم، وهذه الإصلاحات أمر لا مفر منه لعلاج الفوضى البيئيّة المُدمرة التي تحدث بسرعة مثيرة للقلق. وهكذا، تم إلقاء الضوء على عنصر الاقتصاد في القسم الأخير من الدراسة لمكافحة التلوث البلاستيكي.

الكلمات المفتاحية: التلوث البحري البلاستيكي، البلاستيك المجهري، البلاستيك النانوي، الشعر البيئي، الاقتصاد البلاستيكي.

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