WORLD AQUATIC ANIMAL DAY

APRIL 3, 2020

RESOURCE PACKET

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AQUATIC ANIMAL LAW INITIATIVE
ANIMAL LAW CLINIC
LEWIS & CLARK LAW SCHOOL
WorldAquaticAnimalDay.org

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1. About World Aquatic Animal Day

#worldaquaticanimalday

World Aquatic Animal Day is an annual day dedicated to aquatic animals, being launched for the first time on April 3, 2020, and is a project of the Aquatic Animal Law Initiative (AALI) and the Animal Law Clinic at Lewis & Clark Law School (Clinic/we/us). Each year, we intend to raise global awareness about these often-forgotten nonhuman animals.

Aquatic animals play a critical role in our societies and ecosystems. They are important not only as a group, but also have value and intrinsic worth as individuals. By "aquatic animals" we mean not only fish, but also a myriad of other animals that require aquatic habitats, such as: amphibians, marine mammals, crustaceans, reptiles, mollusks, aquatic birds, aquatic insects, starfish, and corals. Aquatic animals are widely used, and abused, around the world and they, and their habitats, face a multitude of significant threats.

There is urgent need to give aquatic animals proper consideration. Through law, policy, education, advocacy, and good stewardship of the earth, efforts to raise awareness of the plight of aquatic animals 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, together, highlight and work to address the issues aquatic animals face.

The focus for 2020 World Aquatic Animal Day is aquaculture. Aquaculture refers to the practice of raising aquatic animals (and plants) for food and other purposes in land or water-based facilities.

The Resource Packet and other information is on our website: WorldAquaticAnimalDay.org

2. About this Resource Packet

A. Background and Rationale

This Resource Packet has been compiled by the students of the Animal Law Clinic at Lewis & Clark Law School (Clinic) together with AALI Fellow, Amy P. Wilson, and Professor Kathy Hessler. Our Clinic students come from a variety of countries and backgrounds and bring a broad range of perspectives and expertise which they share in the materials below.

The purpose of the Resource Packet is to provide a summary of some of the issues faced by aquatic animals and in particular, set out some of the regulation that applies to these animals. In addition, this document offers links to additional resources where one may look to learn more about the subjects covered here.

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

Legally, animals are categorized as *property*, making it difficult to protect them. Some of the protections available require proving cruelty, which is very difficult in the case of aquatic animals who are often out of sight when abuse happens. Additionally, aquatic animals are not included in the vast majority of laws that are designed that offer some protection from harm to other animals.

Because our 2020 focus is aquaculture, we consider some of the regulation, and lack thereof, in this area. Failure to address the welfare of aquatic animals in aquaculture regulation has led to problematic consequences. It is important to note that aquaculture not only impacts the animals who are utilized, but also wild animals, workers, consumers, and the environment more broadly. Thus, it is important to pay careful attention to the issues involved in raising aquatic animals for food or other products. This is especially true as it is projected that aquaculture production will continue to significantly rise in the foreseeable future.

B. The Animal Law Clinic

World Aquatic Animal Day is one project of the Clinic which also works on local, national, and international animal law issues in addition to working with the state and local community. Students conduct research, represent clients, and work on clinic projects to develop the field of animal law and encourage consideration of the interests of animals in legal decision-making. Clinic work includes: policy, legislative, transactional, and administrative law work; occasional litigation work; research; advocacy; and strategic planning. Students also work with other lawyers as well as community members, veterinarians, scientists, economists, and other professionals.

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.

The Clinic works to develop the field of animal law by working to:

i. harmonize human and animal interests;
ii. advance legal protection, representation, and access to justice for non-human animals;
iii. achieve justice for animals and humans by making clear the link between human and animal violence; and
iv. creatively use the laws we have, as well as develop new laws and tools, to better address questions of animal law.

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.

Aquatic animals are too often left out of the legal and regulatory frameworks that provide some protection for other non-human animals. Too little is understood about their welfare, environmental and health, and safety issues associated with aquatic animal use and production. Likewise, too little of the evolving scientific data relating to aquatic animals is available to the public and policy makers. When making decisions affecting their lives, it is important to consider the critical role of aquatic animals within ecosystems, as well as their individual capacities and biological needs.

Given the widespread use of aquatic animals for human goals, it is also important to consider questions raised by that usage - housing, feeding, medical care, transportation, slaughter, processing, breeding, testing, and exhibition. Until now, there has been no entity dedicated to the legal analysis of these issues. 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.

Nothing contained in the Resource Packet is intended to constitute (among other things) legal advice. Accordingly, you should not construe any of the information presented as legal advice.

The Clinic recommends consulting with your own attorney for specific advice that is tailored to your legal needs.

The Resource Packet includes legal information from different jurisdictions. It is important to note that the issues addressed may be regulated at 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, April 2020.

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 in the Resource Packet should not be construed as an endorsement of any organization or its practices.

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

A number of international and foreign resources have been included herein. Some of these have been translated. We do not make any warranties as to the accuracy of these sources nor the information contained herein. Furthermore, these have been provided by students, faculty and staff of the Clinic who may or may not be lawyers in the jurisdictions mentioned herein.

For the sake of brevity, we sometimes utilize the term "fish" as inclusive of other aquatic animals.

While "World Aquatic Animal Day" is a project of the Aquatic Animal Law Initiative of Lewis & Clark and we encourage action for this class of animals, we are not otherwise affiliated with organizations that choose to participate in this day and neither do we endorse their actions. We encourage all to be respectful and follow the relevant procedures, laws, regulations, and policies that apply.

This is a highly complicated subject and we note that there are various dimensions to 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 some information of use and interest. We encourage you to continue your own research on these and other subjects of interest. We have included some additional resources to assist in your further exploration of these topics.

3. Ten Ways to Get Involved

In these challenging times, it can be useful to think of ways to help others. April 3rd is a day to consider Aquatic Animals: the impact human activity has on them and their habitats, as well as our interaction with, treatment, and use of them. While we know that many people are rightly focused on other things right now, we also know that some people are looking for distractions from the news, ways to continue their learning, and means to advocate for others. If that is you, we have this update on some things you can do!

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.

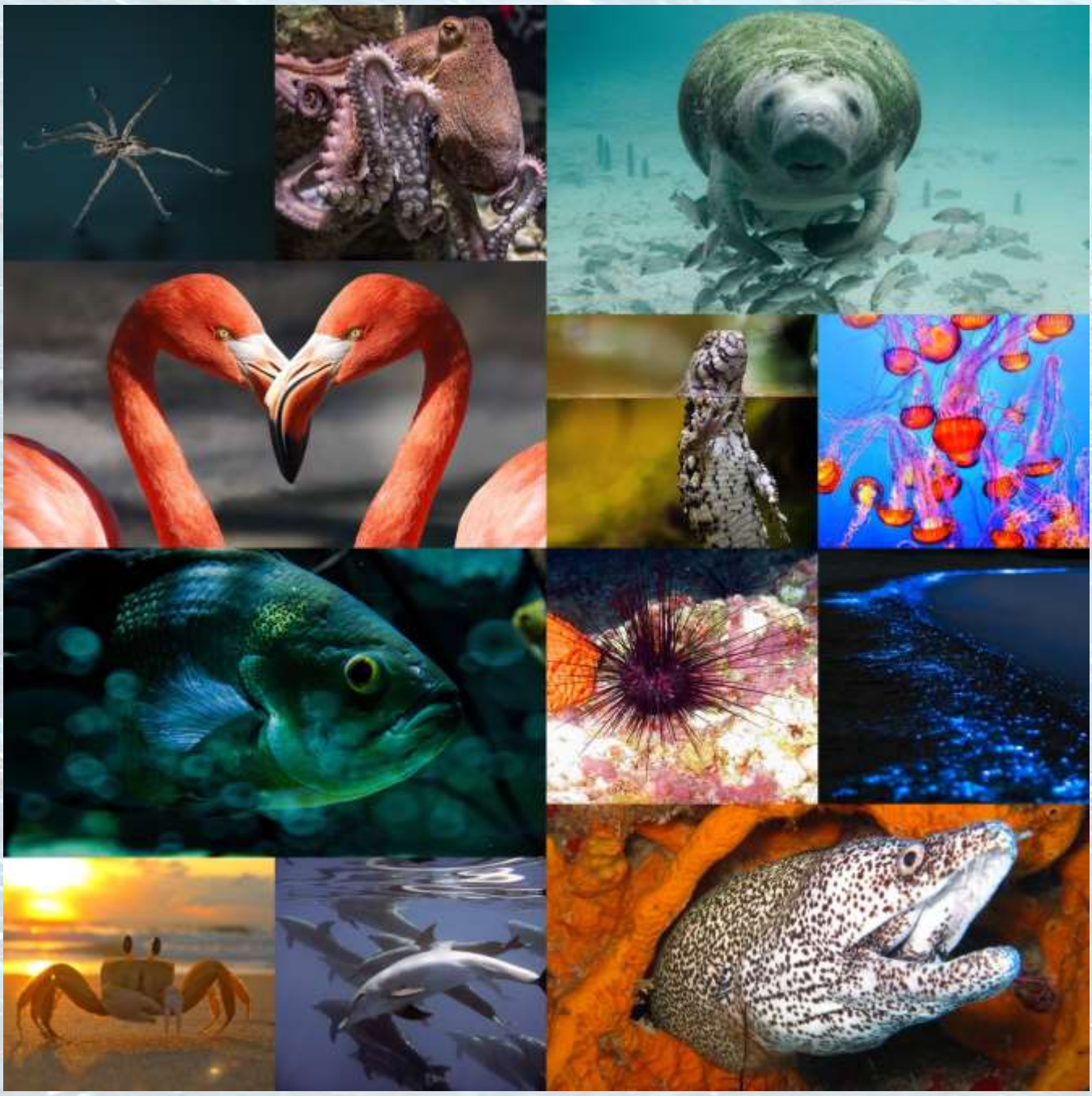
Share your efforts on social media, and we'll share with others - use **#worldaquaticanimalday**.

1. **Educate:** Learn about the threats that aquatic animals face, including threats to their habitats. Watch and share our Webinar Video Series on April 3rd; or read and share the Resource documents, on our website, WorldAquaticAnimalDay.org. You can also share resources from other organizations. Offer to speak remotely for a local school, provide students or others with informative electronic pamphlets, or share information on social media.
2. **Refrain:** Keep aquatic animals off your plate - try a plant-based alternative instead. Look for alternatives online, in stores, or restaurants, and support those who offer these options. Look for recipes for plant-based versions of "seafood" and try out a new dish!
3. **Support:** Connect with and support organizations already working to protect aquatic animals, oceans, lakes, and rivers, and our whole environment.
4. **Appreciate:** Take time to research and better understand aquatic animals in their natural habitat. Documentaries are a great way to see aquatic animals when you can't be there in person! Although there is a lot of bad news right now, there is some positive news to share as well. You can also show your appreciation by creating aquatic animal art!
5. **Get the Word Out:** If you're a student, make aquatic animals the focus of a class paper or publication; write a blog post or letter to the editor for your school or local paper. Anyone can use a Facebook "frame for the day" to support aquatic animals, share a short clip speaking about aquatic animals, or encourage others to support these efforts.
6. **Recycle, Reduce, & Clean Up:** Collect and recycle plastics at your home. Reduce your use of plastics and products containing microbeads. Research ways to reduce your use of plastics. Encourage others to do the same!
7. **Organize:** Plan a webinar or other digital event to help aquatic animals and invite an expert to talk about how to protect them. You can also host a remote documentary viewing or watch party.
8. **Get Active:** Sign a petition (or start your own!) supporting a ban on trade in wildlife, wildlife markets, single use plastics, or other practices that threaten aquatic animals or their habitats. Speak up for aquatic animals – report illegal trade or activities, cases of aquatic animal cruelty, or welfare violations. Help people understand that protecting animals protects humans and the environment as well.

9. **Reach Out:** Plan to contact your representatives when the current crisis has been addressed, and ask how you can help to ensure aquatic animals and their habitats are protected.
10. **Use the Law:** Identify issues in your jurisdiction that negatively impact aquatic animals; work to effect positive change through legislative initiatives, lawsuits, or by making public comments on proposed government action.

Regardless of the way 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 other platforms using the hashtag **#worldaquaticanimalday**.

4. Types of Aquatic Animals and Their Habitats



A. Introduction

When one thinks of aquatic animals, "fin" fish may come to mind. However, it is helpful to learn of the exceedingly vast types of aquatic animals.

"In biological context, the term *aquatic* is used to relate to water, as in aquatic animals, aquatic plants, aquatic environment, aquatic habitat, and aquatic locomotion."[2]

"Aquatic animals pertain to animals that live predominantly in different water forms, such as seas, oceans, rivers, lakes, ponds, etc. . . And these habitats where aquatic animals and plants live on are referred to as aquatic habitats. Aquatic habitats may be freshwater, marine, or brackish water."[3]

"Aquatic animals pertain to animals that live predominantly in different water forms, such as seas, oceans, rivers, lakes, ponds, etc. Examples of aquatic animals include fish, jellyfish, sharks, whales, octopus, barnacle, sea otters, crocodiles, crabs, dolphins, eels, rays, mussels, and so on."[4]

For the Air-Breathing Aquatic Animals, "[m]ost people would assume that all aquatic animals get their oxygen from water, but this isn't always the case. In fact, there are many sea creatures that need to breathe air to survive"[5], including dolphins/whales, manatees, diving bell spiders, mayflies, caddisflies, and lungfish, among others.

Below is a list that you may find surprising. This list is by no means a complete one, but it attempts to highlight some of the different groups.

[2] *Aquaculture*, BIOLOGY ONLINE, https://www.biologyonline.com/dictionary/aquatic (last visited Mar. 20, 2020).
[3] *Id.*
[4] *Id.*
[5] *Air Breathing Animals That Live Under Water*, ANIMALOGIC (Jan. 11, 2020), https://animalogic.ca/blog/air-breathing-animals-that-live-under-water .

B. List of Aquatic Animals

i. **Amphibians:** including frogs; toads; newts and salamanders
ii. **Crustaceans:** crabs; lobsters; shrimp; krill; barnacles; wood louse, water flea
iii. **Finfish:** sharks; other finfishes
iv. **Marine mammals:** cetaceans; pinnipeds; polar bears; otters, badgers, beavers; manatees and dugongs
v. **Mollusks:** mussels, oysters Scallops; mussels; cockles; oysters; clams
vi. **Cephalopods:** Nautiluses; squids; octopuses and cuttlefishes
vii. **Reptiles:** Turtles; snakes; iguana; crocodiles; alligators and geckos
viii. **Echinoderms:** Sea stars; sea urchins; sand dollars; sea cucumbers
ix. **Cnidaria:** Corals and jellyfish
x. **Ponifera:** Sponges
xi. **Birds:** Penguins; flamingos; seagulls; pelicans; ducks; geese; albatross; puffins
xii. **Aquatic insects**: zooplankton

C. Habitats

One may predominantly think of the ocean when thinking of aquatic animal habitats, and while that does indeed cover a large portion of relevant habitats, there are others to consider as well. Aquatic animals can be found in a variety of bodies of water, both freshwater and marine. In addition, there are a large number of aquatic animals in captive situations. For purposes of this section, we have differentiated between captive commercial settings, and those aquatic animals kept in people's homes.

"Aquatic animals are animals that live in the water. They either live in fresh water, such as lakes, rivers, and ponds, or saltwater, like the ocean."[6] "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. Aquatic ecosystems support a diverse assortment of animals including fishes, amphibians, reptiles, mammals, birds and invertebrates."[7]

[6] *Aquatic Animals Information*, STUDY.COM, https://study.com/academy/lesson/aquatic-animals-information-lesson-for-kids.html (last visited Mar. 20, 2020).
[7] *Aquatic Habitats*, WORLD ANIMAL FOUND. (Dec. 19, 2019) https://www.worldanimalfoundation.com/advocate/wild-earth/params/post/1286151/aquatic-habitats.

i. Bodies of water

These include seas, oceans, rivers, lakes, coral reefs, wetlands, islands, and others.

> "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. Captive Facilities

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 as well, such as aquaria, restaurants, offices, zoos, and various other locations. These range from small finfish to large aquatic mammals, such as orcas.

[8] *Id.*

"At aquariums around the country, orcas leap through the air for a handful of fish, and tourists flock to facilities that offer them the opportunity to swim or have their pictures taken with dolphins."[9] These facilities indicate to the public that they are concerned with the welfare of the aquatic animals. However, according to the Animal Welfare Institute,

> "Even a larger, full-size home aquarium can't provide the diversity of habitats and conditions that are found in the wild, and fail to meet the physical and psychological needs of its captives. Often, according to various aquarium publications, these tanks are overstocked with fish living in poor quality water, resulting in suffering and premature death."[10]

> "The public display industry keeps many species of marine mammals captive in concrete tanks, especially whales and dolphins. The very nature of these animals makes them uniquely unsuited to confinement. Life for captive whales and dolphins is nothing like a life in the sea. It is almost impossible to maintain a family group in captivity as animals are traded among different facilities. This unnatural situation can cause skin problems. In a tank, the environment is monotonous and limited in scope.
>
> The public display of whales and dolphins in marine parks and aquariums is waning in Europe and Canada, but it is still common in the United States and is increasing in developing countries, particularly those in Asia.
>
> The businesses that charge the public to see and interact with whales and dolphins in captivity contend that public display serves educational and conservation purposes. However, experience has proven that public display does not effectively educate the public who generally learn little of value about the animals that are on display in shows and swim-with facilities." [11]

iii. Homes, Offices, and Schools

Aquatic animals live in many households around the world - think of goldfish and reptiles kept as companion animals and koi fish or frogs in ponds. Other animals are found in offices, businesses and schools for entertainment, food, or educational uses.

> "Fish tanks are ubiquitous—found in doctor's offices, Chinese restaurants, corporate headquarters, and in millions of homes throughout the world. Some studies report that they reduce anxiety, stress, and blood pressure, calm hyperactive children, and provide some relief for those suffering from Alzheimer's

[9] *Marine Animal Exhibits: Chlorinated Prisons*, PETA, https://www.peta.org/issues/animals-in-entertainment/animals-used-entertainment-factsheets/marine-animal-exhibits-chlorinated-prisons/ (last visited Mar. 20, 2020).
[10] *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).
[11] *Marine mammals in captivity*, THE HUMANE SOC'Y OF THE U.S., https://www.humanesociety.org/resources/marine-mammals-captivity (last visited Mar. 20, 2020).

> disease. …Whether a small, sterile bowl with a single forlorn fish sitting on a kitchen table or a large tank in a municipal aquarium, they are designed to keep fish in captivity for human enjoyment. …Beyond the size of the tank, number of fish, and water quality and temperature, there are ethical and environmental costs inherent to the ornamental fish trade. Sadly, most captive fish live short lives and are easily replaced with new "stock"— creating a constant demand that feeds a cycle of collection/production, acquisition, and death."[12]

[12] ANIMAL WELFARE INST., *supra* note 10.

5. Scope of the Issue

A. Introduction

Aquatic animals face numerous threats and are utilized in a number of ways. In many instances, these uses and threats go hand in hand. Wild caught fishing is one of the activities putting significant pressure on animals in the wild. But other uses, including aquaculture, also exacerbate the problems which can be compounded by non-use dangers such as pollution and climate change.

Many fish species are close to collapse and even extinction. Corals are disappearing or facing "bleaching." This has a huge impact on the marine ecosystem. We have seen dramatic reduction in the populations of certain species. For example, bluefish tuna – since the 1960s there has been a 97% reduction in both Pacific and Atlantic Tuna. Other species also have rapidly swindling numbers, like Vaquitas – there are only nine of these animals left in the entire world.

For purposes of this section, we have categorized some of the uses and threats aquatic animals face. This is by no means a complete list and the contents have been included for illustrative purposes only. Each example warrants a full analysis which space limits do not permit here.

B. Uses

i. Companion animals

a. Aquatic animals kept as companion animals

As indicated above, one may find aquatic animals in countless households across the globe.

According to the American Pet Products Association's 2019-2020 National Pet Owners Survey, 11.5 million U.S. households own 139.3 million freshwater fish, 1.6 million U.S. households own 18.8 million saltwater fish, and 4.5 million U.S. households own 9.4 million reptiles, as companion animals.[13]

Although keeping aquatic animals as companion animals is deemed by some to have certain advantages, such as low maintenance cost and quietness,[14] it can also contribute to the extinction of some animals, including tropical fish who face significant overfishing and illegal fishing.

[13] *Pet Industry Market Size & Ownership Statistics,* AM. PET PRODUCTS ASS'N, https://www.americanpetproducts.org/press_industrytrends.asp, *See also*, *2019-2020 APPA National Pet Owners Survey*, AM. PET PRODUCTS ASS'N, https://www.americanpetproducts.org/pubs_survey.asp (last visited Mar. 20, 2020).

[14] *Why Fish Make Awesome Pets*, VETDEPOT (Jan. 7, 2016), http://blog.vetdepot.com/why-fish-make-awesome-pets.

Keeping these animals as companions also creates welfare and health problems that they may suffer from the small tanks and the unsuitable pairings, temperature, food and habitats.[15]

The welfare of these animals is not properly mandated, nor does the law always include aquatic animals in companion animal protections. For example, companion animals are generally protected under animal cruelty legislation, yet fish and other aquatic animals seldom get these protections. Sometimes they are excluded from the law altogether, and other times even when they are included, prosecutors do not take allegations of cruelty against them seriously, or choose to use their limited resources to protect them. Depending on the state, a goldfish for example, may not even be classified as an animal under the law.[16] It is problematic to exclude these animals from the protections given to other companion animals, but it is instructive to see how little they are considered to realize that they can regularly be excluded even from the definition of animal, which is of course, biologically inaccurate.

b. **Threats with wildlife trade**

The high demand for aquatic animals as companions (particularly "tropical" species) has had a major impact on multiple ecosystems. These animals are often wild-caught and transported across borders in terrible conditions. The removal of these animals from the wild effects biodiversity and other species. The wildlife trade is significant and happens legally and illegally.

> "Species impacted by poaching are sea turtles (for eggs, shells and meat). Sea turtles are protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) but still illegally hunted in areas such as Costa Rica.
>
> Although many shark populations are threatened, illegal fishing still occurs, especially in areas where shark finning persists, such as in the Galapagos Islands.
>
> Another example is illegal harvest of crab by Russian fishing fleets, either by unpermitted vessels or permitted vessels that have already exceeded their allowable catch. This illegally harvested crab is sold in competition with legally harvested crab, causing losses to fishermen that fish legally. It was estimated that in 2012, over 40% of the king crab sold in global markets was illegally harvested in Russian waters.
>
> In addition to illegal take of protected species, illegal fishing methods such as using cyanide (to capture aquarium fish or seafood) or dynamite (to stun or kill fish) are used in areas such as reefs, which destroy important habitat and can affect the health of the fish caught."[17]

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[15] *9 Reasons Why Fish Are Really Sad 'Pets',* PETA (Sept. 10, 2014), https://www.peta.org/living/animal-companions/9-reasons-fish-sad-pets/ (last updated June 28, 2018).
[16] Nicole Pallotta, *Animal Cruelty Charges Dropped Because Fish Are Not "Animals" Under North Carolina Law*, ANIMAL LEGAL DEF. FUND (June 11, 2019), https://aldf.org/article/animal-cruelty-charges-dropped-because-fish-are-not-animals-under-north-carolina-law/.
[17] Jennifer Kennedy, *10 Threats to Ocean Life*, THOUGHTCO., https://www.thoughtco.com/threats-to-ocean-life-4040366 (last updated Jan. 15, 2018).

ii. Entertainment

Aquatic animals, like their terrestrial counterparts, have been utilized for human entertainment for hundreds, if not thousands of years. Aquatic animals such as dolphins and killer whales are kept at facilities and forced to perform in shows and do tricks for audiences, day in and day out. This is extremely unnatural, as are the conditions in which they are kept.

> "Dolphins and whales are amazing creatures to watch, but capturing them from the wild and forcing them to live in captivity for entertainment purposes has a serious impact on natural marine ecosystems. Taking a single dolphin or whale from a pod can completely disrupt the pod's function. Over 145 orca whales have been forced into captivity over the lifespan of the whale captivity business, while nearly 90 percent of these whales died. In the wild, orcas can live to be 90 years old. However, the average orca in captivity only lives four or five years."[18]

One major example of this, is at the popular facility SeaWorld. There are many such facilities around the world. These animals are also used in movies – such as "Free Willy", "Flipper" and others.

a. Recreational fishing

Although it may not appear obvious, recreational fishing is also a form of "entertainment" in which aquatic animals are utilized. Even when the animals are eaten, this is distinguishable from pure subsistence fishing or shopping for food. This can also take the form of "catch and release" where

[18] *The 10 Biggest Threats Marine Mammals Face Today*, ONE GREEN PLANET, https://www.onegreenplanet.org/animalsandnature/biggest-threats-marine-mammals-face-today/ (last visited Mar. 20, 2020).

animals are caught for entertainment and returned to the water. Many of these animals do not survive the process.

Recreational fishing is defined as the "fishing of aquatic animals (mainly fish) that doesn't constitute the individual's primary resource to meet basic nutrition needs and are not generally sold or otherwise traded on export, domestic or black markets." Recreational fishing operates within a competitive sphere that includes commercial fisheries, which may harvest from the same stock, and can multiply stressors on vulnerable populations.

Providing "global estimates of participation in recreational fishing is difficult due to limited data available, particularly in less developed countries. Rough estimates of the global number of recreational fishers vary widely, from a minimum of 220 million to a maximum of 700 million, with this higher estimate almost twice the number of commercial fishers. Regardless of the actual numbers, participation in recreational fishing is increasing on a global scale, particularly in developing nations in accordance with the expansion of the middle class."[19]

> "Recreational Fishing (RF) can cause several conservation issues, including: high stock exploitation, selective harvest of 'trophy fish' (and therefore shifts in population structure), habitat destruction, unwanted catch and release mortality/disease, introduction of non-native species and disturbance of the environment. With these concerns, it is therefore necessary to orient the RF sector towards environmental sustainability on an international level, through various means such as the licensing of anglers and boats, establishing closed seasons and developing size and bag limits. Using these means and others, RF has already been taken into account in fisheries management in many developed countries. Though important, RF inclusion in management can generate conflicts in terms of resource allocation among various stakeholders, especially commercial fishers."[20]

iii. Aquatic Animals as Food

Aquatic animals are a source of food for many people around the world. There are two predominant sources of this: aquaculture and wild caught fishing.

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[19] *Id*.

[20] *The role of Recreational Fisheries in the sustainable management of marine resources*, FAO, http://www.fao.org/in-action/globefish/fishery-information/resource-detail/en/c/1013313/ (last visited Mar. 20, 2020).

a. Aquaculture

Aquaculture, our theme for 2020 World Aquatic Animal Day, will be dealt with more specifically in Section 5 below. However, we felt it important to include it here under the "Uses" section, and also to contrast it with "wild-caught" fishing.

> "Aquaculture is expected to satisfy the growing world population's demand for fish – and at the same time protect ocean fish stocks. Hopes are pinned on farming as an alternative to over-fishing. But the use of copious amounts of feed derived from wild fish, the destruction of mangrove forests and the use of antibiotics have given fish farming a bad name. Current research and development projects, however, show that environmentally-sound aquaculture systems are possible. The impact of aquaculture on the environment depends on several factors. It makes a difference whether the fish are farmed inland in freshwater, or along coastal areas. Intensive fish farms in coastal waters can pollute entire bays with uneaten food and fish faeces."[21]

b. Wild caught fishing

Wild caught fishing includes all fishing where aquatic animals are extracted from their natural habitats, to be utilized as food. This affects multiple species, and ecosystems more broadly.

[21] *Towards more eco-friendly aquaculture*, WORLD OCEAN REV. (2013), https://worldoceanreview.com/en/wor-2/aquaculture/eco-friendly-aquaculture/.

> "Whaling, shark, and dolphin hunting are among some of the most imminent threats to marine mammals. Slaughtering animals for sport or to sell as specialty foods is a practice that has greatly reduced the number of large marine mammals across the world's oceans. During the 2013 to 2014 season, Japan's Taiji dolphin hunt was responsible for the deaths of more than 800 dolphins. Shark finning is another inhumane, senseless practice that slaughters on average 100 million sharks a year. "[22]

Overfishing:

> "Fishing is one of the most significant drivers of declines in ocean wildlife populations. Catching fish is not inherently bad for the ocean, except for when vessels catch fish faster than stocks can replenish, something called overfishing.[23]
>
> The number of overfished stocks globally has tripled in half a century and today fully one-third of the world's assessed fisheries are currently pushed beyond their biological limits, according to the Food and Agriculture Organization of the United Nations. Overfishing is closely tied to bycatch—the capture of unwanted sea life while fishing for a different species. This, too, is a serious marine threat that causes the needless loss of billions of fish, along with hundreds of thousands of sea turtles and cetaceans."[24]

Illegal Fishing:

> "In many maritime regions of the world, illegal fishing has massively contributed to the depletion of fish stocks, especially in developing countries' coastal waters. Better international cooperation to control fishing vessels is now being launched. The aim is to eliminate illegal fishing in future. Nowadays, the world's fish stocks are not only under threat from intensive legal fishing activities; they are also at risk from illegal, unreported and unregulated (IUU) fishing. Illegal Fishing refers to fishing activities conducted by foreign vessels without permission in waters under the jurisdiction of another state, or which contravene its fisheries law and regulations in some other manner. Unreported Fishing refers to fishing activities which have not been reported, or have been misreported, by the vessels to the relevant national authority. Unregulated Fishing refers to fishing activities in areas where there are no applicable management measures to regulate the catch." [25]

Cultural Considerations:

> "Fishing, as one among many ways of providing for human existence, requires certain human adaptations and behaviors, with these adaptations and behaviors necessitating the development of certain cultural characteristics. These adaptations are rooted in the requirements of exploiting particular marine ecosystems with whatever technologies a people have available at a particular time, and then are

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[22] ONE GREEN PLANET, *supra* note 18.
[23] Note that these analyses do not consider the impact on the animals themselves.
[24] *Overfishing Overview*, WORLD WILDLIFE FUND, https://www.worldwildlife.org/threats/overfishing (last visited Mar. 20, 2020).
[25] *Illegal fishing*, World Ocean Rev. (2013), https://worldoceanreview.com/en/wor-2/fisheries/illegal-fishing/.

> ramified through the cultures of their fishing communities. Therefore, it is important to underscore that a fishing community's approaches to fishing, the fishing gear it utilizes, and its organization of other fisheries activities is usually the result of considerable experimentation over a long period of time.
>
> Because fishing cultures are rooted in the exploitation of particular marine ecosystems, the production relations and organization of fishing-activities of small-scale fishers living in very different cultures may be very similar, even though they are members of very distinct cultures. There are noteworthy exceptions to this, of course, which are seen in regions where the larger cultural traditions overwhelm this cross-cultural uniformity. For example, women make decisive contributions to fish processing and distribution in most small-scale fishing communities around the world, but in certain cultures they are not permitted to work in the fisheries."[26]

iv. Research, Science, and Education

Many may find it surprising that aquatic animals are utilized in scientific research[27] at all, let alone that they may currently account for the highest number of animals used. They have slowly been growing in popularity by those who test on nonhuman animals. As a result, scientific research is a major use of, and threat to, aquatic animals.

> "Since the early 1990s, fish have been increasingly used in biomedical research as models of human development and disease, in toxicity testing as subjects for measuring harmful effects of chemicals, and in aquaculture research to expand the farming of fish for food. It is not possible to determine the exact number of fish used in the U.S. because fish are not covered by the Animal Welfare Act. It is estimated, however, that roughly seven percent of all animals used in research are fish, meaning that some 3.5 -7 million fish are used annually in the U.S.
>
> From the researcher's point of view, fish provide simpler systems for the study of complex processes. Because fish are small, inexpensive, and relatively easy to house, they have become a 'convenient' test subject for many scientists. In addition, scientists are increasingly looking towards fish as an alternative to studies that more traditionally use mice and rats, thus, in theory, reducing animal costs by using a 'phylogenetically lower species.'
>
> The zebrafish, in particular, has become 'the fish of choice' for a variety of investigations. Since zebrafish embryos are transparent, develop outside of the mother, and grow rapidly (hatching in just three days), they are frequently used to study vertebrate development and physiology. Scientists are increasingly creating mutant zebrafish to identify genes that are essential for normal development.

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[26] *Cultural Characteristics of Small-Scale Fishing Communities*, FAO, http://www.fao.org/3/y1290e05.htm#bm05.2 (last visited Mar. 20, 2020).

[27] This term broadly encompasses all scientific research, testing, education, etc.

> Platyfish and swordtails, another kind of small fish, have been used as cancer models for more than 70 years. The Japanese medaka is one of the most commonly used fish models for carcinogenicity testing. Fish are also used in environmental toxicity testing to measure the effects of exposure to chemicals or pollution in the environment. Similarly, fish are also used as sentinels of environmental contamination.
>
> While the use of fish is considered a refinement alternative to the use of mammals, the danger is, because fish are so small and cheap, and because we do not have a good intuitive sense of how they feel or suffer, we will consider them expendable, not value their lives, and use them in tremendous quantities. Indeed, as evidenced by the large-scale mutagenesis projects currently underway, this is already happening. Emphasis needs to be placed on the development of alternatives that completely replace the use of all animals."[28]

Zebrafish is a species that has gained popularity with researchers, resulting in significantly increased usage each year.

> "Zebrafish is the new rat. Or mouse. More and more rodents in the lab are being replaced by these nifty little striped fish. They are easy to maintain, reproduce and develop rapidly, and there is a great similarity between the human and zebrafish genome. And because they are easily genetically manipulated, many human diseases and developmental disorders can be modeled in zebrafish, such as Parkinson's, Alzheimer's, and cancer.
>
> Like rodents, zebrafish (*Danio rerio*) can be used in tests investigating fear, stress, and anxiety, learning and memory, and social behavior. And these behaviors can be manipulated by changing their genetics (testing different strains as models for diseases), providing stressful stimuli (tapping on the tank, visuals of predators, etc.) and adding substances (anxiolytics such as buspirone, chlordiazepoxide, and diazepam; anxiogenics; socially relevant substances as ethanol and nicotine) to the water."[29]

Other species, such as cephalopods and crustaceans are being used in increasing numbers as well. As breeders find ways to produce more of these animals, they are more available for a number of research and commercial uses, without adequate consideration for their welfare.

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[28] *Animals in Science-Fish*, AM. ANTI-VIVISECTION SOC'Y, https://aavs.org/animals-science/animals-used/fish/ (last visited Mar. 20, 2020).
[29] Gonny Smit, *Zebrafish as lab animal increasingly popular*, BEHAV. RES. BLOG: NOLDUS INFO. TECH. (July 8, 2011), https://www.noldus.com/blog/zebrafish-as-lab-animal-increasingly-popular.

v. Decoration and Cultural

Perhaps another surprising use of aquatic animals is for their cultural and decorative value.

> "Fish are living beings, not artwork, yet some fish breeders "paint" fish by injecting fluorescent dye into their bodies or alter their genetic makeup to make them more attractive to buyers. Pet shops, discount superstores, florists, and even online catalogs sell "decorative" Betta fish (Siamese fighting fish) in tiny cups or flower vases. The fish often live in just a few ounces of water, which isn't enough to turn around in, much less swim in.
>
> When you purchase fish or support businesses or fairs that give fish away in contests or promotions, it encourages the pet trade to continue kidnapping fish from their ocean homes and breeding them on crowded, filthy farms. If you enjoy watching fish, consider downloading one of the many colorful and realistic fish-themed computer screensavers available on the Web."[30]

Betta Fish in particular are very popular and sold extensively. Some consider them companion animals and some consider them as decoration for homes, restaurants, offices and other businesses.

> "With flashy colors, iridescent scales, and long fins that flow around them like underwater ball gowns, betta fish are some of the most eye-catching creatures you might see for sale at a pet store or flea market. They're cheap, too—the fish are sold for as little as $2 each. It may seem tempting to buy these little gems as captivating, swimming decorations.

[30] *Fish in Tanks*, PETA, https://www.peta.org/issues/animal-companion-issues/cruel-practices/fish-tanks/ (last visited Mar. 20, 2020).

> But living animals aren't decorations, and some animal welfare advocates are concerned that the betta's reputation as an "easy" pet is exaggerated. Critics argue that such popularity and misconceptions about their care and biology can lead to them being some of the most commonly mistreated fish in the pet trade."[31]

C. Threats

In addition to the threats that aquatic animals face from the uses noted above, they face additional indirect threats to their habitats. Some of these additional threats include:

i. Climate change

Much has been written about climate change, and many people are becoming aware of the problems it presents to the environment, but they don't often consider the impact on the many species of aquatic animals directly.

[31] Kristin Hugo, *Betta fish often mistreated in pet industry, evidence suggests*, NAT'L GEOGRAPHIC, https://www.nationalgeographic.com/animals/2018/10/betta-fish-pet-stores-care-mistreatment-news/ (last visited Mar. 20, 2020).

> "Climate change is already impacting ocean species. Species (e.g., the silver hake) are shifting their distribution further north as their waters warm up.
>
> Stationary species such as corals are even more affected. These species can't easily move to new locations. Warmer waters may cause an increase in coral bleaching events, in which corals shed the zooxanthellae that give them their brilliant colors."[32]

The impact of climate change can vary among species and across geographic regions.

> "Climate change is already making a huge impact on the lives of marine mammals, especially in the Arctic. Because their habitat is literally melting away, mammals like the ringed seal must find new places to give birth and raise their young. As the ocean absorbs more carbon dioxide from the atmosphere, global waters are becoming more acidic. High pH levels hinder crustacean's ability to form shells and can harm fish larvae. This effect ripples up the food chain, leaving larger marine mammals without food sources, causing major damage to marine ecosystems across the entire world!"[33]

ii. **Human activities**

There are too many negative consequences of human activities on aquatic animals to fully list here, but a few are presented to help raise awareness of these problems.

[32] Jennifer Kennedy, *supra* note 17.
[33] ONE GREEN PLANET, *supra* note 18.

a. **Ship Strikes**

The number of ships operating in fresh and marine environments is monumental. They conduct a large portion of the world's business and have many resulting impacts on the ecosystems in which they operate.

> "The most tangible problem caused by shipping is ship strikes - when whales or other marine mammals are hit by a ship. This can cause both external wounds and internal damage, and can be fatal.
>
> Other issues include noise created by the ship, release of chemicals, transfer of invasive species through ballast water and air pollution from the ship's engines. They can also cause marine debris through dropping or dragging anchors through fishing gear."[34]
>
> "Ship strikes are the number one culprit in the disappearance of the North Atlantic Right Whale. The Right Whale is only one of many marine mammal species that is at risk of being hit by high-speed ships. It is estimated that over 90 manatees die prematurely due to ship strikes every year in Florida."[35]

b. **The building of dams and other human structures**

Although dams were once seen only as a significant boon to human safety and security, they are currently being reconsidered as a result of new evidence of the environmental damage they cause, along with new and safer ways to achieve the goal of helping humans. "The environmental

[34] Jennifer Kennedy, *supra* note 17.
[35] ONE GREEN PLANET, *supra* note 18.

consequences of large dams are numerous and varied, and includes direct impacts to the biological, chemical and physical properties of rivers and riparian (or "stream-side") environments."[36]

> "The dam wall itself blocks fish migrations, which in some cases and with some species completely separate spawning habitats from rearing habitats. The dam also traps sediments, which are critical for maintaining physical processes and habitats downstream of the dam (include the maintenance of productive deltas, barrier islands, fertile floodplains and coastal wetlands)."[37]

"Another significant and obvious impact is the transformation upstream of the dam from a free-flowing river ecosystem to an artificial slack-water reservoir habitat."[38]

c. Waste and Pollutants

1. Agricultural Runoff

> "Fertilizer and pesticide runoff from farms across the world pose a serious threat to marine mammals' ecosystems. Runoff is especially problematic in coastal regions where the excess nitrogen from fertilizer can spawn massive algae blooms that deplete water of oxygen creating a "dead zone" for fish. While small fish may be most affected, the chemicals from agricultural runoff bioaccumulate up the food chain. In some places, researchers have recovered beached Beluga whales that are so saturated with toxic chemicals from agricultural chemicals they must be handled like toxic waste."[39]

2. Acoustic Pollution

[36] *Environmental Impacts of Dams*, INT'L RIVERS, https://www.internationalrivers.org/environmental-impacts-of-dams (last visited Mar. 20, 2020).
[37] *Id.*
[38] *Id.*
[39] ONE GREEN PLANET, *supra* note 18.

"Human-made noise in the ocean includes noise from ships (propeller noise and noise from the mechanics of the ship), noise from seismic airgun noise from oil and gas surveys that emit regular blasts of noise over long periods of time, and sonar from military ships and other vessels."[40]

> "Whale and dolphins rely on acoustics to navigate their way through the ocean. These mammals rely on sound for communication, mating, foraging, and migration. The addition of loud noises from ships, sonar, drilling rigs, and other human sources can distort messages sent by marine mammals. Scientists believe that acoustic noise pollution prevents these mammals from being able to detect approaching ships or fishing nets, adding to the risk of being killed."[41]

d. **Oil and gas exploration and pollution**

> "Oil in or on the water is extremely dangerous to wildlife. For instance, when an animal lands in an area affected by oil, it will try to preen or clean itself and ingest the toxic petroleum product, causing severe damage to internal organs. Ingesting oil will greatly disrupt the reproductive process, and animals that have survived oil spills may suffer the long-term effects of breeding problems and may produce deformed offspring."[42]

[40] Jennifer Kennedy, *supra* note 17.
[41] ONE GREEN PLANET, *supra* note 18.
[42] *Oil Spill Response and Marine Mammals*, THE MARINE MAMMAL CENTER, https://www.marinemammalcenter.org/what-we-do/rescue/oil-spill-response.html (last visited Mar. 20, 2020).

e. **Drilling**

"The search for undersea oil and gas uses seismic airguns that fire bursts of sound at least as loud as a jet engine every few seconds for days or weeks on end. These bursts are audible underwater as far as 2,500 miles away, harming and even killing sea animals. Marine life may be deafened, have their communication sounds drowned out by airguns, or be driven away from locations they would otherwise inhabit, including crucial breeding grounds. As many as 138,000 Atlantic whales and dolphins are projected to be injured or killed by the use of seismic airguns in the Atlantic offshore drilling regions, according to U.S. government research. Tragically, these projections also include injuring or even killing as many as nine North Atlantic right whales, an endangered species with only 450 individuals left alive."[43]

f. **Habitat loss**

"By and large, loss of habitat is the biggest threat to the livelihood of marine mammals. Habitat loss can occur as the result of pollution, changes in ecosystems, ship traffic, and a number of other human-related problems. Only 0.6 percent of the ocean is protected under conservation laws, meaning there is a whole lot of open water that is fair game."[44]

g. **Invasive species**

"Native species are those that naturally inhabit an area. Invasive species are those who move into or are introduced into an area in which they are not native. These species can cause harm to other species and habitats. They may have population explosions because natural predators don't exist in their new environment.

Native species are impacted through loss of food and habitat, and sometimes an increase in predators. An example is the European green crab, which is native to the Atlantic coast of Europe and northern Africa. In the 1800's, the species was transported to eastern U.S. (likely in the ballast water of ships) and is now found along the eastern coast of the U.S. They have also been transported to the western coast of the U.S. and Canada, Australia, Sri Lanka, South Africa, and Hawaii.

Lionfish are an invasive species in the U.S. that are thought to have been introduced by the accidental dumping of a few live aquarium fish into the ocean during a hurricane. These fish are impacting native species in the southeastern U.S., and harming divers, who can get injured by their venomous spines."[45]

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[43] *Drilling Is Tragic For Marine Life*, ENVIRONMENT AMERICA, https://environmentamerica.org/sites/environment/files/AME_offshoretwopager_2015_print-1.pdf (last visited Mar. 20, 2020).
[44] ONE GREEN PLANET, *supra* note 18.
[45] Jennifer Kennedy, *supra* note 17.

h. Aquaculture Threats

1) Pollution and Diseases from Aquaculture

Aquaculture also causes harm to the natural environment, such as causing the loss of wild fish, pollution and diseases from aquaculture, aquaculture escape and habitat damage. "Concentrated fish can mean concentrated waste. Combined with uneaten food pellets, fish waste can impact the local environment by polluting the water and smothering plants and animals on the seafloor. There are also concerns that diseases and parasites—common occurrences in crowded pens—are spread to wild fish."[46]

2) Aquaculture Escape

"When fish or shrimp are kept in pens or ponds that are connected to natural waterbodies, some can escape. This isn't as harmless as you might think. In some cases, escapees can impact wild populations by competing with them for food, habitat and spawning partners."[47]

3) Habitat Damage from Aquaculture

"Many types of farmed seafood, particularly those grown in coastal net pens and ponds, come at the expense of sensitive and important coastal habitat. Where and how fish are farmed can make all the difference."[48]

i. Wild caught fishing

As referred to above, wild caught fishing creates a number of problems for aquatic animals. The loss of wild fish is a significant problem which does not receive enough attention.

> "While farmed fish and shellfish can supplement our seafood supply, they can't replace the variety and abundance of seafood from the wild. Some fish farms still depend on wild populations to supply eggs or juveniles that the farmers raise for market. Many fish farms also depend on wild fish, like sardines or anchovies, as food for the farmed species."[49]

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[46] *Aquaculture – Pollution & Disease,* SEAFOOD WATCH, https://www.seafoodwatch.org/ocean-issues/aquaculture/pollution-and-disease (last visited Mar. 20, 2020).
[47] *Aquaculture – Escapes*, SEAFOOD WATCH, https://www.seafoodwatch.org/ocean-issues/aquaculture/escapes (last visited Mar. 20, 2020).
[48] *Aquaculture – Habitat Damage*, SEAFOOD WATCH, https://www.seafoodwatch.org/ocean-issues/aquaculture/habitat-damage (last visited Mar. 20, 2020).
[49] *Aquaculture – Wild Fish*, SEAFOOD WATCH, https://www.seafoodwatch.org/ocean-issues/aquaculture/wild-fish (last visited Mar. 20, 2020).

Some additional issues include:

a. Entanglements
b. By-catch
c. Overfishing
d. Illegal fishing
e. Incidental killing
f. Intentional killing to reduce competition
g. Poaching (illegal fishing)
h. Plastic pollution from lost nets and pens
i. Loss of food for wild fish due to overfishing are targeted fishing

6. Aquaculture: Introduction

A. Definition of Aquaculture

The Food and Agriculture Organization of the United Nations collects enormous amounts of information about both wild caught fishing and aquaculture. It produces reports regularly and is one of the best sources of information on the topic. As such, below is information from one of their recent reports.

"Aquaculture or farming in water is the aquatic equivalent of agriculture or farming on land. In this regard, a broad definition of agriculture includes farming both animals and plants. Similarly, aquaculture covers the farming of both animals (including crustaceans, finfish and mollusks) and plants (including seaweeds and freshwater macrophytes)."[50]

According to FAO,

> "[A]quaculture is the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms which are exploitable by the public as a common property resources, with or without appropriate licenses, are the harvest of fisheries."[51]

[50] *Aquaculture-Definitions*, FAO, http://www.fao.org/3/x6941e/x6941e04.htm (last visited Mar. 20, 2020).
[51] *Id.*

B. Types of Aquaculture Systems[52]

"Aquaculture systems range from very extensive, through semi-intensive and highly intensive to hyper-intensive. However, the specific characterization of each system must be defined, as there are no clear distinctions and levels of intensification represent a continuum.

Farming systems are also diverse for example including:

- Water-based systems (cages and pens, inshore/offshore).
- Land-based systems (rainfed ponds, irrigated or flow-through systems, tanks and raceways).
- Recycling systems (high control enclosed systems, more open pond-based recirculation).
- Integrated farming systems (e.g. livestock-fish, agriculture and fish dual use aquaculture and irrigation ponds).

Various aquatic organisms are grown in different ways including:

- Fish (ponds, polishing ponds, integrated pond systems).
- Seaweeds and macrophytes (floating/suspended culture, onshore pond/tank culture).
- Mollusks (bottom, pole, rack, raft, long-line systems also culture-based fisheries)
- Crustaceans (pond, tank, raceway, culture-based fisheries).
- Other minor invertebrates, such as echinoderms, coelenterates, seahorses, etc. (tanks, ponds, culture-based fisheries)

The phases of aquaculture include:

- Broodstock holding.
- Hatchery production of seed.
- Nursing systems.
- Grow-out systems.
- Quarantining.

Together, this mix of intensity, culture systems, species, farming systems and different phases of culture create an extremely diverse collection of aquaculture systems and technologies."[53]

[52] *Aquaculture Systems and Species*, FAO, http://www.fao.org/3/AB412E/ab412e07.htm. (last visited Mar. 20, 2020).
[53] *Id.*

C. Global Statistics on Aquaculture and Fisheries

In its most recent report, the FAO 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).[54] It is also important to note that so many animals are killed each year that their individual numbers are not counted, and 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.

i. Aquaculture

> "Global aquaculture production in 2016 was 110.2 million tonnes (this include plants), with the first-sale value estimated at USD 243.5 billion.[55] 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 tons of non-food products (USD 214.6 million). In this context, the contribution of aquaculture to the global production of capture fisheries and aquaculture combined has risen continuously, reaching 46.8 percent in 2016, up from 25.7 percent in 2000.
>
> The growth of farming of fed aquatic animal species has outpaced the farming of unfed species in world aquaculture.[56] However, in 2016, aquaculture was the source of 96.5 percent by volume of the total 31.2 million tons of wild-collected and cultivated aquatic plants combined."[57]

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[54] FOOD AND AGRIC. ORGANIZATION OF THE UNITED NATIONS, THE STATE OF WORLD FISHERIES AND AQUACULTURE 7 (2018), http://www.fao.org/3/CA0191EN/CA0191EN.pdf.

[55] *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.

[56] *Id*. at 9. The share of unfed species in total aquatic animal production decreased gradually from 2000 to 2016, shrinking by 10 percentage points to 30.5 percent.

[57] *Id*. at 10. Global production of farmed aquatic plants, overwhelmingly dominated by seaweeds, grew in output volume from 13.5 million tonnes in 1995 to just over 30 million tonnes in 2016.

ii. **Fisheries**

"Global total capture fisheries production was 90.9 million tons in 2016, showing a small decrease in comparison to the two previous years. Decreasing catches affected 64 percent of the 25 top producer countries[58] but only 37 percent of the remaining 170 countries.

However, according to FAO the fraction of fish stocks that are within biologically sustainable levels has exhibited a decreasing trend, from 90.0 percent in 1974 to 66.9 percent in 2015. In contrast, the percentage of stocks fished at biologically unsustainable levels increased from 10 percent in 1974 to 33.1 percent in 2015, with the largest increases in the late 1970s and 1980s.

The total number of fishing vessels in the world in 2016 was estimated to be about 4.6 million, unchanged from 2014. The fleet in Asia was the largest, consisting of 3.5 million vessels, accounting for 75 percent of the global fleet. Globally, the number of engine-powered vessels was estimated to be 2.8 million in 2016, remaining steady from 2014, representing the 61 percent of all fishing vessels in that year."[59]

iii. **Fishers and fish farmers**

"The most recent FAO's official statistics indicate that 59.6 million people were engaged in the primary sector of capture fisheries and aquaculture in 2016, with 19.3 million people engaged in aquaculture and 40.3 million people engaged in fisheries. The proportion of those employed in capture fisheries decreased from 83 percent in 1990 to 68 percent in

[58] *Id*. at 8. These countries are China, Indonesia, United States of America, Russian Federation, Peru, India, Japan, Viet Nam, Norway, Philippines, Malaysia, Chile, Morocco, Republic of Korea, Thailand, Mexico, Myanmar, Iceland, Spain, Canada, Taiwan, Province of China, Argentina, Ecuador, United Kingdom, Denmark. *Id*.
[59] *Id.* at 8-9.

2016, while the proportion of those employed in aquaculture correspondingly increased from 17 to 32 percent. In this context, 85 percent of the global population engaged in the fisheries and aquaculture sectors in 2016 was in Asia, followed by Africa (10 percent) and Latin America and the Caribbean (4 percent)."[60]

iv. **Fish utilization and processing**

"In 2016, of the 171 million tons of total fish production, about 88 percent or over 151 million tons were utilized for direct human consumption, a share that has increased significantly in recent decades, as it was 67 percent in the 1960s. In the same year, the greatest portion of the 12 percent used for non-food purposes (about 20 million tons) was reduced to fishmeal and fish oil (74 percent or 15 million tons), while the rest (5 million tons) was largely utilized as material for direct feeding in aquaculture and raising of livestock and fur animals, in culture (e.g. fry, fingerlings or small adults for ongrowing), as bait, in pharmaceutical uses and for ornamental purposes."[61]

v. **Fish trade and commodities**

"Fish and fish products are some of the most traded food items in the world today, and most of the world's countries report some fish trade. In 2016, about 35 percent of global fish production entered international trade in various forms for human consumption or non-edible purposes. In this context, the share of fish and fish products for human consumption alone has shown an upward trend, from 11 percent in 1976 to 27 percent in 2016."[62]

vi. **Fish consumption**

"In per capita terms, food fish consumption has grown from 9.0 kg in 1961 to 20.2 kg in 2015, at an average rate of about 1.5 percent per year. This expansion has been driven not only by increased production, but also by a combination of many other factors, including

[60] *Id.* at 10.
[61] *Id.* at 5.
[62] *Id.* at 15.

reduced wastage, better utilization, improved distribution channels and growing demand, linked with population growth, rising incomes and urbanization."[63]

D. Specific Aquaculture Issues[64]

The farming of aquatic species, also known as aquaculture and aqua farming, is the farming of finfish, crustaceans, mollusks, aquatic plants, algae, and other aquatic organisms.[65] There are two types of operations in the commercial fish industry: commercial sea fisheries[66] and farmed fisheries.[67] This section will focus on farmed fisheries, or aquaculture. Aquaculture operations can use either open-systems or closed-systems. Some of the most common open-system methods include, open net pens or cages – where fish are placed in large netted areas in offshore coastal areas or freshwater lakes; and submersible nets or pens – which are spherical cages located off-shore below the surface.[68] Some of the most common closed-system methods include, raceways – where fish are raised in confined pools/channels and water is diverted into the pools from waterways, such as streams; and recirculating systems – where fish are raised in tanks and water is treated and recirculate through the tanks.[69]

Aquaculture is used for many purposes, including producing food for human and animal consumption; producing commercial products; increasing stocks for commercial and sport fishing; and enhancing/restoring threatened and endangered aquatic species. Human intervention in the rearing process, including breeding, stocking, feeding, protection from predators and transportation, is required to produce these animals.[70]

Whether for purposes of conservation, food production or commerce, aquaculture both derives from and impacts human activity, hence the need for discourse concerning regulation. The development of aquaculture regulation requires conversation both at the federal and state levels and must be guided by the policy and legal framework presently in existence. This conversation is

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[63] *Id.*

[64] This section is taken from a paper previously produced by the Animal Law Clinic, with minor edits for clarity. Full acknowledgements are included at the end of the document.

[65] *Aquaculture*, WIKIPEDIA, https://en.wikipedia.org/wiki/Aquaculture (last visited Mar. 20, 2020).

[66] This is how fish are acquired that are labeled "wild caught." It is the taking of fish and other seafood and resources from oceans, rivers, and lakes for the purpose of marketing them. Practices for commercial fishing include the use of long lines, dragged gear, a variety of massive nets, and harvesting machines. *See* Dag Paul et al., *Commercial Fishing*, ENCYCLOPEDIA BRITANNICA, https://www.britannica.com/technology/commercial-fishing/Types-of-fishery (last visited Mar. 20, 2020) (describing commercial fishing types and techniques).

[67] Also referred to as "aquaculture"

[68] *Fishing & Farming Methods*, SEAFOOD WATCH, http://www.seafoodwatch.org/ocean-issues/fishing-and-farming-methods (last visited Mar. 20, 2020).

[69] *Id.*

[70] U.C. Barg, *Guidelines for the Promotion of Environmental Management of Coastal Aquaculture Development*, FAO, http://www.fao.org/docrep/t0697e/t0697e02.htm (last visited Mar. 20, 2020).

crucial because of the severe environmental,[71] human health,[72] and animal welfare implications. Below, we have set out some of these animal welfare concerns.

There are only a few federal laws that address aquaculture specifically and even fewer that address animal welfare. However, there are none that address animal welfare in aquaculture. Most relevant federal laws are related to either animal welfare in other areas, such as animal testing or human concerns regarding aquaculture more broadly, for instance the Clean Water Act.

Current practices do not sufficiently protect either human or animal welfare, the need for regulation arises.

E. Aquaculture Production[73]

Over half of all fish consumed for food worldwide each year are raised on land- or ocean-based aquafarms.[74] Indeed, the Food and Agriculture Organization of the United Nations reports that the aquaculture industry is growing three times faster than land-based animal agriculture, and aquafarms will soon become even more prevalent as our natural fisheries become exhausted.[75]

Aquaculture however does not exist without drawbacks. Depending on their location, be it a land-based facility, a fishpond, or a floating cage in a saltwater bay, high concentrations of aquatic species can alter or destroy existing wild habitat,[76] increase local pollution levels,[77] and negatively impact the genetic makeup of local species.[78]

Farmed fish spend their entire lives in congested, unclean enclosures, and many suffer from parasitic infections, diseases, and agonizing injuries.[79] The farms that raise fish directly in net pens or other structures in natural waters kill off thriving natural habitats by overloading them beyond

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[71] For example: "The emissions of marine animal waste from aquaculture facilities into the ecosystem will not only affect other fish, but will also result in nutrient pollution. . . waste can contain antibiotics, pesticides and fish feces which pollutes the open water and makes it unsafe for human drinking, recreational use, and for other wildlife." *See* Brianna Healey et. Al, *Aquaculture and Its Impact on the Environment*, DEBATING SCI. (Apr. 20, 2016), https://blogs.umass.edu/natsci397a-eross/aquaculture-and-its-impact-on-the-environment/ (last visited Mar. 20, 2020) (looking at a number of environmental impacts of aquaculture).

[72] The Center for Food Safety explains among other concerns, fish in aquaculture contain various chemicals that are unsafe for human consumption, such as various antibiotics, fungicides, and dyes. *See Human Health Risks*, CTR FOR FOOD SAFETY, https://www.centerforfoodsafety.org/issues/312/aquaculture/human-health-risks (last visited Mar. 20, 2020) (focusing on aquaculture's impacts on humans).

[73] This section is taken from a paper previously produced by the Animal Law Clinic, with minor edits for clarity. Full acknowledgements are included at the end of the document.

[74] *See* Barg, *supra* note 70 (addressing guidelines for promotion of aquaculture).

[75] *Fish*, GEORGIA ANIMAL RIGHTS AND PROTECTION, http://garpga.org/issues/animals-used-for-food/fish (last visited Mar. 20, 2020) [hereinafter Fish*]; Food Outlook: Biannual Report on Global Food Markets*, FAO (June 2017), http://www.fao.org/3/a-i7343e.pdf (Stating that global aquaculture production expands at 4-5 percent every year, while global meat production is set to grow by 2.5 percent per year, and milk production at 1 percept growth per year).

[76] SEAFOOD WATCH, *supra* note 46.

[77] *Id.*

[78] *Id.*

[79] *Id.*

their capacity.[80] Waste from the excessive number of fish can cause huge blankets of green slime on the water's surface,[81] lessening oxygen and destroying much of the life in the water.[82]

On aquafarms, high-volume systems control food, light (on indoor farms), and growth stimulation.[83] Genetic engineering is often used to accelerate growth,[84] and hormones may be injected into fish to change their reproductive behavior.[85] In some countries, fish farmers also add antibiotics to the fish's food or water, and residues of these drugs have been found in fish sold for human consumption.

i. **Crowding, Injury, and Death**

Fish farming is a business model and thus driven by a profit motivation. As such, there is a tendency to use very high stocking densities, meaning that as the animals grow, they are severely crowded,[86] at times to the point of injury,[87] inability to access food,[88] and increased susceptibility to disease.[89] Through such practice, fish are also deprived of space to swim freely and utilize their senses.[90] They also rub against the walls of the enclosures and on each other, inevitably suffering physical injuries or harm. In most of the aquafarms, small fish are bullied and killed by larger ones and so the fish are constantly sorted to make sure that the faster-growing ones are moved to a more appropriately sized grouping.[91] The transfer process is physically damaging to the fish, leaving them, scraped of their protective scales and thus even more vulnerable to diseases.[92]

Additionally, sea lice, for example, eat at the fish, causing their scales to fall off creating large sores. In severely crowded conditions, these parasites often eat down to the bone on fish's faces, resulting in what is sometimes called a "death crown."[93]

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[80] Jeff Chatterton, *Framing the Fish Farmers: The Impact of Activists on Media and Public Opinion about the Aquaculture Industry*, ATLANTIC INSTITUTE FOR MARKET STUDIES (June 2004), http://www.aims.ca/site/media/aims/Chatterton.pdf.
[81] *Id.*
[82] *Id.*
[83] *Aquaculture Methods*, SEA CHOICE, http://www.seachoice.org/info-centre/aquaculture/aquaculture-methods/ (last visited Mar. 20, 2020).
[84] *Food Technology, Nutrition & Health: Conference Report*, FOOD SUMMIT (2018), https://food.global-summit.com/america/ (last visited Mar 7, 2018).
[85] *Id.*
[86] *Fish Farming*, ANIMAL WELFARE INST., https://awionline.org/content/fish-farming (last visited Mar. 20, 2020).
[87] *Id.*
[88] *Id.*
[89] *Id.*
[90] 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.
[91] *See* Fish, *supra* note 75 (analyzing animals used for food).
[92] *Id.*
[93] Allene Edwards, *Safe Fish to Eat and the Fish to Avoid*, ORGANIC LIFESTYLE MAG. (Sept. 11, 2017), http://www.organiclifestylemagazine.com/safe-fish-to-eat-and-the-fish-to-avoid.

These conditions are responsible for death, diseases and deformities in most fish that are produced through aquaculture.[94] It has been reported that fifty percent of the world's farmed fish suffer from hearing loss[95] – just one of the conditions that continue to go unaddressed.

ii. **Diet**

Many suggest aquaculture as an alternative to depleting wild fish populations.[96] They assert that many of the fish species they farm are predators, like salmon and shrimp, and yet continue to feed them on ocean fish.[97] It is estimated that it takes five pounds of ocean fish to produce 1 pound of farmed fish. Aquafarmers have also begun to feed fish oil and fish meal to fish who naturally eat only plants, in an effort to make them grow faster.[98] The aquaculture industry uses up nearly 70 percent of the global supply of fish meal and nearly 90 percent of the global supply of fish oil.[99]

Additionally, fish farmers inject fish feed with powerful chemicals and antibiotics to help fish survive the diseases caused by severe crowding and filth.[100] The ripple effect is that these chemicals are excreted into water systems and also transferred to humans in dangerously high levels[101] when they eat these fish. It has been argued that the levels of chemicals found in farmed fish are seven times higher than the already-dangerous levels found in their wild counterparts.[102]

iii. **Contaminant Stew**

Contaminants from ocean-based aquafarms, 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 fish in the area—even threatening some populations of wild salmon to the point of extinction.[103]

iv. **Coloring**

In some cases, chemicals are added to fish in order to make them more visually appealing to consumers. For example, salmon have artificial coloring added to their feed in order to change the color of their flesh, from their natural gray to pink. As a result, humans are also subjected to ingesting those chemicals when they eat farm-raised salmon.[104]

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[94] 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.
[95] *Id.*
[96] Universiteit Leiden, *Sustainable approach for the world's fish supply*, SCI. DAILY (Jan. 13, 2015), https://www.sciencedaily.com/releases/2015/01/150113090413.htm.
[97] *Id.*
[98] *See* Fish, *supra* note 73 (analyzing animals used for food).
[99] *Id.*
[100] *Id.*
[101] *Id.*
[102] *Id.*
[103] *Id.*
[104] *See* Allene, *supra* note 93 (addressing which fish are safe to eat).

v. Fish Slaughter

Scientific research has established that many methods and slaughter techniques currently used on farmed fish are inhumane, including gill-cutting without prior stunning, asphyxiation in air or on ice, carbon-dioxide stunning, and live chilling.[105] The process of harvesting farmed fish usually comprises three stages: a period of food withdrawal to empty the gut; the collection and movement of the fish to the point of slaughter; and the process of stunning and killing.[106] The impact of these processes on the welfare of the fish varies significantly with the species, the methods used and the care and attention to detail applied throughout.[107]

Each of the above processes has its own impact. Starvation for example, lowers the fishes' metabolic activity, reducing the rate at which ammonia and carbon dioxide build up in the water and transportation.[108] It also prevents fecal contamination during processing, which can shorten the shelf life of the fish.[109] 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.[110] Fish gathering and transportation on the other hand involves crowding, which results in suffocation, even before the fish are delivered to the slaughter.[111]

In the United States, there is little to no regulation to ensure the humane treatment of fish. Nearly 40 percent of farmed fish die before the aquafarm operator is ready to slaughter them.[112] The duration of starvation ranges from one to 10 days.[113]

There is little to no information about how fish raised on farms are slaughtered, this needs to be addressed.

[105] Stephanie Yue, *An HSUS Report: The Welfare of Farmed Fish at Slaughter*, THE HUMANE SOC'Y OF THE U.S., http://www.humanesociety.org/assets/pdfs/farm/hsus-the-welfare-of-farmed-fish-at-slaughter.pdf.
[106] J.A. Lines & J. Spence, *Humane Harvesting and Slaughter of Farmed Fish*, 33 REV. SCI. TECH. OFF. INT. EPIZ., 255-264, (2014), *available at* https://pdfs.semanticscholar.org/bc54/9627077e8876bbaf69928f644295c3a452d7.pdf.
[107] *Id.*
[108] M. Jobling, *The influences of feeding on the metabolic rate of fishes: a short review*, 18 J. Fish Biol., 385–400 (1995), available at https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1095-8649.1981.tb03780.x.
[109] A.J. Wall, *Ethical considerations in the handling and slaughter of farmed fish*, In Farmed fish quality (S.C. Kestin & P.D. Warriss, eds). Fishing News Books, Blackwell Science, Oxford, 108–115 (2001).
[110] *Id.*
[111] *See* Lines et. al, *supra* note 106 (addressing the slaughter of farmed fish).
[112] *See* Fish, *supra* note 73 (analyzing animals used for food).
[113] *Id.*

vi. **Humane Treatment**

Scientific research contends that fish have nerves and brains that sense pain, just as all animals do. According to Professor Donald Broom,[114] the scientific literature is quite clear. Anatomically, physiologically and biologically, the pain system in fish is virtually the same as in birds and mammals, and indeed, neurobiologists have long recognized that fish have nervous systems that comprehend and respond to pain.[115] Scientists tell us that fish brains and nervous systems closely resemble our own.[116] For example, fish (like "higher vertebrates") have neurotransmitters such as endorphins that relieve suffering; the only reason for their nervous systems to produce these painkillers is to relieve pain.[117] A team at the University of Guelph in Canada recently surveyed the scientific literature on fish pain and intelligence. They concluded that fish feel pain and that "the welfare of fish requires consideration."[118]

However, there is another school of thought that opposes the assertion that fish feel pain. They argue that the results of these scientific studies are frequently misinterpreted and that some are not replicable, and thus any claims that fish feel pain remain unsubstantiated.[119] They allege that the

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[114] A scientific advisor to the British government – more of his credentials here: http://www.neuroscience.cam.ac.uk/directory/profile.php?dmb16.

[115] *See* Donald M. Broom, *Fish brains and behavior indicate capacity for feeling pain: Commentary on Key on fish pain*, ANIMAL STUDIES REPOSITORY (2016) available at http://animalstudiesrepository.org/cgi/viewcontent.cgi?article=1031&context=animsent (reviewing ability of fish to feel pain); *See* Lynne U. Sneddon, *Pain in Aquatic Animals*, ANIMAL STUDIES REPOSITORY (2015), http://animalstudiesrepository.org/acwp_asie/55/ (stating that fish, crustaceans, and mollusks (1) demonstrate behavioral responses to potentially painful events, and (2) that all three have at least most of the criteria needed to experience pain); Lynne U. Seddon, *Pain Perception In Fish: Indicators and Endpoints*, ANIMAL STUDIES REPOSITORY (2009), http://animalstudiesrepository.org/cgi/viewcontent.cgi?article=1010&context=acwp_aff (concluding "fish are capable of nociception and appear to experience a negative affective state"); *see also* Isabelle Maccio-Hage, *Pain in Fish*, FAIR-FISH (2005), http://www.fair-fish.ch/media/filer_public/c8/41/c841966b-11d3-4673-9476-fbd93c5ab3c6/tmpimport0eseir.pdf (asserting that fish demonstrate their ability to feel pain through changes in behavior when confronted with noxious stimuli); *see also* Culum Brown, *Fish Intelligence, Sentience & Ethics*, ANIMAL STUDIES REPOSITORY (2015), http://animalstudiesrepository.org/cgi/viewcontent.cgi?article=1074&context=acwp_asie (stating that fish have the requisite "hardware" to feel pain); *see also* Culum Brown, *How Fish Think and Feel, And Why We Should Care About Their Welfare*, WILDLIFE AUSTRALIA 13-14 (Mar. 2016), https://www.researchgate.net/publication/297577331_How_%20sh_think_and_feel_and_why_we_should_care_%20about_their_welfare (finding that brain structures in fish include areas thought to be involved in emotional and cognitive functions); *see also* John Webster, *Fish are Sentient Beings*, 14, 17-22 (2009), http://www.fishcount.org.uk/published/low/fishcountchapter3LR.pdf (concluding fish are sentient animals, meaning they are capable of feeling fear and pain, and they do so via pain receptors, or nociceptors, which connect to the brain); *see also* Nathan Runkle, *New Scientific Study: Crabs, Lobsters, and Other Aquatic Animals Feel Pain*, MERCY FOR ANIMALS (Jan. 18, 2013), http://www.mercyforanimals.org/new-scientific-study-crabs-lobsters-and-other-aquatic-animals-feel-pain (commenting that hermit crabs and prawns display behaviors of pain avoidance).

[116] *Id.*

[117] *Fish Feel Pain*, PETA, https://www.peta.org/issues/animals-used-for-food/factory-farming/fish/fish-feel-pain/ (last visited Mar. 20, 2020).

[118] Mary Finelli & Robert Grillo, Fish Exploited for Food Suffer Like Mammals and Birds, FREE FROM HARM (Mar. 3, 2014), https://freefromharm.org/fish-exploited-for-food-suffer-like-mammals-and-birds/.

[119] J.D. Rose et al., *Can fish really feel pain?*, 15 FISH AND FISHERIES 97–133 (March 2014), file:///C:/Users/user/Downloads/Rose_et_al-2014-Fish_and_Fisheries%20(1).pdf.

Anglers Studies[120] claiming to have found that "fish feel pain" have not been able to distinguish between nociception and conscious pain.[121] Further, critics assert that studies claiming to demonstrate that fish feel pain showed selective use of evidence, poor definitions, and inconsistent and trivial results.[122] As a result of their analysis, they argue that the way we treat and manage fish should be based on respect and further, that sound science, realities and objective views on their well-being should inform management, not human emotion or feelings.[123]

The conversation regarding the ability of fish 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 fish, representing an enormous diversity in morphology, behavior, nutrition, reproduction, and environmental habitats.[124] In addition, morphological, physiological, and behavioral changes may occur in a particular species at different periods of its life.[125] This fact complicates the ability to arrive at a jointly agreed conclusion. The majority of scientific and ethical experts however agree that evidence indicates a high likelihood that fish feel pain.

Moreover, even in the case of those who have not reached a conclusion (including optimistic agnostics,)[126] it can be argued that the precautionary principle applies.[127] Given the monumental number of fish killed each year in commercial fisheries, application of this principle would have a significant impact.[128] Such a position, some would argue, is not only prudent, but also ethically obligatory.[129]

The increasing consciousness and awareness of citizens who want to know more about the regulation and treatment of animals used in food and other production[130] calls for a better policy and regulatory approach. There is an urgent need for citizens and lawmakers to dialogue about animal welfare in aquaculture. This is in addition to the scientists and governmental organizations

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[120] *Id.*
[121] *Id.*
[122] *Id.*
[123] *Id.*
[124] Stephen A. Smith & Laura E. Noll, *Testing the Waters: IACUC Issues Associated with Fish*, 50 ILAR JOURNAL, 397–401 (Oct. 1, 2009), https://academic.oup.com/ilarjournal/article/50/4/397/868677.
[125] *Id.*
[126] Optimistic agnostics are those who encourage the pursuit of approaches that can lead to important insights about animal social cognition.
[127] *See The Precautionary Principle: decision making under uncertainty*, EUROPEAN COMMISSION at 3 (Sept. 2017), http://ec.europa.eu/environment/integration/research/newsalert/pdf/precautionary_principle_decision_making_under_uncertainty_FB18_en.pdf (an overview of the use of the precautionary principle in specific circumstances).
[128] Culum Brown, *Fish Pain: An Inconvenient Truth*, ANIMAL SENTIENCE 3, 32 (2016), *available at* https://www.researchgate.net/publication/286921008_Fish_pain_an_inconvenient_truth.
[129] *Id.*
[130] Alan Yuhas, *A third of Americans believe animals deserve same rights as people, poll finds*, THE GUARDIAN (May 19, 2015), https://www.theguardian.com/world/2015/may/19/americans-animals-human-rights-poll; Bob Meadow & Joshua Ulibarri, *Public Memo: Results from a recent survey of American consumer*, LAKE RESEARCH PARTNERS (June 29, 2016), https://www.aspca.org/sites/default/files/publicmemo_aspca_labeling_fi_rev1_0629716.pdf; *Consumer Perceptions of Farm Animal Welfare*, ANIMAL WELFARE INST., https://awionline.org/sites/default/files/uploads/documents/fa-consumer_perceptionsoffarmwelfare_-112511.pdf (last visited Mar. 20, 2020); Abha Bhattarai, *Millennials are picking pets over people*, THE DENVER POST (Sept. 15, 2016), https://www.denverpost.com/2016/09/15/millennials-picking-pets-over-people/.

involved in the continuous study of aquaculture and the welfare of aquatic animals. Therefore, the need for streamlining and regulating the aquaculture production industry cannot be overemphasized.

7. Aquatic Animals: A Global Perspective

A. Background

For this section, Animal Law Clinic students, staff and faculty provided summaries from selected jurisdictions around the world relating to aquatic animals. While each jurisdiction has its own legal system and other specific issues that are important and relevant for context, we have attempted here to highlight some matters that may be of importance and interest. In particular, we focus on regulation related to aquaculture, as well as the absence of needed regulation.

B. Selected Aquatic Animal Issues in the USA

i. Background

Aquaculture, "the breeding, rearing, and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes, and the ocean"[131] can also occur on land in tanks and via other production methods. As the world population grows and agricultural land availability decreases, the demand for aquaculture increases.[132] These newer production methods have impacts on the environment, human health, and animal welfare, which requires the development of sound policy and regulation protecting these interests. There is also a strong need to develop policy from an animal welfare perspective.

Aquaculture produces a wide variety of aquatic plants and animals such as "fish, shellfish, and seaweeds including food fish, sport fish, bait fish, ornamental fish, crustaceans, mollusks, algae, sea vegetables, and fish eggs."[133] Aquaculture facilities are also used to produce fish and shellfish that are then "released into the wild to rebuild wild populations."[134]

While the United States is a major consumer of aquaculture products, it is only a minor producer, importing approximately 90% of its seafood while producing only 5% from domestic freshwater and marine aquaculture.[135] In the United States, commercial marine aquaculture, also referred to as seafood farming, consists of a diverse and wide-ranging community of producers who "contribute to the seafood supply, complement wild fisheries, and support jobs and other economic activity in the coastal communities and working waterfronts."[136] While marine aquaculture in the United States is comparatively small, it is estimated to be "growing at 8% per year and is poised for additional growth as oyster farming in particular continues to expand."[137]

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[131] *Aquaculture NOAA Fisheries*, NOAA, https://www.fisheries.noaa.gov/topic/aquaculture (last visited Mar. 20, 2020).
[132] Rob McConnel, *The growth of global aquaculture - Fishy business*, DELOITTE (2018), https://www2.deloitte.com/au/en/pages/consumer-business/articles/the-growth-of-aqua-culture-fishy-business.html.
[133] *About Aquaculture*, FISH WATCH, https://www.fishwatch.gov/aquaculture (last visited Mar. 5, 2020).
[134] *Id.*
[135] *Aquaculture in the United States*, FISH WATCH, https://www.fishwatch.gov/aquaculture (last visited Mar. 5, 2020).
[136] *Id.*
[137] *Id.*

U.S. production consists primarily of oysters, clams, and mussels, with significant salmon and shrimp production as well.[138] The aquaculture industry in the United States also supports commercial and recreational fisheries, with "about 40 percent of the salmon caught in Alaska and 80 to 90 percent of those caught in the Pacific Northwest start[ing] their lives in hatcheries - adding millions to the commercial fishery."[139]

ii. Agencies

Aquaculture in the United States is regulated at the state and federal level.[140] The leading federal agencies that regulate aquaculture are: the Food and Drug Administration (FDA); the National Oceanic and Atmospheric Administration (NOAA); the U.S. Army Corps of Engineers; the U.S. Department of Agriculture (USDA); the U.S. Environmental Protection Agency (EPA); and the U.S. Fish and Wildlife Service (FWS).[141] Many of these agencies prepare fact sheets and NOAA prepared the fact sheets on fisheries, marine sanctuaries, marine mammals, threatened and endangered species, and habitat conservation.[142] NOAA also cooperates with other agencies that issue permits for aquaculture activities in state and federal waters.

Despite the high demand of aquaculture products and the large amount of existing regulations, there are still some gaps, such as the growing interest in offshore aquaculture and lack of a clear and comprehensive regulatory framework to guide the industry's development.[143]

iii. Standards

The Global Aquaculture Alliance's Best Aquaculture Practices standards set out a broad range of environmental and social standards, and they have been recognized by several industry benchmarking efforts, including the Global Food Safety Initiative, Global Social Compliance Programme, and Global Sustainable Seafood Initiative.[144] According to the Center for American Progress, "[b]oth fed and unfed aquaculture should adhere to a series of robust environmental standards to minimize effects on surrounding ecosystems and fisheries. Fed aquaculture developments should have to complete an additional series of precautionary measures to address the additional risks associated with the system."[145]

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[138] *U.S. Aquaculture*, NOAA FISHERIES, https://www.fisheries.noaa.gov/national/aquaculture/us-aquaculture (last visited Mar. 5, 2020).
[139] *Id.*
[140] *National Aquaculture Legislation Overview: United States of America*, FAO, http://www.fao.org/fishery/legalframework/nalo_usa/en (last visited Mar. 5, 2020).
[141] *Id.*
[142] *Regulating Aquaculture*, NOAA FISHERIES, https://www.fisheries.noaa.gov/regulating-aquaculture (last visited Mar. 5, 2020).
[143] Kristen L. Johns, *Farm Fishing Holes: Gaps in Federal Regulation of Offshore Aquaculture*, 86 S. CAL. L. REV. 681, 690 (2013), available at https://southerncalifornialawreview.com/wp-content/uploads/2013/03/86_681.pdf.
[144] Alexandra Carter and Miriam Goldstein, *American Aquaculture: An Overview of the Current Status, Environmental Impacts, and Legislative Opportunities*, CTR. FOR AM. PROGRESS (May 13, 2019), https://www.americanprogress.org/issues/green/reports/2019/05/13/469730/american-aquaculture/ (last visited Mar. 5, 2020).
[145] *Id.*

iv. Welfare

Animal welfare is becoming a greater priority for many Americans who increasingly want to know more about, and regulate, the treatment of animals used for food and other production.[146] As a result, there is a need for citizens and lawmakers to have a dialogue about animal welfare in aquaculture. Scientists and governmental organizations have also been studying many aspects of aquaculture as it relates to the welfare of aquatic animals. Most notably, it is becoming the majority view in the scientific community that fish do experience pain in a manner similar to mammals, birds, and humans.[147] While there are still conflicting opinions on this issue, a survey of scientific literature on the issues of fish pain and intelligence concluded that there is substantial scientific evidence that fish feel pain.[148] This leads to a legal conclusion that their welfare should be taken into account when they are being used for the benefit of humans. This conclusion is based on the precautionary principle,[149] which is the idea that it is better to be safe than sorry when the science is unclear in matters that pertain to the environment, human health, or other irreversible harm.[150]

Unfortunately, current aquaculture standard practices frequently subject aquatic animals[151] to significant levels of suffering. For example, "scientific research has established that many methods presently employed [in fish slaughter] are inhumane, including gill-cutting without prior stunning, asphyxiation in air or on ice, carbon-dioxide stunning, and live chilling."[152]

Some countries around the world have implemented laws, regulations, or guidelines for the consideration of the welfare of animals in aquaculture. Most notably, the European Union (EU) includes fish in their recommendations for the European Convention for the Protection of Animals kept for Farming Purposes. These recommendations include, among other things, the protection

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[146] Alan Yuhas, *A third of Americans believe animals deserve same rights as people, poll finds*, THE GUARDIAN (May 19, 2015), https://www.theguardian.com/world/2015/may/19/americans-animals-human-rights-poll; Bob Meadow & Joshua Ulibarri, *Public Memo: Results from a recent survey of American consumer*, LAKE RESEARCH PARTNERS (June 29, 2016), https://www.aspca.org/sites/default/files/publicmemo_aspca_labeling_fi_rev1_0629716.pdf; *Consumer Perceptions of Farm Animal Welfare*, ANIMAL WELFARE INST., https://awionline.org/sites/default/files/uploads/documents/fa-consumer_perceptionsoffarmwelfare_-112511.pdf (last visited Mar. 20, 2020); Abha Bhattarai, *Millennials are picking pets over people*, THE DENVER POST (Sept. 15, 2016), https://www.denverpost.com/2016/09/15/millennials-picking-pets-over-people/.

[147] Donald M. Broom, *Fish brains and behavior indicate capacity for feeling pain: Commentary on Key on fish pain*, ANIMAL STUDIES REPOSITORY (2016), available at http://animalstudiesrepository.org/cgi/viewcontent.cgi?article=1031&context=animsent.

[148] *Id.*

[149] This is the core principle used in EU environmental law. *See The Precautionary Principle: decision making under uncertainty*, EUROPEAN COMMISSION at 3 (Sept. 2017), http://ec.europa.eu/environment/integration/research/newsalert/pdf/precautionary_principle_decision_making_under_uncertainty_FB18_en.pdf.

[150] *Id.* at 3-4

[151] For purposes of this section, the term "fish" to refer to all aquatic animals used in aquaculture, which include finfish, crustaceans, and mollusks.

[152] Stephanie Yue, *supra* note 105.

of the five freedoms.[153] Most countries in the EU have adopted these recommendations in some form.[154]

The United States, however, does not have any federal laws or regulations addressing, or even mentioning, animal welfare in aquaculture. As is discussed further below, animals in aquaculture are not included in the Animal Welfare Act,[155] the Humane Methods of Slaughter Act,[156] or the 28 Hour Transportation Act.[157] Most federal laws are related to either animal welfare in other areas (e.g., in the context of animals used in scientific research) or environmental or conservation issues (e.g., the Clean Water Act, the Marine Mammal Protection Act). Further, though states are permitted to regulate welfare in aquaculture, no state has specifically done so. Many states have specific laws or regulations, to address zoning, commerce, and environmental issues, but not the welfare concerns of animals used in aquaculture.[158] Additionally, all states have anti-cruelty laws, but most explicitly exempt fish and/or farming practices.[159]

The best way to develop policy that appropriately protects human, environmental, and animal welfare in the absence of federal action is for individual states to enact legislation that addresses these issues and provides some degree of protection for aquatic animals.

v. Resources

For further reading:

- https://www.fisheries.noaa.gov/national/aquaculture/us-aquaculture
- https://www.fishwatch.gov/aquaculture
- https://www.usda.gov/topics/farming/aquaculture
- https://www.americanprogress.org/issues/green/reports/2019/05/13/469730/american-aquaculture/
- https://www.fisheries.noaa.gov/regulating-aquaculture

C. International Aquatic Animal Law

Why does international law matter for aquatic animals? Because these creatures are utilized in a myriad of ways including: food; entertainment; the pet trade; cultural traditions; research and other contexts. These animals migrate themselves in the wild across different jurisdictions, and are also traded by humans across borders. Aquatic animals are a good example of an "international issue,"

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[153] 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.
[154] *Animal Welfare*, EUROPEAN COMMISSION: ANIMALS, https://ec.europa.eu/food/animals/welfare_en, (last visited Mar. 20, 2020).
[155] 7 U.S.C. § 2131 et seq. (2012).
[156] 7 U.S.C. § 1901 et seq. (2012).
[157] 49 U.S.C. § 80502 (2012).
[158] *Aquaculture Overview*, NAT'L AGRIC. LAW CTR, http://nationalaglawcenter.org/overview/aquaculture/ (last visited Mar. 20, 2020).
[159] Rajesh K. Reddy, *Animal Welfare in the Federal Farm Bill*, Lewis & Clark Law School Animal Law Clinic, 6 (Apr. 2017).

particularly the ones that live in our oceans and seas. Some examples of key issues for aquatic animals in international law include:

i. Wildlife and Conservation
ii. Aquatic Animals as a Food Source
iii. International Trade
iv. Climate Change

i. International Treaties that may apply to wild-caught aquatic animals

Every year between 1 and 3 trillion fish are intentionally caught from the wild and killed globally.[160] This number does not include farmed fish or fish caught for recreational purposes or fished unintentionally or illegally killed.[161] The market for human consumption of fish is expanding, and fish products account for approximately 39% of animal products consumed globally.[162] Fish migrate through international waters as well as the territorial waters of scores of nations, making it impossible to regulate fisheries without cooperation among nations.

Below is addressed just some of the international treaties that apply to fishing.

a. Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on The High Seas.

Recognizing that fisheries, including aquaculture, provide a vital source of food, employment, recreation, trade and economic wellbeing for people throughout the world, this agreement sets out principles and international standards of behavior for responsible practices with a view to ensuring the effective conservation, management, and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The objective of this agreement is to strengthen international cooperation with a view to ensuring compliance by fishing vessels on the high seas. It applies to all fishing vessels used or intended for fishing on the high seas. Parties agree to take all necessary measures to ensure that fishing vessels entitled to fly their flag do not engage in activity that undermines the effectiveness of international conservation and management measures and adopt enforcement measures in respect of fishing vessels which act in contravention. Since this agreement applies to fishing generally, it also applies to aquaculture.[163]

b. The Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean[164]

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[160] David N. Cassuto; Amy M. O'Brien, *You Don't Need Lungs to Suffer: Fish Suffering in the Age of Climate Change with a Call for Regulatory Reform,* 5 CAN. J. COMP. & CONTEMP. L 31 (2019).
[161] *Id.*
[162] *Id.*
[163] *Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas*, IUCN (Nov. 29, 1993), *available at*: https://www.ecolex.org/details/treaty/agreement-to-promote-compliance-with-international-conservation-and-management-measures-by-fishing-vessels-on-the-high-seas-tre-001183/.
[164] Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean, Feb. 11, 1992.

The Convention works to coordinate efforts and establish an effective mechanism of international cooperation for the conservation of anadromous fish stocks in the North Pacific Ocean. To do so, the treaty establishes the North Pacific Anadromous Fish Commission and defines "fishing" to mean: a) The catching, taking, harvesting of fish, or any other activity which can reasonably be expected to result in the catching, taking and harvesting of fish; b) Any operation at sea in preparation for or in direct support of any activity described in the preceding paragraph (a).

c. **The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)[165]**

CITES is an international agreement with the aim to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Under CITES there are three different Appendices that determine the restrictions on import, export, re-export, and introduction from the sea. Trade restrictions and regulations depend on whether a species is listed under Appendix I, Appendix II, or Appendix III. Aquaculture issues arise under CITES when Parties harvest and trade commercially exploited aquatic species listed in the CITES Appendices.

d. **Convention on Biological Diversity 1992 (CBD)[166]**

The Convention is dedicated to promoting sustainable development recognizing that biological diversity is important not only for plants, animals, micro-organisms and their ecosystems, but also for people globally as it contribute to food security. Aquaculture is particularly dependent on biodiversity for productivity and food security. CBD Parties have been encouraged to create enabling conditions, provide positive incentives and remove perverse incentives for the adoption of sustainable production practices that will benefit biodiversity. CBD also contains several provisions specific to aquaculture particularly concerning the transboundary movement of aquatic organisms and the control of alien species.

e. **Others**

1. U.N. Convention Law of the Sea (UNCLOS)[167]
2. Ramsar Convention[168]
3. International Convention for the Regulation of Whaling (ICRW),1946[169]
4. Geneva Conventions on the Law of the Sea, 1958[170]
5. Law of the Sea Convention,1982[171]
6. The UN Fish Stocks Agreement, 1995[172]

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[165] Convention on International Trade in Endangered Species of Wild Fauna and Flora, Mar. 3, 1973, 993 UNTS 243, *available at*: https://www.cites.org/eng/cop/index.php.
[166] Convention on Biological Diversity, Dec. 29, 1993, 1760 U.N.T.S. 79.
[167] United Nations Convention on the Law of the Sea, Dec. 10, 1982, https://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm.
[168] The Ramsar Convention on Wetlands, https://www.environment.gov.au/water/wetlands/ramsar.
[169] International Whaling Commission, https://iwc.int/home.
[170] UNCLOS, *supra* note 167.
[171] *Id.*
[172] *The United Nations Agreement for the Implementation of the Provision of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and*

7. FAO Code of Conduct for Responsible Fisheries, 1995[173]
8. Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem, 2001[174]
9. Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing, 2009[175]
10. Regional Treaty and Organization Examples
    i. the North Atlantic Salmon Treaty[176]
    ii. the Northwest Atlantic Fisheries Treaty, and the Pacific Salmon Treaty.[177]
    iii. Regional Fisheries Management Organizations (RFMOs) will not be discussed here but should be noted.[178]

ii. International Instruments that may apply to Aquaculture

The market for human consumption of fish is expanding, and fish products account for approximately 39% of animal products consumed globally.[179] Farmed fish account for 70% of all animals farmed worldwide and the fish farming industry has been expanding at a rate of 8% per year since the 1980s.[180] While there are currently no international agreements that apply to aquaculture, there are some that could potentially apply to aquaculture. Listed below are some international treaties that the U.S. is a party to that could apply to aquaculture. Other relevant treaties include, the Convention on International Trade in Endangered Species, Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on The High Seas, and the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean, which are discussed above in the wild-caught fish section.[181]

a. Codex Alimentarius, 1963[182]

The Codex Alimentarius is a collection of food safety standards, codes of practice, guidelines and other recommendations developed under the guidance of the Codex Alimentarius Commission (CAC) to protect consumers' health, ensure fair-trade practices in the food trade and promote coordination of all food standards' work undertaken by IGOs and NGOs. The CAC is the central part of the Joint FAO/WHO Food Standards Program. There are presently around 200 Codex

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Highly Migratory Fish Stocks, OCEANS & LAW OF THE SEA (last updated January 11, 2019), https://www.un.org/Depts/los/convention_agreements/convention_overview_fish_stocks.htm.

[173] *Code of Conduct for Responsible Fisheries*, FAO, http://www.fao.org/fishery/code/en.

[174] *The Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem*, FAO, http://www.fao.org/fishery/docs/DOCUMENT/reykjavik/y2198t00_dec.pdf.

[175] *Agreement on Port State Measures (PSMA)*, FAO, http://www.fao.org/port-state-measures/en/.

[176] *North Atlantic Salmon Treaty*, NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION, http://www.nasco.int/convention.html.

[177] *Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service*, FWS, https://www.fws.gov/laws/lawsdigest/treaty.html#PACIFIC.

[178] *Regional fisheries management organizations and deep-sea fisheries*, FAO, http://www.fao.org/fishery/topic/166304/en.

[179] David N. Cassuto, *supra* note 160.

[180] *Id.*

[181] FAO, *supra* note 140.

[182] *About Codex Alimentarius*, CODEX ALIMENTARIUS, http://www.fao.org/fao-who-codexalimentarius/about-codex/en/#c453333.

Standards, of which several are applicable to fisheries commodities. There are currently 18 standards, two guidelines, and the Code of Practice for Fish and Fisheries Products, which also covers the aquaculture sector.

b. Convention on the Inter-American Institute for Cooperation on Agriculture, 1979[183]

This Convention establishes the Inter-American Institute for Cooperation on Agriculture whose purpose is to encourage, promote, and support the efforts of the Member States to achieve their agricultural development and rural welfare.

The objective is to improve the productivity and competitiveness of the agricultural sector, strengthen agriculture's contribution to the development of rural areas and the well-being of the rural population, improve agriculture's capacity to mitigate and adapt to climate change and make better use of natural resources, and improve agriculture's contribution to food security.

c. World Organization for Animal Health[184] ("OIE")

The World Organization for Animal Health, also known as OIE, is an international organization with the mission to provide a better guarantee of safety of food of animal origin and to promote animal welfare through a science-based approach, among other things. While the OIE's main focus is on animal health and diseases in order to safeguard humans, it is also involved in the development of work relating to animal welfare.

The OIE Aquatic Animal Health Code (the Aquatic Code)[185] provides standards for the improvement of aquatic animal health worldwide. This includes standards for the welfare of farmed fish. The Aquatic Code provides sanitary measures for the import and export of aquatic animals to prevent the spread of disease via international trade in the aquatic animals and their products. OIE also publishes a Manual of Diagnostic Tests for Aquatic Animals (Aquatic Manual) which provides effective laboratory testing for pathogenic agents that may adversely affect aquatic animals to support the Aquatic Animal health Services.

[183] Convention on the Inter-American Institute for Cooperation on Agriculture of 1979, art. 4, Mar. 6, 1979.
[184] *Aquatic Animal Health Code*, OIE, https://www.oie.int/standard-setting/aquatic-code/.
[185] The Aquatic Code and Aquatic Manual can be found at the following links: https://www.oie.int/en/standard-setting/aquatic-code/access-online/ and https://www.oie.int/en/standard-setting/aquatic-manual/access-online/.

D. Selected Aquatic Animal Issues in Chile

i. Scope of Industry

The Chilean aquaculture industry (CHAI), almost non-existent in 1970, reached a production volume of 70,000 tonnes in 1990 and extraordinary development during the 1990's resulted in exceeding 600,000 tonnes at the end of the decade.[186] The spectacular growth of salmon aquaculture was undoubtedly responsible for record growth rates shown by the CHAI by the end of the 20th century, putting Chile among the ten countries with the highest aquaculture production in the world.[187] Today, the CHAI is one of the most developed sectors in Chile, playing an important role in the country's economy.[188]

ii. Production

According to official statistics, fish represent 67.7% of the CHAI production; while the contributions of mollusks and algae are 30.6% and 1.7%, respectively.[189] The primary resources correspond to Atlantic Salmon, Chorito, and Pacific Salmon, contributing 50.9%, 29.6%, and 11%, respectively, which account for 91.5% of the total harvest in 2018.[190] In that year, the Regions of Los Lagos and Aysén contributed with 880 thousand tonnes (64.9%) and 348 thousand tonnes (28%), respectively, which represents 92.9% of the country's total production.[191]

iii. Legal Framework

The CHAI legal framework is mainly determined by the General Fisheries and Aquaculture Law No 18.892 (GFAL).[192] However, there are several other laws and regulations ruling certain aspects of this industry, among them, the General Environmental Law N°19.300,[193] the Environmental Regulation for Aquaculture,[194] and the Decree with force of law N°2 (2011).[195]

iv. Regulation and Enforcement Agencies

Some of the institutions with regulatory or enforcement powers are the General Directorate of the Maritime Territory and Merchant Marine, the Ministry of Economy, the Undersecretariat of Fisheries and Aquaculture, and the National Fisheries and Aquaculture Service.[196]

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[186] *National Aquaculture Sector Overview-Chile*, FAO, http://www.fao.org/fishery/countrysector/naso_chile/en (last visited Mar. 20, 2020).
[187] *Chile*, WORLD FISHING & AQUACULTURE, https://www.worldfishing.net/news101/regional-focus/chile (last visited Mar. 6, 2020).
[188] *Id.*
[189] *Informe Sectorial De Pesca Y Acuicultura*, SUBPESCA 4 (Jan. 2019), http://www.subpesca.cl/portal/616/articles-103653_documento.pdf.
[190] *Id.*
[191] *Id.*
[192] General Fisheries and Aquaculutre Law No. 18.892 (Nov. 21, 2019).
[193] General Environmental Law No. 19.300 (Jan. 23, 2020).
[194] Environmental Regulation for Aquaculture No. 320 (Aug. 24, 2001).
[195] Modify Organic Structure of the National Fisheries Service Decree No. 2 (Feb. 25, 2011).

[196] FAO, *supra* note 186.

v. Authorization System

The authorization and concession system to set up aquaculture facilities is regulated by the General Fisheries and Aquaculture Law. The law identifies three classes of concessions and authorizations to conduct aquaculture: beach, coastal areas, and water-column and sea-bed lots. An authorization or concession is not required for aquaculture activities carried out entirely on private property, even when inland or marine waters are used, provided they are used in accordance with the respective regulations.[197]

vi. Animal Welfare

The Law of Animal Protection (LAP) No. 20.380 recognizes animals as living and sensitive (or sentient) beings which are part of nature, and which deserve protection and respect.[198] In that context, article five establishes that industrial animal production facilities must be appropriately designed with attention to the respective species and categories of animals, in order to prevent abuse and deterioration of their health.[199] In the same direction, article eleven establishes that facilities dedicated to industrial animal production should use rational methods in animal sacrifice or slaughter, in order to avoid unnecessary suffering.[200] Furthermore, the GFAL in article thirteen establishes that "Aquaculture must contemplate norms that protect animal welfare and procedures that avoid unnecessary suffering".[201]

vii. Gaps in Current Regulations

There are many issues that still need to be addressed by the legislature and administrations with regulatory powers. Some of these issues are related to carrying capacity; use of antibiotics; access to the information; and lack of guidelines or codes of conduct within this industry. For example, there are currently no limits for the use of antibiotics in the control of fish diseases.

viii. Major Challenges and Harms

Chile is the second-largest salmon producer after Norway, and salmon from Chile is sold all over the world.[202] Some issues specific to this one type of aquaculture – salmon farming – are:

a. The proliferation of "caligus," a sea lice "a type of parasitic sea lice who can transmit viruses.
b. The eutrophication of coastal marine environments of southern Chile caused by salmon farms;
c. Stocking density, carrying capacity, the interactions between harmful algal blooms and harvested animals; and the regulation thereof

[197] *National Aquaculture Legislation Overview-Chile*, FAO, http://www.fao.org/fishery/legalframework/nalo_chile/en#tcNB007E (last visited Mar. 6, 2020).
[198] Law on Animal Protection No. 20.380 (Sept. 11, 2009).
[199] Law on Animal Protection No. 20.380 Art. 5 (Sept. 11, 2009).
[200] Law on Animal Protection No. 20.380 Art. 11 (Sept. 11, 2009).
[201] General Fisheries and Aquaculture Law No. 18.892 Art. 13 (Nov. 21, 2019).
[202] WORLD FISHING & AQUACULTURE, *supra* note 187.

d. Sea lions in this context, including the mortality of sea lions due to direct and indirect causes;
e. Gaps in the knowledge about the environmental consequences of the aquaculture industry;
f. Deficiencies in the control of welfare standards established for animals;
g. Products quality assurance according to international standards;
h. Others issues.[203]

ix. Resources

For further reading:

- Food and Agriculture Organization of the United Nations, National Aquaculture Legislation Overview: Chile.
- Food and Agriculture Organization of the United Nations, National Aquaculture Legislation Overview: Chile.
- Exequiel González, Chile's National Aquaculture Policy: missing elements for the Sustainable Development of aquaculture.
- Ivonne Lozano and Others, Antibiotics in Chilean Aquaculture: A Review.
- Renato Quiñones and Others, Environmental issues in Chilean salmon farming: a review.
- Alejandro Buschmann and Others, Salmon aquaculture and coastal ecosystem health in Chile: Analysis of regulations, environmental impacts and bioremediation systems.
- Alejandro Buschmann and Others, Salmon Aquaculture and Antimicrobial Resistance in the Marine Environment.

[203] For further examples, see: *National Aquaculture Sector Overview-Chile*, FAO, http://www.fao.org/fishery/countrysector/naso_chile/en#tcN700F6 (last visited Mar. 6, 2020).

E. Selected Aquatic Animal Issues in the European Union

i. Introduction

The European Union (EU) is the leading region for consumption of seafood.[204] Approximately 20% of fish production in Europe is from aquaculture.[205] The main aquaculture producers within the EU are the United Kingdom and Greece for marine aquaculture; and France, Italy, and Spain for shellfish.[206] The main species produced in the EU are Atlantic salmon, rainbow trout, oysters, mussels, and European seabass.[207]

ii. Regulation

In the EU, each Member State has its own regulations and provisions regarding aquatic animals at the national level. However, there are EU directives binding on Member States, which they should comply with. Some of the acts are aimed at regulating actions with respect to aquatic animals,[208] while others are aimed at animals or farmed animals in general, which define animals as vertebrates and do not apply to invertebrate animals, thus excluding entire categories of aquatic animals.[209]

Despite the strong protection and purpose of developing sustainable aquaculture in the EU, there are still existing regulatory gaps at the EU level. For instance, acquisition of the license to perform aquaculture related actions is not required and is not regulated at the EU level.[210] There is no such thing as an EU aquaculture license, and no provision for such in the EU law. Though some nations have such licenses, they vary widely in their requirements, and most nations do not require licenses at all.

iii. Best Practices

As for best practices, there is a broad variety. For instance, the Czech Republic, Croatia, Denmark, Italy, and Slovenia achieved high standards in terms of environmental and economic efficiency and can be used as examples for others.[211] Use of well-developed recirculation systems, which

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[204] *The EU Fish Market 2019 edition is out: everything you wanted to know about the EU market for fish and seafood*, EUROPEAN COMMISSION (Mar. 12, 2019), https://ec.europa.eu/fisheries/press/eu-fish-market-2019-edition-out-everything-you-wanted-know-about-eu-market-fish-and-seafood_en (last visited Mar. 6, 2020).
[205] *European Aquaculture*, EUROPEAN PARLIAMENT, https://www.europarl.europa.eu/factsheets/en/sheet/120/european-aquaculture (last visited Mar. 6, 2020).
[206] *Id.*
[207] *Id.*
[208] Council Directive 2006/88/EC (Oct. 24, 2006), *available at:* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32006L0088.
[209] Council Directive 98/58/EC (July 20, 1998), *available at*: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31998L0058&from=EN.
[210] *See Strategic Guidelines for the sustainable development of EU aquaculture*, EUROPEAN COMMISSION 3 (Apr. 29, 2013), https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/com_2013_229_en.pdf (discussing the issues of the licensing regime and how to better address it on an Administrative level).
[211] *Summary of the 27 Multiannual national Aquaculture Plans*, EUROPEAN UNION 11 (May 2016), https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/27-multiannual-national-aquaculture-plans-summary_en.pdf.

optimizes use of energy, feed, water, and space is a specific example of what some Member States consider best practice (Belgium, the Czech Republic, Denmark and Germany).[212]

Moreover, several Member States, such as Belgium, Ireland, Romania, and the United Kingdom, have already formulated a code in relation to specific fish farming practices.[213] Bulgaria, Finland, Greece, Ireland, Italy, and Latvia have developed monitoring management and production practices in relation to environmental impact, sanitary and veterinary conditions, and food safety, in particular in open marine farming.[214]

iv. Resources

For further reading:

- Strategic Guidelines for the sustainable development of EU aquaculture, European Commission, Brussels (2013): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013DC0229&from=EN
- Summary of the 27 Multiannual National Aquaculture Plans (2016): https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/27-multiannual-national-aquaculture-plans-summary_en.pdf
- Aquaculture in the EU: https://ec.europa.eu/food/animals/live_animals/aquaculture_en
- EU Aquaculture. Policy, methods, agreements, regulations: https://ec.europa.eu/fisheries/cfp/aquaculture_en
- Commission Regulation (EC) 710/2009: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:204:0015:0034:EN:PDF
- Council Directive 98/58/EC (1998): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31998L0058&from=EN

[212] *Id.*
[213] *Id.*
[214] *Id.*

F. Selected Aquatic Animal Issues in China

i. Overview

China is one of 12 mega-biodiversity countries in the world.[215] China's aquatic life is characterized by a high degree of endemism, a large number of relic species, and complete types of ecosystems, due to the impact of climate, geography, and history. There are more than 20,000 aquatic species existing in China, which plays an important role in the biodiversity in the world. China has over 6,400 vertebrate animal species, accounting for 13.7% of the total in the world,[216] and more than 70% of the vertebrate species in China are aquatic species.[217]

According to the report of China National Biodiversity Conservation Strategy and Action Plan (2011-2030),[218] "China has established 170 marine reserves of all types including 32 national marine nature reserves and over 110 local marine nature reserves. China also has established over 40 special marine reserves including 17 national reserves, with the total areas accounting for about 1.2% of China's total marine area."[219] The symbolic Chinese aquatic animals are Chinese Giant Salamander, Yangtze Finless Porpoise, and Indo-Pacific humpback dolphin.

ii. Main Legislation

Chinese law started the protection of aquatic animals in the 1980's, and now the legal framework for aquatic animal protection consists of:

a. Wildlife Protection Law[220] (amended in 2018) - this law offers some protections for listed "precious and endangered" aquatic species;
b. Fisheries Law[221] (amended in 2013) - this law regulates fishing of unlisted aquatic species;

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[215] *China-Main Details*, CONVENTION ON BIOLOGICAL DIVERSITY, https://www.cbd.int/countries/profile/?country=cn (last visited Mar. 20, 2020).
[216] Conserving Biodiversity for a Beautiful China, UNEP (May 2019), http://wedocs.unep.org/bitstream/handle/20.500.11822/29442/BioChina.pdf?sequence=1&isAllowed=y.
[217] 农业农村部渔业渔政管理局:中国水生野生动物保护历程及展望
Fisheries and Fisheries Administration of the Ministry of Agriculture and Rural Affairs: History and Prospects of Aquatic Wildlife Protection in China, MINISTRY OF AGRIC. & RURAL AFFAIRS OF CHINA, http://www.moa.gov.cn/xw/bmdt/201910/t20191024_6330510.htm.
[218] *China National Biodiversity Conservation Strategy and Action Plan (2011-2030)*, CONVENTION ON BIOLOGICAL DIVERSITY, https://www.cbd.int/doc/world/cn/cn-nbsap-v2-en.pdf.
[219] *Id*.
[220] 中华人民共和国野生动物保护法 (2018 修正)
Wild Animal Conservation Law of the People's Republic of China (2018 Amendment), http://www.pkulaw.cn/CLI.1.324957%20/.
[221] 中华人民共和国渔业法(2013 修正)
Fisheries Law of the People's Republic of China (2013 Amendment), http://www.pkulaw.cn/CLI.1.218763.

c. Marine Environment Protection Law[222] (revised in 2017) – this law offers the legal framework for preventing marine pollution and improving the marine ecological environment;
d. Water Pollution Prevention and Control Law[223] (revised in 2017) – this law offers the legal framework for preventing water pollution and improving the water ecological environment in rivers, lakes, canals, channels, reservoirs in the territory of the People's Republic of China;
e. Environmental Protection Law[224] (revised in 2014) – this law offers the foundation for the pollution prevention and control and the protection for the environment;
f. Nature Reserve Regulations[225] (amended in 2017) – this regulation offers the foundation for nature reserve areas in terrestrial water and sea area; and
g. Regulation on the Implementation of the Aquatic Wild Animal Protection[226] (revised in 2013) – this regulation offers the details for the implementation of the Wildlife Protection Law on aquatic wild animals.

iii. **Problems**

Despite the aforementioned protections, aquatic animals are suffering from many threats including water pollution, decrease in living habitat, harm from industry and facilities, illegal trade in wildlife, and illegal fishing and overfishing.

The Chinese Alligator (Alligator sinensis) and the Chinese River Dolphin (Lipotes vexillifer) are considered as "the living fossil," the most ancient and important aquatic animals in China, which have the same importance as the panda.[227] The Chinese Alligator is Critically Endangered by the IUCN Red List, the Chinese River Dolphin (Lipotes vexillifer) was announced as functionally extinct in 2007, and the Chinese paddlefish (Psephurus gladius) was announced to be extinct in 2020. The legal artificial breeding of wildlife and the legal market for them is saving some animals from extinction, such as the Giant Salamander, but it causes new problems at the same time. In

[222] 中华人民共和国海洋环境保护法 (2017 修正)
Marine Environment Protection Law of the People's Republic of China (Amendment 2017), http://www.pkulaw.cn/CLI.1.304315.
[223] 中华人民共和国水污染防治法 (2017 修正)
Water Pollution Prevention and Control Law of the People's Republic of China (2017 Revision), http://www.pkulaw.cn/ CLI.1.297378.
[224] 中华人民共和国环境保护法 (2014 修订)
Environmental Protection Law of the People's Republic of China (2014 Revision), http://www.pkulaw.cn/CLI.1.223979.
[225] 中华人民共和国自然保护区条例 (2017 修正)
Regulations of the People's Republic of China on Nature Reserves, http://www.pkulaw.cn/CLI.2.304107.
[226] 中华人民共和国水生野生动物保护实施条例(2013 修订)
Regulations of the People's Republic of China on the Protection of Aquatic Wild Animals (2013 Revision), http://www.pkulaw.cn/CLI.2.214787.
[227] 环境保护部，中国科学院：《中国生物多样性红色名录—脊椎动物卷》评估报告
Evaluation Report of China Biodiversity Red List-Vertebrate Volume, http://www.mee.gov.cn/gkml/hbb/bgg/201505/W020150525496758954804.pdf.

2020, after the outbreak of the COVID-19, the Chinese government closed wildlife markets and trade.[228]

iv. Fishing and Yangtze River Protection

Over fishing and illegal fishing are a major problem in China. Since 1986, the first Fisheries Law and its Implementing Regulation 1987, established the principle of "[F]ocusing on aquaculture, comprehensive development of aquaculture fishing and conservation management".[229] The government set the limitation on the number of fishing boats, the techniques used, and set fishing quotas.[230] From 2004, the Department of Agriculture established the no-fishing regime in Yangtze River,[231] the largest freshwater ecosystem in China. Since 2020, China began a 10-year fishing ban on key areas of the Yangtze River to protect biodiversity,[232] and in December 2019, the Yangtze Protection Law (Draft),[233] was under deliberation by the National People's Congress.

v. Aquaculture in China

Since 1991, China has produced more aquaculture products every year than the rest of the world combined.[234] In 2018, the total aquaculture production was over fifty million tons in China, which is 78% of the total aquatic products in China, and 60% of the world's aquaculture production.[235] In 2019, China became the only country in the world whose total aquaculture production exceeded total fishing.[236]

According to Xianliang Zhang, Director General of Fisheries of Ministry of Agriculture and Rural Affairs, "It can be said vividly that in China, 3 out of 4 fish are farmed; in the world, 2 out of 3 farmed fish are Chinese."[237] Now, the major problem is the conflict between the development of aquaculture and the pollution of the water environment. "In addition to a clampdown on illegal

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[228] China temporarily bans wildlife trade in wake of outbreak, https://apnews.com/d59f43a911996a729cdf8636f5aa4ce4.

[229] 农业农村部渔业渔政管理局：70 年来我国渔业取得巨大成就，Fisheries and Fisheries Administration of the Ministry of Agriculture and Rural Affairs: China's Fisheries Have Made Great Achievements in the Past 70 Years, http://www.yyj.moa.gov.cn/gzdt/201910/t20191022_6330346.htm.

[230] 农业部关于进一步加强国内渔船管控 实施海洋渔业资源总量管理的通知，http://jiuban.moa.gov.cn/zwllm/tzgg/tz/201701/t20170120_5460583.htm.

[231] 中华人民共和国农业部关于实施 2004 年长江禁渔期制度的通告, Implementation of the 2004 Yangtze River Fishing Ban System, http://www.moa.gov.cn/nybgb/2004/dwuq/201806/t20180623_6152969.htm.

[232] *China starts 10-year fishing ban on Yangtze River*, CHINA DAILY, https://www.chinadaily.com.cn/a/202001/02/WS5e0d4851a310cf3e35581f65.html (last updated Jan. 2, 2020).

[233] 全国人大网：长江保护法立法 National People's Congress : Legislation of Yangtze River Protection Law, http://www.npc.gov.cn/npc/cjbhflf/cjbhflf.shtml.

[234] James Wright, *Aquaculture leads fish production, consumption to new highs*, GLOBAL AQUACULTURE ALLIANCE (July 16, 2018), https://www.aquaculturealliance.org/advocate/aquaculture-leads-fish-production-consumption-to-new-highs/.

[235] 农业农村部渔业渔政管理局：70 年来我国渔业取得巨大成就，Fisheries and Fisheries Administration of the Ministry of Agriculture and Rural Affairs: China's Fisheries Have Made Great Achievements in the Past 70 Years http://www.yyj.moa.gov.cn/gzdt/201910/t20191022_6330346.htm.

[236] 科技日报：我国水产养殖如何实现绿色发展：五千万吨产量背后的忧思，http://www.xinhuanet.com/politics/2019-02/20/c_1124137421.htm.

[237] 科技日报：我国水产养殖如何实现绿色发展：五千万吨产量背后的忧思，http://www.xinhuanet.com/politics/2019-02/20/c_1124137421.htm.

aquaculture ponds, an extended domestic fishing moratorium, and buyouts of smaller fishing vessels, China has been more actively enforcing its ban on electric pulse fishing."[238] China is now seeking a "green" transformation of the aquaculture industry to solve these problems, recently publishing Opinions on Accelerating the Green Development of Aquaculture.[239]

vi. **Resources**

For further reading:

- China starts 10-year fishing ban on Yangtze River:[240]
- Chinese paddlefish, native to the Yangtze River, declared extinct by scientists:[241]
- 7 spotted seal pups rescued from China traffickers released: https://apnews.com/776a8b3249534852b3e053d01ad7d444
- Fisheries and Fisheries Administration of the Ministry of Agriculture and Rural Affairs: History and Prospects of Aquatic Wildlife Protection in China（农业农村部渔业渔政管理局：中国水生野生动物保护历程及展望）http://www.moa.gov.cn/xw/bmdt/201910/t20191022_6330354.htm
- Fisheries and Fisheries Administration of the Ministry of Agriculture and Rural Affairs: Development of Marine Capture Fishery in China（农业农村部渔业渔政管理局：中国海洋捕捞渔业发展历程）http://www.moa.gov.cn/xw/bmdt/201910/t20191022_6330354.htm
- Fisheries and Fisheries Administration of the Ministry of Agriculture and Rural Affairs: China's Fisheries Have Made Great Achievements in the Past 70 Years（农业农村部渔业渔政管理局：70 年来我国渔业取得巨大成就）http://www.yyj.moa.gov.cn/gzdt/201910/t20191022_6330346.htm
- Thirty years of Chinese offshore fisheries（收放之间：中国近海渔业的三十年）https://chinadialogueocean.net/1826-restoring-chinas-coastal-fisheries/?lang=zh-hans
- Massive shift underway in China's aquaculture, fisheries sectors，https://www.seafoodsource.com/news/supply-trade/massive-shift-underway-in-china-s-aquaculture-fisheries-sectors

[238] Mark Godfrey, *Massive shift underway in China's aquaculture, fisheries sectors*, SEAFOOD SOURCE (July 16, 2019), https://www.seafoodsource.com/news/supply-trade/massive-shift-underway-in-china-s-aquaculture-fisheries-sectors.

[239] 农业农村部、生态环境部、自然资源部、国家发展和改革委员会、财政部、科学技术部、工业和信息化部、商务部、国家市场监督管理总局、中国银行保险监督管理委员会关于加快推进水产养殖业绿色发展的若干意见, http://www.pkulaw.cn/CLI.4.329514.

[240] CHINA DAILY, *supra* note 232.

[241] Shuai Zhang, *Giant Chinese paddlefish declared extinct after surviving 150 million years*, CBS (Jan. 9, 2020), https://www.cbsnews.com/news/giant-chinese-paddlefish-declared-extinct-in-china-as-human-presence-kills-off-an-ancient-species/.

G. Selected Aquatic Animal Issues New Zealand

i. Overview

Described as an "ancient life-raft,"[242] New Zealand is a biodiversity hotspot with high levels of endemism in both animal and plant species.[243] New Zealand has a long coastline and one of the largest marine jurisdictions in the world.[244] Its Exclusive Economic Zone (EEZ) covers over 4 million square kilometers, spanning sub-tropical to sub-Antarctic waters, and is home to over 15,000 known species.[245] Scientists estimate there may be as many as 65,000 species in New Zealand waters, many of which are not found anywhere else in the world. It is estimated that as much as 80% of New Zealand's indigenous biodiversity may be found in the sea. However, less than 1% of the marine environment has been surveyed. Every fortnight, an average of seven new marine species are identified.[246]

Marine invertebrates (and protozoa) are highly diverse, with a high proportion of endemic species. Many bottom-dwelling fish are also endemic.[247] About sixty-six types of sharks are found in New Zealand, ranging in size from the tiny pygmy shark to the twelve-meter-long whale shark.[248] Although turtles breed in the tropics and subtropics, five species of turtle are seen in New Zealand waters; Green and Leatherback turtles are the most common.[249] A total of forty-three species and sub-species of cetaceans (approximately half the world's dolphin and whale species) have been recorded in New Zealand's EEZ.[250] Māui dolphins, a sub-species of Hector's dolphins, are the smallest and one of the rarest dolphins in the world. Found only on the West Coast of the North Island, the population is estimated to number between fifty-seven and seventy-five dolphins over the age of one year.[251] New Zealand has the most diverse seabird community in the world. Around 80 species are known to breed there, including the world's highest number of albatross (fourteen species), petrels (thirty-two species), shags (thirteen species), and penguins (nine species).[252]

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[242] *Biodiversity Hotspots – New Zealand*, CRITICAL ECOSYSTEM PARTNERSHIP FUND, https://www.cepf.net/our-work/biodiversity-hotspots/new-zealand (last visited Mar. 20, 2020).
[243] *New Zealand Biodiversity Action Plan 2016-2020*, DEP'T OF CONSERVATION (2016) at 4, https://dcon01mstr0c21wprod.azurewebsites.net/globalassets/documents/conservation/new-zealand-biodiversity-action-plan-2016-2020.pdf.
[244] *Marine – Areas*, ENVTL GUIDE, http://www.environmentguide.org.nz/issues/marine/new-zealands-marine-environment/areas/(last updated 6 February 2018).
[245] *Our marine environment*, DEP'T OF CONSERVATION, https://www.doc.govt.nz/nature/habitats/marine/new-zealands-marine-environment/ (last visited Mar. 20, 2020).
[246] *Id.*
[247] DEPARTMENT OF CONSERVATION, *supra* note 243.
[248] *Sharks/mango*, DEP'T OF CONSERVATION, https://www.doc.govt.nz/nature/native-animals/marine-fish-and-reptiles/sharks-mango/ (last visited Mar. 20, 2020).
[249] *Sea turtles*, DEP'T OF CONSERVATION, https://www.doc.govt.nz/nature/native-animals/marine-fish-and-reptiles/sea-turtles/ (last visited Mar. 20, 2020).
[250] DEPARTMENT OF CONSERVATION, *supra* note 245.
[251] *Māui dolphin*, DEP'T OF CONSERVATION, https://www.doc.govt.nz/nature/native-animals/marine-mammals/dolphins/maui-dolphin/ (last visited Mar. 20, 2020).
[252] DEPARTMENT OF CONSERVATION, *supra* note 245.

New Zealand has around fifty-eight known native species of freshwater fish.[253] Approximately twenty-five of which are found nowhere else in the world.[254] Some species such as whitebait are migratory, moving between fresh and sea water environments to complete their life cycles. Non-migratory species such as mudfish spend their whole life in fresh water.[255] Nearly twenty of the more than fifty galaxiid species known worldwide are found in New Zealand, and most are endemic.[256] Amphibians in New Zealand are represented by four native and three introduced frog species. The native species belong to the ancient and primitive genus *Leiopelma* and have several features that distinguish them from frogs elsewhere in the world: they have no external eardrum; they have round (not slit) eyes; they do not croak regularly like most frogs; and they do not have a tadpole stage.[257] New Zealand also has a diverse population of freshwater invertebrates, including: insects; crustaceans such as crayfish; mollusks such as mussels and snails; leeches; and worms.[258] These animals are fundamental to ecosystem processes.[259]

i. Māori, the Sea and Kkatiakitanga

In Māori culture, the sea is often considered to be the foundation and source of all life. Islands are seen as fish drawn up from the water, and people are considered to have evolved from amphibious beginnings.[260] Traditional Māori knowledge includes genealogies of fish and other marine creatures, and numerous stories and legends are dramas of underwater life.[261] The ethic of kaitiakitanga (guardianship)[262] is central to the expression of Māori culture and identity, and confers obligations on Māori to care for environmental taonga (treasures), including species of indigenous aquatic flora and fauna.[263]

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[253] *Freshwater fish*, DEP'T OF CONSERVATION, https://www.doc.govt.nz/nature/native-animals/freshwater-fish/ (last visited Mar. 20, 2020).
[254] CRITICAL ECOSYSTEM PARTNERSHIP FUND, *supra* note 242.
[255] DEPARTMENT OF CONSERVATION, *supra* note 245.
[256] CRITICAL ECOSYSTEM PARTNERSHIP FUND, *supra* note 242.
[257] *Frogs/pepeketua*, DEP'T OF CONSERVATION, https://www.doc.govt.nz/nature/native-animals/reptiles-and-frogs/frogs-pepeketua/ (last visited Mar. 20, 2020).
[258] *Freshwater invertebrates*, DEP'T OF CONSERVATION, https://www.doc.govt.nz/nature/native-animals/invertebrates/freshwater/ (last visited Mar. 20, 2020).
[259] *Invertebrates*, DEP'T OF CONSERVATION, https://www.doc.govt.nz/nature/native-animals/invertebrates/ (last visited Mar. 20, 2020).
[260] Te Ahukaramū Charles Royal, *Tangaroa – the sea*, TE ARA – THE ENCYCLOPEDIA OF NEW ZEALAND, https://teara.govt.nz/en/tangaroa-the-sea (last visited Mar. 20, 2020).
[261] *Id.*
[262] Katiakitanga is defined in section 2 of the Resource Management Act 1991 as: "the exercise of guardianship by the tangata whenua of an area in accordance with tikanga Mäori in relation to natural and physical resources, and includes the ethic of stewardship," and in section 2 of the Fisheries Act 1992 as: "the exercise of guardianship; and, in relation to any fisheries resources, includes the ethic of stewardship based on the nature of the resources, as exercised by the appropriate tangata whenua in accordance with tikanga Mäori." *See Māori and Aquaculture Development*, TE PUNI KŌKIRI (June 2007) at 22, https://www.aquaculture.org.nz/wp-content/uploads/2011/06/tpk-maoriaquaculture-2007-en.pdf.
[263] DEPARTMENT OF CONSERVATION, *supra* note 245.

ii. Legislation Protecting Aquatic Wildlife

The principal legislation providing legal protection to New Zealand's aquatic wildlife is are the Wildlife Act 1953 and Marine Mammals Protection Act 1978. All seals, whales, and dolphins are absolutely protected under the Marine Mammals Protection Act 1978 (MMPA).[264] The MMPA goes further than protections in other countries as it includes a prohibition on holding any marine mammal in captivity.[265]

The Fisheries Act 1996 governs fisheries management throughout New Zealand's territorial waters and EEZ.[266] The Act gives commercial, customary, and recreational fishers access to resources while ensuring fish stocks are managed sustainably.[267]

The Marine Reserves Act 1971 provides for the establishment of marine reserves in areas with unique or distinctive marine life, or where continued preservation is in the national interest.[268] New Zealand has forty-four marine reserves, the first of which was established in 1975 at Goat Island, north of Auckland. Only 0.4% of New Zealand's mainland territorial sea has marine reserves, leaving many coastal regions with little or no marine protected areas.[269]

iii. Aquaculture

Aquaculture in New Zealand has a long history, having been undertaken by Māori for centuries. However, the modern aquaculture industry only became established during the 1960s.[270] The current industry relies on just three species; indigenous green-lipped mussels account for approximately 65% of the total industry revenue, with Pacific Oysters and Chinook Salmon (King Salmon) being the other significant species.[271] Other species, including kingfish, Hāpuku, eels, and geoduck clams and have been farmed or trialed as possible species for future production.[272]

Aquaculture is the fastest-growing sector of New Zealand's seafood industry, and a significant contributor to employment, national and regional incomes, and export earnings.[273] Following the

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[264] Gerald Hutching & Carl Walrond, *Marine conservation*, TE ARA - THE ENCYCLOPEDIA OF NEW ZEALAND (June 12, 2006), https://teara.govt.nz/en/marine-conservation.
[265] 16 U.S.C. § 1361 et seq.
[266] *Fisheries Act 1996*, ENVTL GUIDE, http://www.environmentguide.org.nz/activities/fishing/im:1857/fisheries-act-1996/ (last visited Mar. 20, 2020).
[267] *Fisheries*, FISHERIES N.Z., https://www.mpi.govt.nz/law-and-policy/legal-overviews/fisheries/ (last visited Mar. 20, 2020).
[268] *Using different processes to protect marine environments*, OFFICE OF AUDITOR GENERAL at 10 (June 2019), https://oag.govt.nz/2019/marine-environment/docs/marine-environments.pdf.
[269] *Id.* at 8.
[270] Raewyn Peart, *Farming the Sea*, ENVTL DEF. SOC'Y (Aug. 2019) at 62, https://www.eds.org.nz/assets/pdf/Farming%20the%20Sea_FINAL.pdf?k=d35d58d9df.
[271] *New Zealand Aquaculture Market Development Strategy*, AQUACULTURE N.Z. (2008) at 3, https://www.aquaculture.org.nz/wp-content/uploads/2011/06/nz_aquaculture_market_development_strategy.pdf.
[272] *Aquaculture*, ENVTL GUIDE, http://www.environmentguide.org.nz/activities/aquaculture/ (last visited Mar. 20, 2020).
[273] Raewyn Peart, *Farming the Sea*, ENVTL. DEF. SOC'Y (Aug. 2019) at 62, https://www.eds.org.nz/assets/pdf/Farming%20the%20Sea_FINAL.pdf?k=d35d58d9df; *Aquaculture Legislative Reforms 2011: Guidance Overview*, MINISTRY FOR PRIMARY INDUSTRIES (Oct. 2012),

Māori aquaculture settlement, there is also a significant Māori presence in the industry.[274] The industry is strongly outward focused with approximately 60% by value of aquaculture products exported.[275] In 2010, aquaculture sales totaled NZD $380 million and accounted for almost 20% of total seafood export earnings.[276] The New Zealand Government has set a goal for aquaculture to be a NZD $3 billion industry by 2035.[277] The *Aquaculture Strategy* states that "[a]quaculture is the proven way to increase sustainable seafood production within the earth's environmental limits."[278] With an Exclusive Economic Zone that is fifteen times larger than its land area, there is significant potential for the growth of New Zealand's aquaculture industry.[279]

iv. Legislation Regulating Aquaculture

Fisheries New Zealand manages land-based aquaculture through the Freshwater Fish Farming Regulations 1983, under the Fisheries Act 1996. Under the regulations, farmers must have a fish-farm license, granted by Fisheries New Zealand, to farm certain listed species. Marine aquaculture is mainly managed under the Resource Management Act 1991 (RMA), which promotes the sustainable management of natural resources. Under the RMA, any new marine farm must have a resource consent from the regional council, and regional councils are responsible for planning and managing aquaculture in their coastal area between high tide and the twelve nautical mile limit.[280]

https://www.fisheries.govt.nz/dmsdocument/15889-aquaculture-legislative-reforms-2011-guidance-overview-an-overview.

[274] Raewyn Peart, *supra* note 270.

[275] AQUACULTURE N.Z., *supra* note 271.

[276] MINISTRY FOR PRIMARY INDUSTRIES, *supra* note 273.

[277] *The New Zealand Government Aquaculture Strategy*, N.Z. GOV. (Sept. 2019), https://www.fisheries.govt.nz/dmsdocument/15895-the-governments-aquaculture-strategy-to-2025.

[278] *Id.* at 4.

[279] MINISTRY FOR PRIMARY INDUSTRIES, *supra* note 273.

[280] FISHERIES N.Z., *supra* note 267.

H. Aquatic Animals in South Africa

i. Introduction

According to 2018 statistics in South Africa, the fisheries industry is worth six billion Rand and employs over 27,000 people.[281] As a country, there is a major emphasis on increasing the use of aquatic animals. Aquatic animals are seen as a resource and a way to achieve various goals, including food security, economic growth, job creation, and others. This is clear from references to terms such as "blue economy;" "ocean economy" and the Government's "Operation Phaskisa."

> "Operation Phakisa focuses on unlocking the economic potential of South Africa's oceans, which could contribute up to R177 billion to the GDP by 2033 and between 800 000 and 1 million direct jobs. Forty-seven detailed initiatives have been identified, which on implementation, will increase the oceans economy's GDP contribution by R20 million and lead to the creation of 22,000 direct new jobs by 2019."[282]

The South African legislative framework does little to protect aquatic animals and their interests. The laws generally look at environmental protection, the use of aquatic animals as resources, and restrictions on certain activities and species. For example, abalone fishing is severely restricted in South African waters, but poaching is rife, as it is a lucrative trade. There are also major issues with human rights abuses and illegal fishing in the country.[283]

ii. Legislative Framework

South Africa's primary piece of legislation protecting animals – the Animals Protection Act, 71 of 1962 (APA)[284] – does not include fish in the definition of "animal." This Act sets out offenses in relation to animals, and thus by the exclusion of these animals from the scope of the act, means they are without protection. This exclusion is similarly reflected in the Performing Animals Protection Act, 24 of 1935 (PAPA),[285] which, as the name suggests regulates the use of animals in performances. Thus, there are no laws in the country specifically protecting aquatic animals, nor regulating their welfare.

There are, however, a number of laws relating to or impacting on aquatic animals insofar as they relate to the environment, protection of wildlife, use of animals as resources, and animal and human health. Some of these have been set out below.

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[281] *Overfishing*, WESTERN CAPE GOV. (2018), https://www.westerncape.gov.za/general-publication/overfishing.
[282] *Operation Phakisa-Oceans Economy*, ENVTL AFFAIR S. AFR., https://www.environment.gov.za/projectsprogrammes/operationphakisa/oceanseconomy (last visited Mar. 20, 2020).
[283] For more information, *see* Isaacs Moenieba & Witbooi Emma, *Fisheries crime, human rights and small-scale fisheries in South Africa: A case of bigger fish to fry*, MARINE POL'Y 105, 158-168 (2019), *available at* https://doi.org/10.1016/j.marpol.2018.12.023
[284] *Animals Protection Act*, ANIMAL L., https://www.animallaw.info/sites/default/files/AnimalsProtectionAct71-62.pdf. (Note that the Animals Protection Act was amended by the Animal Matters Amendment Act No 42 of 1993)
[285] Performing Animals Protection Act, *available at*: https://www.nda.agric.za/docs/AAPS/Legislation/Performing%20Animals%20Protection%20Act/PERFORMING%20ANIMALS%20PROTECTION%20ACT.pdf.

The Marine Living Resources Act, 18 of 1998[286] sets out fishing and other "takes" of various marine species, but it does not contain any welfare provisions. The Act is based on the premise that aquatic animals are "living resources." Some of the issues the Act specifically deals with include: administrative matters; rights of access, other rights, permits and licenses. It does provide for the use and restrictions on certain types of gear – including but not limited to: trawl fishing; purse seine fishing; other nets: beach-seine net, staked net, set-net, hoop net, shove net, cast net, drag net, driftnet and gillnet. Other restrictions relate to specific species and bag limits - such as sharks; hake longlining; abalone; tuna; west and east coast rock lobsters (respectively) and others.

The Threatened or Protected Marine Species Regulations[287] offers some protection to specific species of marine aquatic animals, by providing for certain "restricted activities" in relation to them. However, activities such as hunting these species are allowed if the necessary permits and licenses are obtained, which generally can be done through following an application and payment of a fee. This set of regulations also regulate permits for boat-based whale and dolphin watching and white shark cage-diving.

The Marine Spatial Planning Act[288] provides a framework for, and development of, marine spatial planning in South Africa as well as the governance of the use of the ocean by multiple sectors. It notes that South Africa has a vast exclusive economic zone totaling 1,540,000 square kilometers of ocean, that the ocean presents economic opportunities; the ocean is subject to environmental change and variability and is not homogenous, and that there is a need to balance economic, ecological and social objectives. It also states that the ocean is being used more intensively than it has been in the past and has multiple usages that may conflict with one another. Despite this, its objectives include conserving the ocean for present and future generations (to use) and facilitating "responsible use" of the ocean.

The National Environmental Management: Protected Areas Act, 2003,[289] was enacted to regulate the system of protected areas in South Africa and to provide for their management. Any commercial activity carried out in a protected area (which would include marine protected areas and sensitive estuaries or conservation worthy catchment areas) requires written authorization by the relevant authority.

The National Environmental Management: Integrated Coastal Management Act 24 of 2008[290] establishes a system of integrated coastal and estuarine management in South Africa and notes in

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[286] Marine Living Resources Act, 1998, *available at*: https://www.nda.agric.za/Daffweb3/Portals/0/Acts/MARINE%20LIVING%20RESOURCES%20ACT,%201998%20(ACT%20No.%2018%20OF%201998).pdf.

[287] The Threatened or Protected Marine Species Regulations, GG 40876, GNR477, 30 May 2017, *available at*: https://www.environment.gov.za/sites/default/files/legislations/nemba10of2004_threatenedoprotectedmarinespeciere gulations_gg40876_0.pdf.

[288] The Marine Spatial Planning Act (May 6, 2019), *available at*: https://cer.org.za/wp-content/uploads/2017/03/MSP-Act.pdf.

[289] National Environmental Management: Protected Areas Act, 2003, CTR. FOR ENVTL. RIGHTS, https://cer.org.za/virtual-library/legislation/national/biodiversity-and-conservation/national-environmental-management-protected-areas-act-2003.

[290] National Environmental Management: Integrated Coastal Management Act, 2008), *available at*: https://cer.org.za/wp-content/uploads/2009/12/24-OF-2008-NATIONAL-ENVIRONMENTAL-MANAGEMENT-INTEGRATED-COASTAL-MANAGEMENT-ACT_1-May-2015-to-date.pdf.

the preamble that "much of the rich natural heritage of our coastal zone is being squandered by overuse, degradation and inappropriate management."[291] The provisions of the Act relate to the management of specific areas, again emphasizing the preservation and use of coastal "resources."

Some aquatic species in South Africa receive special protection, such as seabirds and seals under the Sea Birds and Seals Protection Act No. 46 of 1973[292] which prohibits certain actions such as "wilfully damage[ing] the eggs of any sea bird upon any island or collect upon or remov[ing] from any island any such eggs or the feathers of any sea bird or any guano."[293]

As aforementioned, the current framework does little to actually protect aquatic animals from the various threats they face.

iii. **Aquaculture**

According to a 2013 Government Document, the Agricultural Department "as the lead agent for the management of the aquaculture sector, has prioritized the development of this sector because it is seen as having the potential to supplement dwindling fish stocks, increase food security, create jobs, and contribute to rural development in the country."[294]

There is both freshwater and marine aquaculture in South Africa.[295] The following are "cultured" species:[296]

- Marine species: abalone, oysters, mussels and finfish
- Freshwater species: trout (the most cultured species); tilapia North African catfish; carps; South African mullet; largemouth bass; marron crayfish; Atlantic salmon; and a number of ornamental species.

In 2018, the South African government released a "Draft Aquaculture Development Bill[297] which lapsed, but as of March 5, 2020[298] is now making its way through parliament. The Bill essentially provides the administrative framework to develop the aquaculture industry in South Africa. The

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[291] *Id*.
[292] Sea Birds and Seals Protection Act, 1973, *available at:* https://www.nda.agric.za/doaDev/sideMenu/fisheries/03_areasofwork/Aquaculture/AquaPolGuidLeg/Legislation/SeabirdsSealsProtectionActNo46of1973.pdf.
[293] *Id*.
[294] *Legal Guide for the Aquaculture Sector in South Africa*, DEP'T OF AGRIC., FORESTRY, & FISHERIES OF S. AFR. (Sept. 2013), https://www.nda.agric.za/doaDev/sideMenu/fisheries/03_areasofwork/Aquaculture/AquaPolGuidLeg/AquaPolicyGuide/The%20User%20Friendly%20Legal%20Guideline%20for%20the%20Aquaculture%20Sector%20in%20South%20Af....pdf.
[295] *See Aquaculture*, S. AFR., http://southafrica.co.za/aquaculture.html (for more information).
[296] *National Aquaculture Sector Overview: South Africa*, FAO, http://www.fao.org/fishery/countrysector/naso_southafrica/en (last visited Mar. 20, 2020).
[297] *Aquaculture Development Bill, 2018*, CTR. FOR ENVTL. RIGHTS (June 22, 2018), https://cer.org.za/virtual-library/legislation/national/marine-and-coastal/aquaculture-development-bill-2018. Note that there were also attempts in 2016.
[298] Aquaculture Development Bill, 2018, PARLIAMENTARY MONITORING GROUP, https://pmg.org.za/bill/806/?utm_source=transactional&utm_medium=email&utm_campaign=searchalert (last visited Mar. 20, 2020).

preamble states that "aquaculture has the potential to contribute to food security, equity, job creation and economic development and to create export opportunities for South African businesses"[299] and thus the Bill largely sets out the provisions to make this happen - including through planning; developing specific aquacultural zones; setting aside funding; establishing information systems; licenses and permitting and other mechanisms. Chapter 9 regulates issues relating to "Health, Welfare, Safety and Quality of Aquatic Organisms and Products" and empowers the Minister to make regulations relating to animal welfare. It is unclear to what extent this will be done, given the general failure to promulgate specific welfare standards for farmed animals in the country.

iv. **Resources:**

For further reading:

- FAO: http://www.fao.org/fishery/countrysector/naso_southafrica/en
- South African Legislation: https://www.daff.gov.za/daffweb3/Branches/Fisheries-Management/Aquaculture-and-Economic-Development/aaquaculture-sustainable-management/-Policy-Guidelines-and-Legislation
- South Africa Online: http://southafrica.co.za/aquaculture.html
- Farmers Weekly, Aquaculture: https://www.farmersweekly.co.za/animals/aquaculture/
- SA Government: https://www.gov.za/about-sa/fisheries
- Legal Guide For The Aquaculture Sector In South Africa: https://www.nda.agric.za/doaDev/sideMenu/fisheries/03_areasofwork/Aquaculture/AquaPolGuidLeg/AquaPolicyGuide/The%20User%20Friendly%20Legal%20Guideline%20for%20the%20Aquaculture%20Sector%20in%20South%20Af....pdf
- Operation Phakisa: https://www.operationphakisa.gov.za/pages/home.aspx

[299] *Id*.

I. Cephalopod Aquaculture

In addition to considering regulations based on jurisdiction, it is also helpful to look at specific categories of animals who are being bred more regularly for many types of uses. Cephalopods are being used in increasing numbers and in increasing ways, so it is helpful to look at them as one example to consider.

i. What is a Cephalopod?

A Cephalopod is a member of a class of animals that inhabits the ocean. There are four living categories of cephalopods — octopuses, squids, cuttlefishes, and nautiluses.[300] Cephalopods are intelligent animals, each of which has two eyes, a mantle, a funnel, three hearts, and at least eight arms.[301] Some cephalopods have eyes that are as complex as human eyes and some may be able to distinguish colors.[302] They usually move by pushing water through their mantel cavity to propel themselves or by using their arms to walk across the sea floor.[303]

Cephalopods, especially octopuses, are known for their intelligence.[304] They have a centralized brain with dedicated areas for memory and learning.[305] One way that octopuses exhibit intelligence is through their feeding habits – they are able to differentiate and choose meals that will be easier for them to consume and change their feeding methods depending on what they are eating.[306] Octopuses also play and have personalities.[307] Their intelligence has caused problems for the people who have tried to keep them in captivity.[308]

Many cephalopods are also classified by their ability to change their appearance and expel ink. Some cephalopods can quickly change their shape and color in order to blend in or stand out — some even have the ability to mimic other animals.[309] Another way that cephalopods can blend into their surroundings or stand out is through the use of specialized organs to create light called bioluminescence.[310]

ii. Why and how cephalopods are being bred?

Increasing human use of cephalopods is driving the desire to culture them. Some of these uses include production for food, entertainment, and science.[311] Various types of cephalopods are

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[300] Danielle Hall, *Cephalopods*, SMITHSONIAN, https://ocean.si.edu/ocean-life/invertebrates/cephalopods (last visited Mar. 20, 2020).
[301] *Id.*
[302] *See id.* (discussing 2016 study of cephalopod vision).
[303] *Id.*
[304] Brendan Borrell, *Are octopuses smart?*, SCI. AM. (Feb. 27, 2009), https://www.scientificamerican.com/article/are-octopuses-smart/.
[305] *Id.*
[306] *See id.* (discussing observations of octopuses eating clams and mussels).
[307] *Id.*
[308] *Id.* (mentioning octopuses' ability to learn to escape and take things apart).
[309] Danielle Hall, *supra* note 300.
[310] *Id.*
[311] Caitlin O'Brien, Katina Roumbedakis, & Inger E. Winkelmann, *The Current State of Cephalopod Science and Perspectives on the Most Critical Challenges Ahead From Three Early-Career Researchers*, FRONTIERS (Jun. 6,

common food sources around the world — demonstrated by the millions of metric tons of cephalopods fished from the ocean every year.[312] Humans also use the inner shell of the nautilus for jewelry.[313]

Scientific research being done on cephalopods is additionally driving the desire for aquaculture, or the raising of cephalopods for commercial purposes. However, scientists have only been successful at small-scale ventures for a limited number of species.[314] Scientists are hopeful they will find techniques that will allow for larger-scale aquaculture cephalopod operations, which would aid in using them as experimental laboratory research subjects.[315] Growth of cephalopod aquaculture is also important to the fishery industry as wild populations have been under pressure from overfishing.[316]

iii. **What are some issues associated with cephalopod breeding?**

Scientists have identified two major obstacles to cephalopod aquaculture — "a lack of knowledge regarding optimal nutritional requirements and difficulties associated with successful reproduction in captivity."[317] Another complication is that cephalopods exhibit different physiology depending on whether they are living in captivity or in the wild.[318] For instance, growth of captive cephalopods is not the same as those living in their natural habitats – it is less than their wild counterparts.[319] Another obstacle in farming – specifically reported in octopuses – is that they cannot be vaccinated against common infections, which makes it hard to protect them when they are reared in large numbers – this leads to significant loss of life.[320]

An underlying ethical and legal issue indicated by the above obstacles faced in rearing cephalopods is that the people involved are not considering the care or welfare of the cephalopods for their own sake, and only consider what is optimal for the commercial uses intended. Scientists and aquaculturists seem to be focused on optimizing use and profits. For instance, scientists are trying to discover nutrition that will "sustain the existing metabolic costs" in order for the animals to grow and reproduce.[321]

Another important factor to consider is the amount and type regulations regarding the use of cephalopods in science. Many countries, including the United States, do not have regulations that affect the care or welfare of cephalopods in research. These animals are typically excluded from

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2018), https://www.frontiersin.org/articles/10.3389/fphys.2018.00700/full (discussing the popularity of cephalopods in movies and artwork, their contributions to scientific research, and inspiration of technological developments).

[312] Danielle Hall, *supra* note 300.

[313] *Id.*

[314] Caitlin O'Brien et al., *supra* note 311.

[315] *Id.*

[316] *Id.*

[317] *Id.*

[318] Juan Navarro, Antonio Skyes, & Oscar Monroig, *Nutrition as a Key Factor for Cephalopod Aquaculture*, CEPHALOPOD CULTURE (Apr. 2014), https://www.researchgate.net/publication/262943453_Nutrition_as_a_Key_Factor_for_Cephalopod_Aquaculture.

[319] *Id.* at 85.

[320] Katherine Harmon Courage, *First Octopus Farms Get Growing*, SCI. AM. (Sept. 24, 2013), https://blogs.scientificamerican.com/octopus-chronicles/first-octopus-farms-get-growing/.

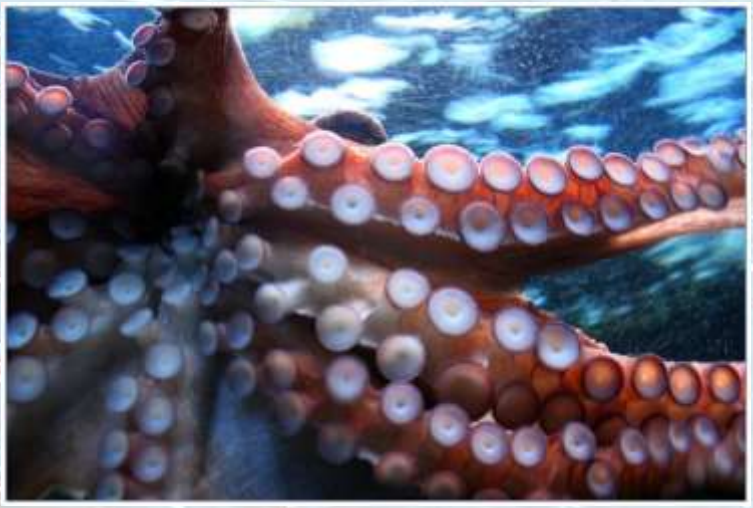
[321] Juan Navarro et al., *supra* note 318, at 85-86.

such regulation. However, in 2013, the European Union began regulating the use of cephalopods in science, requiring scientists to adhere to the principles of the 3Rs – replacement, refinement, reduction.[322] Unfortunately, these regulations do not apply to farming (aquaculture) practices. No matter the reason for cephalopod aquaculture, many ethical concerns should be considered.

iv. Resources

For further reading:

- Website dedicated to information regarding cephalopods: http://www.thecephalopodpage.org/
- Smithsonian provides information on cephalopod anatomy, behavior, human use and conservation, etc.: https://ocean.si.edu/ocean-life/invertebrates/cephalopods
- General information about cephalopods: https://aquarium.ucsd.edu/blog/get-to-know-the-four-types-of-cephalopods/
- Article about octopus intelligence by Jennifer Mather: https://animalstudiesrepository.org/cgi/viewcontent.cgi?article=1370&context=animsent
- Care and welfare of cephalopods used in research: https://3rs.ccac.ca/en/searches-and-animal-index/ai-animal-index/cephalopods.html
- Article on the importance of nutrition in cephalopod culture:
- Discussion of cephalopod genetics and how omic technology can be applied to cephalopod research and aquaculture: https://www.frontiersin.org/articles/10.3389/fphys.2018.00700/full



[322] Graziano Fiorito, et. al., *Cephalopods in neuroscience: regulations, research and the 3Rs*, 14(1) INVERT NEUROSCI. 13-36 (2014), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3938841/.

J. Zebrafish Aquaculture

Like cephalopods, Zebrafish are being used in increasing numbers, especially in research. This means they are being bred in large quantities without a corresponding increase in regulation or concern for their welfare.

i. What is a zebrafish?

Danio rerio, a.k.a. the zebrafish, is a small tropical fresh-water fish that originates from southeast Asia.[323] Zebrafish are transparent in their larval stages, and as adults they have stripes down their body.[324] Each zebrafish has "two eyes, a mouth, brain, spinal cord, intestine, pancreas, liver, bile ducts, kidney, esophagus, heart, ear, nose, muscle, blood, bone, cartilage, and teeth."[325]

ii. Why and how are zebrafish are being bred?

Zebrafish are commonly used in scientific research — so commonly in fact that the majority of online search results discuss them in a research context. The characteristics of zebrafish make them a popular organism for human disease-related research.[326] They possess many characteristics researchers see as valuable, including a fast growth rate, large number of offspring, similar genetic structure to humans, and the development of transparent embryos outside of the mother's body.[327] Because zebrafish embryos grow in eggs and are transparent, scientists can easily analyze and manipulate them.[328] These models are possible because humans share seventy percent of the genes found in zebrafish.[329] Examples of some human diseases that scientists are able to model in zebrafish include a variety of cancers, Alzheimer's disease, heart disease and kidney disease.[330]

Unlike the breeding of many other aquatic species, zebrafish are not produced for human food;[331] In addition to research, they are often bred for purchase in pet stores.[332] Zebrafish also serve as a model for aquaculture nutritional research for other species.[333]

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[323] *Why use zebrafish in research?*, YOUR GENOME, https://www.yourgenome.org/facts/why-use-the-zebrafish-in-research (last visited Mar. 13, 2020).
[324] *Id.*
[325] Elizabeth Burke, *Why Use Zebrafish to Study Human Diseases?*, NIH (Aug. 9, 2016), https://irp.nih.gov/blog/post/2016/08/why-use-zebrafish-to-study-human-diseases (last visited Mar. 13, 2020).
[326] *Zebrafish facts*, ZF-HEALTH, http://www.zf-health.org/information/factsheet.html (last visited Mar. 13, 2020).
[327] YOUR GENOME, *supra* note 326.
[328] *Zebrafish*, UNDERSTANDING AM. RES., http://www.understandinganimalresearch.org.uk/animals/10-facts/zebrafish/ (last visited Mar. 13, 2020).
[329] Elizabeth Burke, *supra* note 325.
[330] *Id.*
[331] *Reference Terms – Zebrafish*, SCI. DAILY, https://www.sciencedaily.com/terms/danio_rerio.htm (last visited Mar. 13, 2020).
[332] Elizabeth Burke, *supra* note 325.
[333] Pilar Ulloa, Juan Medrano, & Carmen Feijoo, *Zebrafish as animal model for aquaculture nutrition research*, 5 FRONT GENET. (2014), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4160086/.

iii. What are some issues associated with zebrafish aquaculture?

With the increase of zebrafish use in research, there has been an increase in the types of breeding and husbandry practices.[334] Some have argued that there should be a systematic analysis of the various methods being employed and a standardization of these methods.[335] Without any standardization or regulations, breeders and scientists are able to employ any number of methods, some of which will be less effective and less humane.

Despite their use in large numbers in laboratories, there is significant evidence that fish in general, and these fish in particular, can experience pain,[336] but little corresponding protection to reduce unnecessary pain, or to require consideration of the pain inflicted. This raises various welfare issues not just for scientific use, but also for breeding and rearing of zebrafish.[337]

In the United States, there is no federal law that protects the welfare of farmed fish.[338] Current laws in place to establish humane handling or humane slaughter of animals exclude these animals.[339]

iv. Resources

For further reading:

i. S. Perathoner et al., Potential of Zebrafish as a Model for Exploring the Role of the Amygdala in Emotional Memory and Motivational Behavior, 94 J. of Neuroscience Res. 445, 446, (2016), https://www.researchgate.net/publication/292949100_Potential_of_zebrafish_as_a_model_for_exploring_the_role_of_the_amygdala_in_emotional_memory_and_motivational_behavior - *Requires 'Researchgate' access*

ii. *Numerous authors:* Potential of zebrafish as a model for exploring the role of the amygdala in emotional memory and motivational behaviour (2016), https://www.researchgate.net/publication/292949100_Potential_of_zebrafish_as_a_model_for_exploring_the_role_of_the_amygdala_in_emotional_memory_and_motivational_behavior - *Requires 'Researchgate' access*

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[334] Benjamin Tsang et al., *Breeding Zebrafish: A Review of Different Methods and a Discussion on Standardization*, 14(6) ZEBRAFISH (2017), https://www.researchgate.net/publication/318813384_Breeding_Zebrafish_A_Review_of_Different_Methods_and_a_Discussion_on_Standardization.

[335] *Id.*

[336] Lynne Sneddon et al., *Ample Evidence for fish sentience and pain*, 162 ANIMAL SENTIENCE (2018), https://animalstudiesrepository.org/animsent/vol3/iss21/17/; *see also* Ferris Jabr, *It's Official: Fish Feel Pain*, SMITHSONIAN MAG. (Jan. 8, 2018), https://www.smithsonianmag.com/science-nature/fish-feel-pain-180967764/

[337] Amanda Nicholas, *Animal Welfare and Aquaculture "Quick Takes"*, NSGLC (Aug. 2018), http://nsglc.olemiss.edu/projects/ag-food-law/files/animal-welfare-and-aquaculture-quick-takes.pdf (last visited Mar. 13, 2020).

[338] *Id.*

[339] *Id.*

8. Alternatives to Aquatic Animals as Food

A. Information about Alternatives

As more and more people subscribe to the ethics and lifestyle of veganism, or the health and sustainability of a plant-based diet, more companies and restaurants are trying to create new products to meet this growing demand.

Many companies have created plant-based products as alternatives to seafood, varying from canned vegan-tuna to microwavable vegan crab-cakes. Similarly, some restaurants have started providing vegan options for seafood, such as vegan sushi rolls, vegan fish & chips, and vegan fish soups. Additionally, as technologies continue to develop around "cultured" or "lab-grown meat," it is highly likely that companies and restaurants will soon be able to offer cultured seafood or seafood "grown" in laboratories in addition to plant-based options.

Across the globe, consumers have been trending toward veganism and plant-based diets, and studies suggest this global shift is here to stay.[340] In the United States, the number of self-identifying vegan consumers grew 600% between 2014 and 2017.[341] In 2016, the number of people identifying as vegan in the UK grew by 350%.[342] In 2017, the Canadian Government issued a new Food Guide that favors plant-based foods.[343] Between 2007 and 2017, vegetarianism in Portugal rose by 400%.[344] In 2017, 22% of the population in Hong Kong, reported practicing a plant-based diet.[345]

As the global population continues to trend toward veganism and plant-based diets, companies and restaurants have quickly adapted to take advantage of this burgeoning consumer market. With the help of plant-based companies such as Impossible Foods, Morningstar Farms, and Beyond Meat, some of the world's most famous fast-food restaurants have for the first time ever added fully-vegan dishes to their menu (e.g., Burger King's Impossible Whopper, Carl's Jr.'s charbroiled Beyond Famous Star, Del Taco's Beyond Burritos, White Castle's Impossible Sliders, etc.).[346] Amidst this growing surge in plant-based alternatives to terrestrial animal meat (e.g., beef, chicken, pork), new companies offering plant-based alternatives to seafood have begun seeing success in the marketplace, both in sales and investments.[347] In 2018, Good Catch Foods, a plant-based

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[340] Janet Forgreive, *The Growing Acceptance of Veganism*, FORBES (Nov 2, 2018), https://www.forbes.com/sites/janetforgrieve/2018/11/02/picturing-a-kindler-gentler-world-vegan-month/#67caf0762f2b.
[341] *Id.*
[342] Lindsay Oberst, *Why the Global Rise in Vegan and Plant-Based Eating Isn't a Fad (600% Increase in U.S. Vegan + Other Astounding Stats)*, FOOD REVOLUTION NETWORK (Jan. 18, 2018), https://foodrevolution.org/blog/vegan-statistics-global/.
[343] *Id.*
[344] *Id.*
[345] *Id.*
[346] Brian Kateman, *Vegan Restaurants on the Rise*, FORBES (Aug. 21, 2019), https://www.forbes.com/sites/briankateman/2019/08/21/vegan-restaurants-are-on-the-rise/#6edb87b31e80.
[347] Katrina Fox, *Vegan Seafood is About to Become Big Business—And Not a Moment Too Soon*, FORBES (Aug. 6, 2018), https://www.forbes.com/sites/katrinafox/2018/08/06/vegan-seafood-is-about-to-become-big-business-and-not-a-moment-too-soon/#34384c61645d.

seafood company, received $5.5 million in investments as it geared up for its launch of vegan tuna, crab cakes, fish sliders, and fish burgers.[348] In 2017, Ocean Hugger Foods launched Ahimi, the first plant-based alternative to raw tuna.[349] The first restaurant to carry Ahimi, a poke restaurant in Canada called Benzaquen, sold over 300 pounds from one location in just the first month it was available.[350]

Alongside the growing market for plant-based alternatives, companies are collaborating with scientists to further develop the production and sale of "cultured meat" or meat grown in a laboratory. As cultured meat is real meat grown from stem cells removed from the muscle of an animal, it is neither plant-based nor vegan, but is instead an alternative to meat obtained through the raising and slaughter of farmed animals (both terrestrial and aquatic). One of the leaders in the "lab-grown meat" movement is a company called Shiok Meats, which was founded by Sandhya Sriram after she visited a shrimp farm in Vietnam.[351] Horrified by the conditions the shrimp were kept in, Sriram quit her job at a lab and started her own company in an effort to create shrimp meat without the unnecessary animal suffering caused by the farming and killing of shrimp.[352] According to Sriram, cultured shrimp meat from Shiok Meats will be available to consumers in 2021.[353]

[348] *Id.*
[349] *Id.*
[350] *Id.*
[351] Graham Lawton, *Lab-Grown Meat Will be on Your Plate Soon. It Won't be What You Expect*, NEWSCIENTIST (Feb. 19, 2020), https://www.newscientist.com/article/mg24532700-700-lab-grown-meat-will-be-on-your-plate-soon-it-wont-be-what-you-expect/.
[352] *Id.*
[353] *Id.*

B. Regulatory Challenges

With the invention of cultured seafood and plant-based food alternatives to aquatic animals, comes a number of regulatory questions and challenges. Some of these include:

- Which government agencies should and do regulate these products?
- What are the labeling requirements?
- Should these products be easily distinguishable from products made from aquatic animals?

In the case of cultured meat and seafood in the U.S., regulators have struggled to decide who has jurisdiction, as "cell-cultured meat does not fit neatly into the current framework" of either the U.S. Food and Drug Administration (FDA) or the U.S. Department of Agriculture (USDA).[354] Considering that cultured meat originates from livestock, it would appear to fall within the jurisdiction of the USDA, but the process of growing it in a lab involves techniques that the FDA currently regulates.[355] To address these issues, in 2018 the Food Safety and Inspection Service (FSIS) had a joint public meeting with the FDA to discuss "the potential hazards, oversight considerations, and labeling" of cell cultured meat.[356] Following this meeting, the FDA and the USDA released a statement announcing that the two agencies will be working together to regulate lab-grown meat as they continue to "adapt to the new technology that challenges existing regulatory schemes."[357] The joint regulatory framework will ensure that the FDA oversees all aspects of meat production that involve the culturing of cells, while the USDA will oversee the collection of cell samples from animal muscle and the final stages of production and labeling.[358] Oversight by the USDA has caused some commentators to conclude that the agencies seem to already consider cultured meat to be a "meat food product."[359]

The question still remains as to whether the term "meat" will appear on the labels of cultured meat products when they finally come to market.[360] Many groups from the traditional meat production industry are opposed to cultured meat products using the term "meat" on their labeling—often voicing concerns that the term with confuse consumers—and have requested that the USDA narrowly define the term "meat" to include only products deriving from the carcass of an animal.[361] While the regulation of plant-based meat alternatives is a little more straight-forward, with the FDA currently regulating all production and labeling, plant-based foods have faced new challenges with labeling, similar to those discussed above.[362] In 2018, under the guise of avoiding consumer confusion, Missouri passed a law prohibiting the use of the term "meat" for any product that "is

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[354] Erin Quick, *Regulations Coming Soon for Lab-Grown Meat*, THE REGULATORY REV. (Mar. 5, 2019), https://www.theregreview.org/2019/03/05/quick-regulations-lab-grown-meat/.
[355] *Id.*
[356] *Id.*
[357] *Id.*
[358] *Id.*
[359] *Id.*
[360] *Id.*
[361] *Id.*
[362] Nathan A. Beaver & Brian P. Sylvester, *What's in a Name? The Plant-Based Foods Labeling Debate*, FOLEY & LARDNER LLP (Oct. 8, 2019), https://www.foley.com/en/insights/publications/2019/10/whats-in-a-name-plant-based-foods-labeling-debate.

not derived from harvested production livestock or poultry."[363] This was done at the urging of the meat and poultry industries. Similar challenges have been brought with regard to the labelling of plant-based milk.

Other states have since passed legislation similar to Missouri's, including Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Montana, North Dakota, Oklahoma, South Carolina, South Dakota, and Wyoming.[364] State laws restricting the definition and use of the term "meat" have been met with various lawsuits by Tofurky, the Good Food Institute, the Animal Legal Defense Fund, and the American Civil Liberties Union, who argue that these state laws violate First Amendment rights, the Due Process Clause, and the Dormant Commerce Clause.[365] In the midst of this growing legal debate, the FDA has yet to take a firm stance one way or another.[366] And the lawsuits have not yet been resolved. Thus, the way forward in addressing these issues is unclear. What is clear, is that consumers, regulators and industry stakeholders are very involved in these conversations and they will continue for some time.

Considering the aforementioned information, the future of regulation and labeling of plant-based and cultured seafood in particular is unclear and is a few steps behind the meat and dairy debates.

[363] *Id.*
[364] *Id.*
[365] Beth Kaiserman, *Plant-Based Labeling: Tofurky's Lawsuit, PBFA Standards*, NOSH (Dec. 12, 2019, 5:51 PM), https://www.nosh.com/news/2019/plant-based-labeling-tofurkys-lawsuit-pbfa-standards.
[366] Beaver & Sylvester, *supra* note 362.

C. Seafood Alternative Companies

While the number of companies producing alternatives to seafood continues to grow every year, we have included a non-exhaustive list of some companies below:

i. Tofuna Fysh
ii. Ocean Hugger Foods
    a. Unami
    b. Ahimi
iii. Gardein
iv. Good Catch Foods
v. Quorn
vi. New Wave Foods
vii. Tuno
viii. Plant Based Foods
ix. Sophie's Kitchen
x. May Wah Vegetarian Market

There are also companies working in the area of "cultured" or lab grown seafoods, sometimes referred to as "cell-based" or "clean meat," such as:

i. BlueNalu
ii. Shiok Meats
iii. Finless Foods

9. Resources

There are a number of useful resources to find out more about aquatic animals. These range from scientific evidence about their capacities and abilities, to the law that applies to them.

Below is a non-exhaustive list of resources where one can look to find out more about these fascinating creatures. Some other resources can be found throughout the Resource Packet, in Resource Sections and in the footnotes.

A. Animal Law Resources

i. Articles
   1. Kathy Hessler, Rebecca Jenkins and Kelly Levenda: Cruelty to Human and Nonhuman Animals in the Wild-Caught Fishing Industry
   2. Kelly Levenda: Legislation to Protect the Welfare of Fish
   3. Corrigan Z. (2017) Water and Marine Animal Law. In: Steier G., Patel K. (eds) International Farm Animal, Wildlife and Food Safety Law. Springer, Cham

ii. Websites
   1. Let Fish Live: Legal Treatment of Fishes
   2. NOAA Fisheries Website: Laws and Policies

iii. Webinars
   1. Aquatic Animal Law: Overview, Aquaculture, and Alternatives 2019
   2. Captive Aquatic Animals in Public Aquariums 2019

B. Websites

i. Food & Agriculture Organization of the United Nations: 2018 The State of the World Fisheries and Aquaculture (Browse)
ii. Center for American Progress: American Aquaculture An Overview of the Current Status, Environmental Impacts, and Legislative Opportunities
iii. Friends of the Earth: The Dangers of Industrial Fish Farming
iv. Center for Food Safety: Case Summary and Papers
v. Dr. Martin Cooke - Animal Welfare in Farmed Fish
vi. Center for Food Safety: Various Tabs (Browse Website)
vii. World Aquatic Animal Day Website
viii. Aquatic Animal Law Initiative Website
ix. Fish Feel: Home and Resources

C. Scientific Resources

1. Culum Brown, Fish intelligence, sentience and ethics.
2. Donald Broom, Cognitive ability and sentience: Which aquatic animals should be protected?
3. Mark Bekoff, Aquatic Animals, Cognitive Ethology, and Ethics: Questions About Sentience and Other Troubling Issues that Lurk in Turbid Water.
4. Jonathon Balcombe, What a fish knows

5. Jonathan Balcombe, Cognitive evidence of Fish Sentience
6. Culum Brown: How fish think and feel, and why we should care about their welfare
7. Victoria Braithwaite, Do fish feel pain?
8. Lynne U. Sneddon, Pain in Aquatic Animals
9. Lynne U. Seddon, Pain perception in fish: indicators and endpoints
10. Professor John Webster, Fish are sentient beings
11. Isabelle Maccio-Hage, Pain in fish
12. Johnathan Balcombe, Cognitive evidence of Fish Sentience
13. Victoria A. Braithwaite: Why human pain can't tell us why fish feel pain
14. Donald M. Broom: Fish brains and behaviour indicate capacity for feeling pain
15. Culum Brown: Comparative evolutionary approach to pain perception in fishes
16. Pentii O. Haikonen: On the sentience of fish
17. Robert C Jones: Fish sentience and the precautionary principle
18. Yew-Kwang Ng: Could fish feel pain? A wider perspective
19. Anil K Seth: Why fish pain cannot and should not be ruled out
20. Lynne U. Seddon and Mathew C. Leach: Anthropomorphic denial of fish pain
21. V.A Braithwaite, P. Boulcott: Pain Perception, Aversion and Fear in Fish
22. *Numerous authors:* Adult Cleaner Wrasse Outperform Capuchin Monkeys, Chimpanzees and Orangutans in a Complex Foraging Task Derived from Cleaner - Client Reef Fish Cooperation
23. Carl Safina: Fish pain - a painful topic
24. Silji Kittilsen: Functional Aspects of Emotions in Fish
25. *Numerous authors:* Behavioural Indicators of Welfare in Farmed Fish
26. *Numerous authors:* Variation in Emotion and Cognition Among Fishes
27. *Numerous authors*: Fish can show emotional fever: Stress-induced hyperthermia in zebrafish
28. Kelly Levenda, Sensitizing humans to fish sentience. Commentary on Balcombe on Fish Knows

D. Documentaries

i. Sonic Sea
ii. Damnation
iii. Blackfish
iv. The Cove
v. Chasing Coral
vi. A Plastic Ocean
vii. Seaspiracy
viii. Artifishal
ix. Lolita – A Slave to Entertainment

E. Additional Articles

i. Financial Times: Plant-based fish is the new plant-based meat
ii. Kristin Hettermann: Fish as food or fish as wildlife

F. Organizations

There are so many wonderful organizations around the work working on aquatic animal issues, as well as protection of their habitat and the environment more broadly. Some of these organizations focus on specific species; issues and threats; geographic locations; or other matters; while some organizations work on animal protection and have specific projects relating to aquatic animals.

We encourage you to research the various organizations; and if you have a specific interest; connect with an organization and offer to assist or see how you may get involved and support their work!

10. Looking ahead

A. Fish Projections

According to FAO's analysis,

"The following are the major trends emerging for the period up to 2030:

- World fish production, consumption and trade are expected to increase, but with a growth rate that will slow over time.
- Despite reduced capture fisheries production in China, world capture fisheries production is projected to increase slightly through increased production in other areas if resources are properly managed.
- Expanding world aquaculture production, although growing more slowly than in the past, is anticipated to fill the supply–demand gap.
- Prices will all increase in nominal terms while declining in real terms, although remaining high.
- Food fish supply will increase in all regions, while per capita fish consumption is expected to decline in Africa, which raises concerns in terms of food security.
- Trade in fish and fish products is expected to increase more slowly than in the past decade, but the share of fish production that is exported is projected to remain stable." [367]

B. Aquatic Animal Law

The field of aquatic animal law in very new and will continue to grow. In 2019, the first Aquatic Animal Law course was taught by Professor Kathy Hessler at Lewis & Clark Law School. It will be taught again in June 2020 and is completely online and available to students around the world. It will present an overview of the laws and regulations affecting aquatic animals as well as analysis of areas needing regulation. The course will consider U.S. federal law (including the Marine Mammal Protection Act, Animal Welfare Act, Endangered Species Act) as well as state anti-cruelty laws and some local ordinances (including those related to zoning, breeding, transportation, and display). It will also include examination of the scientific underpinnings of legal decision-making with regard to aquatic species. The course will look at the application of law, or lack thereof, in contexts including: agriculture, research, entertainment, and companion animals. The course will also briefly review some international laws and treaties. See more here.

We are pleased to note that we are working on the first of its kind "Aquatic Animal Law" textbook with Carolina Academic Press due for release in 2021. The authors are: Professor Kathy Hessler, Kelly Levenda, Rebecca Jenkins, Amy P. Wilson and Sonia Waisman.

[367] *2018 The State of The World Fisheries And Aquaculture*, FAO, http://www.fao.org/state-of-fisheries-aquaculture (last visited Mar. 20, 2020).

11. Acknowledgements

Thank you for reading our Resource Packet, we hope you found it useful and educational. We would like to acknowledge those who made it possible.

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For more information, about us and the work we do, please check our Website.