Bridging the Ocean

Part 3

Food Security

authored by the
All-Atlantic Ocean Youth Ambassadors

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The **All-Atlantic Ocean Youth Ambassadors** believe that collaboration is a strong foundation to successful initiatives that work towards protecting the marine environment; and we are grateful to all contributing parties for their inputs, expertise and funding.

Introduction

This booklet series aims to bridge gaps between people and the ocean to encourage citizens to become stewards of the ocean and its resources. Conversations around ocean conservation are often filled with terminology that excludes many people who may not understand these terms, but are wanting to learn and be a contributing part of the conversation. Through *Bridging the Ocean* we hope that people feel welcomed to the **ONE ocean that we love and are all a part of**. With this initiative, we can start to engage more freely with each other without the separations of geography, technicalities, language or fields of work. **It is up to all of us** to protect this beautiful shared blue space, and we can only do so to the best of our ability when we are well-informed.

Food Security

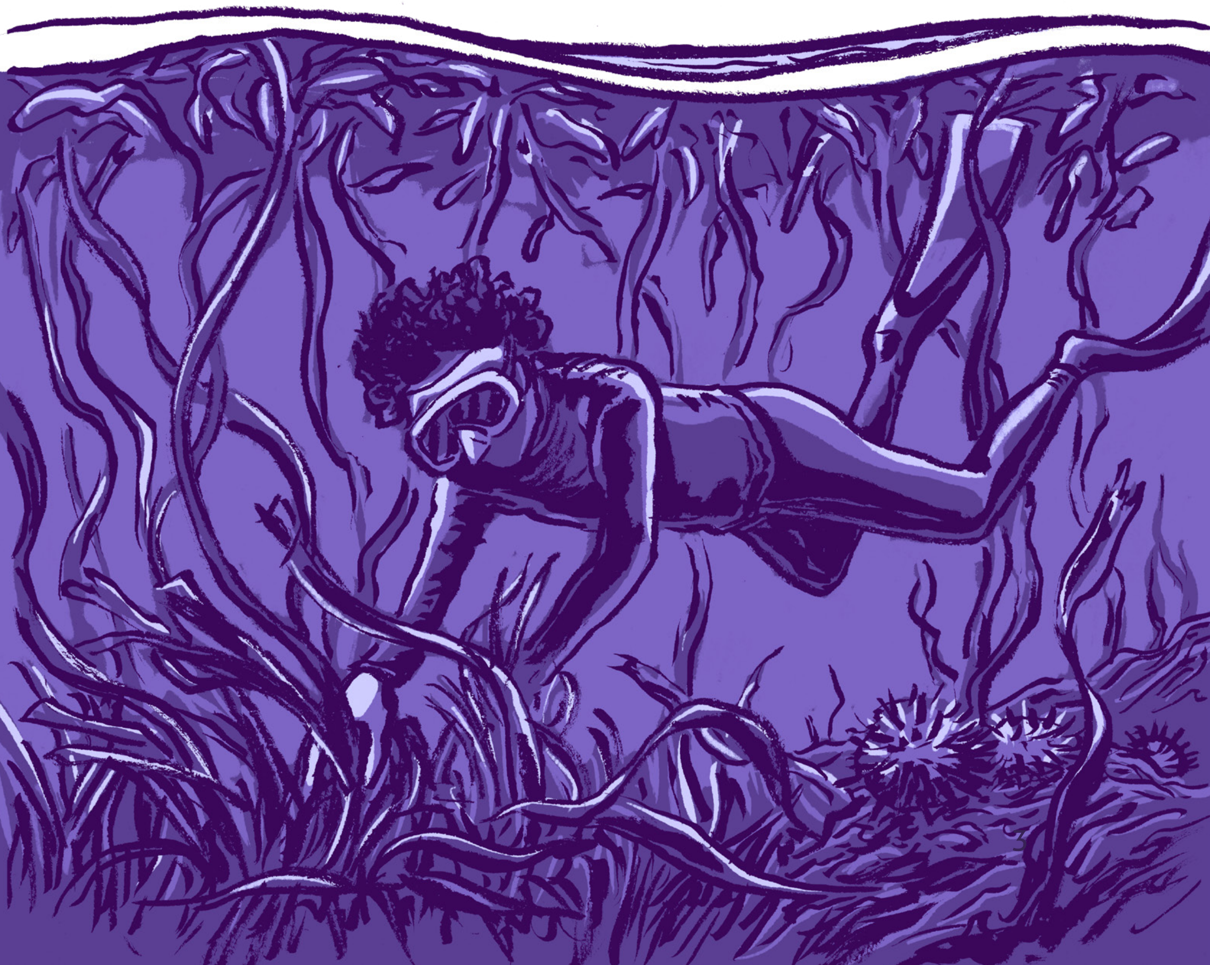
The global population of nearly 8 billion people has a large demand on natural resources, including those that contribute to food security. Food security, as defined by The World Food Summit, means that people have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. More than 3 billion people rely on seafood as a primary source of protein. Food security relies on the equal distribution of natural resources from the ocean. This volume aims to share information that may develop understanding of these processes so that you can contribute to their sustainable practices and we, as civil society, can continue to meet our food security demands in a way that respects our oceans.

Foraging: Historical and Continued Ways

The practice of foraging dates back millions of years from the days of our hominid ancestors. Foraging, which is the act of collecting food mostly through searching and browsing large wild spaces for edible **provisions**, took place both on land and in our oceans. Some examples of foraged goods on land include mushrooms, fruits, small animals, roots, various plants; and if you are on the coast, various **invertebrates** such as sea snails, mussels, or oysters. Foraging has long been a part of ancient communities and continues to be a way of life for some communities today.

Foraging Explained

Foraging was, and still is, a great way to supplement the big hunts or big fishing trips to ensure food security of communities. This is because foraging considers all edible and nutritious food as a source of energy and it is flexible depending on the area or season. Communities have learned which foods are safe to eat, nutritious, and medicinal. This is sacred knowledge as it has been passed down for many, many generations. In this way, foraging is one of the ways of honoring and maintaining Indigenous knowledge. It respects the principle of harvesting from the earth and ocean sustainably so that the environment can thrive and continue to provide.



Coastlines have been particularly important in providing coastal communities with sustenance. Foraging on coastlines mostly takes place on rocky **intertidal shores**, where the rocks provide a surface for many algae and invertebrates to root and develop intertidal ecosystems. Some communities have also been known to dive and forage in subtidal areas, to gather different types of algae, such as the brown seaweed kelp.

It is important for us to consider that coastal environments have long been important for communities to thrive and forage, especially when developing infrastructure on our coastlines. Activities such as building and mining in these environments can have devastating consequences for coastal environments, and therefore on the act of foraging as a source of food for local communities. Let's conserve the long and beautiful history, as well as the heritage of coastal communities.

Now You Know

- Kelp has been, and continues to be, used for many dishes such as pasta, lasagne and salads! Kelp is a great source of Iodine, Iron, Calcium, Folate, Magnesium and Vitamin K.
- Some examples of communities that forage on the coast are along the eastern Arctic coast in Nunavut, where they include kelp with animal fats for delicious and nutritious meals. Another example can be seen in South Africa, where communities forage various molluscs, such as **Alikreukal**, to incorporate in their soups; or echinoderms like the sea urchin as a raw high-energy snack.

Global Fisheries

Fisheries and aquaculture play an important role toward achieving global food security. In 2020, global fisheries, together with aquaculture, produced about 214 million tonnes of food! That is equal to about 1.4 million airplanes in weight. The global seafood industry is the production of seafood for human consumption such as fish, shellfish and molluscs. The seafood coming from wild-caught fisheries has remained stable while fisheries products from aquaculture have been increasing in recent years. Climate change and the increasing pressure of the unequal distribution of resources has caused a global push to ensure commercial fishing activities are sustainable for future generations.

Global Fisheries Explained

Most seafood can be divided into two major categories: wild and aquaculture. Wild-caught fisheries is the process of harvesting fish or invertebrates from the wild in marine and freshwater ecosystems. Aquaculture is seafood that is raised or grown in a controlled environment, such as large underwater fish pens. This happens sometimes on land, but mainly in open waters.

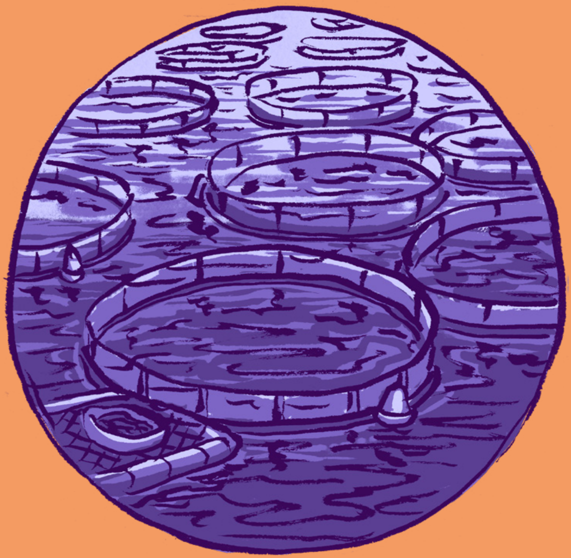
Using global fisheries to address food security can be challenging. Climate change impacts marine and freshwater environments, which means that the habitats for fish and invertebrates that humans rely on for food, have been changing. Additionally, the human consumption of fish per capita has nearly doubled over the past half century. This statistic has been increasing twice as quickly as the yearly population growth of humans, showing that people are consuming more seafood now than in previous years. Improvements in fishing technology to meet the demands of food security has caused an increase in fish consumption. For example, sonar allows ships to see schools of fish from the surface, making them much easier to target. Fishing vessels have also become much larger and can carry heavier yields of fish, resulting in overfishing.

Some of the environmental impacts of wild fishing include bycatch, bottom contact, and illegal maritime activities. Bycatch is the practice of catching fish or other marine species that are not the targeted species and will therefore likely not be used and will be discarded. It can negatively impact large predators, such as sharks and marine mammals (whales, dolphins and porpoises), either through them being caught as bycatch or through their food source being caught. This could impact the entire ecosystem, as sharks and marine mammals play important roles in balancing ecosystems. Vulnerable ecosystems, such as coral reefs, can also be harmed by fishing vessels when their nets make contact with the seafloor. Nets that are designed to drag across the seafloor are called trawlers, and these are used when searching for bottom-dwelling species such as flounder or skate. Lastly, illegal activities such as fishing more than the allowed amount, fishing in Marine Protected Areas (MPAs), or using illegal harvesting methods such as coral reef blasting (using dynamite to quickly decimate a coral reef and the fish that use it as a habitat), threaten the sustainability of global fisheries and food security.

Despite the challenges, there are opportunities for sustainable change. This industry represents a renewable resource, meaning it provides economic benefits and, if managed properly, can be maintained for future generations. Improving sustainable management practices in wild fisheries may ensure that humans can continue enjoying seafood in the future.

Now You Know

- There are more than 4.1 million fishing vessels in operation across the globe.
- The top ten countries that produced fish in 2020 were China, Indonesia, Peru, India, Russian Federation, United States, Viet Nam, Japan, Norway and Bangladesh.



Fish Aquaculture

Aquaculture is one of the oldest forms of food farming in human history – just as early humans **domesticated** and herded land animals, they did the same with aquatic animals. Fish and shellfish that could be contained within enclosed areas (lakes, ponds and netted cages) were a very useful and reliable source of food for when other food sources were unavailable. Fish that were easy to farm, such as carp and catfish, became popular first. This reduced the pressures of wild-caught fisheries on **natural fish stocks**. People can still eat plenty of protein, omega fats and other nutrients from fish without the impacts of overfishing and industrialised fishing practices.

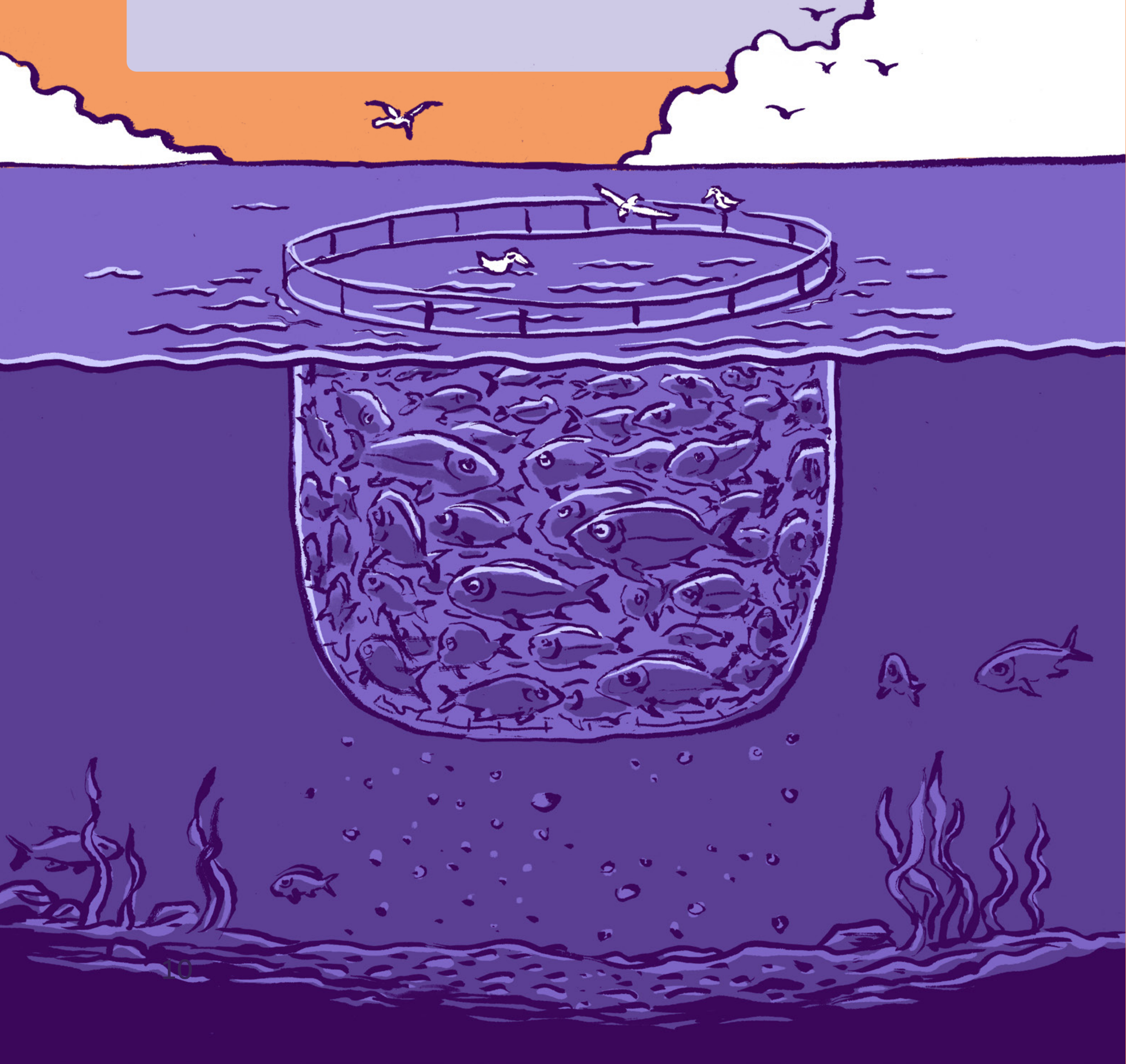
Fish Aquaculture Explained

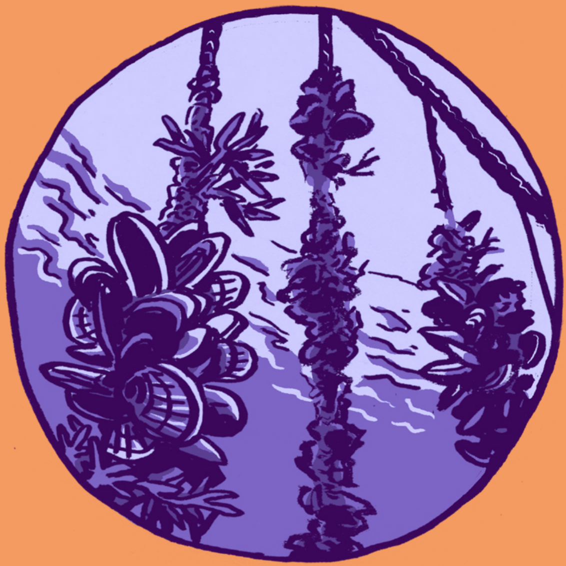
Aquaculture and fish farming also create environmental challenges. Fish farming refers to the practice of raising fish for human consumption in underwater cages. The fish farming industry supplies 40% of the global seafood market! Fish that are stocked at high densities (many fish in a small area) may be more prone to diseases, and although these diseases can be combated with the use of antibiotics, there is a risk that the antibiotics **leach** into the nearby environment. Additionally, enclosing high volumes of fish in a small underwater area can cause infections to spread through sea lice, which can spread to fish outside of the cages. To deal with this issue in Atlantic salmon fish farms, chemical treatments are given to the fish to get rid of the sea lice. When farms are in the open ocean, these contaminants are not contained and may negatively impact other wild species such as the sea floor fauna (crustaceans, worms, sea stars, clams etc.) that live under the farms. It is encouraging that some farms are moving towards natural solutions to fight sea lice by using cleaner-fish such as lumpfish, that cohabit in the farm and eat the sea lice. This reduces the need for chemicals by up to 80%!

Aquaculture is a good alternative to catching seafood from the wild, but this industry still relies on wild caught fisheries, as farmed fish need to be fed and these feeds mainly come from wild-caught fisheries. Therefore, aquaculture can not yet occur independent of fisheries. Fortunately there are exciting new developments in plant-derived foods, such as soybeans, barley, rice, peas, canola, lupine, wheat gluten, corn gluten, other various plant proteins, yeast, insects and algae! Responsible fish-farming uses low-density stocking, minimal antibiotics, and responsibly sourced fish food.

Now You Know

- The fish farming industry runs the risk of being wasteful of resources because it takes 5 pounds of **feed fish** to produce one pound of fish for humans.
- Approximately 58.5 million people are employed in the fisheries and aquaculture sector, therefore this industry not only contributes towards food security, but also contributes towards people’s livelihoods.





Invertebrate and Aquatic Plant Aquaculture

Aquaculture is increasingly in demand across the world due to depleting fish stocks. Although it is not perfect, it is far better than land-based agriculture in terms of carbon emissions, land-use, water needs, antibiotics and animal welfare. **Extractive aquaculture** is the growing of invertebrate and aquatic plant species that remove excess nutrients from the environment – this is very helpful, as it can reduce the environmental impact of culturing aquatic animals.

Invertebrate and Aquatic Plant Aquaculture Explained

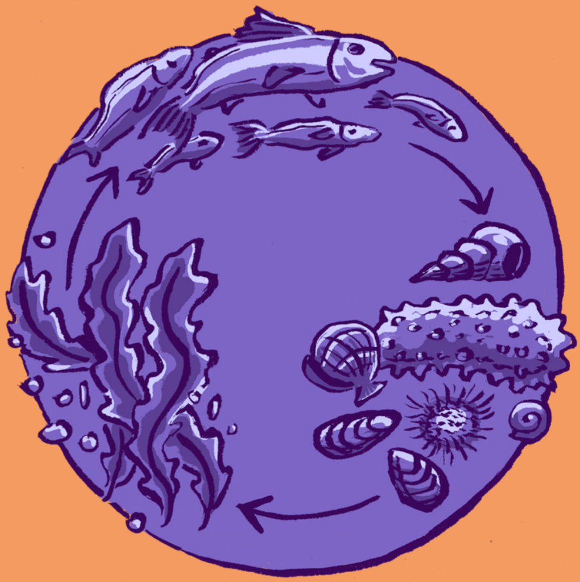
Extractive species like shellfish (such as bivalves: oysters, mussels, cockles, scallops, or gastropods: abalone, limpets, etc.) and seaweed use these excess nutrients to grow and in turn, clean or filter the water around them. Oysters are not only grown for food! Because they are so good at filtering water and improving water quality, they can also be farmed in polluted waterways such as urban rivers to reduce **eutrophication** and make the water cleaner and safer. Eutrophication occurs when water has built up too many nutrients in a specific area. This can be caused by many factors. For example, rainwater run-off from agricultural areas using fertiliser is a common cause, but fish aquaculture can also contribute to this. Eutrophication is bad for seawater as it prevents good bacteria from creating oxygen for other animals and can even spur **Harmful Algal Blooms**. An example of where extractive species have been used to improve water quality can be seen in the Hudson river in New York where the BIllion Oyster Project has farmed over 75 million oysters since 2014, which greatly helped to improve the health of the river. In fact, shellfish species are so good at extracting nearby nutrients, carbon, and pollutants that some people are growing these in polluted waters, not for human consumption but for pollution control.

Seaweeds and shellfish are the main types of species used in extractive farming. Seaweeds (sea veg, sea greens, aquatic plants) make up over half of all marine and coastal aquaculture. Seaweeds are healthy for humans, because they are high in nutrients, but they are also grown for animal feeds, biofuels, biomaterials and biocompounds, pharmaceuticals, cosmetics, and soil fertiliser. Similarly, shellfish aquaculture is an environmentally friendly way of producing healthy sources of protein, fats and minerals, such as zinc and magnesium. Shellfish such as **bivalve molluscs** and **crustaceans** such as crabs, lobsters, and shrimp, grow their shells by pulling carbon out of the seawater, acting as a form of **carbon sequestration**.

Currently, aquaculture faces several challenges in marine climate change and extreme weather, increasing demand for coastal space, and diseases. However, new developments in technology and innovation make the sector both increasingly competitive and sustainable each year. As space on land becomes more competitive and human food requirements increase with the growing population, using the sea and other aquatic environments to grow our food will be more important to food security. Therefore, this sector will be a source of employment for farmers, fishers, scientists, chefs, marketing experts, nutritionists, environmentalists, and many more people around the world!

Now You Know

Oysters create a reef habitat which has helped provide safety and food for other species like fish and mammals. These reef structures can also protect coastal areas from storms and extreme weather. After the oysters have grown, they can further be used for human or animal feed or as fertiliser to improve plant growth, they can be refined into biominerals for pharmaceutical and cosmetic use, and the shells can be used for other carbon calcite uses.



Integrated Aquaculture

Aquaculture needs to be done in a sustainable way where we consider the environment surrounding the farm, as well as the health and well-being of the animals on the farm. If there was a way we could use the waste or **by-products**, we could improve the **environmental footprint** related to these practices. The good news is, we can!

Integrated Aquaculture Explained

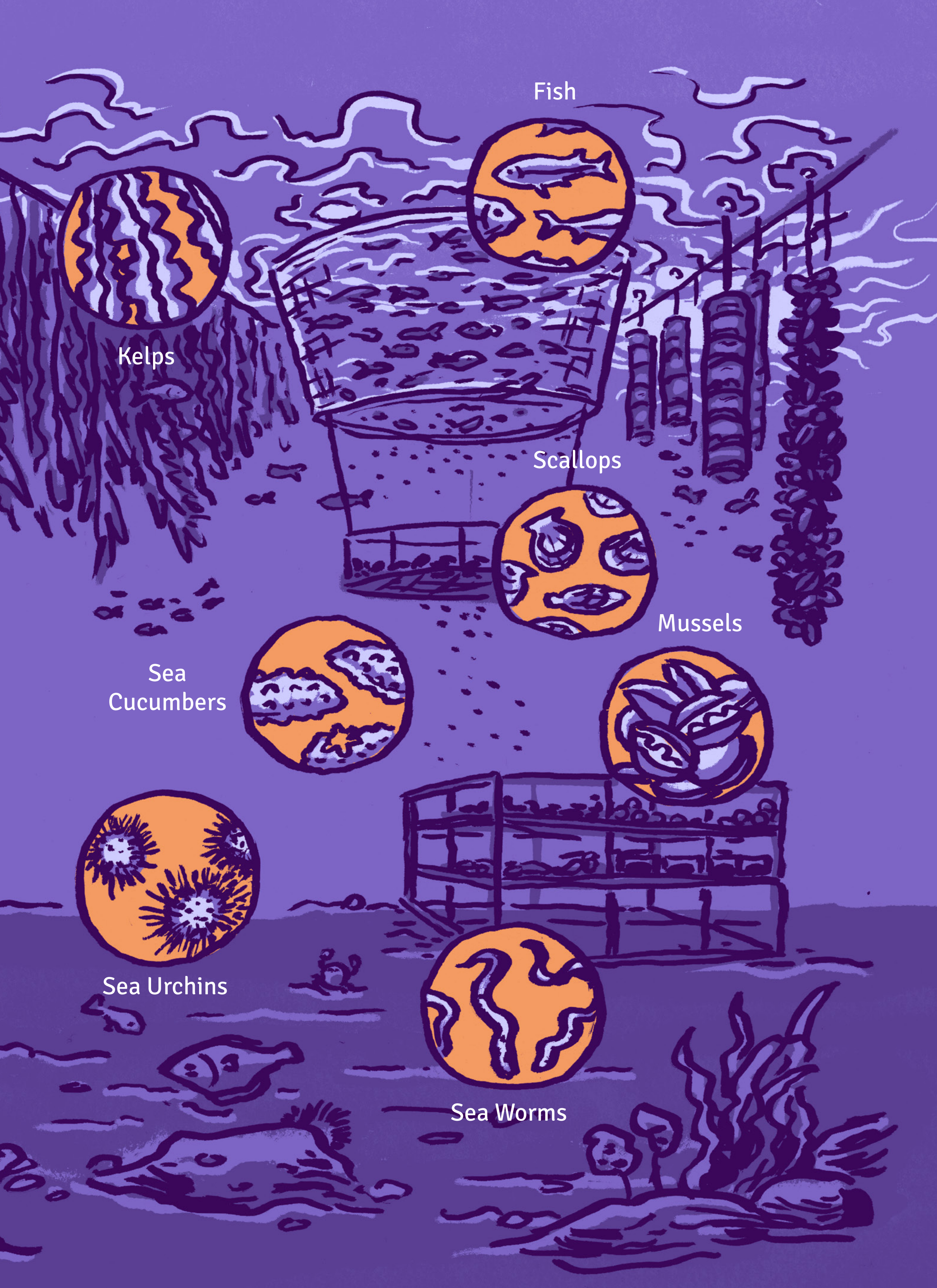
In nature, the waste from some species is often used by others. For example, along the South African coast, there is an abalone species that lives under sea urchins for shelter and protection in its juvenile stages, and they also eat the sea urchin's waste. We could take advantage of this in an aquaculture environment by **culturing** sea urchins and juvenile abalone together. In doing so, the amount of unused waste produced by the sea urchins would decrease and the nutrients released from the farm would be reduced, as the abalone will take up the nutrients in the waste from the sea urchins. This could also benefit animal health, as the abalone could receive good bacteria from the sea urchins that can improve their digestion.

Culturing species in this way is called **Integrated Multi-Trophic Aquaculture** (IMTA), and this is considered a sustainable production method that can reduce the environmental impacts of aquaculture while increasing production. Another example of IMTA is when sea urchins are cultured in systems linked with sea cucumbers and seaweed. The waste and particles excreted by sea urchins can serve as a food source for sea cucumbers. The **dissolved nutrients**, such as ammonia, in the water in these tanks can be rerouted to a tank with seaweed to act as a fertiliser for the seaweeds. With this additional fertiliser, the seaweeds will grow better! Seaweed is not only a food source for the animals, but also acts as **bio-filters** that clean the water so that water can be **re-circulated** in the system and be used in the tanks where the animals are held again. It is important that species that are cultured together are **complementary** to one another in their natural **ecosystem** so that the by-products produced by one can be used by another, thereby reducing the amount of waste produced by aquaculture and released into the environment.

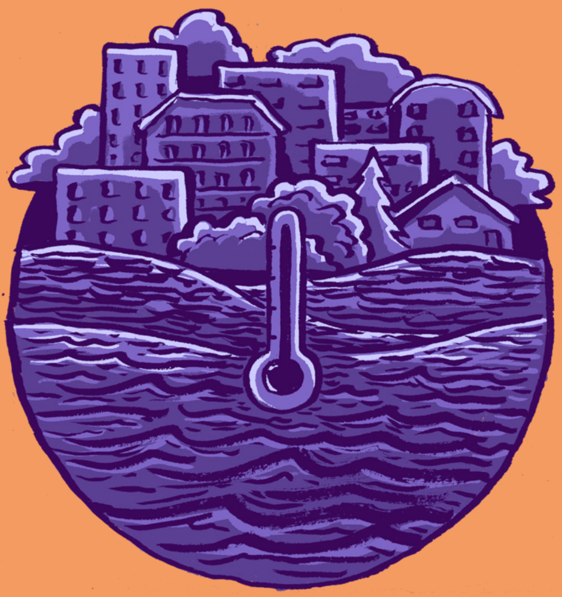
Integrated aquaculture not only improves the environmental footprint of aquaculture practices, but can contribute to additional feed for animals, increase the number of products produced, improve animal health and result in a more sustainable method of farming in the ocean. Although IMTA still requires research on how to implement it in the best way possible in different environments, it can contribute to food security for current and future generations.

Now You Know

- More than 50% of seafood consumed by humans is produced by aquaculture! The Food and Agriculture Organization of the United Nation predicts that 62% of fish used as food will be produced by aquaculture by the year 2030.
- Aquaculture can help to protect the environment by reducing overfishing of natural stocks and provide food security by providing a reliable source of seafood.



Fish
Kelps
Scallops
Mussels
Sea Cucumbers
Sea Urchins
Sea Worms



Impact of Climate Change on Food Security

The shift in temperature and weather patterns (i.e. climate change) that is being observed across the planet could also affect global food security. These shifts are mainly driven by human activities, such as clearing forests or burning fossil fuels (coal, oil and gas) that result in the emission of carbon dioxide or methane, also known as greenhouse gasses, that wrap around the earth like a blanket and trap the sun's heat. There are many expected impacts of climate change on our planet and human life, and we are already witnessing some of these changes. These include increasing temperature, increased frequency of extreme weather events and changes in rain patterns.

Climate Change Explained

Climate change can impact both the amount of food that is produced and the stressors that directly change food systems, such as water availability and diseases. Food systems are also impacted by other **stressors**, such as global pandemics and economic instability. On land, climate change causes warming and drying in certain areas, which can lead to droughts that negatively impact crop growth. Although the increased CO_2 (carbon dioxide) in the Earth's atmosphere, as a result of human activity, could be beneficial to crop growth, it also leads to lower **nutritional quality** of the crops.

Environmental changes, such as temperature and water level changes, can also cause changes in the distribution of pests and disease and this will negatively affect food production in various regions across the globe. Extreme weather events such as flooding, droughts and storms can negatively impact critical growth periods. Many farmers and agricultural workers are now subject to extreme weather events and increased temperatures, which increases the difficulty in producing food. Food transport is also impacted by climate change, for example higher water levels and coastal surges can disrupt transport paths. Disruptions in productivity and food transport will lead to increased food prices and decrease in food accessibility for large centres of human populations.

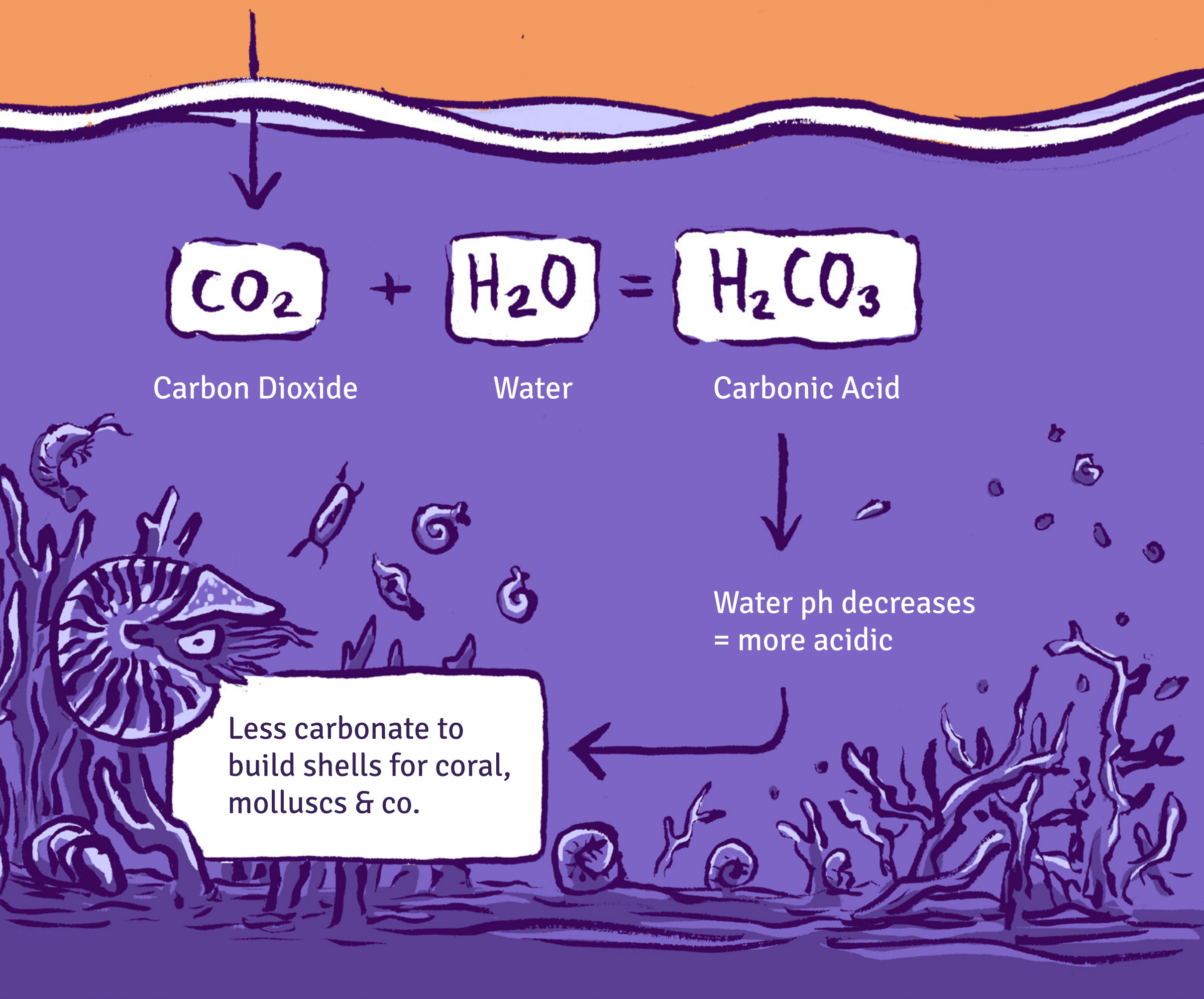
Climate change also influences underwater-ecosystems that support food security. Along with changes in water temperature and a shortage of dissolved oxygen in the water, **ocean acidification** will cause fish habitat distribution to change. This will have an impact on global fisheries production. Ocean acidification reduces the ability of marine organisms to form shells, which are made from calcium carbonate. This could also affect the many fish that feed on these **calcareous** organisms.

Water availability and quality will change due a change in **dissolved oxygen** content and a change in groundwater levels. This lack of dissolved oxygen can lead to **hypoxia**. Hypoxia impacts growth rates of fish and their ability to reproduce. Increased rainfall and flooding can impact the water quality of coastal waters and increase agricultural run-off and urban waste in the environment. Sea-ice melting will create a longer fishing season in some ice-covered areas, however the change in fish distribution may negatively impact fisheries productivity. Increased water temperatures also impacts the **metabolic rate** of fish and their susceptibility to disease.

Climate change causes changes in air and water temperature and water levels. These environmental changes shift the foundation that the global food system depends on. These shifts will change how food is grown, transported and accessed. In order to **mitigate** the impacts of climate change on the global food system, food production greenhouse gas emissions will need to decrease. Additional strategies to mitigate these impacts include improving land management and decreasing carbon dioxide in our atmosphere through soil carbon sequestration/storage practices and afforestation, which means to re-plant more trees. Fossil fuel substitutions, by changing to electric cars for example or using wind turbines to generate power at aquaculture facilities, are also ways to mitigate the impacts of climate change on food systems. An increase in Indigenous land practices, such as **agroforestry** and **conservation-agriculture**, have a positive impact on food production.

Now You Know

- A temperature rise of 1 to 2 degrees Celsius will generally mean a loss in yield of a number of crop varieties, both in tropical and temperate regions.
- The Food and Agriculture Organization (FAO) defines food security as a "situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life".



Conclusion

Knowing that we rely so much on our ocean to provide us with food resources, it is important that we learn and stay curious about where the food on our plate comes from. By staying curious, we can be better stewards for the ocean by shifting our buying and eating habits, if it is within our means. We can also hold our suppliers accountable for the various practices of producing seafood. By engaging with the society and making an effort to learn about socio-economic challenges, we learn that food security is highly inequitable, meaning that not everyone has the same access to food and nutrition. The ocean holds a great opportunity to make food security equitable but this requires us to not only better manage our marine resources, but also to rethink how we distribute them globally. Perhaps some of these processes covered in this chapter are familiar to your community and environment, and so we encourage you to use this booklet as a springboard to learn more about them and become an active part of the solution.

Blue Schools

The All-Atlantic Blue Schools Network (AA-BSN) Joint Pilot Action aims to promote Ocean Literacy and society awareness, with no geographical, cultural, social, or language boundaries through the connection of educational structures. The AA-BSN works towards cultivating space for and encouraging citizens to be ocean-engaged through enhanced Ocean Literacy activities. This helps to create responsible and active generations that contribute to the ocean's sustainability through an international collaborative programme of different National Blue Schools Networks at the Atlantic Ocean level.

AAOYA

The All-Atlantic Ocean Youth Ambassadors (AAOYA) are a group of dedicated individuals from all walks of life and backgrounds, who promote sustainable development and stewardship of the Atlantic Ocean. Within the context of the All-Atlantic Ocean Research Alliance and the AANChOR-CSA, Ambassadors develop campaigns and communication strategies to reach out to local communities, students and civil society, engage decision makers, as well as work with local media to promote the conservation and protection of the Atlantic Ocean for future generations. Ambassadors lend their capacities to various AANChoR Joint Pilot Actions, such as the AA-BSN, to support the implementation of the Galway and Belém Statement.

About the Authors

Marissa Brink-Hull is a Marine Scientist, holds a PhD in Genetics and is a South African AAOYA representative with a passion for education and promoting ocean stewardship. Currently, she is a postdoctoral research fellow at the University of Cape Town, South Africa, where her research is focused on assessing the microorganisms associated with various aspects of integrated multi-trophic aquaculture (IMTA) systems as part of an EU-project ASTRAL (All-Atlantic Sustainable, Profitable and Resilient Aquaculture) that will contribute to the development of sustainable aquaculture across the Atlantic. A special thanks to her colleagues Prof John Bolton, Dr Brett Macey and Dr Mark Cyrus for their contribution to the research on integrated aquaculture included in this booklet.

Gary Kett is a Marine Ecologist from Ireland, he holds a BSc and PhD degree in Zoology from University College Cork and is the Irish AAOYA to AANChOR. His main research focus is in sustainable low-impact aquaculture systems, understanding how the health of fish and shellfish are impacted by marine climate change. He believes that food security is one of the greatest challenges we face and that the sustainable aquaculture of fish, shellfish and algae will be incredibly important in feeding the world's population. Gary also works on-board sea research vessels studying marine mammal (whales, dolphins, and seals) populations in the Northeast Atlantic, assessing their ecosystems, habitats and health. Gary aims to empower local communities and citizens and connect them with scientific research and policy-decisions.

Eloïse Savineau has a B.Sc in Marine Biology, a M.Sc. in Oceanography and is currently undertaking her Ph.D. in Biological Oceanography at the National Oceanography Centre Southampton, United Kingdom. She is also the Belgian AAOYA representative. Her research aims to investigate zooplankton ecology in the twilight zone, to better understand how carbon is cycled and stored in this part of the ocean. Eloïse has a strong interest in ocean literacy and bridging the gap between scientists and the public, to empower citizens to get involved in ocean science and advocacy.

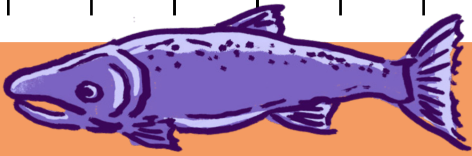
Thando Mazomba, qualified Marine Biologist, Physical Oceanographer and Environmental Scientist, is a South African AAOYA to AANChOR. Using her qualifications, Thando works to contribute to the expansion of communities of care for the blue and green space for the justice to come; she is an intersectional environmentalist at the core of her being. Thando is a marine manager at a metocean consulting company as well as a co-founder and director at The Beach Co-op, an NPO that effectively connects people, institutions and organisations through evidence-based education and experiential learning to keep South Africa's beaches clean and healthy and to protect and enhance ocean health.

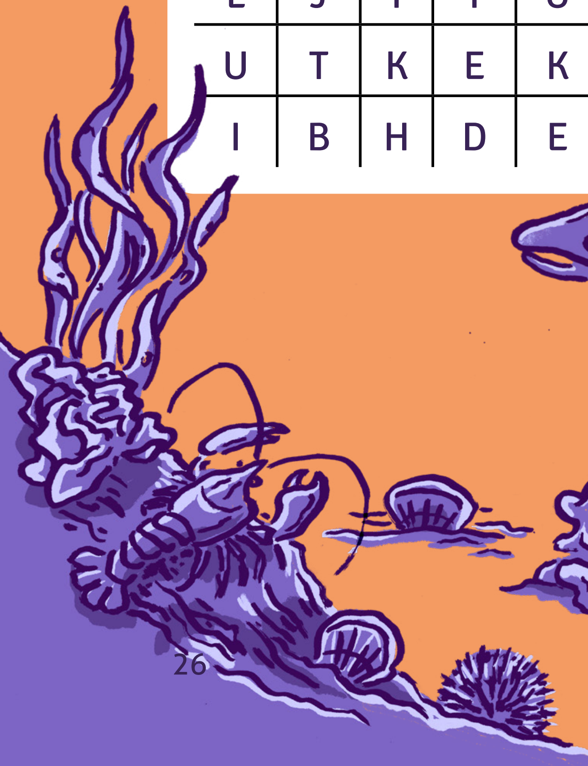
Jesslene Jawanda is one of the Canadian representatives in the All-Atlantic Ocean Youth Ambassador Program. They completed their B.Sc in Marine Biology at Dalhousie University and completed the Oceans Technology Advanced Diploma Graduate program at the Nova Scotia Community College. Their academic research focused on the behavior of climate change gases in the ocean. Since 2017, Jesslene has been conducting sustainable arctic fisheries development research in partnership with communities based in Nunavut, Canada. Jesslene identifies as a Panjabi Sikh, gender-queer person of colour and integrates this lived experience with their passion for arctic fisheries and marine climate science.

Crossword Puzzle

Can you spot the 8 aquaculture species in this crossword?

A	U	R	C	H	I	N	L	H	F
X	N	U	H	S	I	O	O	S	C
V	G	C	R	R	S	M	B	I	S
S	E	E	I	F	H	L	S	F	C
O	N	W	N	P	G	A	T	P	A
A	Q	V	P	O	B	S	E	M	L
V	M	P	X	U	L	H	R	U	L
L	J	I	Y	U	U	A	C	L	O
U	T	K	E	K	V	U	B	X	P
I	B	H	D	E	E	W	E	A	S





Created by Waniko Stephanie and Alao Umar Busayo under the Supervision of Dr. Patricia Anyanwu for **NIOMR / ASTRAL Horizon2020** Project

Glossary

A

Agroforestry is agriculture that incorporates the cultivation and conservation of trees

Aquaculture is the controlled breeding, rearing, cultivating, and harvesting of fish, shellfish, algae, and other organisms in all types of water environments.

B

Bio-filters act as a means to to capture and degrade pollutants in aquaculture systems using biological mechanisms.

Bivalve molluscs are soft-bodied invertebrate organisms that have a two-part hinged shell made from calcium carbonate (e.g. clams, oysters, mussels, scallops)

Bycatch is a fish or other marine species that is caught unintentionally while fishing for specific species or sizes of wildlife. Bycatch is either the wrong species, the wrong sex, or is undersized or juveniles of the target species.

By-products are the secondary products produced along with the main product and can include the waste produced or offcuts from the main product.

C

Calcareous means containing calcium carbonate, usually described for animals with calcareous shells or skeletons (such as corals, sea urchins, clams, oysters, mussels, starfish, shell-forming algae and amoebas).

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide, one of the most commonly produced greenhouse gasses.

Culturing is when aquatic animals are grown in a controlled way to improve production.

Complementary species are species that are able to make use of each other's by-products as resources or share resources in a sustainable manner.

Conservation-agriculture Farming practises that prioritise the health of the ecosystem

Coral reef blasting includes the destructive fishing methods of explosives to kill or stun fish, which destroys corals. This method, called blast or dynamite fishing, shatters coral colonies and kills the coral tissues on nearby colonies.

Crustaceans are a group of aquatic invertebrate animals, with a few terrestrial (land-based) species, which have hard exoskeletons on the outside of their bodies. This group contains crabs, lobsters, shrimp, prawns, as well as barnacles, sea lice, woodlice and sandhoppers.

D

Dissolved oxygen is a measure of how much oxygen is dissolved in the water as a gas, it is the amount of oxygen available to living aquatic organisms which also need oxygen to survive.

Dissolved nutrients are organic (decomposed plants, bacteria or algae) or inorganic (minerals) particles that have dissolved in the water column, but can be reused by other organisms.

Domesticated organisms are animals that have been held captive, fed and bred by humans for food (cattle, sheep etc.), protection (dogs), transport (horses), or entertainment (other pets).

E

Ecosystems are geographical areas where there is a group or community of interacting organisms surviving within a specific temperature range and climatic zone.

Environmental footprint refers to the effect that a person, company or activity has on the environment.

Eutrophication is the process by which excessive nutrients accumulate in a body of water.

Extractive aquaculture is the growing of species that remove excess nutrients from the environment.

F

Feed fish are fish species that are reared in captivity to be later used as food for more economically valuable fish species such as salmon.

H

Harmful algal blooms occur when algae grow in high concentrations and produce toxic or harmful or fatal effects on people, fish, shellfish, marine mammals and birds.

Hypoxia is when there is a lack of oxygen in a body of water or in living tissue.

I

Integrated Multi-Trophic Aquaculture is where aquaculture species from different trophic levels (the position of an organism in the food web) are co-cultured in a way where one species' by-products are recaptured and converted for use by another.

Intertidal shore is the shore area between high tide mark and the low tide mark.

Invertebrates are animals without a backbone or bony skeleton (such as sea urchins, clams, squid and octopus). They can range in size from being invisible to the naked eye (microscopic) to giant squid with soccer-ball-size eyes.

L

Leaching is the movement of nutrients from one location into another, normally caused by water or liquid substances.

M

Marine protected areas (MPA) are sections of the ocean where a government has placed limits on human activity. Many MPAs allow people to use the area in ways that do not damage the environment, for example where no fishing is allowed.

Metabolic rate The rate at which a living organism converts food or water into energy.

Mitigate Reduce or avoid the impact.

N

Natural fish stocks are groups of fish of the same species that live in the same geographic areas and are able to breed with each other at maturity.

Nutritional quality The value of a food for the consumer's physical health, growth, development, reproduction and psychological or emotional well-being.

O

Ocean acidification The gradual rate of the ocean becoming more acidic, this is harmful to living organisms in the ocean.

P

Particulate matter is a complex mixture of various fine solid particles in water.

Provisions are resources intended to be consumed.

Per capita is a Latin term that translates to "by head." Per capita means the average per person and is often used in place of "per person" in statistical observances. The phrase is used with economic data or reporting but is also applied to almost any other occurrence of population description.

R

Recirculation is a technology used in aquaculture, where water is recycled and reused after some form of filtration.

Renewable resources are natural resources which can be replenished at a faster rate than non-renewables such as coal which take millions of years to form. Renewable resources are replenished through natural processes or other recurring processes. Examples of renewable resources include solar energy, wind energy and hydrological energy.

S

Sonar (sound navigation and ranging) is a technique that uses sound propagation (usually underwater, as in submarine navigation) to navigate, measure distances (ranging), communicate with or detect objects on or under the surface of the water, such as other vessels.

Stressors are external things that cause disharmony, irritation, annoyance, or disturbance to individuals or systems.

W

Wild-caught fishery is an industry harvesting sizable free-ranging fish or other aquatic animal (crustaceans and molluscs) populations for their commercial value in a natural body of water. Wild fisheries can be marine (saltwater) or lacustrine/riverine (freshwater).

Y

Yield loss The difference between the amount of produce that could be grown under ideal conditions and the amount of produce that is actually grown.

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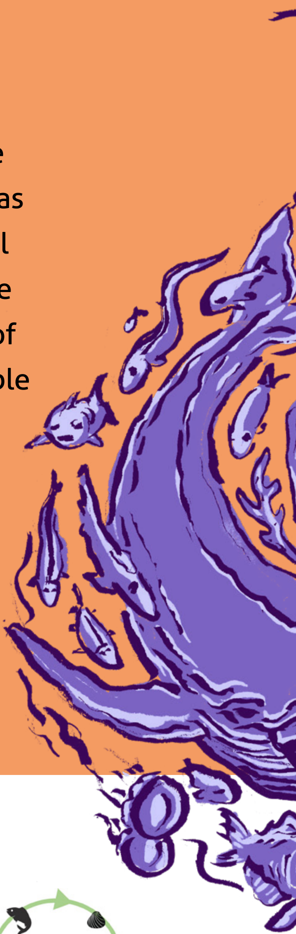
Recommended reading:

Eat Like a Fish: My Adventures as a Fisherman Turned Restorative Ocean Farmer. Smith, B., 2019. Knopf. ISBN 978-0-451-49454-2.

Cod: A biography of the fish that changed the world. Kurlansky, M., 2011. Vintage Canada.

Bridging the Ocean
Part 3: Food Security

The global population of nearly 8 billion people has a large demand on natural resources, including those that contribute to food security. Food security, as defined by The World Food Summit, means that people have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. More than 3 billion people rely on seafood as a primary source of protein. Food security relies on the equal distribution of natural resources from the ocean. This volume aims to share information that may develop understanding of these processes so that you can contribute to their sustainable practices and we, as civil society, can continue to meet our food security demands in a way that respects our oceans.



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BUILDING AN ALL ATLANTIC OCEAN COMMUNITY
Implementing the Belém Statement

ASTRAL

ALL-ATLANTIC BLUE SCHOOLS NETWORK

ALL-ATLANTIC OCEAN RESEARCH ALLIANCE
Creating an Atlantic Ocean Community by Implementing the Galway and Belém Statements