WORLD AQUATIC ANIMAL DAY

2022

RESOURCE PACKET

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PART I: INTRODUCTION

1. About World Aquatic Animal Day

#worldaquaticanimalday

World Aquatic Animal Day is an annual day dedicated to aquatic animals, launched for the first time on April 3, 2020. Each year, we work to raise global awareness about these often-forgotten nonhuman animals.

Aquatic animals play a critical role in our societies and ecosystems. They are important as species, but they also have value and intrinsic worth as individuals. By "aquatic animals" we mean not only fishes or whales but also the many other animals who require aquatic habitats such as: amphibians, marine mammals, crustaceans, reptiles, mollusks, aquatic birds, aquatic insects, starfish, and corals.

Aquatic animals urgently need to be properly considered in policy initiatives, education, advocacy, the law, and good stewardship of the earth. Efforts to raise awareness of aquatic animals' plight must rise to meet the immense challenges they face. We must consider our interactions with aquatic animals, our treatment of them, and the often-devastating impacts we are having on them and on their habitats.

Join us on April 3rd each year as we celebrate these creatures and call for action to protect them through education, law, policy, outreach, and other avenues. With a different focus each year, we will highlight and work to address the issues aquatic animals face.

The theme for 2022 is "The Myth of Sustainability in Fishing and Aquaculture."

This Resource Packet and other information are on our website: WorldAquaticAnimalDay.org.

2. About this Resource Packet

A. Background and Rationale

This Resource Packet has written been by Natassia Tuhovak and Jessica Dantzler, with help from Rebecca Critzer, of the Aquatic Animal Law Initiative (AALI), and Animal Law Clinic at Lewis & Clark Law School (Clinic), and Clinical Professor Kathy Hessler. It is divided into three main parts along with various sub-sections: Part I offers an introduction to the Clinic, our work, aquatic animals, and their habitats; Part II focuses on aquaculture; and Part III addresses wild-caught fishing.

The purpose of the Resource Packet is to provide an overview of some of the issues faced by aquatic animals and in particular, to set out some of the regulations that apply to these animals. In addition, this document contains links to additional resources that might be helpful to others in their work.

As mentioned above, aquatic animals are often invisible victims—yet they account for the largest number of animals impacted by humans—directly and indirectly. By making these animals and the threats they face more visible, we hope to increase awareness and efforts to address them.

Legally, animals are typically categorized as property, which makes establishing protection for animals difficult. Some of the protections available to animals require proving cruelty, which is very difficult in the case of aquatic animals who are often out of sight when abuse happens. Even if this requirement were met, it would fail to protect aquatic animals because they are not included in most of the animal cruelty laws.

Failure to address the welfare of aquatic animals in regulation has led to problematic consequences. It is important to note that use of aquatic animals not only impacts the animals themselves, but also wild animals, workers, consumers, and the environment. Thus, it is important to pay careful attention to the issues involved in the use of aquatic animals. This is especially true as it is projected that a variety of these uses will continue to significantly rise in the foreseeable future.

Efforts to protect aquatic animals are increasing. In response, governments and industry leaders have been looking for ways to offer minimal protections for these animals while continuing to use them at astronomical rates. One response has been to frame fishing and aquaculture as sustainable. Though there are instances of sustainable use, they are far from the norm. And even where use is less harmful, it still neglects the fundamental welfare of the animals, and treats them as a resource to be used rather than as fellow living beings. The Resource Packet this year addresses some of this conversation.

B. The Animal Law Clinic

World Aquatic Animal Day is one project of the Clinic which also works on local, state, national, and international animal law issues. The Clinic was established in 2008. It serves as a training ground for students interested in a full range of legal issues related to animal interests, through the direct representation of clients. Students conduct legal research, analyze legal problems, develop persuasive written works, further the field of animal law through clinic projects, and encourage consideration of animal interests in legal decision-making.

The Clinic promotes the academic and professional growth of its students by working to:

i. Foster the transition from law student to lawyer;
ii. Create life-long learners who are excellent and effective advocates;
iii. Create respectful dialogue on difficult conversations; and
iv. Invite and engage different perspectives.

C. Aquatic Animal Law Initiative (AALI)

The Aquatic Animal Law Initiative works to protect and promote the interests of aquatic animals by:

i. Advocating on their behalf through the legal system;
ii. Promoting their value to the public by providing education about their cognitive, emotional, and physiological capacities; and
iii. Harmonizing human, animal, and environmental interests.

Legal and regulatory frameworks often leave out aquatic animals even though these systems provide some protection to other non-human animals. Too little is understood about the potential issues related to aquatic animal welfare along with the environmental health and safety issues associated with their use and production. Likewise, the public and policymakers are unaware of the ever-evolving scientific data relating to the complex lives of aquatic animals. The critical role aquatic animals play within ecosystems along with the individual capacities and biological needs they possess need to be considered when making life-altering decisions related to their well-being.

Aquatic animals have been used extensively to promote the goals of humans. However, their use has rarely been accompanied by consideration for the aquatic animals as individuals. Species level concerns are usually raised only after the animal population has suffered greatly and the human-use has become impacted. Before 2016, no entity dedicated to the legal analysis of the issues affecting aquatic animals existed. Thus, AALI was created in order to consider the legal as well as scientific and economic contours of issues resulting from the use of aquatic animals.

D. Disclaimers

The Resource Packet is provided by the Clinic for informational and educational purposes only. It is not a complete source of information of the issues addressed. The resources provided are not exhaustive; they are illustrative and thus limited in scope. Law students, who are not legal professionals or experts in the subject matter covered herein, have compiled this research.

Nothing contained in the Resource Packet is intended to constitute legal advice, and readers should not construe any of the information presented as legal advice. The Clinic recommends consulting an attorney for specific advice that is tailored to particular legal needs.

The Resource Packet includes legal information from different jurisdictions. It is important to note that the issues addressed may be regulated at international, federal, state, tribal, and local levels and can vary widely among different jurisdictions within and across countries. Specific laws and regulations may also apply to different species of animals.

The content of the Resource Packet is provided "as is" at the date of publication, March 2022.

The Resource Packet contains resources created by the Clinic itself and by other organizations. Any mistakes in attribution are unintentional. The Clinic is not affiliated with the organizations referenced

in the Resource Packet. Inclusion of information or documentation from the organizations referenced should not be construed as an endorsement of any organization, its views, or its practices.

The Clinic makes no representation or warranty of any kind, express or implied, including, without limitation to, any warranties of merchantability, fitness for a particular purpose, title, and/or non-infringement. The Clinic does not accept responsibility for any loss or damage suffered by any person as a result of reliance on the contents of the Resource Packet.

Some international and foreign resources have been included herein. We do not make any warranties as to the accuracy of these sources, translations, or the information contained therein.

For the sake of brevity, we sometimes utilize the term "fish" as inclusive of other aquatic animals. Additionally, we are generally using the term fishes (which more properly indicates that there are many types and large numbers) instead of fish.

While we encourage action for this class of animals, we are not otherwise affiliated with organizations that choose to participate in this day nor do we endorse their actions. We encourage all to be respectful and to follow the relevant procedures, laws, regulations, and policies that apply to any given action or circumstance.

This subject is complicated, and we note that various dimensions exist within it, including but not limited to: political, economic, social, cultural, technological, environmental, legal, and otherwise. We cannot hope to cover all these complexities and considerations but trust that the Resource Packet provides a starting point for information relating to aquatic animals. We encourage readers to engage in further research on these and other subjects of interest. We have included some additional resources to assist in further exploration of these topics.

We encourage you to take a look at our previous World Aquatic Animal Day Resource Packets, with further information and resources, which can be found here. Some of the information and resources from the 2020 and 2021 Resource Packet have been included here.

3. Ten Ways to Get Involved

April 3rd is a day to consider aquatic animals and how you may be able to help them. Consider, for example, the impact human activity has on aquatic animals and their habitats. Consider the way your community interacts with, treats, and uses aquatic animals. While we know that many people understandably feel overwhelmed with all of the other crises in the world, we also know that some people are looking for new ways to continue their education and new opportunities to advocate for others.

Anyone can be an advocate for aquatic animals no matter who or where you are. Below is a list of ten

ways you can participate in World Aquatic Animal Day. And there are many other ways you can get involved—be creative, think local, and be sensitive to issues raised by the pandemic, as well as economic, political, and social upheaval.

Regardless of how you decide to get involved, and whether it is on World Aquatic Animal Day or any other day of the year, let us know what you did and how you chose to participate by taking a photo of your action and sharing on social media and elsewhere using the hashtag #worldaquaticanimalday.

4. Introduction: Aquatic Animals

A. What Classifies as an Aquatic Animal?

When one thinks of aquatic animals, "fin" fishes may come to mind.[1] However, it is helpful to understand that the term "aquatic animals" encompasses a diverse group of animal species.

The term "aquatic animals" refers to any animal that primarily lives in a body of water, which is termed an aquatic habitat.[2] "Aquatic habitats may be freshwater, marine, or brackish water."[3] For example, oceans, seas, rivers, lakes, and ponds are all considered aquatic habitats.[4]

Although many aquatic animals absorb oxygen by pushing water over their gills, a significant number of aquatic animals breathe air including dolphins, whales, manatees, diving bell spiders, mayflies, caddisflies, lungfish, and many more.[5]

Below is a list of aquatic animals–some you may find surprising! This list is not comprehensive, but it highlights the depth of diversity included within the aquatic animal group.

B. List of Aquatic Animals

i. **Amphibians:** frogs; toads; newts; salamanders
ii. **Crustaceans:** crabs; lobsters; shrimp; krill; barnacles; wood lice; water fleas
iii. **Finfishes:** sharks; other finfishes
iv. **Marine mammals:** cetaceans; pinnipeds; polar bears; otters, badgers, beavers; manatees; dugongs

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[1] "Term used to describe the strictly classified biological group of fishes, sometimes called true fishes to distinguish them from other aquatic life whose common names also end in "fish", including mollusks (e.g., cuttlefish), crustaceans (e.g., crayfish), echinoderms (e.g., starfish), and other animals (e.g., jellyfish); or any other aquatic life harvested in fisheries or aquaculture (e.g. shellfish)." *Finfish*, INT'L SEAFOOD SUSTAINABILITY FOUND., https://www.iss-foundation.org/glossary/finfish/.
[2] *Aquaculture*, BIOLOGY ONLINE, https://www.biologyonline.com/dictionary/aquatic (last visited Mar. 20, 2020).
[3] *Id.*
[4] *Id.*
[5] *How Do Fish Breathe?*, IOWA DEP'T OF NAT. RES. (2017), https://www.iowadnr.gov/About-DNR/DNR-News-Releases/ArticleID/1454/How-do-fish-breathe; *Air Breathing Animals That Live Under Water*, ANIMALLOGIC (Jan. 11, 2020), https://animalogic.ca/blog/air- breathing-animals-that-live-under-water.

v. **Mollusks:** scallops; mussels; cockles; oysters; clams
vi. **Cephalopods:** nautiluses; squids; octopuses and cuttlefish
vii. **Reptiles:** turtles; snakes; iguanas; crocodiles; alligators; geckos
viii. **Echinoderms**: sea stars; sea urchins; sand dollars; sea cucumbers
ix. **Cnidaria:** corals and jellyfish[6]
x. **Porifera:** sponges
xi. **Birds:** penguins; flamingos; seagulls; pelicans; ducks; geese; albatross; puffins
xii. **Aquatic insects:** zooplankton

....and many, many more!

C. Habitats

One may predominantly think of the ocean when thinking of aquatic animal habitats. While the ocean covers a large portion of relevant habitats, there are other habitats to consider as well. Aquatic animals can be found in a variety of bodies of water, both freshwater and marine. "The aquatic biome includes habitats around the world dominated by water. Aquatic ecosystems are divided into two main groups based on their salinity—freshwater habitats and marine habitats." [7]
In addition, there are a large number of aquatic animals in captive situations.

i. Bodies of water

Aquatic animals inhabit almost every kind of body of water regardless of salinity content.

> "Freshwater habitats are aquatic habitats with low levels of salt, less than one percent. They include rivers, lakes, streams, ponds, swamps, wetlands, bogs and lagoons. Marine habitats are aquatic habitats with salt concentrations of more than one percent. They include oceans, seas and coral reefs. Some habitats exist where saltwater and freshwater mix together. These include mud flats, mangroves and salt marshes."[8]

ii. Farming

Aquafarming—more commonly known as aquaculture—refers to the process of "breeding, rearing, and harvesting fishes, shellfish, algae, and other types of organisms in all types of water

[6] Jellyfish are scientifically referred to as sea jellies. *Jellyfish or Sea Jellies Which Is Correct?*, SEAUNSEEN (Feb. 23, 2016), https://seaunseen.com/jellyfish-sea-jellies/.
[7] *Aquatic Habitats*, WORLD ANIMAL FOUND. (Dec. 19, 2019), https://www.worldanimalfoundation.com/advocate/wild-earth/params/post/1286151/aquatic-habitats.
[8] *Id.*

environments."[8] Aquaculture occurs offshore and on land.[9] Further information on the aquaculture industry will be discussed in Part II of this Research Packet.

iii. Captivity

In addition to keeping and raising aquatic animals for food, it is important to note that millions of these animals are living in other forms of captivity such as aquaria, restaurants, offices, and zoos. These range from small finfishes to large aquatic mammals such as orcas.

Aquariums may appear to the public as if they are concerned with the welfare of aquatic animals. However, even large aquariums cannot provide environmental diversity and novelty that aquatic animals would have in the wild.[9] This deprivation can cause physical and psychological problems in captive aquatic animals.[10]

Aquatic animals also live in many households around the world. Consider goldfish and reptiles kept as companion animals and koi fishes or frogs kept in ponds. Other animals are found in offices, businesses, and schools for entertainment, food, or educational uses. Fish tanks "are designed to keep fishes in captivity for human enjoyment. . . . Sadly, most captive fishes live short lives and are easily replaced with new "stock." This creates a constant demand that feeds a cycle of collection/production, acquisition, and death."[11]

D. Why Protecting Aquatic Animals Matters

Protecting, conserving, and reducing or refraining from using aquatic animals is in the best interests of aquatic animals, humans, and the environment itself.

i. Ability to Feel Pain

In the 1600s, René Descartes asserted that animals felt no pain and more closely resembled machines than humans.[10] Descartes went so far as experimenting on fully conscious animals to attempt to prove his hypothesis.[11] During these vivisections, Descartes attributed an animal's reaction to pain to mere programmed responses.[12] Much work has been required over a long period of time to evolve beyond this thinking.

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[8] *What Is Aquaculture?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://oceanservice.noaa.gov/facts/aquaculture.html.
[9] Simon Funge-Smith & Michael Phillips, *Aquaculture Systems and Species*, FOOD & AGRIC. ORG. OF THE U.N., https://www.fao.org/3/ab412e/ab412e07.htm.
[9] *Ethical and Ecological Implications of Keeping Fish in Captivity*, ANIMAL WELFARE INST., https://awionline.org/awi-quarterly/2015-fall/ethical-and-ecological-implications-keeping-fish-captivity (last visited Mar. 20, 2020).
[10] *Id.*
[11] *Id.*
[10] Ross Pomeroy, *Scientists Have Learned from Cases of Animal Cruelty*, REAL CLEAR SCI. (Jan. 23, 2012), https://www.realclearscience.com/blog/2012/01/scientists-can-be-cruel.html.
[11] *Id.*
[12] *Id.*

While a majority of scientists have long acknowledged that mammals feel pain,[13] scientific consensus that fishes also feel pain has been reached only recently.[14] Some scientists still argue that fishes do not feel pain because they do not possess the same structures in the brain that cause humans to feel pain.[15] However, many scientists challenge these claims, explaining that fishes have developed their own unique structures in the brain to detect pain.[16] Proponents maintain that possessing the ability to feel pain is an evolutionary necessity to survival.[17] If fishes were not able to detect dangerous environments, they would be less likely to survive due to predation, over-exhaustion, or injury.[18]

The conversation regarding the ability of fishes to perceive pain relates to only one of the many fish capabilities that are the subject of numerous scientific studies. Furthermore, researchers have described approximately 30,000 species of fishes, representing an enormous diversity in morphology, behavior, nutrition, reproduction, and environmental habitats.[19] In addition, morphological, physiological, and behavioral changes may occur in a particular species at different periods of its life.[20] Currently, there are many unknowns around the lived experience of fishes, and this has complicated scientists' ability to understand fishes' perception of pain. However, the majority of scientific and ethical experts agree that the evidence indicates that all fishes likely feel pain.

Researchers have supported these hypotheses with many studies showing responses in fishes that indicate fishes reaction to a noxious event.[21] Some of the responses included avoiding an area in the tank where the fishes were electrically shocked, refusing to eat after receiving lip injections, and increasing gill ventilation rates when injected with noxious chemicals.[22] Additionally, fishes given painful treatments have been found to choose the unfavorable area containing analgesia compared to the more favorable area containing no analgesia.[23] In contrast, fishes who did not undergo painful treatments spent a majority of their time in the favorable area with no analgesia compared to the unfavorable area with analgesia.[24] Fishes have also been found to have higher levels of cortisol when out of water and they can stay conscious for up to two hours on dry land.[25]

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[13] The Cambridge Declaration on Consciousness, July 7, 2012, http://fcmconference.org/img/CambridgeDeclarationOnConsciousness.pdf.
[14] Ferris Jabr, *It's Official: Fish Feel Pain*, HAKAI (Jan. 2018), https://www.smithsonianmag.com/science-nature/fish-feel-pain-180967764/; Jennifer Jacquet et al., *The Great Fish Pain Debate*, 36 ISSUES IN SCI. & TECH. 49–53 (2020), https://issues.org/the-great-fish-pain-debate/.
[15] Brian Key, *Why Fish Do Not Feel Pain*, 3 ANIMAL SENTIENCE (2016), https://www.wellbeingintlstudiesrepository.org/cgi/viewcontent.cgi?article=1011&context=animsent.
[16] Isabelle Maccio-Hage, *Pain in Fish* (2005), http://www.fair-fish.ch/media/filer_public/c8/41/c841966b-11d3-4673-9476-fbd93c5ab3c6/tmpimport0eseir.pdf; Lynne U. Sneddon, *Pain in Aquatic Animals*, 218 J. OF EXPERIMENTAL BIOLOGY 967–76 (2015), https://www.wellbeingintlstudiesrepository.org/acwp_asie/55/.
[17] Sneddon, *supra* note 16.
[18] *Id.*
[19] Stephen A. Smith & Laura E. Noll, *Testing the Waters: IACUC Issues Associated with Fish*, 50 INST. FOR LAB'Y ANIMAL RSCH. J. 397 (Oct. 2009), https://academic.oup.com/ilarjournal/article/50/4/397/868677.
[20] *Id.*
[21] Sneddon, *supra* note 16.
[22] *Id.*
[23] *Id.*
[24] *Id.*
[25] *Do Fish Feel Pain? Growing Research Says Yes*, HUMANE LEAGUE (Dec. 14, 2020), https://thehumaneleague.org/article/do-fish-feel-pain.

From these studies, it is highly likely that fishes feel pain when either being caught and killed by fishers[26] or raised and slaughtered in aquaculture facilities. Legislatures, fishing industries, and fish farms must contend with these new discoveries and create strategies, employing the precautionary principle, to help minimize pain in fishes when engaging in fishing or farming, or go so far as to stop these practices all together.

ii. Fish Intelligence

Many people still believe fishes do not possess intelligence and therefore justify eating fishes over other land animals. However, many studies have debunked this idea.[27] Fishes have been found to learn from other fishes,[28] possess long working memories,[29] develop complex social structures,[30] and even transmit culture to their young.[31]

The argument that fishes are lesser, unintelligent beings cannot continue to be used as a justification for eating them, especially now that there is scientific evidence to the contrary. Fishes have complex inner and social lives and suffer great harm at the hands of humans. Any industry utilizing fishes needs to be re-examined; this is especially true within the wild-caught fishing and aquaculture industry where the largest proportions of fishes suffer.

iii. Environmental Impacts

Overfishing has caused drastic declines in fish populations and has even led to the extinction of several species.[32] For instance, the Hong Kong Grouper, Knobsnout parrotfish, and Blackspot tuskfish have been declared commercially extinct.[33] Top-predator species including tuna, shark,

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[26] While fishermen is normally used when referring to people who fish, the Clinic intended on using a gender neutral term for this practice.

[27] Joseph Stromberg, *Are Fish Far More Intelligent Than We Realize?*, VOX (Aug. 4, 2014), https://www.vox.com/2014/8/4/5958871/fish-intelligence-smart-research-behavior-pain.

[28] Guppies can learn from other guppies to go through a door to obtain food. Culum Brown & Kevin N. Laland, *Social Learning of a Novel Avoidance Task in the Guppy: Conformity and Social Release*, 64 ANIMAL BEHAVIOUR 41–47 (Jan. 2002), https://www.sciencedirect.com/science/article/abs/pii/S0003347202930216.

[29] Rainbowfish remember how to escape traps they have encountered one year ago. Culum Brown & Kevin Warburton, *Differences in Timidity and Escape Responses Between Prey-naive and Predator-sympatric Rainbowfish Populations*, 105 ETHOLOGY 491–502 (June 1999), https://onlinelibrary.wiley.com/doi/abs/10.1046/j.1439-0310.1999.00442.x.

[30] Rainbowfish can observe attacks between two individuals and the observers of the attack have a preference in later attacking the fish who lost the attack compared to the winner. Mathieu Colleter & Culum Brown, *Personality Traits Predict Hierarchy Rank in Male Rainbowfish Social Groups*, 81 ANIMAL BEHAVIOUR 1231–37 (June 2011), https://www.sciencedirect.com/science/article/abs/pii/S0003347211001084.

[31] French grunts normally migrate out to foraging patches. If a French grunt is transplanted to a different area, they will follow the local French grunts to the foraging patches. However, if a French grunt is transplanted with no other French grunts in the area, the individual will go in the same direction as they would have at home, and subsequently struggle to find foraging areas. Gene Helfman & Eric T. Schultz, *Social Transmission of Behavioural Traditions in Coral Reef Fish*, 32 ANIMAL BEHAVIOUR 379–84 (May 1984), https://www.sciencedirect.com/science/article/abs/pii/S0003347284802729.

[32] *Overfishing*, REVOLUTION, https://therevolutionmovie.com/index.php/open-your-eyes/overfishing/impacts/.

[33] *Id.*

swordfish, cod, and halibut are near extinction with only 10% of their original populations in the oceans today.[34] The loss of top-predators allows smaller fish populations to grow exponentially, which results in drastic changes to the ecosystem.[35] These changes include the depletion of coral coinciding with an increase in algae.[36] Algae overgrowth prevents light and oxygen from reaching plants underneath the water and causes many plant species—along with the animals who rely on these plants for food—to die.[37] Areas with algae overgrowth are termed dead zones because hardly any life exists in these areas.[38]

E. Sustainability

This year's World Aquatic Animal Day focuses on the myth of sustainability in fishing and aquaculture. The United Nations defined sustainability in 1987 as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."[39] However, this definition has some shortcomings because it tends to be read from an anthropocentric lens which fails to consider non-human animals' needs. A broader and more helpful understanding would suggest explicitly considering the interests of non-human animals and the environment to protect future generations of humans and non-human animals alike.

As fish populations become increasingly depleted, alternatives to taking them need to be created to protect the animals and their water habitats from an ecological collapse that will severely impact economies. Companies have begun to move towards what they call sustainably caught fishing methods and aquaculture to meet with the growing demand for seafood products, but these actions do not offer long-lasting solutions to the problem. Often, these are misleading labels that do not reflect truly sustainable operations. It is quite difficult for industrial systems to be sustainable. Ultimately, the demand for seafood must be lowered. Creating an industrialized system of housing fishes to keep up with the demand will only shift resource problems—to eliminate them, whereas plant-based or other alternatives provide a more beneficial path.

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[34] *Id.*
[35] *Id.*
[36] *Id.*
[37] *The Effects: Dead Zones and Harmful Algal Blooms*, ENV'T PROT. AGENCY, https://www.epa.gov/nutrientpollution/effects-dead-zones-and-harmful-algal-blooms.
[38] *Id.*
[39] *Sustainability*, UNITED NATIONS, https://www.un.org/en/academic-impact/sustainability.

PART II: Sustainability Myths in Aquaculture

1. Aquaculture Background

A. Introduction

"Aquaculture is the breeding, rearing, and harvesting of fish, shellfish, algae, and other organisms in all types of water environments."[40] Aquaculture has taken the industrialized practices used within the animal agriculture system and has applied it to the seafood industry.[41] Aquaculture began to grow in the 1990s due to developments in fish breeding, hatchery technology, disease control, and nutrition.[42] Today, aquatic species used in aquaculture include finfishes, crustaceans, mollusks, seaweeds, macrophytes, echinoderms, coelenterates, and seahorses.[43]

As the world's insatiable appetite for seafood increases, and due to the impacts of wild-caught fishing (discussed below), aquaculture is being promoted as the future of producing fishes.[44] Fishes raised in aquaculture systems accounted for 53% of the total seafood consumed by humans in 2016.[45] China has led the movement towards implementing aquaculture practices and accounts for 61.5% of the total aquaculture production.[46]

B. Aquaculture Methods

Aquaculture practices vary depending on the species and type of water in which aquatic animals are raised. Aquaculture practices occur in marine water, freshwater, brackish water, and even in facilities on land. Facilities raise aquatic animals in the middle of the ocean, in protected bays, in manmade ponds, and in indoor facilities.

Confinement methods for aquatic animals used in aquaculture include floating cages, net enclosures, earth ponds, and constant water circulation systems.[47] However, some aquaculture harvesting

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[40] *What Is Aquaculture?*, *supra* note 8.
[41] Conner Bailey & Nhuong Tran, *Aquatic CAFOs: Aquaculture and the Future of Seafood Production*, *in* GLOBAL MEAT SOCIAL AND ENVIRONMENTAL CONSEQUENCES OF THE EXPANDING MEAT INDUSTRY, 55–74 (Bill Winders & Elizabeth Ransom eds., 2019).
[42] *Id.*
[43] Funge-Smith & Phillips, *supra* note 9.
[44] Bailey & Tran, *supra* note 41.
[45] *Id.*
[46] *Id.*
[47] *Id.*

methods do not even require confinement.[48]

Farmers may simply provide equipment to enhance the reproduction and growth of aquatic species naturally.[49] For example, farmers have returned old oyster shells to waters to help encourage new oysters to regenerate in these shells.[50] Another practice is providing ropes, which gives mussels and scallops a place to grow and multiply with little human interference.[51] Because these species are stationary enclosures are not necessary.

In contrast, mobile species, including shrimp and fishes, require enclosures to prevent them from escaping into the wild, and as a result, require supplementary feedings.[52] Floating cages are normally used in choppy waters because they can handle wave movements.[53] However, cages are also used in deep freshwater as an easier alternative to catching free-roaming fishes with nets.[54]

Net enclosures section off large areas of sheltered bays to maintain aquatic animal stocks.[55] However, nets can become corroded, which can lead to frequent and costly repairs as well as environmental pollution.[56] Supplementary feedings are also required under this system.[57]

Earth ponds are manmade structures located in areas with significant tide changes.[58] At high tide, farmers let ocean water in through a floodgate and which is closes once the pond becomes full.[59] Earth ponds can also house freshwater aquatic animals by pumping in water.[60]

Aquatic animals can also be raised indoors by using constant water circulation systems.[61] Constant circulation systems pull in seawater or freshwater and pump it into tanks.[62] The water is either discarded or filtered and recirculated back into the tanks.[63] These types of facilities often function as hatcheries and places to hold broodstock before the animals are transferred to one of the above-mentioned enclosures.[64]

Within the past decade, a newer form of aquaculture has been proposed: integrated multi-trophic

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[48] *Mariculture*, WATER ENCYCLOPEDIA, http://www.waterencyclopedia.com/La-Mi/Mariculture.html.

[49] *Id.*
[50] *Id.*
[51] *Id.*
[52] Bailey & Tran, *supra* note 41.
[53] *Id.*
[54] LaDon Swann, *A Basic Overview of Aquaculture*, N. CENT. REG'L AQUACULTURE CTR. 1–10 (Aug. 1992), https://www.ncrac.org/files/biblio/tb102.pdf.
[55] Bailey & Tran, *supra* note 39.
[56] *Id.*
[57] *Id.*
[58] *Id.*
[59] *Id.*
[60] *Mariculture*, *supra* note 48.
[61] Bailey & Tran, *supra* note 41; Swann, *supra* note 54.
[62] *Mariculture*, *supra* note 48.
[63] *Id.*
[64] *Id.*

aquaculture (IMTA).[65] Under an IMTA system, "multiple aquatic species from different trophic levels are farmed in an integrated fashion to improve efficiency, reduce waste, and provide ecosystem services . . . ."[66] IMTA can occur in bodies of water and on land.[67]

C. Phases of Aquaculture

Four distinct phases of aquaculture exist and producers can engage in just one or all four phases.[68] These phases include: 1) securing and spawning broodstock 2) hatchery production 3) nursing systems, and 4) grow-out systems.[69]

i. Broodstock

The broodstock phase of agriculture involves placing sexually mature aquatic animals in the same enclosure to produce future generations through breeding.[70] Broodstock can be raised within the aquaculture system or taken from the wild upon reaching sexual maturity.[71] Wild capture is the most common practice for broodstock because the maturation and spawning of aquatic animals in captivity can be unreliable.[72] Aquatic animals require changes within the water to trigger breeding behaviors, which can become costly to recreate in captivity.[73] However, broodstock can also be placed in cages, net enclosures, or earthen ponds to assist in naturally triggering these environmental factors to breed.[74]

ii. Hatchery

When eggs are fertilized, they are then moved to flow-through tanks to incubate.[75] The tanks have paddles to circulate the water and aerate the eggs.[76] The eggs usually hatch within five to eight days and remain in the tank until they have grown enough to be transferred into either a nursery pond or grow-out pond.[77] Some hatchery fishes are used for the food system for humans. Others are used as bait fish, or are released into the wild for sport fishing or even conservation purposes.

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[65] *Integrated Multi-Trophic Aquaculture*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/content/integrated-multi-trophic-aquaculture.
[66] *Id.*
[67] *Id.*
[68] Swann, *supra* note 54.
[69] *Id*; Funge-Smith & Phillips, *supra* note 9.
[70] Greg Lutz, *Collecting and Transporting Wild Broodstock: Best Practice*, THE FISH SITE (Mar. 24, 2021), https://thefishsite.com/articles/collecting-and-transporting-wild-broodstock-best-practice.
[71] *Id.*
[72] *Id.*
[73] *Id.*
[74] Sujan Adhikari, *Fish Breeding, Broodstock, Management, Hypophysation, Care and Management*, AGRI SUJAN (Apr. 8, 2018), https://agrisujan.wordpress.com/2018/04/09/fish-breeding-broodstock-management-hypophysation-care-and-management/.
[75] *Production Phases and Systems*, MISS. STATE UNIV., http://extension.msstate.edu/agriculture/catfish/production-phases-and-systems.
[76] *Id.*
[77] *Id.*

iii. Nursing

Juvenile aquatic animals can be transferred to a nursery to help in their maturation.[78] Nurseries tend to be smaller in size and in number of individuals than grow-out ponds.[79] This set-up allows aquatic animals to have a faster maturation period and a higher survival rate.[80]

iv. Grow-out Systems

Grow-out systems hold aquatic animals for the rest of their rearing until they are ready to be sold on the market.[81] Grow-out systems can be placed into three categories: extensive grow-out systems, semi-intensive grow-out systems, and intensive grow-out systems.[82]

Extensive grow-out systems require little care or management.[83] Aquatic animals are able to naturally sustain themselves.[84] This system normally occurs in ponds and produces the smallest amount of aquatic animals.[85] Semi-intensive grow-out systems are usually smaller ponds with more individuals and more care is required compared to extensive-grow out systems.[86] Natural food production still exists within the pond, but supplementary food is also provided.[87] Intensive grow-out systems produce the highest yields of aquatic animals but also require the most care and management.[88] Water quality and aeration are closely supervised.[89]

D. Global Statistics on Aquaculture and Fisheries

The 2018 FAO report noted that in 2016, total global fish production peaked at approximately 171 million tons of animals captured or produced, with aquaculture production accounting for 80 million tons, representing forty-seven percent of total fish production (53 percent if non-food uses are excluded).[90] It is also important to note that so many aquatic animals are killed each year that their individual numbers are not counted, rather most figures measure how many *tons* of animals are produced or killed. At this scale, it is not possible to adequately address the welfare needs of these animals. It is also important to note that these figures do not take into account the numbers of animals killed in illegal, unreported and unregulated fishing, or by pollution, ship strikes, climate change, lack of food, or the other harms these aquatic animals face.

Global aquaculture production (including aquatic plants) in 2016 was 110.2 million

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[78] UNITED NATIONS EDUC., SCI., & CULTURAL ORG., FISHERIES AND AQUACULTURE 39 (Patrick Safran, 4th ed. 2009).
[79] *Id.*
[80] *Id.*
[81] *Id.*
[82] *Id.* at 40.
[83] *Id.*
[84] *Id.*
[85] *Id.*
[86] *Id.*
[87] *Id.*
[88] *Id.*
[89] *Id.*
[90] FOOD & AGRIC. ORG. OF U.N., THE STATE OF WORLD FISHERIES AND AQUACULTURE (2018), http://www.fao.org/3/CA0191EN/CA0191EN.pdf [hereinafter FAO 2018 REPORT].

> tonnes, with the first-sale value estimated at USD 243.5 billion.[91] The total production included 80.0 million tons of food fish (USD 231.6 billion) and 30.1 million tons of aquatic plants (USD 11.7 billion) as well as 37,900 tonnes of non-food products (USD 214.6 million).[92]

In comparison, each year "586 million tons of milk, 124 million tons of poultry, 91 million tons of pork, 59 million tons of cattle and buffalo meat, and 11 million tons of meat from sheep and goats" are produced in the livestock industry.[93] Aquaculture's contribution to global production has been on the rise. In 2000, global production of aquaculture grew by 25.7% while in 2018 it grew 46.0%.[94]

The demand for fish is on the rise. "Per capita food fish consumption has grown from 9.0 kg . . . in 1961 to 20.5 kg in 2018," at an average rate around 1.5 percent per year.[95] To meet this demand countries have continued to increase trade of seafood. In 2018, 38% of fishery and aquaculture production were internationally traded and seafood now makes up 11% of agricultural products traded internationally.[96] Countries are also urging the growth of this sector to meet nutrition and economic goals.

2. The Myth of Sustainable Aquaculture

A. Industry Claims of Sustainable Aquaculture

Proponents continuously claim that aquaculture can help save wild fish populations from further decline and can significantly contribute to feeding the world's growing human population. Aquaculture supporters stress that this production method can keep up with the increasing demand for seafood, but they fail to address why the demand for seafood continues to rise and whether other alternatives can satiate consumers' desires. They also fail to address the stress their production processes put on both wild and raised animal populations.

B. The True Costs of Aquaculture

Aquaculture has serious animal welfare, environmental, consumer, and other consequences.

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[91] *Id.* at 9. According to FAO, the first-sale value, re-estimated with newly available information for some major producing countries, is considerably higher than previous estimates.
[92] *Id.*
[93] Bryan Walsh, *The Triple Whopper Environmental Impact of Global Meat Production*, TIME (Dec. 16, 2013), https://science.time.com/2013/12/16/the-triple-whopper-environmental-impact-of-global-meat-production/.
[94] FOOD & AGRIC. ORG. OF U.N., THE STATE OF WORLD FISHERIES AND AQUACULTURE 6 (2020), https://www.fao.org/3/ca9229en/ca9229en.pdf [hereinafter FAO REPORT 2020].
[95] *Id.* at 3.
[96] *Id.* at 8.

i. Raising Carnivorous Fishes

Although proponents of aquaculture claim that raising fishes in aquaculture facilities creates less need to capture and consume wild fishes, this statement is not true. More wild fishes are caught to help sustain aquaculture practices than would be if they were caught solely for human consumption. Most fishes raised on farms are predators (e.g., tuna, salmon, halibut) so farmers are required to provide smaller fishes to feed to these animals.[97] Fishers will take these smaller fishes, turn them into fish meal, and sell the product to aquaculture producers.[98]

It is estimated that it takes five pounds of ocean fishes to produce one pound of farmed fishes. This is clearly not a reduction in the deaths of wild fishes. Aquaculture producers have also begun to feed fish oil and fish meal to fishes who naturally eat only plants to make them grow faster.[99] The aquaculture industry uses up nearly seventy-percent of the global supply of fish meal and nearly ninety percent of the global supply of fish oil.[100]

Some facilities have begun feeding carnivorous fishes a soy diet with little fish meal or fish oil, but the impacts of a soy-based diet on fishes is largely unknown.[101] So far, studies have found fishes who are fed a soy-based diet have inflamed intestines and have a higher likelihood of hatching female offspring than male offspring.

ii. Accumulation of Toxins

Many chemicals have a high solubility in water, which causes a build-up of toxins and makes life unsustainable. Contaminants from ocean-based facilities—such as fish excrement, uneaten chemical-laden food, antibiotic residue, disease, chemical leaching from sea pens, and swarms of parasites—spread to the surrounding ocean and to free-swimming fishes in the area and have threatened some already threatened populations of wild salmon to the point of extinction.[102]

However, the aquaculture industry has recognized this problem and asserts that it has cut down its therapeutants and antifoulants in the wild by ninety-five percent,[103] but the industry cannot limit the amount of feed or fish excrement produced, which can have detrimental effects on their own. The high concentrations of nitrogen and phosphorous present in fish feed and feces create the perfect environment for algal blooms.[104] Algae can cover large areas on the surface of the water, which

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[97] Kathryn White et al., *At a Crossroads: Will Aquaculture Fulfill Its Promise of the Blue Revolution?*, SEAWEB AQUAULTURE CLEARINGHOUSE 1, 4 (2004), http://mauricoast.com/pics/mauricoastpics/reports_crossroads.pdf.
[98] Sarah Zielinski, *Most Fish Turned into Fishmeal Are Species that We Could Be Eating*, SCI. NEWS (Feb. 27, 2017), https://www.sciencenews.org/blog/wild-things/most-fish-turned-fishmeal-are-species-we-could-be-eating.
[99] *See Fish*, GA. ANIMAL RTS. & PROTECTION, http://www.waterencyclopedia.com/La-Mi/Mariculture.html (analyzing animals used for food).
[100] *Id.*
[101] Zion Lights, *Why Fish Farming Is Unsustainable and Harming the Planet*, ONE GREEN PLANET (2012), https://www.onegreenplanet.org/animalsandnature/why-fish-farming-is-unsustainable-and-harming-the-planet/.
[102] Carol Seals Price & James A. Morris, Jr., *Marine Cage Culture & The Environment*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. 1, 5 (Dec. 2013), https://www.noaa.gov/stories2013/pdfs/2013_PriceandMorris_MarineCageCultureandTheEnvironment(5).pdf.
[103] *Id.*
[104] Brianna Healey et al., *Aquaculture and Its Impact on the Environment*, DEBATING SCI. (Apr. 20, 2016),

prevents light and oxygen from reaching deeper parts of the water.[105] Plants and corals below the water's surface soon begin to die from lack of nutrition and leaves herbivorous fishes without food.[106] Soon, no life besides the algae is present under the water.[107] These areas are termed dead zones, and they have become increasingly common due to anthropogenic causes.[108]

iii. Contaminated Products

Aquaculture producers inject fish feed with powerful chemicals and antibiotics to help fishes survive the diseases caused by severe crowding and filth.[109] The ripple effect is that these chemicals are excreted into water systems and transferred to humans in dangerously high levels when they eat these fishes.[110] In some operations, the levels of chemicals found in farmed fishes are seven times higher than the already-dangerous levels found in their wild counterparts.[111]

In some cases, chemicals are added to fishes to make them more visually appealing to consumers. For example, salmon have artificial coloring added to their feed to change the color of their flesh from their natural gray to pink.[112] As a result humans also ingest those chemicals when they eat farm-raised salmon.[113]

Humans also have the potential of ingesting hormones, such as steroids, that fishes have accumulated while being raised in aquaculture.[114] Aquaculture producers place hormones into enclosures to encourage breeding. These hormones can cause negative effects on humans, especially children. These effects include a higher risk of developing cancer and problems with premature sexual development.

iv. Prevalence of Disease

Because fishes are kept in close, confined enclosures, disease in aquaculture facilities is rampant.[115] New diseases impacting fishes emerge every three to five years.[116] Aquatic pathogens have not been

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https://blogs.umass.edu/natsci397a-eross/aquaculture-and-its-impact-on-the-environment/.

[105] Michael F. Chislock et al., *Eutrophication: Causes, Consequences, and Controls in Aquatic Ecosystems*, NATURE EDUC. (2013), https://www.nature.com/scitable/knowledge/library/eutrophication-causes-consequences-and-controls-in-aquatic-102364466/.

[106] *Id.*

[107] *Id.*

[108] *Id.*

[109] *Id.*

[110] *Id.*

[111] *Id.*

[112] Mike Pomranz, *Your Salmon Might Be Lying to You: Farm-Raised Salmon Isn't Naturally Pink*, FOOD & WINE (Mar. 16, 2015), https://www.foodandwine.com/news/your-salmon-might-be-lying-you-farm-raised-salmon-isn-t-naturally-pink.

[113] *See* Allene Edwards, *Safe Fish and the Fish to Avoid*, ORGANIC LIFESTYLE MAG. (Sept. 11, 2017), http://www.organiclifestylemagazine.com/safe-fish-to-eat-and-the-fish-to-avoid (addressing which fish are safe to eat).

[114] Celia A. Hoga et al., *A Review on the Use of Hormones in Fish Farming: Analytical Methods to Determine Their Residues*, 16 J. of Food 679–691 (2018), https://www.tandfonline.com/doi/full/10.1080/19476337.2018.1475423.

[115] Sarah DeWeerdt, *Cultivating a Sea Change: Can Aquaculture Overcome Its Sustainability Challenges to Feed a Growing Global Population?*, 588 NATURE 60–62 (Dec. 18, 2020).

[116] *Id.*

studied in-depth, so predicting what disease will impact fishes next is nearly impossible.[117] Additionally, scientists do not even understand what causes some of these diseases.[118] For example, ice-ice disease bleaches and subsequently kills seaweed, but scientists are still unsure what is the contributing factor that causes the disease.[119]

To combat the prevalence of disease, facilities use high amounts of antibiotics, which has led to increased microorganisms with antibiotic resistances.[120] These microorganisms then enter the waterways and impact wild fish populations. There is a high likelihood that this antibiotic resistance could then be transferred to human pathogens and thereby impact the effectiveness of human medicines, something that has already resulted from terrestrial factory farming.

v. Environmental Destruction

Creating earthen ponds and enclosures in protected bays destroys habitat and the ecosystems within it.[121] For example, mangroves have been severely impacted by the aquaculture of shrimp.[122] In Malaysia, the government sponsored projects that built shrimp aquaculture facilities and tore down significant portions of the country's mangroves.[123] The government believed these projects would help the economy, but instead the projects lost money because citizens relied on these mangroves for sustenance.[124] Environmental harms are not being sufficiently measured for either the land or water-based facilities and more information needs to be gathered.

vi. Harming Wildlife

Aquaculture practices can also harm wild fishes in a number of ways, especially systems using net enclosures. Many predators become attracted to these large aggregations of fishes and subsequently get entangled in the nets.[125]Predators include birds, seals, and other fishes.[126] Farmers will harass these animals or even kill them to keep their fish stocks safe.[127] Farmers have frequently used devices that emit loud noises into the water, which can cause disorientation, pain, or hearing loss in aquatic animals.[128] Additionally, the pollution from these enclosures harms the wildlife for miles around.

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[117] *Id.*
[118] *Id.*
[119] *Id.*
[120] Pathmalal M. Manage, *Heavy Use of Antibiotics in Aquaculture: Emerging Human and Animal Health Problems—A Review*, 23 SRI LANKA J. AQUATIC SCI. 13–27 (2018).
[121] Michael Souza, *Problems Inherent to Aquaculture*, TREEHUGGER (Aug. 22, 2019), https://www.treehugger.com/aquaculture-problems-inherent-to-aquaculture-1301970.
[122] *Id.*
[123] *Id.*
[124] *Id.*
[125] Rebecca J. Goldburg et al., *Marine Aquaculture in the United States*, PEW OCEANS COMM'N 1, 18 (2021), https://www.iatp.org/sites/default/files/Marine_Aquaculture_in_the_United_States_Enviro.pdf.
[126] *Id.*
[127] *Id.*
[128] *Id.*

vii. Fishes Escaping Captivity

Fishes can escape from captivity and cause harm to wild or native fish populations. Escapee fishes who are not endemic to the aquaculture site's location can wreak havoc on the local ecosystem. For example, Asian carp were used to limit the amount of algae, weed, and parasite growth in aquatic farms since the 1970s.[129] Eventually, some of these carp escaped into the Mississippi River and have rapidly increased their population size.[130] Because Asian carp have no natural predators in the river, they are uninhibited from growing and out-competing the native fishes.[131] Silver carp in particular pose a problem by threatening the safety of boaters.[132] When silver carp feel threatened, they jump out of the water to escape predators.[133] This behavior occurs whenever boats pass by, and as a result, carp have injured boaters and fishers and damaged boats and equipment.[134] Carp have upset the fishing industry within the Mississippi River and could soon impact the fishing industry and ecosystem of the Great Lakes.[135] In these conversations, as in so many others, the welfare of the carp themselves are not considered.

Domesticated fishes raised in aquaculture systems within their native waters can also create detrimental impacts by inter-breeding or spreading diseases and parasites to their wild counterparts.[136] Domesticated fishes often possess maladaptive traits to survival in the wild.[137] When these domesticated fishes escape, they can breed with wild fishes and pass these traits to their offspring causing even smaller population sizes.[138] Escaped farmed Atlantic salmon (Salmo salar) are a particular problem and may threaten endangered wild Atlantic salmon in the Pacific Northwest.[139]

viii. Negative Impact on Economies

Multinational corporations have increasingly controlled the aquaculture industry.[140] The corporations generally promise job opportunities if countries create aquaculture facilities in the region.[141] Countries that accept this offer hope to expand their economies, but often find that corporations instead exploit workers, pollute waterways, and destroy habitats.[142] Corporations generally take the profits from their aquatic production[143] rather than investing in their host countries.[144]

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[129] *Asian Carp Overview*, NAT'L PARK SERV. U.S. DEP'T OF INTERIOR (June 24, 2019), https://www.nps.gov/miss/learn/nature/ascarpover.htm.
[130] *Id.*
[131] *Id.*
[132] *Id.*
[133] *Id.*
[134] *Id.*
[135] *Id.*
[136] Brendan F. Wringe et al., *Extensive Hybridization Following a Large Escape of Domesticated Atlantic Salmon in the Norwest Atlantic*, 1 COMMC'N BIOLOGY 108 (Aug. 9, 2018), https://www.nature.com/articles/s42003-018-0112-9#citeas.
[137] *Id.*
[138] *Id.*
[139] Goldburg et al., *supra* note 125.
[140] White et al., *supra* note 97, at 7.
[141] *Id.*
[142] *Id.*
[143] *Id.*
[144] *Id.*

Corporations also fail to uphold their promises of giving jobs to citizens.[145] In the 1990s, corporations exploited the cheap labor within Chile and built salmon farms.[146] Salmon prices then drastically dropped and caused fishers all across the Pacific Coast of North America to lose money or even go out of business.[147] Norway has also found that the number of employment opportunities within its booming fishing sector declined.[148] Even though the salmon production in Norway's hatcheries from 1994 to 2000 has doubled, the number of employees declined by 18 percent.[149] The U.S. has faced similar declines. In Alaska, salmon fishers declined from 10,487 to 6,567 within 12 years.[150]

ix. Lack of Fish Welfare

Fish farming is a business and thus driven by profit. As such, facilities use very high stocking densities. Consequently, as the animals grow, they are severely crowded often resulting in injury, inability to access food, and increased susceptibility to disease.[151] Through such practices, fishes are also deprived of space to swim freely and utilize their senses.[152] They rub against the walls of the enclosures and on each other inevitably suffering physical injuries or harm. In most of the facilities, small fishes are bullied and killed by larger ones or prevented from eating. To prevent fighting, workers at these facilities need to regularly sort the fishes to make sure that the faster-growing ones are moved to a more appropriately sized groupings.[153] The transfer process is physically damaging, causing scrapes the protective scales of the fishes, thus leaving them even more vulnerable to diseases.[154]

Additionally, lice eat at the fishes and cause their scales to fall off creating large sores. In severely crowded conditions, these parasites often eat down to the bone on fishes' faces, resulting in what is termed a "death crown."[155]

These conditions are responsible for death, diseases, and deformities in fishes that are produced through aquaculture.[156] It has been reported that fifty percent of the world's farmed fishes suffer from hearing loss[157]—just one of the conditions that continue to go unaddressed.

x. Fish Slaughter

Scientific research has established that slaughter methods and techniques currently used on farmed

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[145] *Id.*
[146] *Id.*
[147] *Id.*
[148] *Id.*
[149] *Id.*
[150] *Id.*
[151] *Fish Farming*, ANIMAL WELFARE INST., https://awionline.org/content/fish-farming.
[152] The five freedoms are (1) freedom from hunger and thirst, (2) freedom from discomfort, (3) freedom from pain injury and disease, (4) freedom to express normal behavior, and (5) freedom from fear and distress.
[153] *See Fish*, *supra* note 99 (analyzing animals used for food).
[154] *Id.*
[155] Edwards, *supra* note 113.
[156] University of Melbourne, *Hear No Evil: Farmed Fish Found to Be Hard of Hearing*, SCI. DAILY (Apr. 28, 2016), https://www.sciencedaily.com/releases/2016/04/160428094451.html.
[157] *Id.*

fishes are inhumane, including gill-cutting without prior stunning, asphyxiation in air or on ice, carbon-dioxide stunning, and live chilling.[158] The process of harvesting farmed fishes usually comprises three stages: a period of food withdrawal to empty the gut; the collection and movement of the fishes to the point of slaughter; and the process of stunning and killing.[159] The impact of these processes on the welfare of the fishes varies significantly with the species, the methods used, and the care and attention to detail applied throughout.[160]

Each of the above processes has its own impact. Starvation for example, lowers the fishes' metabolic activity, which reduces the rate at which ammonia and carbon dioxide build up in the water during transportation.[161] It also prevents fecal contamination during processing, which can shorten the shelf life of the fishes.[162] The duration of fasting necessary to empty the gut is species- and water-temperature-dependent but may be expected to be from one to five days.[163] Others indicate that the duration of starvation ranges from one to ten days.[164] Fish gathering and transportation on the other hand involve crowding, which results in suffocation, even before the fishes are delivered to the slaughter.[165]

In some cases, nearly forty percent of farmed fishes die before slaughter.[166] There is little regulation anywhere in the world that addresses the welfare and treatment of aquatic animals in aquaculture facilities during breeding, rearing, transportation or slaughter. In the United States, there is no regulation to ensure the humane treatment of fishes and there is also insufficient information about how fishes raised on farms are slaughtered; these are issues that need to be addressed.

C. Moving Past Aquaculture

Although the aquaculture industry claims to have addressed and mitigated the impacts of the previously mentioned problems,[167] those claims are very much contested, and clearly the industry has still failed to address the horrible welfare conditions of aquatic animals. The poor treatment of aquatic animals is not improved because it would increase the costs to the facilities. Thus, aquaculture will always fail to achieve sustainability. Technology can make moderate improvements, for instance by creating new ways of feeding carnivorous fishes a plant-based diet (which may solve one problem and create another), using fewer antibiotics and additives, limiting the amount of effluent released into waterways, destroying less land, creating new enclosures that decrease the likelihood of

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[158] Stephanie Yue, *An HSUS Report: The Welfare of Farmed Fish at Slaughter*, HUMANE SOC'Y OF U.S., http://www.humanesociety.org/assets/pdfs/farm/hsus-the-welfare-of-farmed-fish-at-slaughter.pdf.
[159] J.A. Lines & J. Spence, *Humane Harvesting and Slaughter of Farmed Fish*, 33 REVUE SCIENTIFIQUE ET TECHNIQUE 255 (2014), https://pdfs.semanticscholar.org/bc54/9627077e8876bbaf69928f644295c3a452d7.pdf.
[160] *Id.*
[161] M. Jobling, *The Influences of Feeding on the Metabolic Rate of Fishes: A Short Review*, 18 J. FISH BIOLOGY 385 (1995) https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1095-8649.1981.tb03780.x.
[162] A.J. Wall, *Ethical Considerations in the Handling and Slaughter of Farmed Fish*, *in* FARMED FISH QUALITY 108–115 (Steve C. Kestin & Paul D. Warris eds., 2001).
[163] *Id.*
[164] *Id.*
[165] *See* Lines & Spence, *supra* note 159 (addressing the slaughter of farmed fish).
[166] *See Fish*, *supra* note 99 (analyzing animals used for food).
[167] Claude E. Boyd et al., *Achieving Sustainable Aquaculture: Historical and Current Perspectives and Future Needs and Challenges*, 51 J. OF THE WORLD AQUACULTURE SOC'Y 578–633 (2020).

escapees. However, the welfare of aquatic animals cannot be enhanced while maintaining industry profitability and using them as resources.

Instead of focusing on ways to expand aquaculture, governments should find ways to invest in providing and encouraging citizens to eat alternatives. Many companies producing plant-based meat and seafood alternatives have increased in popularity over the past five years.[168] These plant-based seafood products are sold in grocery stores across the U.S.[169] Many of these products are also being tested in Asian and European markets.[170] Companies are also working to create fermentation-based seafood alternatives as well as products that use cells from animals but do not require raising and killing animals.

Aquaculture facilities can also transition to farming aquatic plants instead of raising fishes. Kelp, seaweed, and sea cucumbers all absorb pollution and have a large market in Asian countries.[171] Initiatives can be made to expand the popularity in aquatic plants and find ways to incorporate these plants into the daily diets of people around the world. This transition could still sustain profits and not detrimentally impact aquaculture producers and is already beginning to happen.

[168] Alexis Benveniste, *Plant-Based Meat Was All the Rage. Now Plant-Based Seafood Is Taking the* Spotlight, CNN (Oct. 4, 2021), https://www.cnn.com/2021/10/02/business/plant-based-fish/index.html.
[169] *Id.*
[170] *Id.*
[171] DeWeerdt, *supra* note 115.

PART III: Sustainability Myths in Wild Caught Fishing

1. Overview

This section of the Resource Packet outlines current wild-caught fishing trends, case studies, and sustainability. It is meant to serve as a compilation of relevant resources and as a guide. There is a wide array of additional issues that is beyond the scope of this resource packet. This resource packet does not address all problems related to wild-caught fishing including, but not limited to, worker's rights,[172] human trafficking and slavery,[173] indigenous fishing treaty rights,[174] and environmental justice issues,[175] which are all important issues that are addressed elsewhere.

The National Oceanic and Atmospheric Administration (NOAA) fisheries oversees federal, regional, state, and territorial partners to ensure the sustainable management of United States fisheries.[176] Most marine fishery regulations implemented in federal waters (generally from 3 to 200 nautical miles from shore) are developed under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) in conjunction with the eight regional fishery management councils in the U.S.[177] The MSA is the primary law that governs marine fisheries management in U.S. federal waters.[178]

NOAA estimates that between 70% and 85% of seafood consumed in the United States is imported.[179] The U.S. mainly imports seafood from China, Thailand, Canada, Indonesia, Vietnam,

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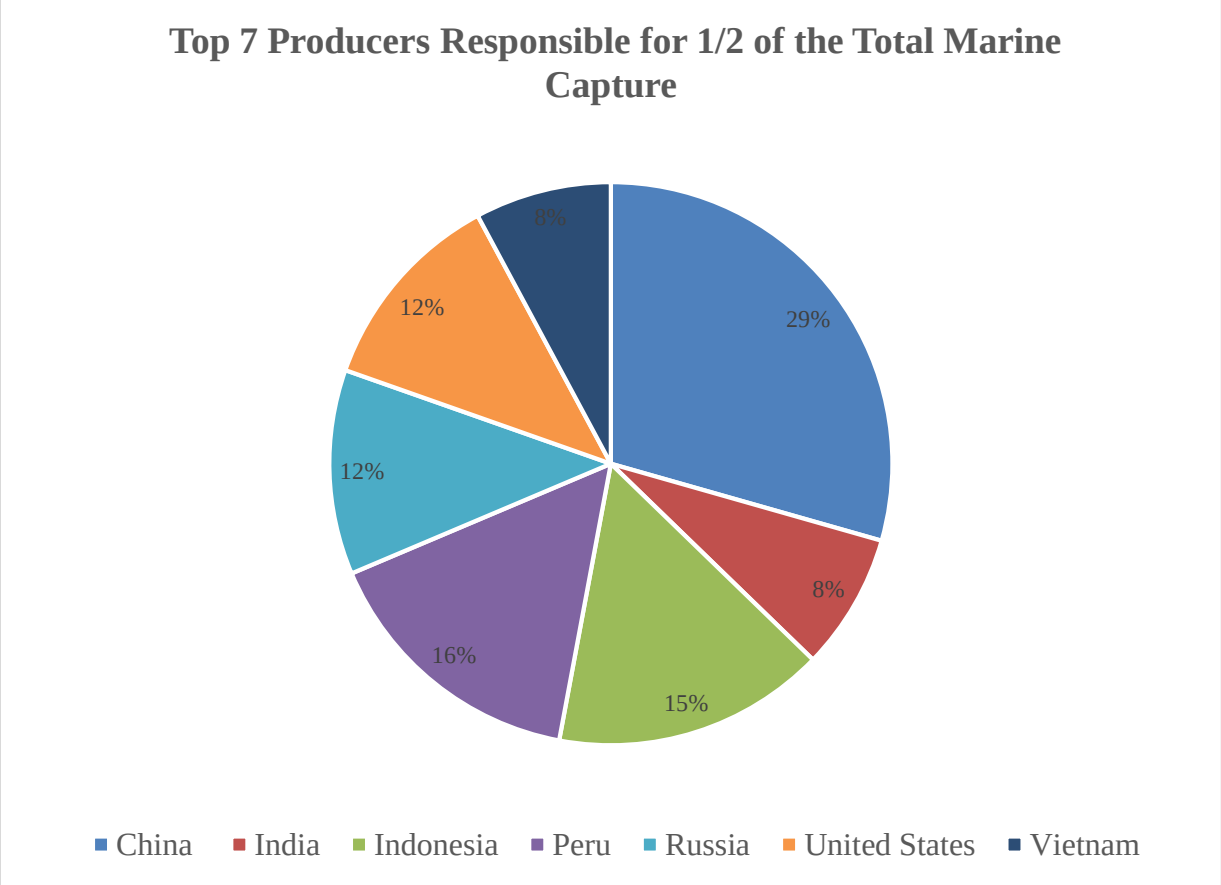
[172] *See* Faith Waithera Ngaruiya et al., *Occupational Health Risks and Hazards Among the Fisherfolk in Kampi Samaki, Lake Baringo, Kenya*, 13 ENV'T. HEALTH INSIGHTS 1 (2019); *see* Zakia A. M. Ahmed et al., *Review Article; Occupational Hazards in Fish Industry*, 4 WORLD J. OF FISH & MARINE SCI. 201 (2012).
[173] *See* TREVOR SUTTON & AVERY SICILIANO, CTR. FOR AM. PROGRESS, SEAFOOD SLAVERY: HUMAN TRAFFICKING IN THE INTERNATIONAL FISHING INDUSTRY (2016); *see* HUMAN RIGHTS WATCH, HIDDEN CHAINS: RIGHTS ABUSES AND FORCED LABOR IN THAILAND'S FISHING INDUSTRY (2018); *see generally* BUS. & HUMAN RIGHTS RES. CTR., ALL AT SEA: AN EVALUATION OF COMPANY EFFORTS TO ADDRESS MODERN SLAVERY IN PACIFIC SUPPLY CHAINS OF CANNED TUNA (2021).
[174] *See* Gabriel Chrisman, *The Fish-in Protests at Franks Landing*, THE SEATTLE CIVIL RIGHTS & LABOR HISTORY PROJECT, https://depts.washington.edu/civilr/fish-ins.htm (2008).
[175] *See* NAT'L ENV'T JUST. ADVISORY COUNCIL, FISH CONSUMPTION AND ENVIRONMENTAL JUSTICE (2002).
[176] *Our Partners*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/insight/our-partners (last visited Nov. 28, 2021).
[177] *Id*.
[178] *Laws & Policies: Magnuson-Stevens Act*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/topic/laws-policies (last visited Nov. 28, 2021).
[179] *U.S. Aquaculture*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/aquaculture/us-aquaculture (July 8, 2021).

and Ecuador.[180] The United Nations Food and Agricultural Organization (FAO) reported that in 2018, the total global capture fisheries production reached the highest level ever recorded at 96.4 million tons, an increase of 5.4% from the average of the previous three years.[181] In 2017, among FAO's major fishing areas, the Mediterranean and the Black Sea had the highest percentage at 62.5% of stocks fished at unsustainable levels, followed by the Southeast Pacific at 54.5%, and Southwest Atlantic at 53.3%.[182] Other areas varied between 13% and 44%.[183] In 2018, the top seven producers were responsible for over 50% of the total marine captures:[184]



Small scale farming of aquatic animals or plants has been practiced for over 2,000 years.[185] Large-scale, intensive farming between 1980 and 2000 grew significantly with production increasing

[180] *Sustainable Seafood*, FISHWATCH, https://www.fishwatch.gov/sustainable-seafood/the-global-picture (last visited Nov. 23, 2021).
[181] FOOD & AGRIC. ORG. OF THE U.N., THE STATE OF WORLD FISHERIES AND AQUACULTURE: SUSTAINABILITY IN ACTION 7 (2020) [hereinafter FAO, SUSTAINABILITY IN ACTION].
[182] *Id*. at 7-8. *supra* note 94.
[183] *Id*. at 8.
[184] *Id*. at 10.
[185] CHANGING MKT. FOUND. & COMPASSION IN WORLD FARMING, UNTIL THE SEAS RUN DRY: HOW INDUSTRIAL AQUACULTURE IS PLUNDERING THE OCEANS 19 (2019).

sevenfold and doubling again between 2000 and 2012.[186] It is estimated that globally—between 2007 and 2016—0.79 to 2.3 trillion fishes were caught and killed each year.[187] No other global sector removes a comparable volume of wild animals from any natural habitat on earth. This estimate does not account for sports fishing, unrecorded fisheries captures, fishes caught by lost and discarded fishing gears, fishes caught for use as feed, or fishes that have escaped from fishing gear but have become fatally stressed or injured in the process.[188] Nor does it take into account animals killed from illegal, unreported and unregulated fishing, or from pollution, ship strikes or other harms. Based on the FAO's long-term monitoring of the marine fish stocks, marine fishery resources have continued to decline to the point that the proportion of fish stocks that are within the biologically sustainable levels has decreased from 90% in 1974 to 66% in 2017, with 60% classified as being maximally sustainably fished stocks and 6% underfished stocks.[189]

"Exploitive fishing" is a phrase used to describe unsustainable fishing practices that damage the long-term health of fishery resources for the sake of profit.[190] Exploitive fishing includes overfishing and destructive fishing. Population and economic growth, together with urbanization, technological developments, and dietary diversification, are expected to expand food demand, particularly for animal products, including fishes.[191] The FAO estimates that 85% of marine fish stocks are either fully exploited or overfished.[192]

Fisheries are considered fully exploited when a stock is fished to the maximum and an increase in the catch is not possible. Overfishing occurs when too many fishes or marine animals are caught at once. The remaining populations cannot sufficiently reproduce and recover.[193] Fishes are underpopulated in the overfished areas, which creates imbalance in the surrounding ecosystem.[194] Overfishing is often associated with commercial wild-caught fishing companies.[195] In 2012, 4,714 fisheries were assessed. Of those fisheries, 32% were at the level that supports a maximum sustainable yield.[196] Only one-third of fisheries are fished at levels that allow fishes to repopulate.[197]

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[186] *Id*.
[187] *Number of Fish Caught from the Wild Each Year*, FISH COUNT, http://fishcount.org.uk/fish-count-estimates-2/numbers-of-fish-caught-from-the-wild-each-year (last visited Nov. 23, 2021).
[188] A. Mood & P. Brooke, *Estimating the Number of Fish Caught in Global Fishing Each Year*, FISH COUNT (July 2010), http://fishcount.org.uk/published/std/fishcountstudy.pdf.
[189] FAO, SUSTAINABILITY IN ACTION, *supra* note 181.
[190] THE CORAL REEF ALL., CORAL REEFS & EXPLOITIVE FISHING 1 (2005).
[191] FAO, SUSTAINABILITY IN ACTION, *supra* note 181, at 164.
[192] WORLD WILDLIFE FOUND., *Sustainable Seafood*, https://www.worldwildlife.org/industries/sustainable-seafood (last visited Nov. 23, 2021).
[193] Calen Otto, *Overfishing Was Bad for Marine Life. Now It's Getting Worse.*, SENTIENT MEDIA (Oct. 29, 2021), https://sentientmedia.org/how-does-overfishing-affect-the-environment/.
[194] *Id*.
[195] *Id*.
[196] Boris Worm, *Averting a Global Fisheries Disaster*, 113 PNAS 4895, 4895 (2016).
[197] *Id*.

Destructive fishing refers to any type of fishing method that destroys the fish habitat.[198] The two most common forms are dynamite (or "blast") and poison (or "cyanide") fishing.[199] As the name may suggest, dynamite fishing is a method where dynamite or homemade bombs are used to stun or kill fishes for easy collection. Poison fishing is generally used to capture fishes for aquariums.

Another issue that pertains to wild-caught fishing is illegal, unreported, and unregulated (IUU) fishing. IUU fishing is a broad term that includes fishing without a license, not reporting or misreporting catches, fishing in prohibited areas, catching or selling prohibited species, and fishing in areas not covered by a regulatory framework.[200] IUU fishing contributes to the overexploitation of fish stocks and hinders the recovery of fish populations and ecosystems.[201] IUU fishing is a particularly important issue because it is estimated to account for 20% to 30% of the global catch.[202] When fishers use prohibited gear, take unauthorized species, catch excessive numbers of animals, fish out of season, misreport catch quantities, or operate in vulnerable and protected areas, their actions threaten the sustainability of resources and damage fragile habitats and ecosystems.

2. What is Happening Now?

This portion of the Resource Packet outlines current wild-caught fishing trends, case studies, ways in which the term 'sustainability' is being used.

A. Fishing Methods

Current fishing methods have a massive impact on aquatic animals and their habitats. There are also significant problems with bycatch and faulty gear. Fishing methods vary in different locations and cultures, and the precise impacts of each method are dependent on the robustness of the management and techniques used on individual boats. The main commercial capture methods are described here to help one broadly understand the ways in which wild fishes are caught.

Fishing Methods	Type	Description	Target Species
Purse Seine	Net	A long wall of netting framed with a float line and lead line with purse rings hanging from the lower edge, through which runs a purse line made from steel	Schooling pelagic fish of

[198] THE CORAL REEF ALL., CORAL REEFS & EXPLOITIVE FISHING *supra* note 190.
[199] *Id.*
[200] *Illegal, Unreported and Unregulated (IUU) Fishing*, FOOD & AGRIC. ORG. OF THE U.N., https://www.fao.org/iuu-fishing/fight-iuu-fishing/en/ (last visited Nov. 23, 2021).
[201] David J. Agnew et al., *Estimating the Worldwide Extent of Illegal Fishing*, PLOS ONE (Feb. 25, 2009).
[202] Ganapathiraju Pramod et al., *Estimates of Illegal and Unreported Fish in Seafood Imports to the USA*, 48 MARINE POL'Y 102, 102 (2014).

		wire or rope which allow the pursing of the net.[203] The bottom of the net is drawn together to enclose the fish, similar to tightening the strings of a drawstring purse.[204]	all sizes; Squid.[205]
Bottom Trawl	Net	Floats are attached to the top of the trawl opening, while weights and special gear are connected to the footrope, bottom of the trawl opening, to keep the net open as it moves through the water across the ocean floor.[206] The mesh is designed to confine fish inside the net, trapping them in the cod-end (the rearmost part of the trawl) as the trawl is hauled to the surface and a sweep is attached to the net's footrope collects marine animals as they lay on the bottom or gather by the trawl opening.[207]	Whiting; Red hake; Dogfish; Crab; Shrimp; Flounder.[208]
Pelagic (Midwater) Trawl	Net	Generally much larger than bottom trawls and can be towed by one or two boats.[209] They are designed to target fish in the mid and surface water. Acoustic technology is used to locate the position and depth of the target fish, and the path of the boats and trawls are adjusted accordingly.[210]	Large tunas; Swordfish; Billfish; Dolphinfish; Herring; Hoki; Mackerel.[211]
Skimmer Trawl	Net	Skimmer trawls are fished from booms on either side of the vessel, while nets remain in the fishing configuration while the cod-end is emptied about every half hour, allowing fishermen to quickly retrieve the catch.[212] A chained footrope and the tickler chain are used to stir up the bottom and raise the catch into nets.[213]	Shrimp.[214]
Gillnet	Net	Wall or curtain of netting that hangs in the water, typically made of monofilament or multifilament nylon, which is practically invisible to fish attempting	Salmon; Cod; Haddock; Pollock; Flounder; Hake;

[203] *Fishing Gear Types: Purse Seines*, FOOD & AGRIC. ORG. OF THE U.N., https://www.fao.org/fishery/geartype/249/en (last visited Nov. 23, 2021).
[204] *Id.*
[205] *Id.*
[206] *Fishing Gear: Bottom Trawls*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-bottom-trawls (June 1, 2021).
[207] *Id.*
[208] *Id.*
[209] *Pelagic Trawl*, MARINE STEWARDSHIP COUNCIL, https://www.msc.org/what-we-are-doing/our-approach/fishing-methods-and-gear-types/pelagic-trawls (last visited Nov. 23, 2021).
[210] *Id.*
[211] *Fishing Gear: Midwater Trawls*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-midwater-trawls (June 1, 2021).
[212] *Fishing Gear: Skimmer Trawls*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-skimmer-trawls (June 1, 2021).
[213] *Id.*
[214] *Id.*

		to swim by. [215] Mesh sizes allow fish to get only their head through the netting but not their body and the fish's gills get caught in the mesh as the fish tries to back out of the net. [216] As the fish struggles to free itself, it becomes more and more entangled.	Barracuda; Herring; Mullet; Rockfish; Seabass; Shad; Sharks; Sturgeon; Swordfish; Tuna.[217]
Pound Net	Net	Fence leader that interrupts the movements of target species and a heart that funnels fish into the trap (pound) via a mesh tunnel. [218] The netting usually reaches above the waterline with the pound open at the surface. [219]	Bluefish; Catfish; Menhaden; Flounder.[220]
Pelagic (Midwater) Longline	Line	A long line behind a boat that baited hooks (most commonly j-hooks and circle hooks) are attached to with nets at intervals to attract the target species.[221] The longline set can be suspended at any depth within the water column, depending on the target species.[222] The average U.S. longline set is 28 miles long.[223]	Tuna; Swordfish; Other Pacific billfish.[224]
Demersal (Bottom) Longline	Line	Consists of a mainline weighted to the seafloor with buoy lines marked by flags on either end, called highflyers. [225] Leaders, called gangions or snoods, with baited hooks, are attached to the mainline and a longline set which can have up to a thousand baited hooks and, once deployed, can soak anywhere from hours to days. [226]	Sharks; Halibut; Cod; Flounder; Sole; Other groundfish.[227]
Pole and Line Fishing	Line	This method is used to catch one fish at a time. When a school of target fish is located, water is sprayed from the back of the fishing vessel and small baitfish are	Tuna; Other large pelagic species.[230]

[215] *Fishing Gear: Gillnets*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-gillnets (Feb. 22, 2021).
[216] *Id.*
[217] *Id.*
[218] *Fishing Gear: Pound Nets*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-pound-nets (Feb. 12, 2019).
[219] *Id.*
[220] *Id.*
[221] Longlines, MARINE STEWARDSHIP COUNCIL, https://www.msc.org/what-we-are-doing/our-approach/fishing-methods-and-gear-types/longlines (last visited Nov. 25, 2021).
[222] *Fishing Gear: Pelagic Longlines*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-pelagic-longlines (May 9, 2019).
[223] *Id.*
[224] *Id.*
[225] *Fishing Gear: Bottom Longlines*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-bottom-longlines (July 23, 2019).
[226] *Id.*
[227] *Id.*
[230] *Id.*

		scattered onto the water's surface, creating the illusion of an active school of prey fish. [228] Fishers line up along the back of a fishing vessel, each with a hand-held pole with a short line and barbless hook attached. [229]	
Dredging	Other	Dredging is similar to bottom trawling. Instead of a net, a metal rake is dragged across the seafloor, scrapping or penetrating the bottom to collect target species. [231] Scraping dredges collect animals in the top layer of seafloor sediment with rakes that scoop the substrate and penetrating dredges use pressurized water jets to chase animals from beneath muddy or rocky bottom substrate and into the collection bag. [232]	Oysters; Scallops; Clams; Mussels; Crabs; Sea Urchins; Sea Cucumbers; Conch[233]
Fish Aggregating Device (FAD)	Other	FADs are floating objects that are designed and placed to attract pelagic fish. [234] Ropes and lines encourage the settlement of marine plants and small crustaceans and mollusks, attracting small fish. [235] Fishfinders may be attached to a FAD allowing fishermen to electronically connect to the FAD and see how many and at what depth the fish are located. [236]	Tuna; Billfish; Dolphinfish.[237]
Traps and Pots	Other	Stationary and typically made from wood, wire netting, or plastic, are used to catch crustaceans. [238] All feature a cone-shaped entrance tunnel through which a crab or lobster is enticed with bait but cannot escape. [239] Traps are deployed on the seabed for around 24 hours before being hauled aboard a boat for harvesting and re-baiting. [240]	Crab; Lobster; Whelk; Scup; Black Sea Bass; Eels; Langoustines; Octopus.[241]

An important aspect of fishing to consider is how the animals are killed. The Humane Slaughter Act is a United States federal law designed to decrease the suffering of livestock during

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[228] *Pole and Line*, MARINE STEWARDSHIP COUNCIL, https://www.msc.org/en-us/what-we-are-doing/our-approach/fishing-methods-gear-types/pole-and-line (last visited Nov. 25, 2021).
[229] *Id*.
[231] *Fishing Gear: Dredges*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-dredges (Aug. 6, 2018).
[232] *Id*.
[233] *Id*.
[234] *Fishing Gear: Fish Aggregating Device*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-fish-aggregating-devices (Nov. 30, 2017).
[235] *Id*.
[236] *Id*.
[237] *Id*.
[238] *Pots and Traps*, MARINE STEWARDSHIP COUNCIL, https://www.msc.org/what-we-are-doing/our-approach/fishing-methods-and-gear-types/pots-and-traps (last visited Nov. 15, 2021).
[239] *Id*.
[240] *Fishing Gear: Traps and Pots*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-traps-and-pots (Mar. 14, 2019).
[241] *Id*.

slaughter.[242] Fishes are not covered by the Humane Slaughter Act[243] and there is little regulation anywhere in the world addressing how these animals are killed. Wild-caught fishes are currently slaughtered in ways that do not meet humane slaughter standards.[244]

Numerous methods are used to slaughter wild-caught fishes. Most wild-caught fishes are left to suffocate in the air as they desperately try to escape while their gills collapse which prevents them from breathing.[245] Another process is evisceration, in which the fishes' internal organs are removed, excluding the brain and gills.[246] This is usually done without prior stunning.[247] Sometimes fishes are put into ice water in a process called chilling. Chilling has been shown to be extremely stressful for fishes and may lead them to try to violently escape and may also cause them to suffer for a longer period of time.[248] Tuna, swordfish, and other larger animals, are often clubbed to death leading the animals to lose and regain consciousness causing the process to have to be repeated several times.[249]

B. Bycatch

Bycatch is a generic term referring to catch that is incidental to the target species.[250] For purposes of this resource packet, we refer to the term 'bycatch' as the incidental capture of non-target species, including non-target fishes, seabirds, marine mammals, and sea turtles. The term is sometimes used interchangeably for the unwanted portion of the catch that is discarded and can refer to the less desirable fishes that are landed.[251] Wherever there is wild-caught fishing, there is bycatch. While estimates of bycatch are variable due to the difficulty of obtaining accurate data, some sources approximate that 40% (38.5 million tons) of all animals caught in fisheries are discarded as trash.[252] Much of this catch is thrown overboard either dead or dying due to contact with fishing gear, handling upon the fishing vessel, and the general shock from capture and removal from water.[253] Modern fishing gear, often undetectable by sight and manufactured to be extremely strong, are efficient at catching the desired fish species but they also catch everything else that comes in their path. Much of the fishing industry targets specific species for capture, but other animals become hooked or trapped when attracted to the bait or target catch. Some animals are simply unable to avoid

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[242] *See generally* Humane Methods of Slaughter Act, S. 3092, 95th Cong. (1978).
[243] *Id*.
[244] Mood & Brooke, *supra* note 188.
[245] *The Deadly Fish Industry*, ANIMAL EQUAL., https://animalequality.org/issues/fish/ (last visited Nov. 23, 2021).
[246] *Glossary: Eviscerated Fish*, CABI, https://www.cabi.org/isc/glossary/94626 (Dec. 13, 2006).
[247] *Humane Slaughter*, FISH COUNT, http://fishcount.org.uk/fish-welfare-in-commercial-fishing/humane-slaughter (last visited Nov. 23, 2021).
[248] *Id*.
[249] *The Deadly Fish Industry*, *supra* note 245.
[250] Ivor Clucas, *A Study of the Options for Utilization of Bycatch and Discards from Marine Capture Fisheries*, FOOD & AGRIC. ORG. OF THE U.N., https://www.fao.org/3/w6602e/w6602E03.htm (Oct. 1997).
[251] *Id*.
[252] *See* R. W. D. Davies, *Defining and Estimating Global Marine Fisheries Bycatch*, 33 MARINE POL'Y 661 (2009).
[253] KARLY KELSO & NICOLE SARTO, ENV'T DEF. FUND, ELIMINATING DISCARDS 1 (2018).

capture or entanglement in fishing gear. [254] Some people have argued that bycatch is an acceptable and unavoidable consequence necessary to supply the world with wild-caught seafood.[255] Others, including the Consortium for Wildlife Bycatch Reduction argue that the benefits do not outweigh the bycatch costs:

> ...too often the scale of mortality is so high that it threatens the very survival of species and their environments. Every year, at least 7.3 million tons of marine life are caught incidentally. In some fisheries, the percentage of bycatch far outweighs the amount of target catch. For example, for every shrimp caught by nets dragged behind trawls in the Gulf of Mexico, over four times its weight is bycatch. [256]

New technology has been introduced that aims to reduce bycatch. These bycatch reduction devices include turtle excluder devices, metallic repellents (used to repel sharks and rays), trap net modifications, artificial illumination (may decrease bycatch of endangered chinook salmon), and revival boxes.[257] Despite these new technologies, bycatch is still a significant problem. Not only does it cause avoidable deaths and injuries, but the fishing methods used can be harmful to the marine environments where they are employed and can lead to even more incidental deaths than are calculated because of additional habitat damage.

Below is a discussion of the incidental catch of non-target fishes (discards), seabirds, sea turtles, and marine mammals caused by current wild-caught fishing practices.

i. Discards

Bycatch often will result in throwing unwanted fishes and other aquatic animals back into the water. The animals they throw back are called discards. Discards can be dead or alive, but the survival rate is low. Some hardy shellfish might survive, but most discarded fishes are already dead when thrown back. An estimated 9.1 million tons are discarded or 10.8% of the global catch.[258] Ninety-three percent of discards come from industrial fishing.[259] Bottom trawling has the highest discard rate; twenty-one percent of catch from bottom trawls is discarded.[260] Some forms are even higher: shrimp trawls, for example, throw half of their catch back.[261]

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[254] *What Is Bycatch?*, CONSORTIUM FOR WILDLIFE BYCATCH REDUCTION, https://www.bycatch.org/about-bycatch (last visited Nov. 24, 2021).
[255] *Id*.
[256] *Id*.
[257] AQUATIC ANIMAL ALL., ANIMAL WELFARE CONSIDERATIONS FOR MARINE STEWARDSHIP COUNCIL'S 2020-2021 STANDARDS REVIEW (2021).
[258] E. Gilman et al., *Benchmarking Global Fisheries Discards*, SCI. REPORTS (Jan. 14, 2020).
[259] Hannah Ritchie & Max Roser, *Fish and Overfishing: Discards*, OUR WORLD IN DATA, https://ourworldindata.org/fish-and-overfishing#discards (Oct. 2021).
[260] *Id*.
[261] *Id*.

There are generally two classifications of discards: regulatory discards and economic discards.[262] Regulatory discards include discards that must be thrown back according to the law.[263] For example, the catch may not be lawfully landed because the fishes are below the legal minimum size limit, the fisherfolk reached their quota for a specific species, or the catch may be a protected fish species (e.g., sturgeon or certain species of shark).[264] Economic discards occur when fishes are thrown back for any other reason.[265] There are many reasons that a fisher may decide to discard unwanted animals. For one, the catch may have little or no market value. However, selective harvesting or high grading is an illegal practice and occurs when fisherfolk throw fishes of a certain size back because other sizes are more profitable.[266]

Discards are wasteful because animals die and no one benefits. Discards can also "alter scavengers' foraging behavior, distribution, diet, competition amongst species, and community composition."[267] Some discards can include relatively vulnerable species with low reproduction rates and other 'slow' life-history traits.[268] Additionally, discards create a problem for scientists who estimate fishing mortality (the total number of fishes removed from the ocean). This information is vital because it informs important decisions about fisheries management and the ability of species to recover.[269]

ii. Seabirds

Commercial fisheries pose a serious threat to the world's seabirds. Bycatch affects 41% of threatened species of seabirds (40 species), and each year longline, trawl, and gillnet fisheries are responsible for the incidental deaths of hundreds of thousands of seabirds.[270] Several species of albatross are now dangerously close to extinction.[271] This level of mortality is unsustainable.

Seabirds are attracted to fishing vessels and fishing operations. Offal and bait are tempting sources of food and can cause seabirds to become hooked or entangled in fishing gear, especially in longline and gillnet fisheries. Seines, trawls, traps, pots, and related equipment can also capture and kill seabirds but not at rates as high as longlines and gillnets.[272] Most seabirds hooked during longline operations are attracted to the baited hooks while the gear is being set. The seabirds try to eat the bait, become

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[262] KELSO & SARTO, *supra* note 253, at 3.
[263] *Id*.
[264] *Discards—Unwanted Catch*, WAGENINGEN UNIV. & RESEARCH, https://www.wur.nl/en/Dossiers/file/Discards-Unwanted-catch.htm (last visited Nov. 25, 2021).
[265] KELSO & SARTO, *supra* note 253, at 3.
[266] *Discards—Unwanted Catch*, *supra* note 264.
[267] Gilman et al., *supra* note 258.
[268] *Id*.
[269] KELSO & SARTO, *supra* note 253, at 1.
[270] *Data Zone: Spotlight on Seabirds*, BIRD LIFE INT'L, http://datazone.birdlife.org/sowb/spotseabirds (2012).
[271] *Id*.
[272] Albert M. Manville II, *Seabird and Waterbird Bycatch in Fishing Gear: Next Steps in Dealing with a Problem*, USDA FOREST SERVICE, https://www.fs.usda.gov/treesearch/pubs/32107 (2005).

hooked at the surface, and are then dragged underwater where they drown. Twenty-three species of seabirds are in danger of extinction partially because of mortality caused by longline fishing.[273]

The first global review of seabird mortality was published in 2013 in the journal of *Biological Conservation*—the study found that at minimum 400,000 seabirds are killed incidentally in gillnets each year.[274] The highest bycatch has been reported in the Pacific Northwest at about 194,000 seabirds, Iceland at around 100,000, and the Baltic Sea at around 76,000.[275] However, the report stated that it is almost certain that the actual number of birds killed in gillnets globally is much higher because of data gaps.[276]

Seabirds are affected twofold by wild-caught fishing. In addition to the reasons stated above, seabirds are negatively impacted by wild-caught fishing because overfishing often depletes sources of food for seabirds. The negative impact of overfishing on seabirds continues to increase as fisheries target even smaller fishes—the size seabirds depend on for food. According to an international study by *Institut de Recherche pour le Développement (IRD)*, overfishing threatens the survival of all seabirds.[277] The research team compared almost 450 years' worth of data from all over the world to see how the supply of fishes correlated with the reproduction of seabirds.[278] *IRD* found that all seabirds suffer the same drop-in birth rates when the supply of fishes drops to less than a third of maximum capacity.[279]

iii. Sea Turtles

Six out of seven species of sea turtles are either threatened or endangered due to wild-caught fishing.[280] The single greatest threat to sea turtles is fishing gear. Purse seines can capture sea turtles; the turtles become entangled in the net mesh as it is hauled in.[281] Entangled sea turtles may sustain injuries to their flippers and shells due to the force of the net as it is hauled. In a large catch, sea turtles risk being crushed under the weight of the animals towed into the boat.[282] Sea turtles rest and forage at the ocean floor and can be captured in a bottom trawl causing them to drown from being trapped in the net and held underwater, break appendages or shells from the weight of the catch on top of them, suffer injuries from the drop to the deck when the net is emptied aboard the fishing

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[273] *Id*. at 1074.
[274] *See* Ramūnas Žydelis et al., *June: The Incidental Catch of Seabirds in Gillnet Fisheries: A Global Review*, 162 BIOLOGICAL CONSERVATION 76 (2013).
[275] *Id*. at 84.
[276] *Id*. at 85.
[277] Institut de Recherche pour le Développement, *Overfishing Threatens the Survival of Seabirds*, SCI. DAILY, https://www.sciencedaily.com/releases/2012/02/120228123852.htm (Feb. 28, 2012).
[278] *Id*.
[279] *Id*.
[280] *Why Are Sea Turtles Endangered?*, SEA TURTLE CONSERVATION BONAIRE, http://www.bonaireturtles.org/wp/explore/why-are-sea-turtles-endangered/ (last visited Nov. 25, 2021).
[281] *Fishing Gear: Purse Seines*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-purse-seines (Feb. 12, 2019).
[282] *Id*.

vessel, or become stressed and exhausted from capture and release.[283] Gillnetting has also been a significant source of sea turtle mortality. The nylon can tighten around the turtle's soft body parts and cause deep cuts, potentially leading to infections, limited movement, or complete loss of a limb.[284]

Pelagic longline fisheries are responsible for the critically endangered status of the Pacific leatherback.[285] Lightsticks are often used along the baited lines which attract the sea turtles, causing them to become hooked and drowned. Their population has declined by as much as 95% in the last couple of decades.[286] When a turtle is caught unintentionally, the hook can kill them because it can prevent them from getting to the surface to get air.[287] Furthermore, if they don't die from drowning, the hook can permanently debilitate the sea turtle because it can get lodged in the digestive system and eventually cause a much slower death.[288]

Dredges, when towed across the seafloor, can crush sea turtles or capture them in the collection bag.[289] Large rocks that accumulate inside the collection bag can damage the shell of captured sea turtles.[290] Captured sea turtles also become injured when they are dropped on the boat deck as the collection bag is emptied.[291] The largest threat to sea turtles from FADs (fish aggregating devices) is entanglement. Nets, ropes, and lines that are used (or lost or discarded) entangle sea turtles that come into contact with them.[292] If a turtle becomes entangled beneath the FAD, the turtle will likely drown. Injuries resulting from entanglement include broken limbs, exhaustion, and lacerations that may occur as the turtle struggles to free itself from the lines or nets.[293]

iv. Marine Mammals

Bycatch is the greatest direct cause of marine mammal injury and death.[294] Purse seines' major negative impact is the incidental capture of dolphins. Once the netting has been set, encircled marine mammals cannot escape and can become entangled, injured, or stressed.[295] Even with quick retrieval,

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[283] *Fishing Gear: Bottom Trawls*, *supra* note 206.
[284] *Fishing Gear: Gillnets*, *supra* note 215.
[285] *Fisheries Bycatch*, SEE TURTLES, https://www.seeturtles.org/fisheries-bycatch (last visited Nov. 25, 2021).
[286] *Id*.
[287] *Information About Sea Turtles: Threats from Commercial Longline Fisheries*, SEA TURTLE CONSERVANCY, https://conserveturtles.org/information-sea-turtles-threats-commercial-longline-fisheries/ (last visited Nov. 25, 2021).
[288] *Id*.
[289] *Fishing Gear: Dredges*, *supra* note 231.
[290] *Id*.
[291] *Id*.
[292] *Fishing Gear: Fish Aggregating Devices*, *supra* note 234.
[293] *Id*.
[294] *Marine Mammal Bycatch*, MARINE MAMMAL COMM'N, https://www.mmc.gov/priority-topics/fisheries-interactions-with-marine-mammals/marine-mammal-bycatch/ (last visited Dec. 2, 2021).
[295] *Fishing Gear: Purse Seines*, *supra* note 281.

marine mammals' sensitive bodies and internal organs cannot usually withstand the weight of the catch or the impact of being placed on the vessel.[296]

Marine mammals can become entangled by trawl gear when swimming to forage or migrate; risks differ widely between species. Species that feed on or near the seafloor are at risk of being captured or entangled in netting or tow lines.[297] Pilot whales and common dolphins in the Atlantic are particularly susceptible to being caught in bottom trawls.[298] Small cetaceans, like dolphins and porpoises, spend the majority of their time at the surface of the water while swimming and can easily become caught in the path of skimmer trawls.[299] Species most commonly caught in gillnets include large whales, harbor porpoises, dolphins, steller sea lions, and gray seals. Marine mammals can become entangled around their necks, mouths, and flippers.[300] Entanglement can prevent proper feeding, constrict growth, or cause infection after many months.[301]

The risks to marine mammals from dredging are similar to the risks involved from bottom trawling. Many species of marine mammals forage on or near the seafloor and are at risk of being captured or injured in dredging gear. The largest threat to marine mammals is entanglement in nets, ropes, and lines that are used in the FADs.[302] Static FADs secured to the seafloor are of significant concern because marine mammals can become entangled or injured in the anchoring lines.[303] Cetaceans and pinnipeds can become entangled around their bodies, neck, or flippers. These FADs can also alter marine mammal feeding behavior by habituating them to a temporary and unnaturally aggregated food source.[304]

C. Aquaculture's Effect on Wild Fish

As discussed above, the use of wild fishes to feed farmed fishes also places direct pressure on wild-caught fishing resources. Aquaculture can also diminish wild fishes by habitat modification, food web interactions, the introduction of exotic species, and nutrient pollution. This section will focus on the problems of fish meal and fish oil (FMFO), disease and genetic contamination, and eutrophication.

i. Fish Meal and Fish Oil (FMFO)

[296] *Id*.
[297] *Fishing Gear: Bottom Trawls*, *supra* note 206.
[298] *Id.*
[299] *Fishing Gear: Skimmer Trawls*, *supra* note 212.
[300] *Fishing Gear: Gillnets*, *supra* note 215.
[301] *Id*.
[302] *Fishing Gear: Fish Aggregating Devices*, *supra* note 234.
[303] *Id*.
[304] *Id*.

Every year, billions of fishes—almost one-fifth of the world's annual wild catch—are dried, pressed, and ground into FMFO.[305] The majority of this material is fed to other fishes and crustaceans; in 2016, 69% of fishmeal and 75% of fish oil were used for aquaculture production.[306] Fish meal is a commercial product mostly made from fishes that are used to feed farmed animals in an agricultural setting.[307] FMFO production is a significant contributor to overfishing and an indicator that farmed animal systems do not save wild animals.

'Aquafeed' is a general term used to refer to all feed that is fed to aquatic animals and falls into two categories.[308] First, there is commercial aquafeed. Ingredients of commercial feeds may include a combination of fishmeal, fish oil, vegetable proteins, vegetable oils, animal byproducts, vitamins, and pigments.[309] Second, non-commercial aquafeeds are farm-made. In some cases, wild-caught fishes or trimmings are fed directly to the farmed fishes either whole or after being processed into a slurry or mash.[310] Frozen, whole, pelagic fishes are also used for fattening tuna and other large fishes in cages.[311] Fishes used directly for feed are mainly from the bycatch of non-selective fisheries such as shrimp trawls.[312]

According to NOAA, FMFO supplies essential amino acids and fatty acids reflected in the normal diet of fishes.[313] About 70% of FMFO is produced from the harvest of small, pelagic fishes such as anchovies, herring, menhaden, capelin, anchovy, pilchard, sardines, and mackerel. [314] The incredible amount of FMFO puts significant pressure on these wild fish populations. The other "30% is generated from the scraps produced when fishes are processed for human consumption."[315]

While some companies have taken initial steps towards reducing their reliance on fishes in a selection of their aquafeed products, the use of FMFO needs to be phased out across the entire industry for transformational change to take place.

ii. Diseases & Genetic Contamination

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[305] *Fishing the Feed*, CHANGING MKT. FOUND., https://changingmarkets.org/portfolio/fishing-the-feed/ (last visited Nov. 23, 2021).
[306] *Id*.
[307] *See* R. D. Miles & F. A. Chapman, *The Benefits of Fish Meal in Aquaculture Diets*, IFAS EXTENSION, https://edis.ifas.ufl.edu/pdf/FA/FA12200.pdf (May 2006).
[308] CHANGING MKT. FOUND. & COMPASSION IN WORLD FARMING, *supra* note 185.
[309] *Id*. at 20.
[310] *Id*.
[311] *Id*.
[312] *Id*.
[313] *Feeds for Aquaculture*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/insight/feeds-aquaculture (last visited Nov. 23, 2021).
[314] *Id*.
[315] *Id*.

In aquaculture, high stocking densities are conducive to disease outbreaks, which can then spread to wild populations. The extremely high density of intensive fish farming facilitates disease outbreaks.[316] In cage aquaculture, there is a constant interface between the captive fishes and the outside waters. Consequently, pathogens can travel between captive and wild populations relatively unencumbered. Wild fishes collected near fish farms are sixteen times more likely to carry disease and parasites.[317] For example:

> Atlantic salmon—the dominant salmon species farmed—frequently escape from net pens. As much as 40% of Atlantic salmon caught by fishermen in areas of the North Atlantic Ocean are of farmed origin. In the north Pacific Ocean, over 255,000 Atlantic salmon have reportedly escaped since the early 1980s and are caught by fishing vessels from Washington to Alaska. Increasing evidence suggests that farm escapees may hybridize with and alter the genetic makeup of wild populations of Atlantic salmon which are genetically adapted to their natal spawning grounds. Such genetic alterations could exacerbate the decline in many locally endangered populations of wild Atlantic salmon.[318]

Fish stocking is the practice of raising fish in hatcheries and releasing them into rivers, lakes, or the ocean.[319] The goal of fish stocking is typically to provide an additional catch for commercial and recreational fishers, rebuild spawning stock biomass, and increase the survival of stocks threatened by extinction.[320] The FAO claims that stocking programs aim to support commercial fisheries.[321] The total number of stocked fished in 2017 was estimated to be 39 to 150 billion finfish.[322] Fish stocking can have negative effects on wild populations of fishes. These negative effects include loss of genetic diversity, transmission and introduction of infectious diseases and pathogens, releasing chemicals that are used in aquaculture facilities, and non-endemic stocked fishes may out-compete, displace, or prey on native endemic species altering food web and community structure.[323]

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[316] Claire Asher, *Does Farming Drive Fish Disease?*, THE SCIENTIST, https://www.the-scientist.com/news-opinion/does-farming-drive-fish-disease-31641 (Apr. 19, 2017).
[317] *See* Luke T. Barrett et al., *Impacts of Marine and Freshwater Aquaculture on Wildlife: A Global Meta-Analysis*, 11 REV. IN AQUACULTURE 1022 (2019).
[318] Rosamond L. Naylor et al., *Effect of Aquaculture on World Fish Supplies*, 405 NATURE 1017, 1021 (2000).
[319] *Definitions and History of Stocking Cultured Organisms into the Sea*, SCI. CONSORTIUM FOR OCEAN REPLENISHMENT, https://www.stockenhancement.org/about/history.html (last visited Nov. 30, 2021).
[320] *Id*.
[321] *Stocking Techniques for Increased Production*, FOOD & AGRIC. ORG. OF THE U.N., https://www.fao.org/fishery/topic/14885/en (last visited Nov. 30, 2021).
[322] *Number of Fish Stocked Every Year*, GUESSTIMATE, https://www.getguesstimate.com/models/12854 (last visited Nov. 30, 2021).
[323] *See* BRETT A. INGRAM & SENA S. DE SILVA, NETWORK OF AQUACULTURE CTR. IN ASIA-PACIFIC, GENERAL ASPECTS OF STOCK ENHANCEMENT IN FISHERIES DEVELOPMENTS (2015).

iii. Eutrophication

Eutrophication is a common result of aquaculture production. Eutrophication refers to excessive nitrogen and phosphorus in an ecosystem which leaves insufficient amounts of oxygen for the survival of aquatic life and can occur naturally, but human activities have accelerated the rate and extent through aquaculture.[324] Global fish production has altered global flows of phosphorus. Excessive phosphorus in water has been widely recognized as the dominant driver of eutrophication, which degrades water quality, decreases biodiversity, alters ecosystem dynamics, and results in dead zones.[325] In open water aquaculture systems, the excess feed introduces extra nitrogen and phosphorous directly into the waterbody, and in closed-off inland systems the excess effluent is sometimes dumped directly into natural waterways.[326]

> As with the husbandry of livestock, aquaculture production relies on an external supply of [phosphorus] either directly through feeds (e.g., for carnivorous fish) or through fertilizers that enhance the primary productivity of aquatic ecosystems (e.g., for herbivorous and omnivorous species). Phosphorus that is not harvested might end up in inland and coastal waters and result in eutrophication.[327]

Eutrophication of excessive nutrients creates dense algal blooms that reduce water clarity and harm water quality.[328] Algal blooms limit light penetration, reduce growth, and cause die-offs of plants while also lowering the success of predators that need light to catch prey.[329] High rates of photosynthesis associated with eutrophication can deplete dissolved inorganic carbon and raise pH to extreme levels during the day.[330] When these dense algal blooms eventually die, microbial decomposition severely depletes dissolved oxygen, which creates hypoxia (low-oxygen) and anoxia (an extreme form of hypoxia) 'dead zones' that lack sufficient oxygen to support most organisms.[331] This can kill fishes, seagrass, and essential fish habitats.[332]

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[324] *Id*.
[325] Yuanyuan Huang et al., *The Shift of Phosphorus Transfer in Global Fisheries and Aquaculture*, 11 NATURE COMM. 1, 2 (2020).
[326] *Aquaculture Methods*, SEA CHOICE, https://www.seachoice.org/info-centre/aquaculture/aquaculture-methods/ (last visited Nov. 30).
[327] Huang et al., *supra* note 325.
[328] *What is Eutrophication?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://oceanservice.noaa.gov/facts/eutrophication.html (last visited Nov. 20, 2021).
[329] Michael F. Chislock et al., *Eutrophication: Causes, Consequences, and Controls in Aquatic Ecosystems*, NATURE EDUC., https://www.nature.com/scitable/knowledge/library/eutrophication-causes-consequences-and-controls-in-aquatic-102364466/ (2013).
[330] *Id*.
[331] *Contaminants and Eutrophication*, AQUATIC LIFE LAB, http://www.aquaticlifelab.eu/4-7-contaminants-and-eutrophication/ (last visited Nov. 30, 2021).
[332] *What is Eutrophication?*, *supra* note 328.

D. Environmental Impacts

Wild-caught fishing causes many environmental impacts. This section focuses only on those impacts that directly affect aquatic animals. These environmental impacts include microplastics, ghost gear and ghost fishing, and impacts to coral reefs.

i. Microplastics

Plastic is the most prevalent type of marine debris found in our oceans.[333] Microplastics are small plastic pieces less than five millimeters long that aquatic animals can mistake for food.[334] In recent decades, marine debris composition has seen a shift from natural materials—such as seaweeds, shells, pumice, and wood—floating in the oceans to domination by plastic.[335] Studies suggest that 60% to 80% of marine debris on shorelines, the seafloor, and floating in the oceans consist of plastic.[336] All plastic debris can be traced back to human activities, either on land or at sea.[337]

The majority of marine plastic originates from land-based sources.[338] However, plastic can also be released from ocean-based sources such as fishing activity, shipping, and aquaculture.[339] Although wild-caught fishing is not the only source of microplastics in the ocean, it is a large contributor. It is estimated that fishing nets make up 86% of the large plastic waste in the Pacific garbage patch.[340] According to a technical paper produced by the FAO, commercial fishing gear has the potential to be the greatest contributor of microplastics in the oceans.[341] Specifically, the ground ropes, used for netting in bottom dredges and trawls, are often made of plastic and must be replaced over time because of the wear. [342] [343]

ii. Ghost Gear

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[333] *What Are Microplastics?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://oceanservice.noaa.gov/facts/microplastics.html (Feb. 26, 2021).
[334] *Id*.
[335] Christina J. Thiele et al., *Microplastics in Fish and Fishmeal: An Emerging Environmental Challenge?*, SCI. REPORTS (Jan. 21, 2021).
[336] *Id*.
[337] *Id*.
[338] José G.B Derraik, *The Pollution of the Marine Environment by Plastic Debris: A Review*, 44 MARINE POLLUTION BULL. 842, 843 (2002).
[339] *See generally* GESAMP, FATE AND EFFECTS OF MICROPLASTICS IN THE MARINE ENVIRONMENT: A GLOBAL ASSESSMENT (2015).
[340] Sandra Laville, *Dumped Fishing Gear is Biggest Plastic Polluter in Ocean, Finds Report*, THE GUARDIAN, https://www.theguardian.com/environment/2019/nov/06/dumped-fishing-gear-is-biggest-plastic-polluter-in-ocean-finds-report (Nov. 5, 2019).
[341] *See generally* FOOD & AGRIC. ORG. OF THE U.N., MICROPLASTICS IN FISHERIES AND AQUACULTURE: STATUS OF KNOWLEDGE ON THEIR OCCURRENCE AND IMPLICATIONS FOR AQUATIC ORGANISMS AND FOOD SAFETY (2017).
[342] *See Id*. at 27-28.
[343] *See Id*. at 27.

Ghost gear refers to any fishing gear that has been abandoned, lost, or otherwise discarded (ALDFG).[344] Countless marine species are threatened by ghost gear. Fishes, crabs, and lobsters can get caught in lost traps.[345] Sea turtles, marine mammals, and seabirds can get entangled in or ingest plastic fishing lines, which prevents them from being able to swim.[346] An estimated 45% of marine mammals listed on the International Union for Conservation of Nature (IUCN) Red List have been negatively affected by ghost gear.[347] Coral reefs and seagrass ecosystems can be smothered by ghost gear.[348] There are many reasons why fishing gear can be lost or abandoned, including severe weather, snags beneath the surface, conflict with other gear, interaction with other vessels and, intentional discard.[349]

> *Near-bottom ALDFG can cause damage to coral reefs and physical damage to the seabed, whilst surface ALDFG presents a safety hazard for ocean users. Once washed ashore, ALDFG pollutes beaches with plastic litter. ALDFG is commonly composed of plastic and does not readily degrade and may be present for hundreds of years. It can also be a source of secondary micro-plastic as it fragments over time.*[350]

A recent study, attempting a global estimate of rates of fishing gear loss, estimated that 5.7% of all fishing nets, 8.6% of traps and pots, and 29% of all fishing lines used globally are abandoned, lost, or discarded into the environment.[351] Studies show that some types of plastic ghost gear will persist for up to 600 years in the marine environment, where they continue to catch and kill marine life before eventually breaking down into microplastics (which present a different risk).[352] The FAO and the United Nations Environment Program (UNEP) estimate that at least 640,000 tons of fishing gear have been lost or abandoned in the world's oceans every year, making up approximately 10% of all marine litter when measured by weight.[353] Studies from 2017 and 2018 have also suggested that ghost gear could make up as much as 46% to 70% of all macro-plastic in our oceans when measured by weight.[354]

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[344] *See* GLOB. GHOST GEAR INITIATIVE, https://www.ghostgear.org/ (last visited Nov. 25, 2021).
[345] *Fighting for Trash Free Seas*, OCEAN CONSERVANCY, https://oceanconservancy.org/trash-free-seas/plastics-in-the-ocean/global-ghost-gear-initiative/ (last visited Nov. 25, 2021).
[346] *Id*.
[347] *Id*.
[348] *Id*.
[349] *See* GLOB. GHOST GEAR INITIATIVE, *supra* note 344.
[350] *FAQ*, GLOB. GHOST GEAR INITIATIVE, https://www.ghostgear.org/faq (last visited Nov. 25, 2021) from https://www.fao.org/documents/card/en/c/ca9348en/.
[351] Kelsey Richardson et al., *Estimates of Fishing Gear Loss Rates at a Global Scale*, 20 FISH & FISHERIES 1218, 1227 (2019).
[352] *FAQ*, *supra* note 350.
[353] *Id*.
[354] *Id*.

iii. Coral Reefs

Coral reefs are large underwater structures composed of the skeletons of colonial marine invertebrates called coral.[355] Each individual coral, called a polyp, lives on the calcium carbonate exoskeletons, adding their exoskeleton to the existing coral structure.[356] As centuries pass, the coral reef gradually grows until they become a massive marine environment.[357]

Coral reefs contain over 4,000 species of fishes and 800 species of hard corals as well as other invertebrates.[358] Globally, about 830,000 species of multicellular plants and animals are estimated to occur on coral reefs.[359] Coral reefs contribute around one-quarter of the total marine catch in developing countries.[360] But once coral and sponge communities are destroyed, commercial fishes and other species dependent on them for spawning, shelter, nurseries, protection, and food, may also disappear. In addition, overfished species such as rockfish and crab may need corals and other seafloor structures to provide appropriate habitat if they are to recover.[361]

A paper, published in *Nature*, estimates that around 5 million square kilometers (km^2) of the seabed is trawled each year.[362] Bottom trawling is the most widespread human threat to deep-sea coral communities.[363] In Alaskan waters alone, the National Marine Fisheries Service (NMFS) estimates over one million pounds of corals and sponges are removed from the seafloor every year by commercial fishing, roughly 90% by bottom trawlers.[364]

Unsustainable fishing has been identified as the most pervasive of all local threats to coral reefs.[365] Scientists predict that 90% of coral reefs will go extinct by 2050.[366] The use of non-selective gears, like nets and traps, often removes more herbivorous fishes. These fishes eat algae and help keep the ecosystem in balance.[367] Fifty-five percent of the world's coral reefs are affected by overfishing because when fish populations that feed on algae decline, algae can grow and eventually smother

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[355] Rachel Ross, *What Are Coral Reefs?*, LIVE SCI., https://www.livescience.com/40276-coral-reefs.html (Sep. 24, 2018).
[356] *Id*.
[357] *Id*.
[358] THE CORAL REEF ALL., CORAL REEFS & EXPLOITIVE FISHING *supra* note 190; GLOB. CORAL REEF MONITORING NETWORK, *The Sixth Status of Corals of the World: 2020 Report*, Ch. 1, at 5 (2020).
[359] GLOB. CORAL REEF MONITORING NETWORK, *supra* note 358.
[360] THE CORAL REEF ALL., CORAL REEFS & EXPLOITIVE FISHING *supra* note 358.
[361] *Bottom Trawling*, OCEANA, https://usa.oceana.org/bottom-trawling/ (last visited Nov. 25, 2021).
[362] E. Sala et al., *Protecting the Global Ocean for Biodiversity, Food and Climate*, 592 NATURE 397, 399 (2021).
[363] OCEANA, DEEP SEA CORALS: OUT OF SIGHT, BUT NO LONGER OUT OF MIND 3 (2009).
[364] *Id*. at 12.
[365] *Overfishing and Destructive Fishing Threats*, REEF RESILIENCE NETWORK, https://reefresilience.org/stressors/local-stressors/overfishing-and-destructive-fishing-threats/ (last visited Nov. 25, 2021).
[366] Elena Becatoros, *More Than 90 Percent of World's Coral Reefs Will Die by 2050*, INDEP., https://www.independent.co.uk/climate-change/news/environment-90-percent-coral-reefs-die-2050-climate-change-bleaching-pollution-a7626911.html (Mar. 13, 2017).
[367] *How Does Overfishing Threaten Coral Reefs?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://oceanservice.noaa.gov/facts/coral-overfishing.html (Oct. 8, 2021).

corals.[368] Some regions are particularly threatened. For example, 95% of reefs are affected in Southeast Asia.[369] Other unsustainable fishing practices can physically destroy entire sections of coral reefs. Blast fishing, for example, can destroy 64 square feet of a reef with a single blast.[370]

Since 2010, almost all regions globally have experienced a decline in coral cover, with South Asia, Australia, the Pacific, and the East Asian Seas regions exhibiting the greatest declines.[371]

3. Case Studies

A. Assault on Sharks

As one of the top ocean predators, sharks play an important role in the food chain and help ensure balance in the ocean's ecosystem.[372] With increased demand and exploitation rates for shark species and shark products, concern has steadily grown regarding the status of many shark species and their exploitation in global fisheries.[373] The first global assessment of the IUCN estimated that one-quarter of sharks were threatened with extinction (classified as critically endangered, endangered, or vulnerable according to the criteria of the IUCN Red List of Threatened Species), which makes sharks the most threatened vertebrate lineage after amphibians.[374] Currently, there are 21 species of sharks that are either listed as endangered or threatened under the Endangered Species Act.[375]

Sharks are being fished at a rate of up to 150 to 250 million sharks per year, and approximately 50 million sharks are killed every year as bycatch.[376] Sharks are extremely vulnerable to overfishing based on their biological factors. Sharks are characterized by relatively slow growth, reaching sexual maturity more slowly than other marine fishes, and they produce very few offspring—making it even harder for sharks to recover from overfishing.[377] Once depleted, shark populations can take years, decades, or more to recover.[378] Moreover, the loss of such significant numbers of large predators threatens the health of entire marine ecosystems.[379]

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[368] *Coral Reefs 101: Direct Threats*, CORAL REEF ALL., https://coral.org/en/coral-reefs-101/direct-threats/ (last visited Nov. 25, 2021).
[369] *Overfishing and Destructive Fishing Threats*, *supra* note 365.
[370] *Coral Reefs 101: Direct Threats*, *supra* note 368.
[371] GLOB. CORAL REEF MONITORING NETWORK, *supra* note 358, at 7.
[372] *See* S. Piraino et al., *Variability of Species Roles in Marine Communities* 140 MARINE BIOLOGY 1067 (2000).
[373] *Shark Conservation*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/international-affairs/shark-conservation (Aug. 24, 2021).
[374] Nathan Pacoureau et al., *Half a Century of Global Decline in Oceanic Sharks and Rays*, 589 NATURE 567, 567 (2021).
[375] *Shark Conservation*, *supra* note 373.
[376] *Shark Finning*, ANIMAL WELFARE INST., https://awionline.org/content/shark-finning (last visited Nov. 25, 2021).
[377] *See* Pacoureau et al., *supra* note 374, at 568.
[378] *See* E. CORTÉS ET AL., SUSTAINABLE FISHERIES DIV., STOCK ASSESSMENT OF THE DUSKY SHARK IN THE U.S. ATLANTIC AND THE GULF OF MEXICO, SUSTAINABLE FISHERIES DIVISION (2006).
[379] 155 Cong. Rec. 1, E21 (2009) (Introduction of the Shark Conservation Act of 2009).

> Dusky sharks, for example, have experienced population declines of 85 percent due to overfishing and bycatch. In 2010 alone, more than 3,400 dusky sharks were captured as bycatch in two bottom longline fisheries in the southeast region of the U.S. But, duskies aren't the only species to be negatively impacted by bycatch; great whites, tigers, hammerheads, and many other species are also accidentally caught in fishing gear around the world. Throughout the 1990s, fishermen captured 12 million sharks and rays as bycatch every year, just in international waters alone.[380]

Many shark species have been over-exploited because their fins are highly valued for shark fin soup, an Asian delicacy eaten around the world. The demand for shark fins continues to increase. Shark fins are considered one of the highest-priced food items in the world, reaching prices as high as $700 per kg.[381] In the last 50 years, the slaughter of sharks has risen by 400%, and in the next decade, it is anticipated that 20 species of sharks could become extinct.[382] While shark fin soup does account for a considerable amount of shark consumption, it is estimated that of the sharks killed a year—almost half are being killed for other shark products, including shark oil and shark cartilage.

Shark 'finning' is the practice of cutting off the shark's fins at sea and discarding the rest of the shark. By keeping only the fins, a single vessel can kill an extraordinary number of sharks on a single trip. For example, in 2002, the U.S. vessel King Diamond II was caught by the U.S. Coast Guard off the coast of Guatemala with 32 tons of fins on board (estimated to represent 30,000 sharks), without the corresponding carcasses.[383] In the United States, the Shark Finning Prohibition Act of 2000 amended the MSA (Magnuson-Stevens Fisheries Act) to prohibit shark finning.[384] The law only prohibits any person under U.S. jurisdiction from engaging in the finning of sharks, possessing shark fins aboard a fishing vessel without the corresponding carcass, and landing shark fins without the corresponding carcass—it does not generally prohibit the possession of shark fins off of a vessel.[385] Ten U.S. states currently have shark fin laws that prohibit the possession and retention of shark fins even if they are legally landed under the requirements of the Shark Conservation Act.[386]

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[380] Emily Tripp, *Bycatch Spotlight: One of the Biggest Issues Facing Sharks Today*, OCEANA, https://usa.oceana.org/blog/bycatch-spotlight-one-biggest-issues-facing-sharks-today/ (Aug. 14, 2014).
[381] THE PEW ENV'T GROUP, SHARKS IN TROUBLE: HUNTERS BECOME THE HUNTED 18 (2011).
[382] Federico Borella, *Sharks on the Brink of Extinction*, WATER SCI. POL'Y, https://watersciencepolicy.com/article/sharks-on-the-brink-of-extinction-c7e884e846e0?language=English (Apr. 8, 2021).
[383] Edward Dorson, *Shark and Awe in the U.S. Senate*, HUFFPOST, https://www.huffpost.com/entry/shark-and-awe-in-the-us-s_b_776240 (Oct. 29, 2010).
[384] Shark Finning Prohibition Act of 2000, H.R. 5461, 106th Cong. (2000).
[385] *Shark Conservation Act*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/laws-and-policies/shark-conservation-act (Aug. 2, 2021).
[386] *Id.*

B. Whaling

The hunting and killing of cetaceans by humans is termed 'whaling.' People have been whaling for thousands of years, with an estimated 2.9 million whales being killed during the 20th century.[387] Historically whaling was for oil, rendered from whale fat or blubber, and spermaceti, from the head cavity of sperm whales which was used to make candles and cosmetics.[388] Today, cetaceans are mainly hunted for food commercially and by Indigenous peoples for nutritional and cultural subsistence, termed Aboriginal Subsistence Whaling (ASW). Cetaceans are also killed to reduce competition for fishes and several small cetaceans are hunted for use as bait to catch fishes.[389] Odontocetes are hunted in some communities for their teeth, which are used as currency.[390]

Because whales migrate worldwide through both coastal waters and the open oceans, the need for international cooperation in their conservation became clear. In 1946, several countries came together to create the International Whaling Commission (IWC) under the International Convention for the Regulation of Whaling (ICRW).[391] IWC's purpose is to prevent the overhunting of whales.

In 1986, the IWC agreed to a moratorium to halt commercial whaling.[392] Despite the moratorium on commercial whaling Japan, Norway, and Iceland have declined to join (or left) the countries that agreed to the terms of the international whaling agreement and have continued to commercially whale.[393] Japan allows the sale of whale products despite claiming that it's whaling is for scientific research, Norway objected to the moratorium which allows it to continue commercial whaling, and Iceland has a disputed reservation to the moratorium, which it has used to justify commercial catch quotas since 2006.[394] The three countries have killed over 38,000 whales since 1986 when the moratorium went into effect.[395] Japan has killed fewer whales since leaving the agreement as it can now only whale in its own waters. Iceland has announced that it intends to end its whaling operations in 2024 due to dwindling demand.[396]

The IWC allows for whaling of otherwise protected animals when it is conducted by certain indigenous people to satisfy subsistence needs. The rules for ASW are contained in paragraph 13 of the Schedule to the ICRW and allow for "aborigines" who's cultural, subsistence, and nutritional

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[387] ENV'T INVESTIGATION AGENCY, COMMERCIAL WHALING: UNSUSTAINABLE, INHUMANE, UNNECESSARY 4 (2018).
[388] *Whaling*, ANIMAL WELFARE INST., https://awionline.org/content/whaling (last visited Nov. 26, 2021).
[389] *Small Cetacean Hunts*, ANIMAL WELFARE INST., https://awionline.org/content/small-cetacean-hunts (last visited Nov. 26, 2021).
[390] *Whaling*, *supra* note 388.
[391] *History and Purpose*, IWC, https://iwc.int/history-and-purpose (last visited Dec. 2, 2021).
[392] *See* ENV'T INVESTIGATION AGENCY, supra note 387.
[393] *Id*.
[394] *Norway Now Kills More Whales Than Japan*, INT'L MARINE MAMMAL PROJECT, https://savedolphins.eii.org/news/norway-now-kills-more-whales-than-japan (July 20, 2019).
[395] *See* ENV'T INVESTIGATION AGENCY, supra note 387.
[396] *Iceland To End Whaling in 2024 as Demand Dwindles*, THE GUARDIAN, https://www.theguardian.com/environment/2022/feb/04/iceland-to-end-whaling-in-2024-demand-dwindles (Feb. 4, 2022).

need for whales and whaling has been recognized by the IWC, to hunt some baleen whale species "exclusively for local consumption."[397]

4. Sustainability

A. How We Currently Approach Sustainability

i. The Code

In 1991, the 19th session of the FAO Committee on Fisheries (COFI) requested that FAO outline the concept of responsible fisheries and develop a code of conduct.[398] The Code of Conduct for Responsible Fisheries (the Code) was adopted by the FAO in 1995 and is considered a foundational document that sets out international principles and standards for the use of fisheries and aquaculture resources, including thorough regional mechanisms and cooperation to ensure sustainable use of aquatic living resources in harmony with the environment.[399] According to the FAO, the Code recognizes the nutritional, economic, social, environmental, and cultural importance of fisheries and aquaculture.[400] It is directed toward members and non-members of FAO, fishing entities, subregional, regional, and global organizations (governmental and nongovernmental), everyone concerned with conserving fishery resources, managing fisheries, and developing fisheries, and other users of the aquatic environment concerning fisheries.[401] The Code does not consider the welfare of the animals involved.

ii. Sustainable Development Goal (SDG) 14

The Sustainable Development Goals (SDGs) are a universal call to end poverty, protect the planet, and improve lives.[402] There are 17 SDGs and 169 targets that were adopted by the United Nations (UN) Member States in 2015, as part of the 2030 Agenda for Sustainable Development. Goal 14—Life Below Water—is to conserve and sustainably use the oceans, seas, and marine resources for sustainable development.[403] The targets of Goal 14 include:[404]

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[397] *Aboriginal Subsistence Whaling*, ANIMAL WELFARE INST., https://awionline.org/content/subsistence-whaling (last visited Nov. 26, 2021).
[398] FAO, SUSTAINABILITY IN ACTION, *supra* note 181, at 93.
[399] *Id*.
[400] *Id*.
[401] *Code of Conduct for Responsible* Fisheries, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/international-affairs/code-conduct-responsible-fisheries (last visited Dec. 2, 2021).
[402] *Sustainability Development Goals*, UNITED NATIONS, https://www.un.org/sustainabledevelopment/development-agenda/ (last visited Nov. 29, 2021).
[403] G.A. Res. A/70/1, at 14 (Oct. 21, 2015).
[404] *Id*. at 23-24.

Target	Target Year	Target Description
#1	2025	“prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution”
#2	2020	“sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans”
#3	n/a	“Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels”
#4	2020	“effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics”
#5	2020	“conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information”
#6	2020	“prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation”
#7	2030	“increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism”
#A	n/a	“Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries”
#B	n/a	“Provide access for small-scale artisanal fishers to marine resources and markets”
#C	n/a	“Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources”

These targets are formulated in anthropocentric terms, meaning that they are to be achieved for the sake of humans. This implies that the SDGs highlights values that are of interest to humans. This

becomes clear when reading the descriptions of the respective SDGs—in this case, SDG 14—and their targets, as well as the reasons why it is important to achieve a sustainable future. SDG 14 is also directly relevant to non-human animals, which should include goals that pertain to their welfare as well.

iii. Magnuson-Stevens Act (MSA)

In the United States the MSA—the primary law that governs marine fisheries in the United States—first passed in 1976, was created to "foster the long-term biological and economic sustainability of marine fisheries."[405] The MSA's objectives include preventing overfishing, rebuilding overfished stocks, increasing long-term economic and social benefits, and ensuring a safe and sustainable supply of seafood.[406] Congress has made two significant revisions to the MSA. First in 1996, with the passage of the Sustainable Fisheries Act, and in 2007 with the MSA Reauthorization Act.[407] The Sustainable Fisheries Act includes strengthened requirements to prevent overfishing and rebuilding overfished areas, national standards to address bycatch, and introduced fish habitat as a key component in fisheries management.[408] MSA Reauthorization Act includes requirements that establish annual catch limits and accountability measures.[409]

The current framework on wild-caught fishing sustainability seems to focus mainly on replenishing fishing stocks in order to continue fishing. None of the frameworks goes any further than suggesting that only overfishing is the main sustainability concern. Looking at wild-caught fishing through a holistic framework would include animal welfare, less environmentally damaging fishing gear, less fishing in general, more areas that are completely protected from fishing, other environmental stressors and more harms in order to regain healthy aquatic habitats.

iv. Current Definitions

Currently, NOAA suggests "[w]ell-managed wild-capture fisheries and environmentally responsible marine aquaculture play an increasingly important role in our food supply, our health, and the environment."[410] It is unclear from NOAA's definition what they consider to be 'well-managed' and 'environmentally responsible'. This definition also leaves out any indication of animal welfare issues and focuses only on human food supply from fishes. 'Sustainable seafood' is not possible unless the animals used for seafood and the animals incidentally caught are addressed in definitional language within agencies and organizations.

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[405] *Laws & Policies: Magnuson-Stevens Act*, *supra* note 178.
[406] Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, 16 U.S.C. § 1801 (2007).
[407] *Laws & Policies: Magnuson-Stevens Act*, *supra* note 178.
[408] Sustainable Fisheries Act, 16 U.S.C § 1801 (1996).
[409] Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, 16 U.S.C. § 1801 (2007).
[410] *Understanding Sustainable Seafood*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/insight/understanding-sustainable-seafood (last visited Nov. 29, 2021).

The FAO defines 'sustainable development' as "the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry, and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable."[411]

More specifically, the FAO defines 'sustainable agriculture' and 'rural development' as processes that meet the following criteria:

> *(1) they ensure that the basic nutritional requirements of present and future generations, qualitatively and quantitatively, are met while providing a number of other agricultural products;*
>
> *(2) they provide durable employment, sufficient income and decent living and working conditions for all those engaged in agricultural production;*
>
> *(3) they maintain and, where possible, enhance the productive capacity of the natural resource base as a whole, and the regenerative capacity of renewable resources, without disrupting the functioning of basic ecological cycles and natural balances, destroying the socio-cultural attributes of rural communities, or contaminating the environment;*
>
> *(4) they reduce the vulnerability of the agriculture sector to adverse natural and socio-economic factors and other risks, and strengthen self-reliance.*[412]

The Marine Stewardship Council—an international non-profit organization that certifies sustainable seafood—measures and assesses sustainability with three main principles. First, fishing must be at a level population to remain productive and healthy.[413] Second, fishing activity must be managed carefully so that other species and habitats within the ecosystem remain healthy.[414] Lastly, complying with relevant laws and being able to adapt to changing environmental circumstances is necessary.[415]

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[411] FLAVIO CORSIN ET AL., FOOD & AGRIC. ORG. OF THE U.N., A QUALITATIVE ASSESSMENT OF STANDARDS AND CERTIFICATION SCHEMES APPLICABLE TO AQUACULTURE IN THE ASIA-PACIFIC REGION (2007).
[412] *Id.*
[413] *What is the MSC?*, MARINE STEWARDSHIP COUNCIL, https://www.msc.org/about-the-msc/what-is-the-msc; (last visited Nov. 29, 2021); *What is Sustainable Fishing?*, MARINE STEWARDSHIP COUNCIL, https://www.msc.org/what-we-are-doing/our-approach/what-is-sustainable-fishing (last visited Nov. 29, 2021).
[414] *Id.*
[415] *Id.*

Again, we can see that these agencies and organizations do little to define sustainability beyond concepts that focus solely on population sizes. The Marine Stewardship Council does address other species and habitats within their definition. But it falls short in actually describing what true sustainability in wild-caught fishing would look like.

B. True Sustainability

i. Indigenous Practices

There is growing recognition that the ecological knowledge and stewardship practices of Indigenous peoples can offer pathways for effective and socially just conservation and resource management. Traditional ecological knowledge systems are combined with practices, concepts, and modes of teaching and learning that can be related directly and indirectly to resource stewardship and conservation.[416]

The foundation of effective and resilient resource management systems addresses the health of ecosystems within legal and political institutions. In the same way that global economics shapes Western political institutions, pre-Western salmon fisheries have and continue to shape Indigenous institutions. Within these systems, the right to access land goes hand in hand with a set of responsibilities that protect future abundance and promote long-term stability. For example, some principles that guide the work of the Haíłzaqv Nation in modern management plans are:

> "The right to use a river system comes with the responsibility to maintain a river system."
>
> "The primary focus should be on what is left behind, not what is taken."[417]

Indigenous fishing technologies are highly effective and allow fishers to harvest large quantities of fishes; the main difference between Indigenous and non-indigenous fishing practices is the methodology.[418] These technologies have been regulated by traditional structures of resource management that control harvest pressure.[419] Western societies emphasize the extraction of resources for short-term profit in a capitalistic society, whereas Indigenous resource management is guided by key differences in cultural values and knowledge. Emphasis is placed on multigenerational sustenance and reciprocity to protect the world beyond reasons that are human-centric. The

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[416] Nancy J. Turner, *Coming to Understanding: Developing Conservation through Incremental Learning in the Pacific Northwest*, 34 HUM. ECOLOGY 495, 496 (2006).
[417] William I. Atlas et al., *Indigenous Systems of Management for Culturally and Ecologically Resilient Pacific Salmon (Oncorhynchus spp.) Fisheries*, 71 BIOSCIENCE 186, 190 (2021).
[418] *See* Charles R. Menzies & Caroline F. Butler, *Returning to Selective Fishing through Indigenous Fisheries Knowledge*, 31 AM. INDIAN Q. 441 (2007).
[419] *Id*. at 442.

reintroduction of traditional Indigenous fishing techniques is crucial for sustainable fisheries, in particular the traditional fishing gear that reduces ecological damage.[420]

A study published by *BioScience* reviewed Indigenous management of salmon, including selective fishing technologies, harvest practices, and governance grounded in multigenerational place-based knowledge.[421] The study found when they contrasted Indigenous systems with contemporary Western management, they found vulnerabilities of Western governance and harvest management that have contributed to declining salmon fisheries.[422] The study focused on Indigenous peoples of the Northern Pacific Rim who have harvested salmon for more than 10,000 years, evidence suggests that Indigenous peoples had been using salmon long-term and intensively deliberate and well-honed systems of salmon management.[423] All the systems used were rooted in traditional laws, cultural beliefs, spiritual beliefs, and best management practices that promote sustainability and access to salmon by limiting the risks of overharvesting and population decline. The study went on to suggest that revitalizing traditional systems of salmon management can improve prospects for sustainable fisheries and healthy fishing communities.[424]

In New Zealand, all fisheries after 1980 have been managed under a system that allocates a certain quota of fishes to fishers around the country.[425] Māori were largely left out of the decision-making process and few rights were granted to them. Because of this, proceedings started and concluded in 1992 with Māori being awarded 10% of the original quota, 20% of the new quota, and $150 million to purchase additional quota and half of the largest seafood company in the country.[426] Currently, Māori own about 40% of the fishing quota in New Zealand, and New Zealand is recognized as having one of the most sustainable fishery management systems in the world.[427] Countries that have effective fisheries management systems generally have healthy fish stocks, while those without effective fisheries management have declining abundance and increasing fishing pressure on fish stocks.

Indigenous communities have inhabited the United States for millennia, and they have more experience than anyone in land management. Research has also shown that biodiversity tends to decline more slowly on land managed by Indigenous peoples.[428] Indigenous peoples' practices can give us an insight into ways that we can transform our current wild-caught fishing practices into ones that are less harmful to animals. Creating a sustainability framework that includes both Indigenous

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[420] *See id*.
[421] *See* Atlas et al., *supra* note 417.
[422] *See id*.
[423] *Id*. at 286-87.
[424] *Id*. at 287.
[425] *Social & Environmental Justice in Seafood*, SUSTAINABLE FISHERIES, https://sustainablefisheries-uw.org/seafood-101/social-environmental-justice-in-seafood/ (last visited Dec. 2, 2021).
[426] *Id*.
[427] *Id*.
[428] Benji Jones, *The Biden Administration Has a Game Changing Approach to Nature Conservation*, VOX, https://www.vox.com/2021/5/7/22423139/biden-30-by-30-conservation-initiative-historic (May 7, 2021).

knowledge and scientific data may be an avenue to base sustainability assessment on. When it comes to the conversation about sustainable fishing, it is important to include the voices of Indigenous peoples who have been living and fishing on these lands for thousands of years.

ii. Disentangling The Sustainability Myth

The word 'sustainability' has become overused and has become somewhat meaningless—a sort of buzzword. When trying to find a definition of the word 'sustainability' it becomes increasingly clear that 'sustainability' is a word used without precise definitional language. In 1987, the UN Brundtland Commission defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."[429] The Brundtland Report goes on to define 'needs' specifically in terms of prioritizing the essential needs of the world's poor.[430]

When it comes to narrowing 'sustainability' and defining 'wild-caught fishing sustainability' we have seen (*above*) organizations and agencies give the phrase more precise language than 'sustainability.' We have not seen wild-caught fishing organizations or agencies address the welfare of the animals or come close to defining wild-caught fishing sustainability without an anthropocentric focus.

'Sustainability' is an economic and ecological concept, but it is not currently a good wild-caught fishing conservation term. Organizations and agencies tend to base sustainability on estimating the population size of fish stocks in terms of replenishing. Multi-species interactions are also an important concern in establishing population size and catch limits. Given the current framing of 'sustainability' as a fisheries management goal and the historical economic origins of the term, fishing to maximum sustainable yield is often seen as one of potentially many goals of successful fisheries management. The term underfished also has clear exploitation connotations, implying that more should be done to increase the harvest of these stocks, rather than the true meaning that these populations are depleted, but not yet to the extent that their reproductive capacity has been damaged.[431] Predators eat prey species, and prey species provide food for predators.[432] As such, fixing a level of mortality for a given fish stock may not be reasonable, as different species will influence each other's population sizes.[433]

Wild-caught fishing from a conservation perspective needs to consider the ocean in an all-encompassing approach, this approach must include animal welfare. Understanding the overall impact of fishing, rather than whether each individual stock is still able to replenish its population size in the following year, would be a better alternative.

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[429] *Sustainability*, *supra* note 39.
[430] *Id*.
[431] Richard Stafford, *Sustainability: A Flawed Concept for Fisheries Management?*, 7 ELEMENTA 1, 3 (2019).
[432] *Id*.
[433] *Id*.

One study published by *Nature* suggested marine protected areas (MPAs) as an effective tool for restoring ocean biodiversity and ecosystems.[434] Most MPAs restrict or prohibit harmful extraction uses to some degree.[435] Nearly every country in the world has agreed to a goal of protecting at least 10% of the world's coastal and marine areas by 2020.[436] As of June 2020, MPAs that prohibit commercial fishing account for 23% of U.S. waters.[437] Only 3% of U.S. waters are highly protected, prohibiting all extractive uses (or "no take").[438] Developing a conservation planning framework that prioritizes highly protected MPAs would result in benefits including protecting fishes, biodiversity, and securing marine carbon stocks that are at risk from human activities. [439] The *Nature* study found "that we could achieve 90% of the maximum potential biodiversity benefits from MPAs by strategically protecting 21% of the ocean." [440] This would increase the average protection of endangered and critically endangered species from currently 1.5% and 1.1% of their ranges to 82% and 87%, respectively.[441] This suggests that the best method to sustain wild-caught fishing is to not allow any sort of commercial fishing within MPAs.

In January of 2021, President Biden signed Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*.[442] The Executive Order commits to a "30 by 30" goal that was first envisioned in the *Ocean-Based Climate Solution Act*, which was introduced into the United States House of Representatives in 2020.[443] This "30 by 30" plan aims to commit 30% of lands and oceans to conservation by 2030, which in the House version of the bill entails a complete ban on "commercial extractive use" in areas of the ocean conserved.[444] Title II of the Act would require the executive branch to establish MPAs over 30% of oceans in the U.S., an action that the Biden administration said it plans to take even without the passage of the Act.[445]

The United States is among more than 50 countries that have committed to "30 by 30."[446] Currently, in the United States, one-quarter of the oceans are within permanently protected areas.[447] Language in

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[434] *See* Enric Sala et al., *Protecting the Global Ocean for Biodiversity, Food and Climate*, 592 NATURE 397 (2021).
[435] *Understanding Area-based Management in U.S. Waters*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://marineprotectedareas.noaa.gov/gallery/understanding-area-based-mgmt-in-us-waters.html (last visited Dec. 2, 2021).
[436] *Id*.
[437] *Id*.
[438] *Id*.
[439] Sala et al., *supra* note 434.
[440] *Id*. at
[441] *Id*. at
[442] U.S. DEP'T OF THE INTERIOR, CONSERVING AND RESTORING AMERICA THE BEAUTIFUL, 10 (2021).
[443] *See* Ocean-Based Climate Solution Act of 2021, H.R. 3764, 117th Cong. (introduced).
[444] *Id*. at 6.
[445] Chris Chase, *Biden's "30 by 30" Order Could Close-off 30 Percent of US Ocean to Fishing*, SEAFOOD SOURCE https://www.seafoodsource.com/news/environment-sustainability/biden-s-planned-30-by-30-order-draws-widespread-opposition-from-commercial-fishing (Jan. 27, 2021).
[446] Jones, *supra* note 428.
[447] *Id*.

the "30 by 30" plan is to "conserve" and does not include "protect." The Executive Order does not define the level of conservation that would be applied to measure progress toward the "30 by 30" target—Federal agencies will conduct further stakeholder engagement on formulating the concept or definition of "conserve."[448]

Creating more protected areas is a step that is needed in order to be sustainable within the wild-caught fishing sphere. An Agreement similar to the Central Arctic Ocean Fisheries Agreement (Agreement) is needed in order to make any difference. The Agreement created two basic commitments. First, the committed Parties, are not to allow vessels to conduct commercial fishing operations in the large portion of the Central Arctic Ocean.[449] The Agreement is a preventative measure in the area it is protecting since no commercial fishing has ever taken place in this area. This is because ice has covered it, until now. Due to climate change, the Arctic is warming causing a significant percentage of the Arctic Ocean to be free from ice for part of the year. The second commitment creates a Joint Program of Scientific Research and Monitoring for the Central Arctic Ocean, "with the aim of improving their understanding of the ecosystems of the Agreement Area and, in particular, of determining whether fish stocks might exist in the Agreement Area now or in the future that could be harvested on a sustainable basis and the possible impacts of such fisheries on the ecosystems of the Agreement Area."[450]

The Agreement includes representatives of Arctic Indigenous communities from Canada, Denmark, and the United States. Even though the Indigenous people and others who live near the Arctic coastline do not engage in high seas fishing, the potential depletion of fish stocks in the high seas area by commercial fishing vessels would threaten marine resources closer to shore on which those communities depend.[451]

The *Aquatic Animal Institute* recently published a report, *Benefits of Aquatic Animal Welfare for Sustainability*, with the objective of showing that animal welfare issues are linked to ethical, environmental, and social issues.[452] Yet, aquatic animals have largely been overlooked in the animal welfare movement, while animal welfare itself has been largely absent from the sustainability sector's discourse.[453] Although the report mostly focuses on aquaculture, the same can be said about sustainability and animal welfare issues pertaining to wild-caught fishes.

It is important to reduce the death and suffering of wild-caught fish by licensing, controlling, and design of fishing gear. Ongoing measures need to reduce habitat destruction, bycatch, and ghost gear

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[448] *Understanding Area-based Management in U.S. Waters*, *supra* note 435.
[449] Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, available at https://www.mofa.go.jp/files/000449233.pdf.
[450] *Id*.
[451] David Balton, *The Arctic Fisheries Agreement Enters into Force*, POLAR INST., https://www.wilsoncenter.org/blog-post/no-9-arctic-fisheries-agreement-enters-force (June 25, 2021).
[452] AQUATIC ANIMAL INST., BENEFITS OF AQUATIC ANIMAL WELFARE FOR SUSTAINABILITY (Sep. 2021).
[453] *Id*.

to reduce the fishing industry's impacts on biodiversity.[454] Developing the fisheries sector using an animal welfare lens can help meet many of these challenges and at the same time contribute to livelihoods and nutrition globally.[455] In capture fisheries, the type of gear used can reduce carbon emissions, ocean plastics, overfishing, and animal suffering.[456] When the welfare of fishes is considered within wild-caught fishing, then sustainability will inevitably follow.

It is important to recognize that wild fishes and their habitats possess intrinsic value above and beyond what can be defined by conventional economics. Moreover, aquatic animals have value beyond those that are beneficial to humans. There remains very little recognition of this relationship and the crucial role animal welfare plays in sustainable development for people and the planet. For the last century, conservation has taken a species-based approach that encouraged the 'sustainable use' of wildlife.[457] However, the crisis of species extinction and biodiversity loss only continues to grow. We have lost 60% of birds, mammals, fishes, reptiles, and amphibians over the last 40 years.[458] Consideration of wildlife—aquatic animals in this case—as "resources" only results in overexploitation and unsustainable consumption patterns, which fails to achieve the sustainability goals that we currently have. Our sustainability goals will never come close to being reached if the welfare of aquatic animals is not at the forefront of the conversations and regulations.

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[454] *Id.*
[455] *Id.*
[456] *Id.*
[457] JANICE COX & JESSICA BRIDGERS, UNITED NATIONS ENV'T, WHY IS ANIMAL WELFARE IMPORTANT FOR SUSTAINABLE CONSUMPTION AND PRODUCTION? 8 (2019).
[458] *Id.*