Nourishing the Future: Sustainable Food Systems for Nutrition and Dietetic Students

JOHNS HOPKINS
CENTER *for* A LIVABLE FUTURE

FOOD + PLANET

Presented by:
Johns Hopkins Center for a Livable Future
Food + Planet

Aquatic Foods, Nutrition, and Sustainability

Module 4

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Four Modules

Module 1

Introduction to Sustainable Food Systems

Module 2

Food Systems for All

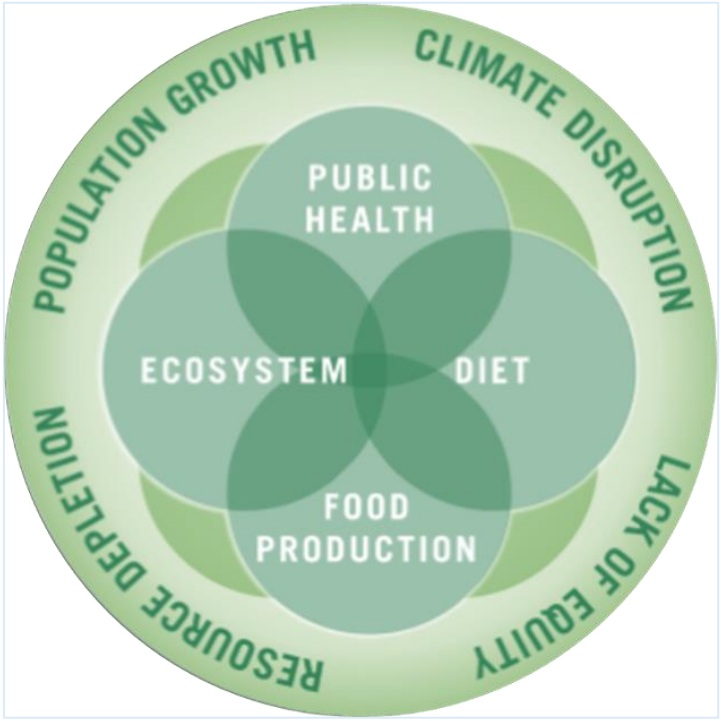
Module 3

Food and our Climate

Module 4

Aquatic Foods, Nutrition, and Sustainability

The Johns Hopkins Center for a Livable Future



- Interdisciplinary academic center at the Johns Hopkins Bloomberg School of Public Health
- Education, research, policy, and practice
- Vision: a healthier, sustainable and resilient food system for all

Image source: Johns Hopkins Center for a Livable Future.

Food + Planet

- *A collective, visionary 501c3 founded by four registered dietitians with varied experience in the food system*
- *Aim: empower health care professionals to be leaders in sustainable food systems*

Vision: a science and practice of nutrition that honors nature as the foundation of health through the four dimensions of sustainability

Image source: Vogliano, C., Geagan, K., Chou, S., Palmer, S. (2021). *Figure 1. The 4 dimensions of sustainable diets*. [Infographic]. Empowering nutrition professionals to advance sustainable food systems [White Paper]. *Food and Planet*. Retrieved September 14, 2025, from https://7157e75ac0509b6a8f5c-5b19c577d01b9ccfe75d2f9e4b17ab55.ssl.cf1.rackcdn.com/GVISUTJI-PDF-1-675987-4519061561.pdf

Blue Foods and Sustainable Foods

Four themes:

1. *Sociocultural*
2. *Economic*
3. *Planetary*
4. *Nutrition*

Sociocultural

- A rich variety of blue foods are culturally relevant and play a role in traditional diets and medicine
- Production can support indigenous, small-scale, local producers
- Blue foods' versatility offers abundant opportunity to explore delicious diverse flavors and culinary applications

Planetary

- Blue foods, such as bivalves and sea vegetables, can improve water quality and provide habitat
- Well-managed production and harvest of blue foods can support human health and planetary health
- Replacing more carbon-intensive animal food sources with blue foods can reduce climate impact of diets

Economic

- Many Americans already enjoy diverse options prepared in culturally appropriate, affordable formats
- Sustainable practices con support long-term economic viability for producers and boost community resilience
- Affordable formats (such as canned, dried, or frozen) support access, affordability, and convenience

Nutrition

- Blue foods are an essential protein source for over three billion people
- Blue foods are rich in micronutrients and essential fatty acids, helping close nutrient gaps
- Blue foods are prominently featured in a variety of dietary guidelines and food-as-medicine frameworks

Source: Food + Planet.

Learning Objectives

- Define aquatic foods
- Describe how aquatic foods are sourced
- Explain five challenges in the aquatic foods sector
- Explain three health benefits of consuming aquatic foods
- Discuss the evidence about the health benefits of consuming aquatic foods
- Gain confidence in providing advice and guidance on selection and preparation of aquatic foods

Section A: Aquatic Food Production

What Are Aquatic Foods?

Finfish: Mahi-mahi, tuna, swordfish, trout, salmon, pollack, sardines

Crustaceans: Crabs, shrimp

Cephalopods: Octopus, squids

Other mollusks: Clams, oysters, snails

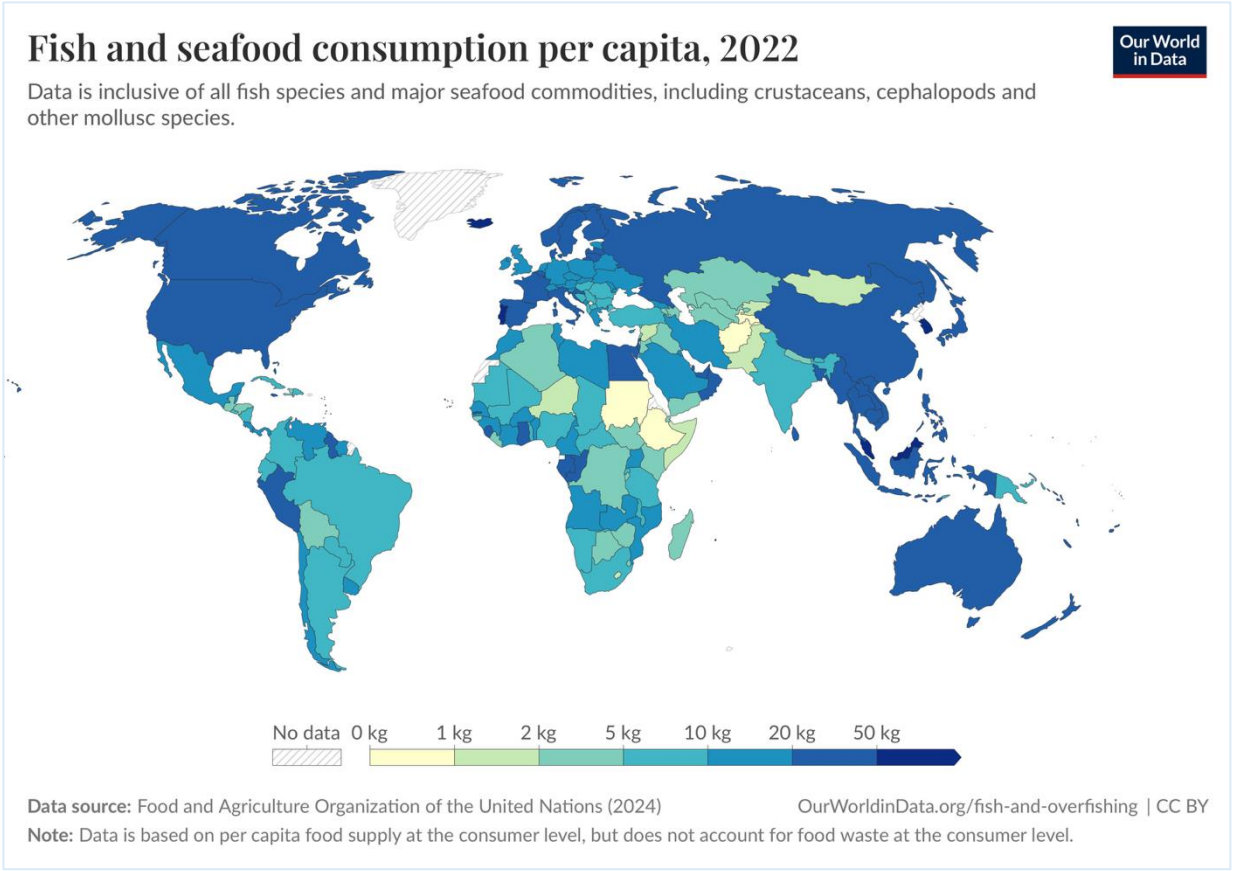
Aquatic plants: Water spinach; aquatica

Algae: Seaweed

Aquatic animals: Insects, sea cucumbers

Source: Golden, C., Koehn, Z., Shepon, A., Passarelli, S., Free, C., Viana, D., Matthey, H., Eurich, J., Gephart, J., Fluet-Chouinard, E., Nyboer, E., Lynch, A., Kjellevold, M., Bromage, S., Charlebois, P., Barange, M., Vannuccini, S., Cao, L., Kleisner, K., … Thilsted, S. (2021). Aquatic foods to nourish nations. *Nature, 598,* 315–320. https://doi.org/10.1038/s41586-021-03917-1
Image source: Food + Planet, used with permission.

Per Capita Fish and Seafood Consumption, 2022



Source: Our World in Data. (2025). *Yearly per capita supply of fish and seafood*. https://ourworldindata.org/grapher/fish-and-seafood-consumption-per-capita

Where Do Aquatic Foods Come From?

- Capture fisheries
  - Caught in the wild with fishhooks, nets, or pots
- Aquaculture
  - Farmed in ponds, cages, pens, tanks

- Marine
  - Oceans
  - Seas
  - Bays
  - Estuaries
- Inland
  - Freshwater lakes, ponds, rivers, streams, reservoirs

Production from Capture Fisheries and Aquaculture

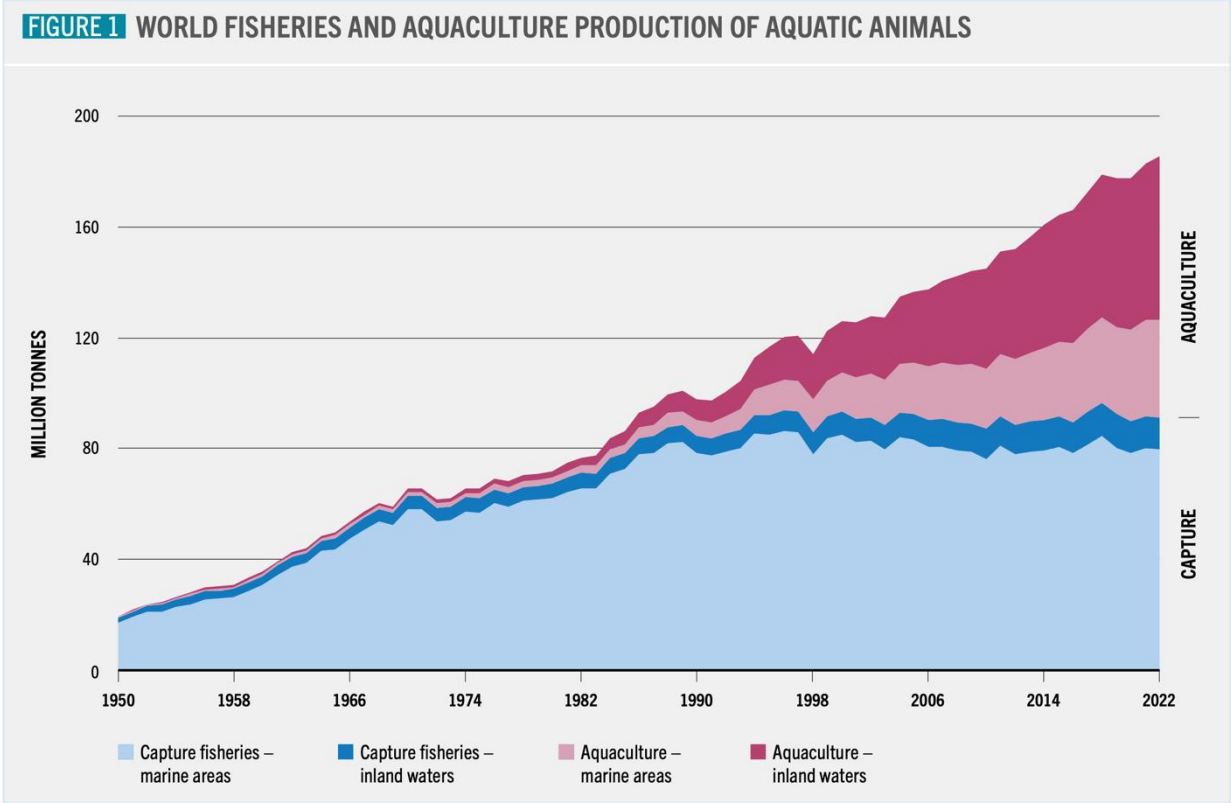


Image source: FAO. (2024). *Figure 1. World fisheries and aquaculture production of aquatic animals* [Chart]. *The state of world fisheries and aquaculture 2024. Blue transformation in action*. Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cd0683en

Marine Capture Fisheries, Average 2018–2020

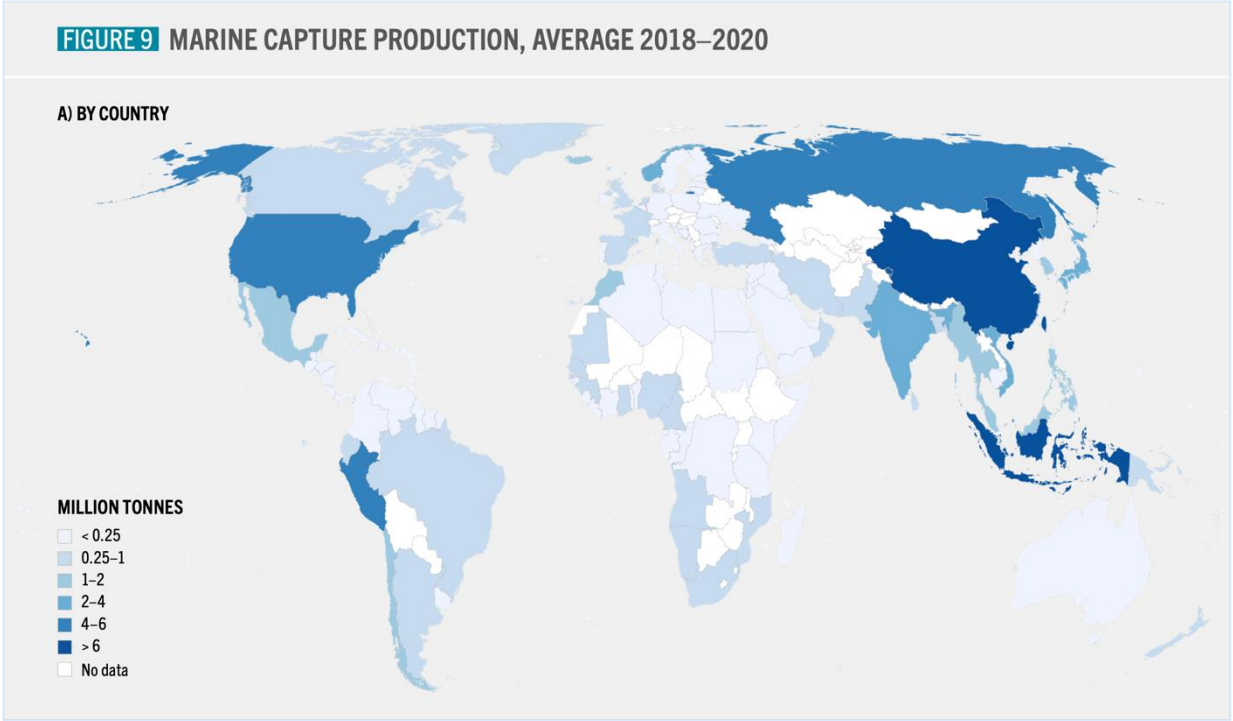


Image source: FAO. (2022). *Figure 9. Marine capture production, average 2018–2020* [Chart]. *The state of world fisheries and aquaculture 2022. Towards blue transformation.* Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cc0461en

Smaller-Scale Capture Fisheries

- Smaller fishing vessels
- Shorter trips
- Less capital and energy
- Important for lower-income countries
  - Contribute half of the global seafood harvest
  - Employ 90% of fishing sector

Image sources: Top, Lumwe, Festo. (n.d.). WorldFish. CC BY-NC-ND 2.0. https://flic.kr/p/2qyWCtT; Bottom, Microsoft Stock Images.

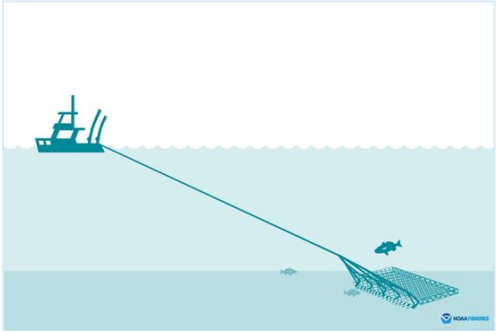
Larger-Scale Capture Fisheries

- Larger boats, travel further and stay out to sea longer
- More technology and energy
- Include catcher-processor vessels

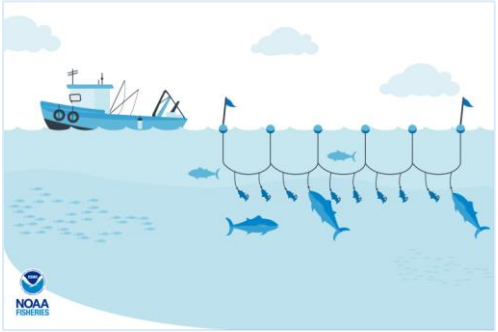
Image source: NOAA. (2010). A full cod end of the trawl on deck. https://www.noaa.gov/media/digital-collections-photo/fis00508jpg

Common Commercial Fishing Techniques

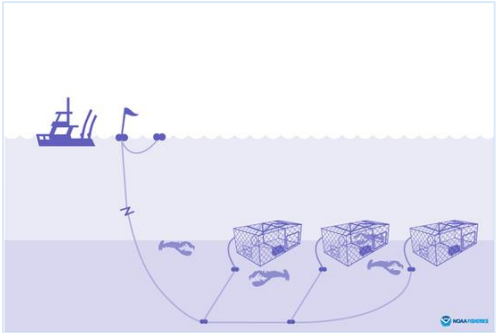
A. Dredge
(Raking the seabed floor)



B. Longline
(Baited hooks trailing boat)



C. Pots and traps
(For crustaceans)



D. Purse seine
(For schools of fish)

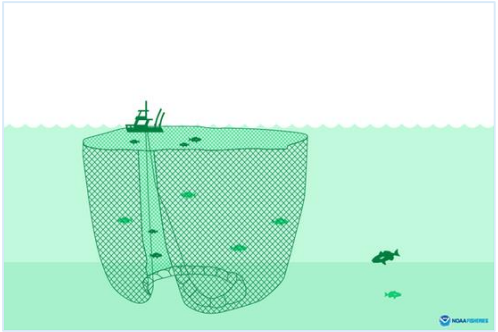


Image source: NOAA Fisheries. (2022). *Fishing gear and risks to protected species*.
https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-and-risks-protected-species

Aquaculture

- Diverse in size, scale, methods
- Produces 52% of all seafood available for consumption
- Predicted to rise to 62% by 2030

Image sources: Left, courtesy of Dave Love, Johns Hopkins Bloomberg School of Public Health; Center and right, Shutterstock.

Aquaculture Production by Country, 2022

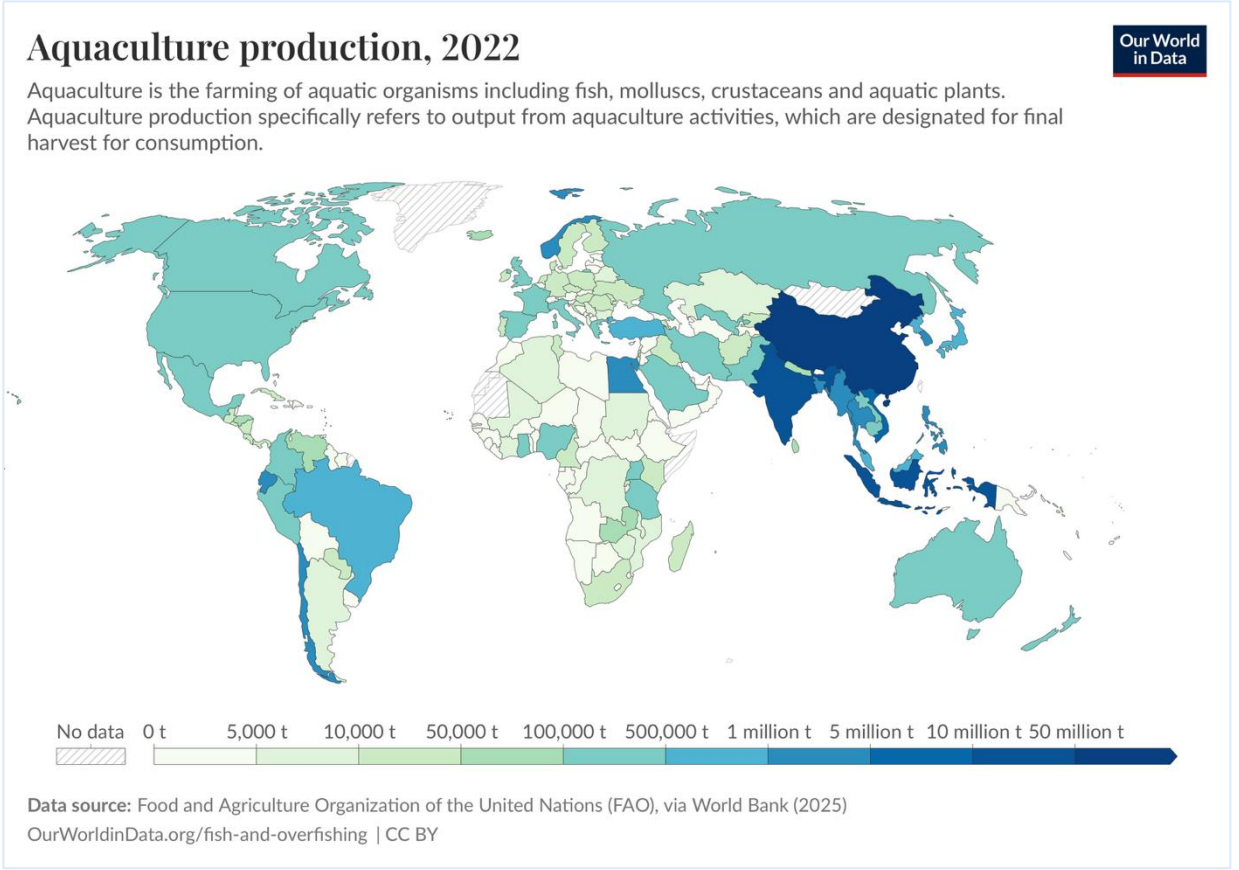


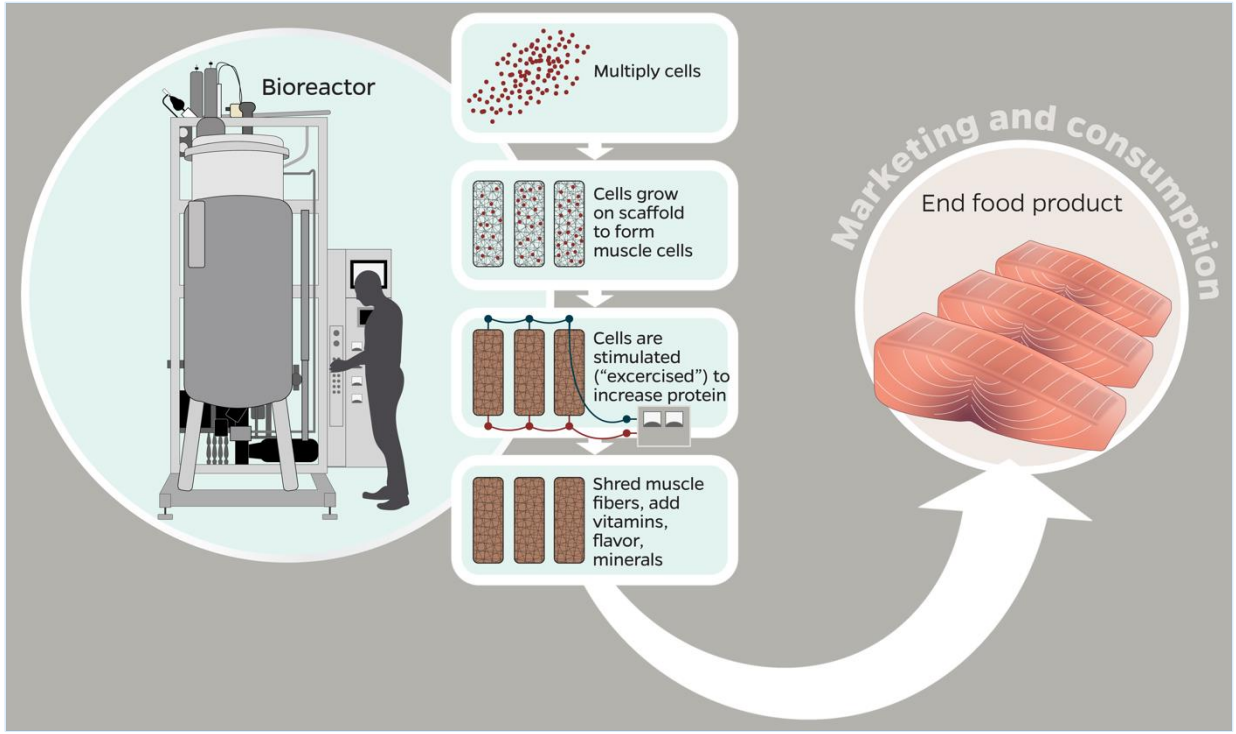
Image source: Our World in Data. (2025). *Aquaculture production*. https://ourworldindata.org/grapher/aquaculture-farmed-fish-production?tab=map

Aquaculture in the United States

- Small compared to Asia but growing rapidly
- Valued at almost $2 billion (2023)
- Top production: Mississippi, Washington, Louisiana, Florida, Alabama
- Species include catfish, oysters, trout, tilapia, clams, Atlantic salmon, kelp

Sources: USDA National Agriculture Statistics Service. (2024). 2023 Census of aquaculture. https://www.nass.usda.gov/Publications/AgCensus/2022/Online_Resources/Aquaculture/index.php; USDA National Agriculture Statistics Service. (2024). USDA releases the 2023 census of aquaculture results. https://www.nass.usda.gov/Newsroom/2024/12-16-2024.php;
Image is from NOAA Fisheries/Jordan Hollarsmith.

Cell-Based Seafood Production



Sources: Food and Agriculture Organization of the United Nations. (2022). *The pros and cons of cell-cultured seafood*. https://openknowledge.fao.org/server/api/core/bitstreams/a6a1fedf-f368-479c-b143-58cbcdd095e7/content

Image source: Johns Hopkins Center for a Livable Future.

Section B: Sustainability Challenges in the Seafood Sector

Sustainability Challenges in the Seafood Sector

- Governance of vast oceans
- Globalization and trade
- Mislabeling, fraud, food safety
- Illegal fishing, bycatch/discards
- Occupational health and human trafficking
- Aquaculture challenges
- Climate and Water Impacts
- Microplastic pollution

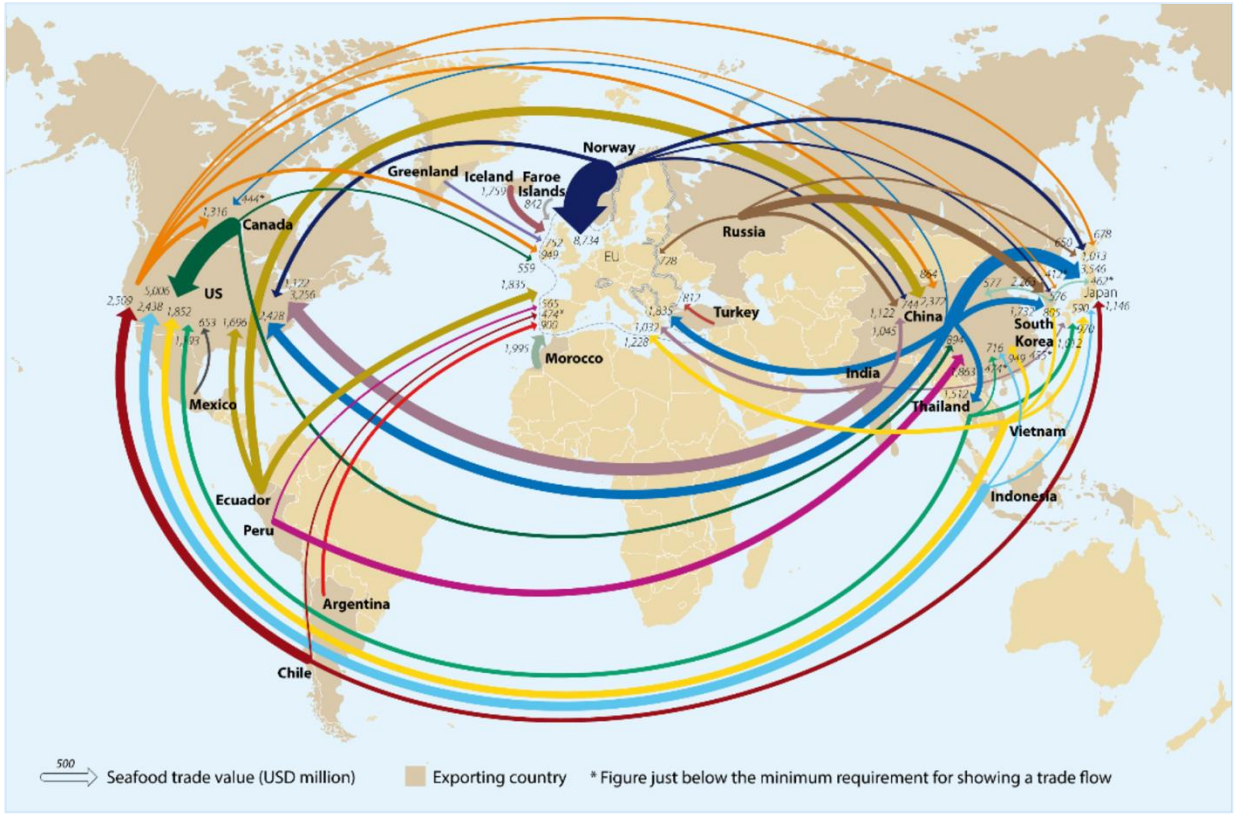
Image sources: Top, Shutterstock. Bottom, NOAA/Allen M. Shimada.

Why Aquatic Resource Governance Is Complex

- Oceans are interconnected and cover 70% of the planet
- Beyond 200 nautical miles from a nation's coastline, the ocean and its resources are owned by everyone (and no one)
- Fish stocks migrate and some have higher rates of overfishing or illegal fishing, making management difficult
- Inland and marine aquaculture can involve many resource users and pose resource conflict challenges

Source: NOAA Fisheries. (2012). *Fish stock assessment 101 series: Part 1—Data required for assessing U.S. fish stocks* (National).
https://www.fisheries.noaa.gov/feature-story/fish-stock-assessment-101-series-part-1-data-required-assessing-us-fish-stocks

Global Seafood Trade



Source: Holland, J. (May 23, 2022.) *Rabobank: Global seafood trade value rebounds to USD 164 billion.* https://www.seafoodsource.com/news/supply-trade/rabobank-global-seafood-trade-value-rebounds-to-usd-164-billion

Image source: CFSI Staff. (2022). *Global seafood trade value rebounds to USD 164 billion.* California Fisheries and Seafood Institute. https://calseafood.net/2022/05/23/global-seafood-trade-value-rebounds-to-usd-164-billion

Food Safety

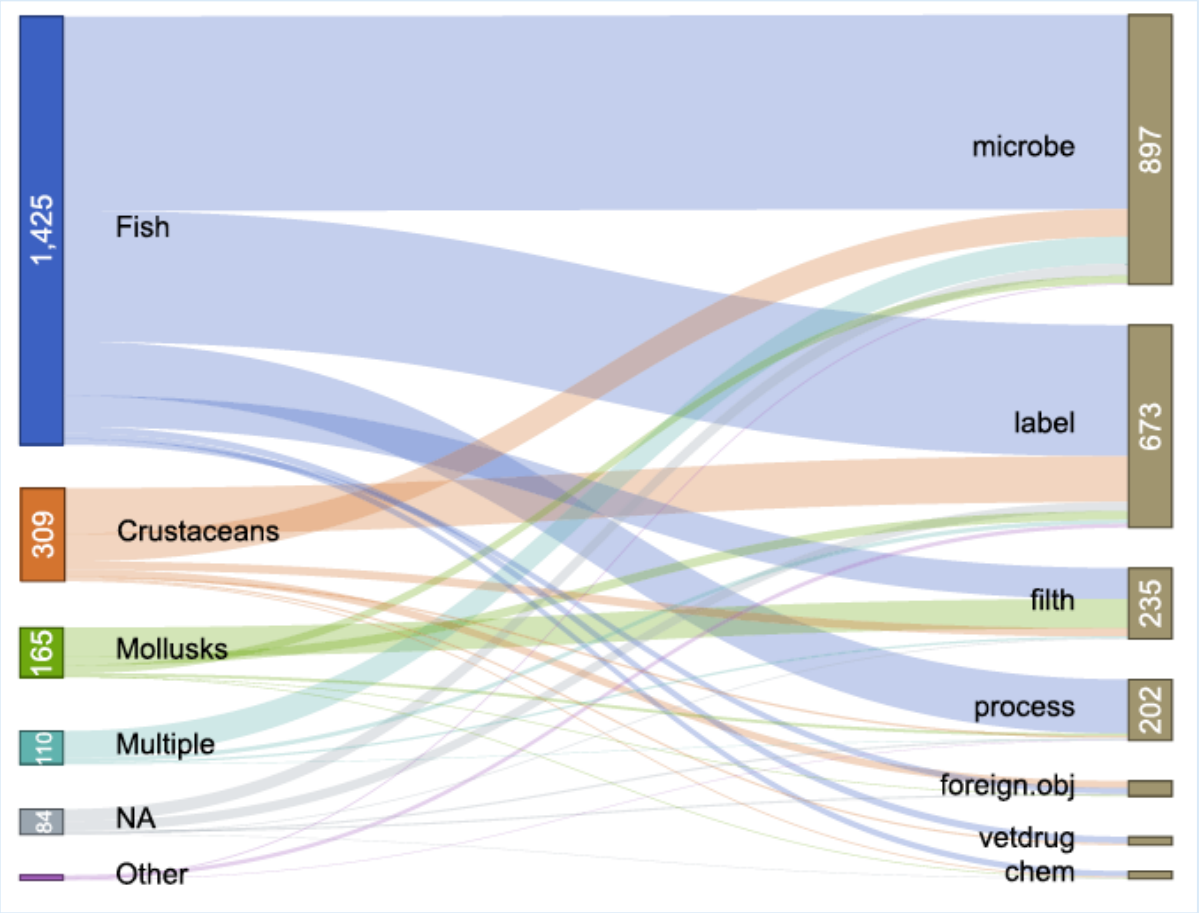


Image source: David C. Love, D. & Nussbaumer, E. (2021). *Fig. 6. IFSAC species groups and reason for U.S. seafood recalls* [Chart]. Risks shift along seafood supply chains. *Global Food Security 28*(3):100476. https://doi.org/10.1016/j.gfs.2020.100476

Mislabeling, Fraud, and Traceability

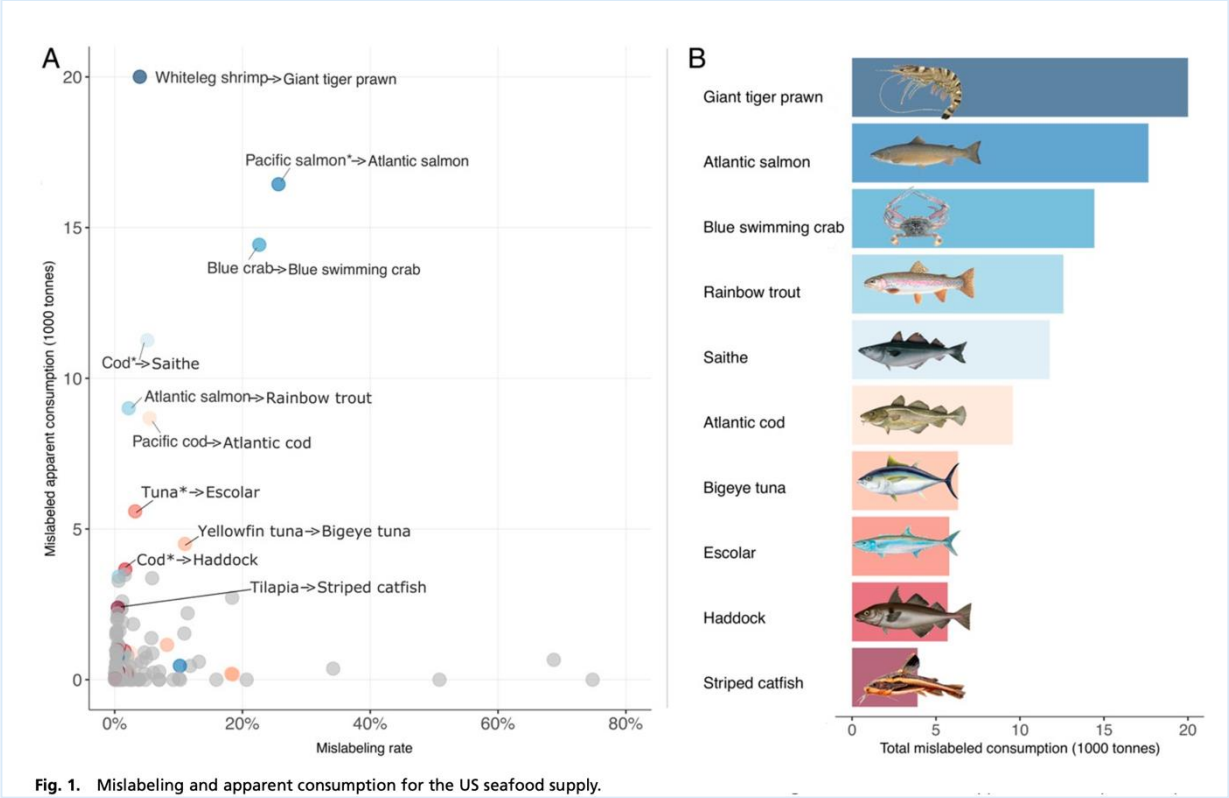


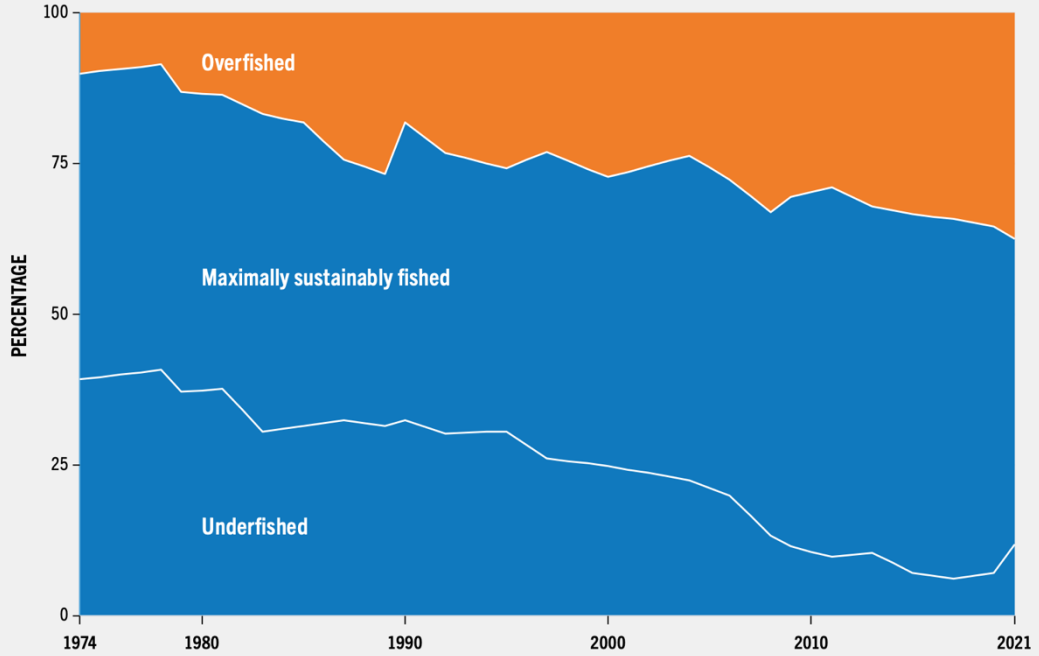
Fig. 1. Mislabeling and apparent consumption for the US seafood supply.

Image source: Kroetz, K., Luque, G. M., Gephart, J. A., Jardine, S. L., Lee, P., Chicojay Moore, K., Cole, C., Steinkruger, A., & Donlan, C. J. (2020). *Figure 1. Mislabeling and apparent consumption for the US seafood supply* [Chart]. Consequences of seafood mislabeling for marine populations and fisheries management. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(48), 30318–30323. https://doi.org/10.1073/pnas.2003741117

State of the World's Fisheries

Global Trends in the State of the World's Marine Fishery Stocks, 1974–2021

FIGURE 18 GLOBAL TRENDS IN THE STATE OF THE WORLD'S MARINE FISHERY STOCKS, 1974–2021



SOURCE: FAO estimates.

Image source: FAO. (2024). *Figure 18. Global trends in the state of the world's marine fishery stocks, 1974–2021* [Chart]. *Blue transformation in action*. Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cd0683en

Discards and Unreported Catch in Marine Fisheries: Illegal, Unreported, Unregulated (IUU)

FIGURE 2 Total global reconstructed catches (Pauly & Zeller, 2016a,c), separated into reported landings (data reported by FAO on behalf of member countries), unreported landings and estimated discards (both as estimated by individual country-specific catch reconstructions). Here, all data have been updated to 2014. Note that, in line with Zeller et al. (2016), these data exclude marine mammals, reptiles and plant material, as well as all freshwater catches

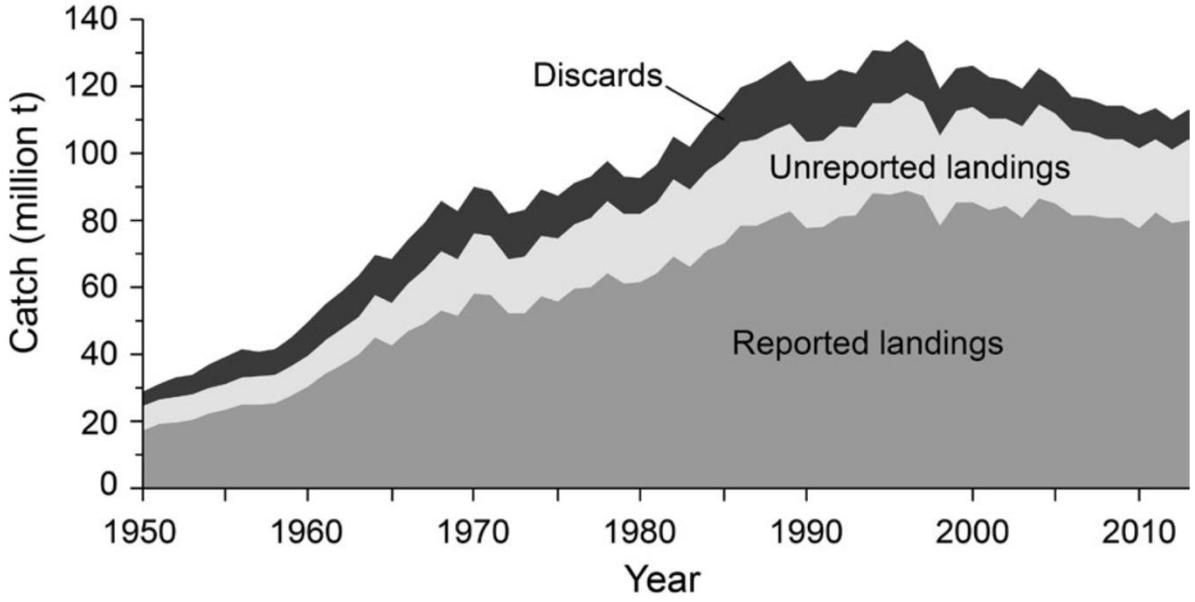


Image source: Zeller, D., Cashion, T., Palomares, M., & Pauly, D. (2017). *Figure 2. Total global reconstructed catches separated into reported landings, unreported landings and estimated discards* [Chart]. Global marine fisheries discards: A synthesis of reconstructed data. *Fish and Fisheries*, *9*(2), 30–39. https://doi.org/10.1111/faf.12233

Discarded Seafood: Bycatch

Images source: Shutterstock.

Human Rights Abuses: Closely Tied to Illegal, Unreported, and Unregulated Fishing

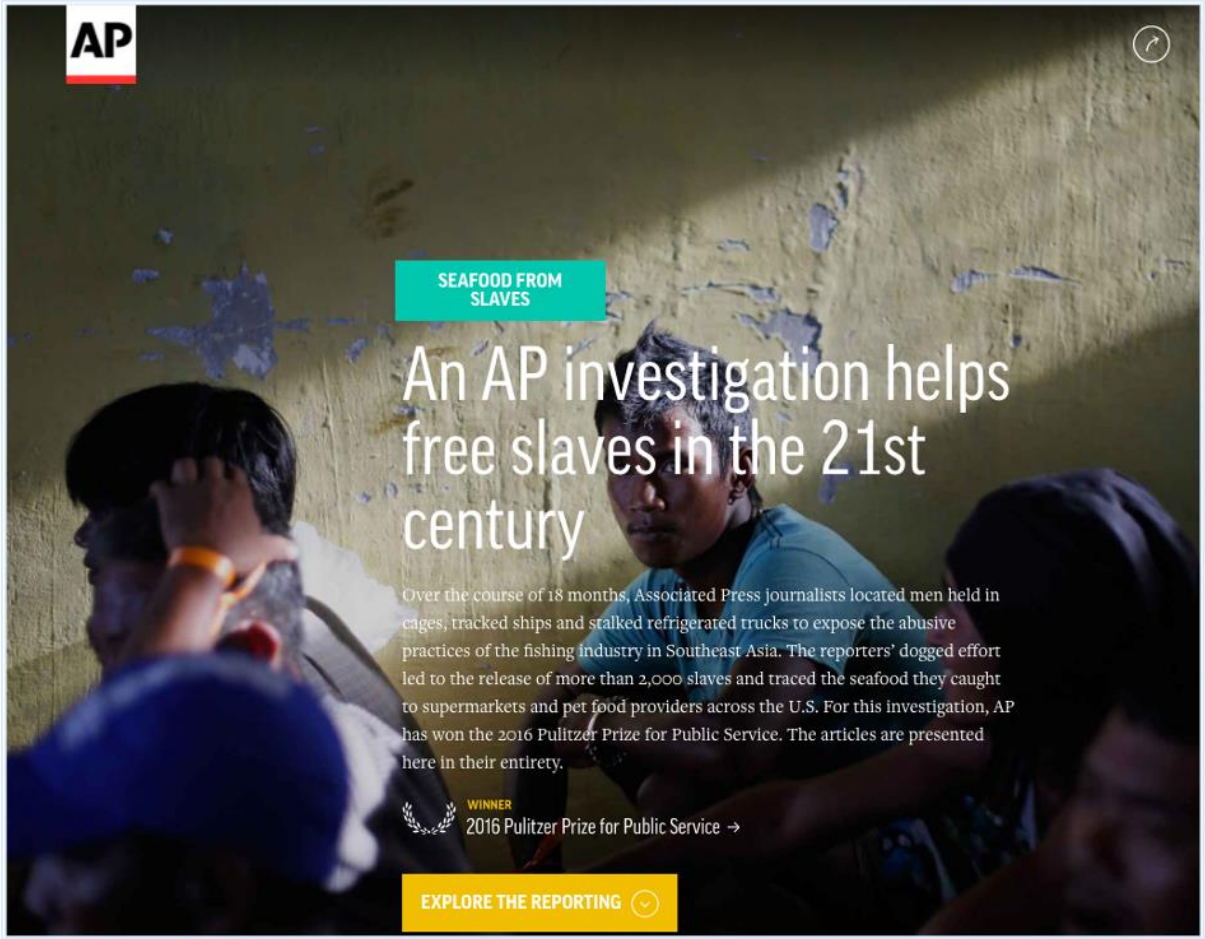


Image source: Screenshot of Mendoza, M., McDowell, R., Htusan, E., & Mason, M. (2015). *AP Investigation: Are slaves catching the fish you buy?* The Associated Press. https://apnews.com/general-news-b9e0fc7155014ba78e07f1a022d90389

Occupational Health and Safety

- Estimated 61 million people employed in aquatic foods sector
  - 65% capture fisheries
  - 35% aquaculture
- Capture fisheries: among highest occupational fatality rates
- Noise and ergonomic risks (repetitive motion injuries)
- Exposure to chemicals and allergens

Source: FAO. (2024). *Blue transformation in action*. Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cd0683en
Image source: Shutterstock.

Challenges Specific to Aquaculture

- Sourcing of fish feed
- Antimicrobial use and risk of resistance
- Escapes
- Sea lice
- Nutrient contamination and water quality

Image source: Shutterstock.

Sourcing of Fish Feed

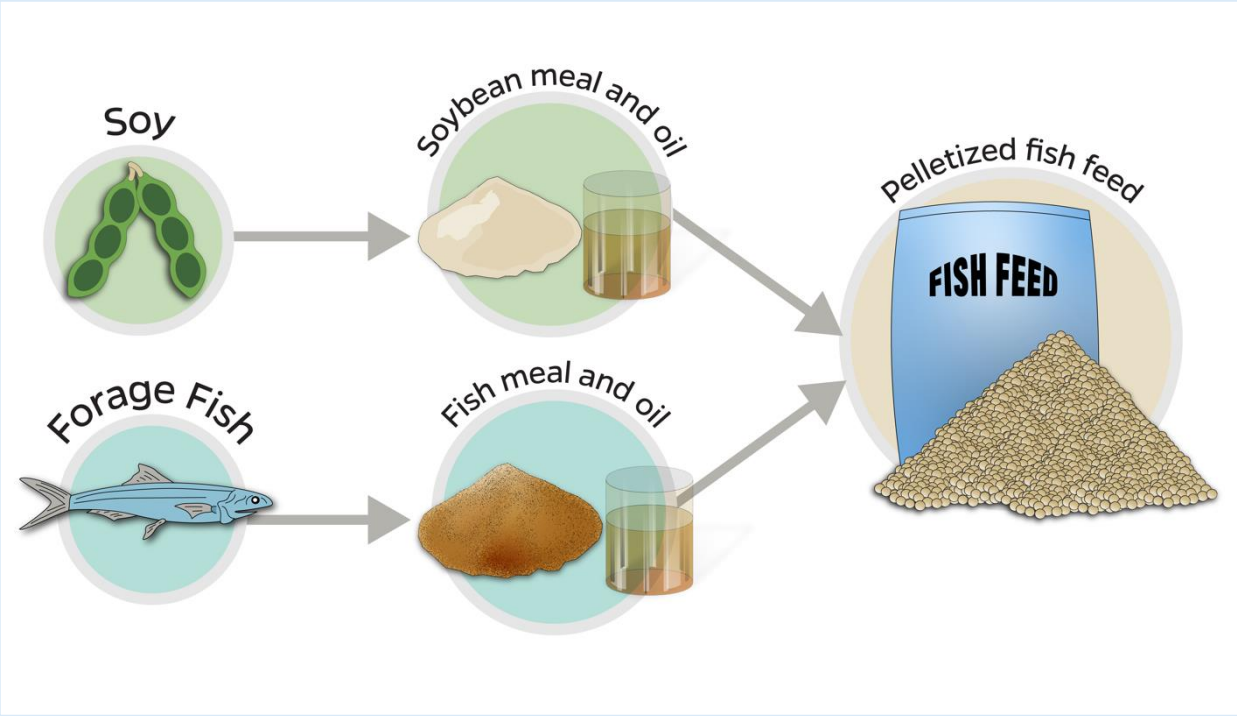


Image source: Johns Hopkins Center for a Livable Future.

Antimicrobial Use in Aquaculture

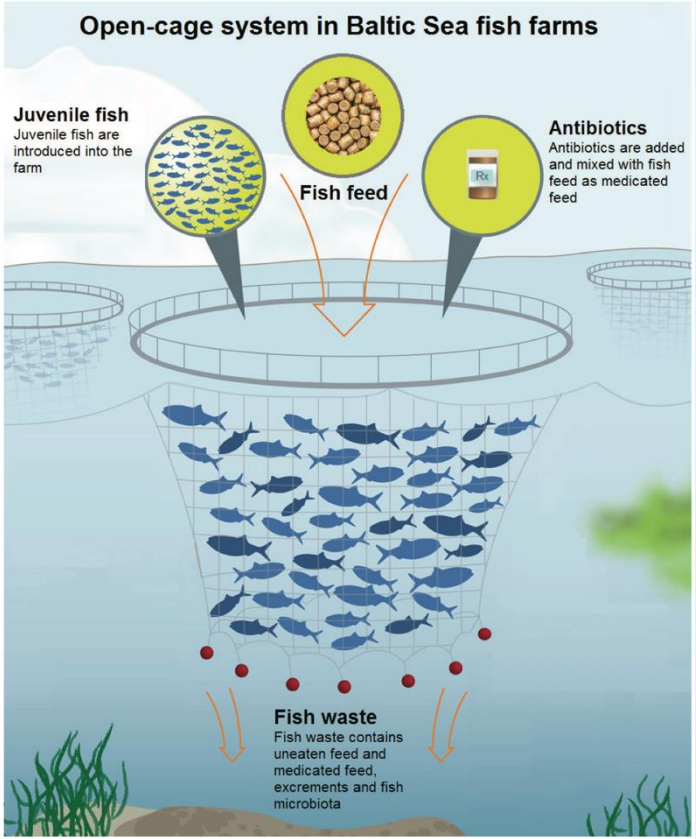
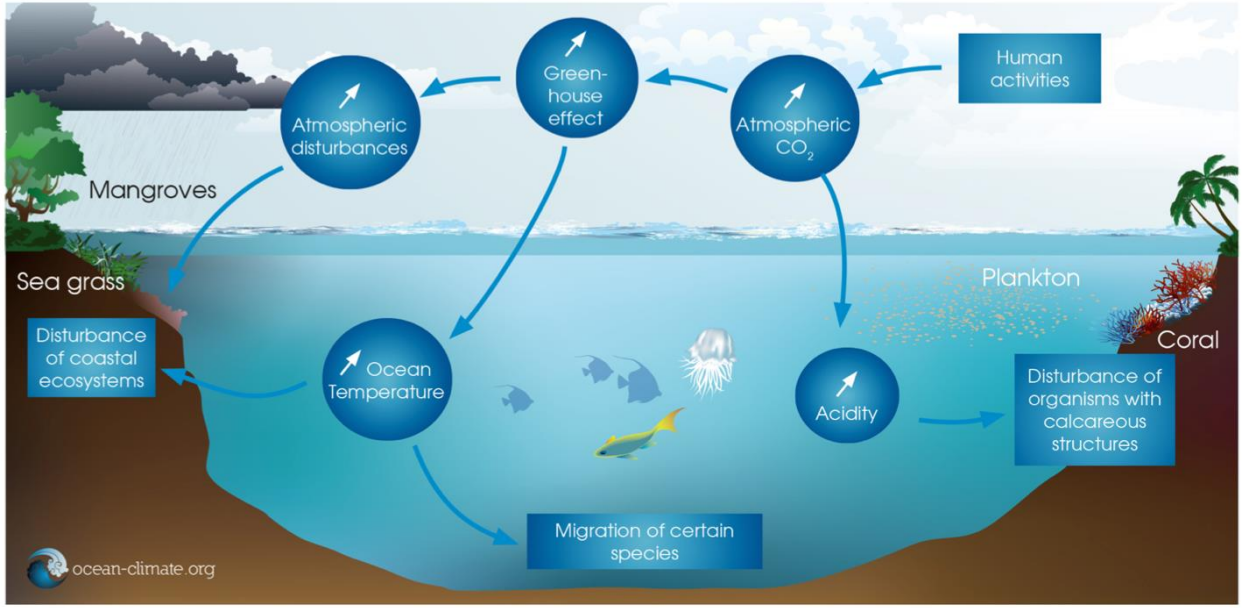


Figure 1. Baltic Sea fish farms use an open-cage system which allows free transfer of water from the farms to the surrounding water and eventually to the sediments (adapted and modified from Ocean Conservancy: Aquaculture).

Image source: Muziasari, W. (2016). *Figure 1. Baltic Sea fish farms use an open-cage system* [Chart]. In: *Impact of fish farming on antibiotic resistome and mobile elements in Baltic Sea sediment* [Academic Dissertation]. University of Helsinki Division of Microbiology and Biotechnology. https://helda.helsinki.fi/server/api/core/bitstreams/616b50f8-718a-437d-85c4-c0d27439e98e/content

Case Study 1

Climate Change and Oceans



Consequences of CO_2 increase on the ecosystems © Ocean Climate Platform

Image source: Ocean & Climate Platform. (2021). *Our infographics*. https://i0.wp.com/ocean-climate.org/wp-content/uploads/2021/01/ocean-climate-climate-change-6.png?ssl=1

Greenhouse Gas Emissions per Kilogram of Seafood

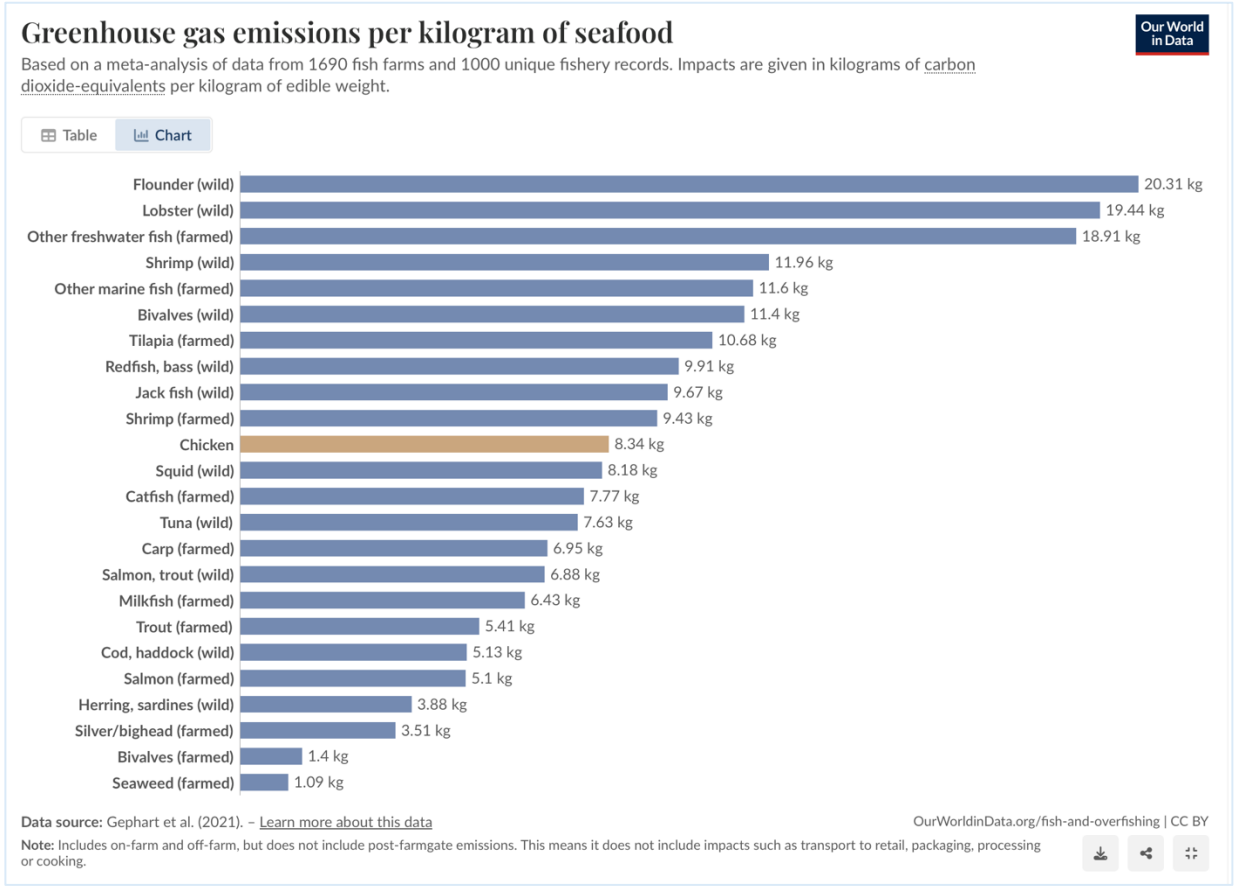


Image source: Ritchie, H., & Roser, M. (2021). *Greenhouse gas emissions per kilogram of seafood* [Chart]. In: *Fish and Overfishing*. Our World in Data. https://ourworldindata.org/grapher/ghg-emissions-seafood

Greenhouse Gas Emissions Footprint of Top 10 Seafood Species Consumed in the United States

- Lowest greenhouse gas emissions
  - Canned, fresh, and frozen sockeye salmon
  - Frozen pollock
  - Canned and frozen tuna
  - Frozen Atlantic salmon

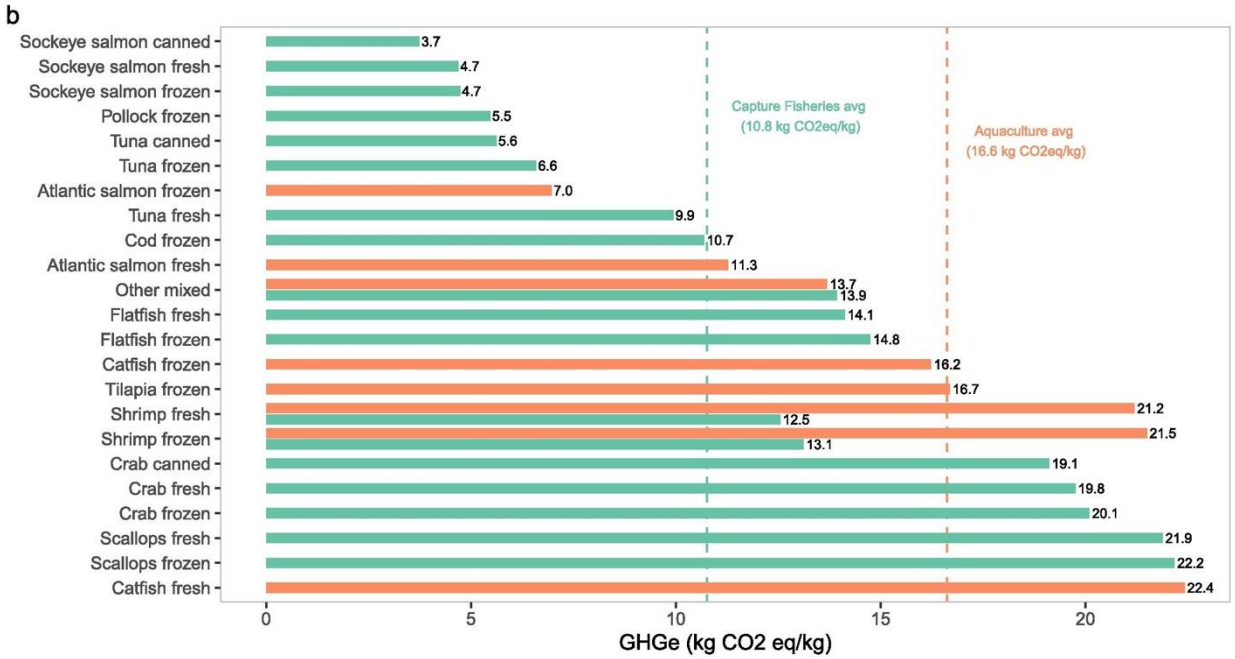
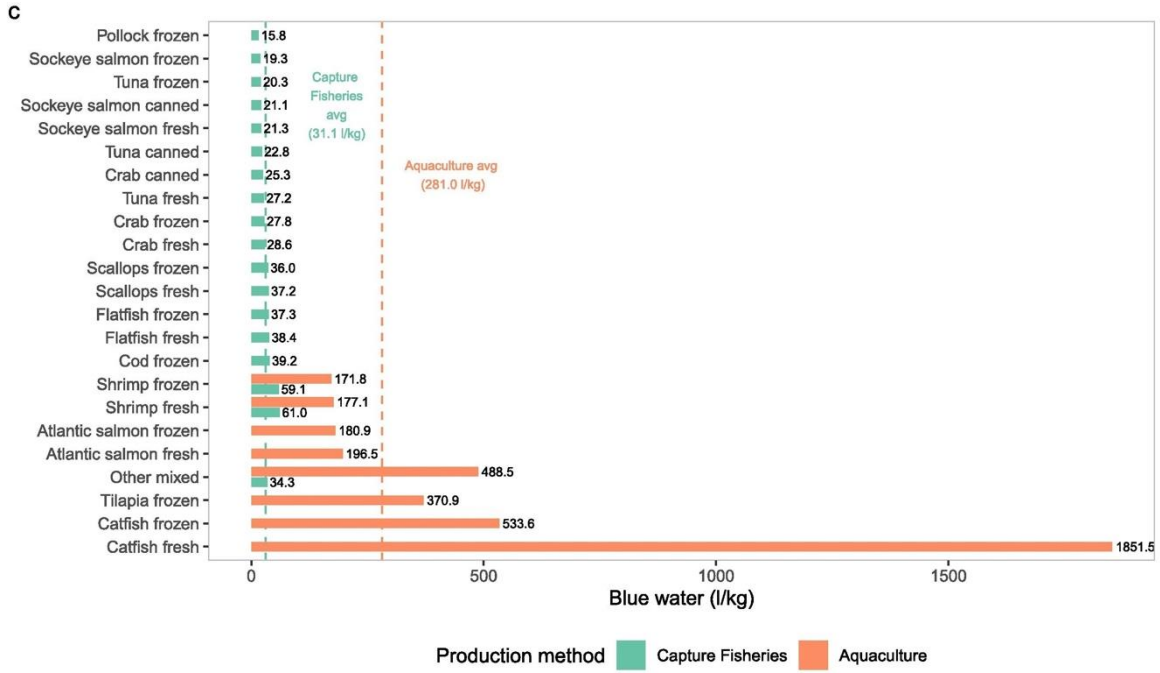


Image source: Love, D., Brown, M., Viglia, S., Asche, F., Fry, J., Garlock, T., Jenkins, L., Nguyen, L., Anderson, J., Nussbaumer, E., & Neff, R. (2025). *Figure 1b, Environmental impacts of the top-10 aquatic food species in the United States by production method and product form* [Chart]. Environmental impacts and food loss and waste in the U.S. aquatic food system. *Global Environmental Change*, *90*.
https://www.sciencedirect.com/science/article/pii/S0959378025000019

Water Footprint of Top 10 Seafood Species Consumed in the United States



- All wild caught species had significantly lower blue water use impacts than farmed products

Image source: Love, D., Brown, M., Viglia, S., Asche, F., Fry, J., Garlock, T., Jenkins, L., Nguyen, L., Anderson, J., Nussbaumer, E., & Neff, R. (2025). *Figure 1c, Environmental impacts of the top-10 aquatic food species in the United States by production method and product form* [Chart]. Environmental impacts and food loss and waste in the U.S. aquatic food system. *Global Environmental Change*, *90*.
https://www.sciencedirect.com/science/article/pii/S0959378025000019

Microplastic Pollution in the Ocean

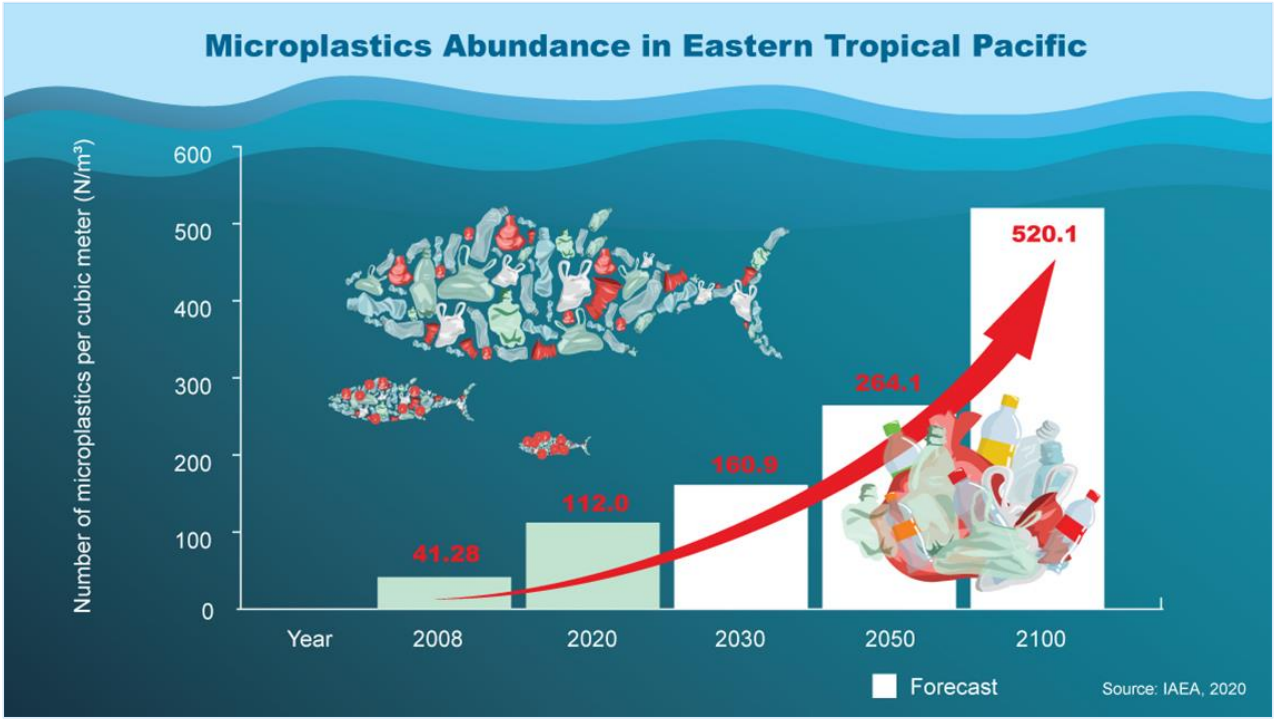


Image source: Orayeva, J. (2020). *World oceans day 2020: new IAEA research records dramatic increase in microplastic pollution in Eastern Tropical Pacific Ocean*. International Atomic Energy Agency (IAEA). https://www.iaea.org/newscenter/news/world-oceans-day-2020-new-iaea-research-records-dramatic-increase-in-microplastic-pollution-in-eastern-tropical-pacific-ocean

Discussion—1

- Based on the information presented, what questions do you have about seafood safety and the aquatic food system?
- Would this impact your seafood consumption recommendations?
- What additional information would help inform your guidance?

Section C: Aquatic Foods and Nutrition

Health Benefits of Consuming Aquatic Foods

- Reduce all-cause mortality
- Improve heart health
- Aid in absorption of nutrients from other foods
- Have benefits for cognitive development
- Improve birth outcomes

Image source: Shutterstock.

Nutritional Attributes of Aquatic Foods

- Protein
- Low in saturated fat and total fat
- Natural source of long-chain polyunsaturated omega-3 fatty acids
  - Eicosapentaenoic acid (EPA)
  - Docosahexaenoic acid (DHA)
  - Alpha-linolenic acid (ALA): converted to EPA and DHA
- Micronutrients
  - Calcium, iron, zinc, vitamin A, vitamin B12

Source: Maire, E., Graham, N. A. J., MacNeil, M. A., Lam, V. W. Y., Robinson, J. P. W., Cheung, W. W. L., & Hicks, C. C. (2021). Micronutrient supply from global marine fisheries under climate change and overfishing. *Current Biology*, *31*(18), 4132-4138.e3. https://doi.org/10.1016/j.cub.2021.06.067
Image source: Shutterstock.

Omega-3 Long-Chain Polyunsaturated Fatty Acids (PUFAs) and Cardiovascular Disease (CVD)

- Mechanisms through which omega-3 long-chain PUFAs could affect CVD outcomes
  - Changes in circulating blood lipids
  - Reduced blood pressure and systemic vascular resistance
  - Improved arterial wall compliance
  - Lower platelet aggregation, reduced endothelial cell dysfunction, and decreased plaque inflammation

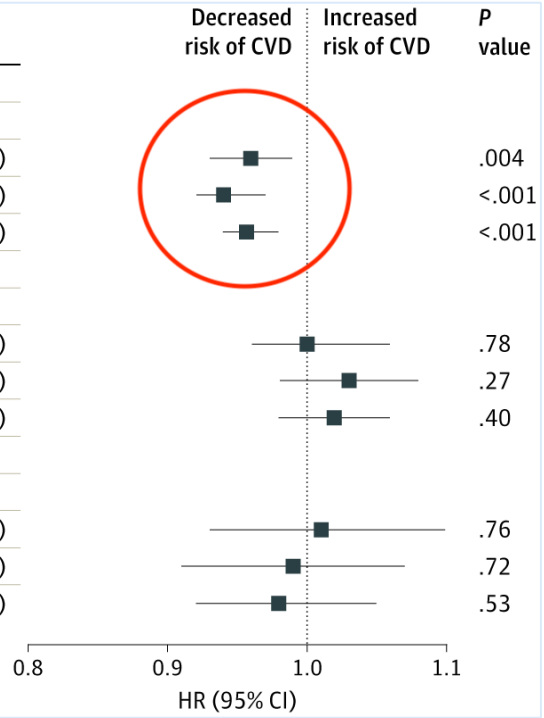
Interpreting Observational Studies of Fish Intake

- 2016 meta-analysis: Twelve prospective cohort studies with 672,389 participants and 57,641 deaths
- Compared with the lowest category, the highest category of fish intake was associated with about a **6% lower risk of all-cause mortality**
- Compared with never consumers, consumption of 60 g of fish per day was associated with a **12% reduction in risk of total death**
- Note:
  - Observational studies
  - Many nutritional and lifestyle factors associated with fish consumption

Image source: Zhao, L., Sun, J., Yang, Y., Ma, X., Wang, Y., & Xiang, Y. (2016). *Figure 3. Relative risks of all-cause mortality associated with fish consumption (from seven studies)* [Chart]. Fish consumption and all-cause mortality: A meta-analysis of cohort studies. *European Journal of Clinical Nutrition*, *70*(2), 155–161. https://doi.org/10.1038/ejcn.2015.72

Associations Between Type of Fish and CVD for Each Five-Gram Increment in Consumption in the ORIGIN Study

Study	No. of CVD events, %	HR (95% CI)	P value
High or moderate ω-3 fish			
Event			
Total mortality	1877	0.96 (0.93-0.99)	.004
Major CVD	2020	0.94 (0.92-0.97)	<.001
Composite	2674	0.96 (0.94-0.98)	<.001
Low ω-3 fish			
Event			
Total mortality	1877	1.01 (0.96-1.06)	.78
Major CVD	2020	1.03 (0.98-1.08)	.27
Composite	2674	1.02 (0.98-1.06)	.40
Shellfish			
Event			
Total mortality	1877	1.01 (0.93-1.10)	.76
Major CVD	2020	0.99 (0.91-1.07)	.72
Composite	2674	0.98 (0.92-1.05)	.53



Omega-3 fish

High: Herring, mackerel, sable, salmon, tuna (steak), and sardine
Moderate: Anchovy, bluefish, oyster, tuna (can), salmon (can), and trout
Low: Bass, barramundi, bream, flathead, flounder, perch, snapper, octopus, sword fish, tile fish, and shark

*Adjusted for age, sex, study center, BMI, education, smoking, physical activity, alcohol intake, urban rural location, diabetes, cancer, statin/antihypertension medication, intake of fruit, vegetables, red meat, poultry, dairy and total energy

Image source: Adapted from Mohan, D., Mente, A., Dehghan, M., Rangarajan, S., O'Donnell, M., Hu, W., Dagenais, G., Wielgosz, A., Lear, S., Wei, L., Diaz, R., Avezum, A., Lopez-Jaramillo, P., Lanas, F., Swaminathan, S., Kaur, M., Vijayakumar, K., Mohan, V., Gupta, R., ... PURE, O., TRANSCEND, and ORIGIN investigators. (2021). *Figure 2. Associations between types of fish (per 5-g increment) and clinical events in the outcome reduction with initial glargine intervention (ORIGIN) trial* [Chart]. Associations of fish consumption with risk of cardiovascular disease and mortality among individuals with or without vascular disease from 58 countries. *JAMA Internal Medicine, 181*(5), 631–649. https://doi.org/10.1001/jamainternmed.2021.0036

Consumption During Pregnancy: Benefits and Risks

Benefits	Risks
▶ Cognitive and language development ▶ Lower risks of hypertension ▶ Reduced risk of preterm birth ▶ Essential nutrients: iron, iodine, choline	▶ Large predator fish can contain high levels of mercury, a neurotoxin ▶ Shark, swordfish, orange roughy, some types of tuna

Image source: Shutterstock.

Nutrient Diversity of Aquatic-Source Foods

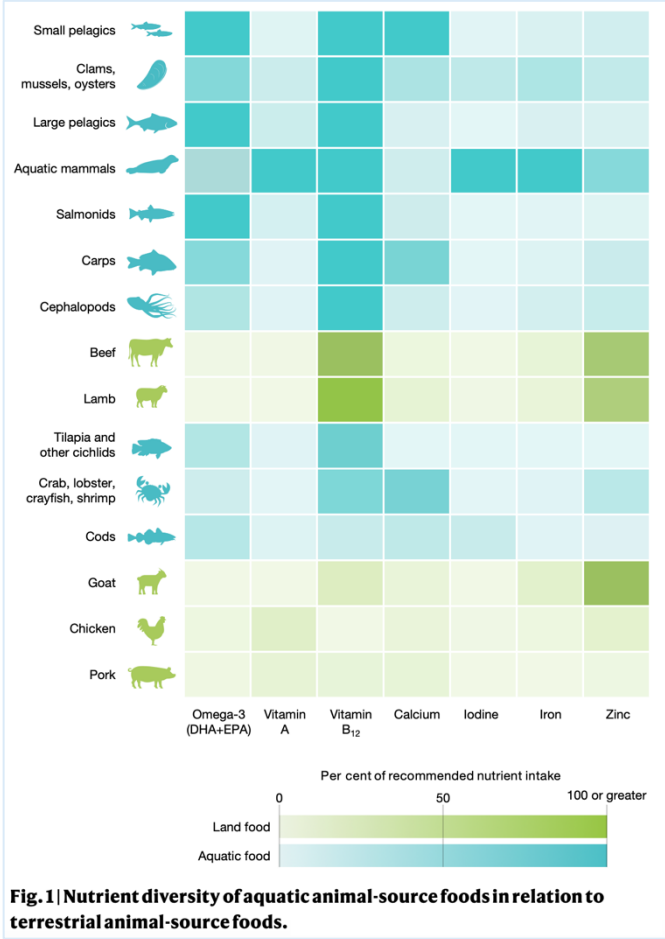


Fig. 1 | Nutrient diversity of aquatic animal-source foods in relation to terrestrial animal-source foods.

Image source: Golden, C., et al. Fig. 1, Nutrient diversity of aquatic animal-source foods in relation to terrestrial animal-source foods [Chart]. Aquatic foods to nourish nations. Nature, 598, 315–320. https://doi.org/10.1038/s41586-021-03917-1

Top Five Aquatic Species Consumed in the United States

Species group	Primary origin	Primary production method
Shrimp	Import (Asia)	Farmed
Salmon	Import (Canada, Chile, Norway)	Farmed
Canned tuna	Import (Pacific region)	Wild caught
Tilapia	Import (Asia, South America)	Farmed
Catfish	Import (Asia) / Domestic (Mississippi)	Farmed
Alaska pollock	Domestic (Alaska)	Wild caught

Micronutrient Content Depends on Edible Portion

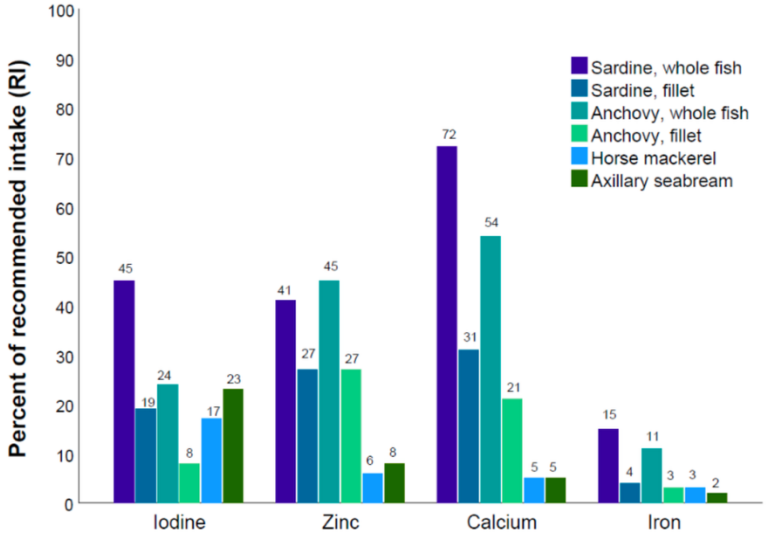


Figure 1. Percent of recommended intake of selected minerals and trace elements for 100 g of sardine (whole fish and fillet), anchovy (whole fish and fillet), horse mackerel, and axillary seabream. Recommended Nutrient Intake (RNI) values from WHO are used (WHO, 1998).

Image source: Aakre, I., Bøkevoll, A., Chaira, J., Bouthir, F. Z, Frantzen, S., Kausland, A., & Kjellevold, M. (2020). *Figure 1. Percent of recommended intake of selected minerals and trace elements for 100 g of sardine (whole fish and fillet), anchovy (whole fish and fillet), horse mackerel, and axillary seabream* [Chart]. Variation in nutrient composition of seafood from North West Africa: implications for food and nutrition security. *Foods*, *9*(10), Article 10. https://doi.org/10.3390/foods9101516

Wild-Caught or Farmed Salmon: Does it Matter for Nutrition?

Farmed salmon	Nutrients per 100g serving (raw)	Wild salmon
20.5 g	Protein	20 g
13 g	Fat	6 g
0.3 mg	Iron	0.8 mg

Data from USDA FoodDataCentral: https://fdc.nal.usda.gov/food-details/173686/nutrients; https://fdc.nal.usda.gov/food-details/2684441/nutrients

Exploring Complexities: Seafood and Health Outcomes

- Nutrition research is complicated!
- Diversity of seafood types and form, including fish oil supplements
- Contribution of other dietary and lifestyle factors
- Dietary substitutions
- Shifts in other risk factors (such as statin use, removal of trans fats) may be changing the risk profile

Image source: Microsoft Stock Images.

Case Study 2

Section D: Aquatic Foods as Part of a Healthy and Sustainable Diet

Dietary Patterns and Healthy Eating Guidance

US Dietary Guidelines (2020)

- **Pregnancy and postpartum**
  - 8–12 ounces/week, high omega-3 sources (best choices list)
- **Children 6 months and older**
  - 2 servings/week (best choices list)
- **Adults**
  - 8–12 ounces/week or 2 servings/week

Compatible with other dietary guidance and patterns

- American Heart Association
- American Diabetes Association
- American Pediatric Association
- Mediterranean
- Dietary Approaches to Stop Hypertension (DASH)
- Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND)
- Engage, Act, Transform (EAT)-Lancet Planetary Health
- Fermentable Oligosaccharides, Disaccharides, Monosaccharides, and Polyols (FODMAP)
- Gluten-free

Source: USDA & HHS. (2020). *Dietary Guidelines for Americans, 2020-2025* (No. 9th Edition; DGA). United States Department of Agriculture & United States Department of Health and Human Services. https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf

Choosing Lower Mercury Fish (EPA)

Best Choices

- Anchovy
- Atlantic croaker
- Atlantic mackerel
- Black sea bass
- Butterfish
- Catfish
- Clam
- Cod
- Crab
- Crawfish
- Flounder
- Haddock
- Hake
- Herring
- Lobster, American and spiny
- Mullet
- Oyster
- Pacific chub mackerel
- Perch, freshwater and ocean
- Pickerel
- Plaice
- Pollock
- Salmon
- Sardine
- Scallop
- Shad
- Shrimp
- Skate
- Smelt
- Sole
- Squid
- Tilapia
- Trout, freshwater
- Tuna, canned light (includes skipjack)
- Whitefish
- Whiting

Good Choices

- Bluefish
- Buffalofish
- Carp
- Chilean sea bass/ Patagonian toothfish
- Grouper
- Halibut
- Mahi mahi/dolphinfish
- Monkfish
- Rockfish
- Sablefish
- Sheepshead
- Snapper
- Spanish mackerel
- Striped bass (ocean)
- Tilefish (Atlantic Ocean)
- Tuna, albacore/ white tuna, canned and fresh/frozen
- Tuna, yellowfin
- Weakfish/seatrout
- White croaker/ Pacific croaker

Choices to Avoid HIGHEST MERCURY LEVELS

- King mackerel
- Marlin
- Orange roughy
- Shark
- Swordfish
- Tilefish (Gulf of Mexico)
- Tuna, bigeye

What about fish caught by family or friends? Check for fish and shellfish advisories to tell you how often you can safely eat those fish. If there is no advisory, eat only one serving and no other fish that week. Some fish caught by family and friends, such as larger carp, catfish, trout and perch, are more likely to have fish advisories due to mercury or other contaminants.

Image source: Adapted from US EPA. (2025). *EPA-FDA advice about eating fish and shellfish: for females who might become pregnant, are pregnant, are breastfeeding, and forchildren.* United States Environmental Protection Agency. https://www.fda.gov/media/102331/download

Dietary Intakes Compared to Recommendations

Dietary Intakes Compared to Recommendations: Percent of the U.S. Population Ages 1 and Older Who Are Below and At or Above Each Dietary Goal

•**NOTE:** Recommended daily intake of whole grains is to be at least half of total grain consumption, and the limit for refined grains is to be no more than half of total grain consumption.

Data Source: Analysis of What We Eat in America, NHANES 2013-2016, ages 1 and older, 2 days dietary intake data, weighted. *Recommended Intake Ranges*: Healthy U.S.-Style Dietary Patterns (see ***Appendix 3***).

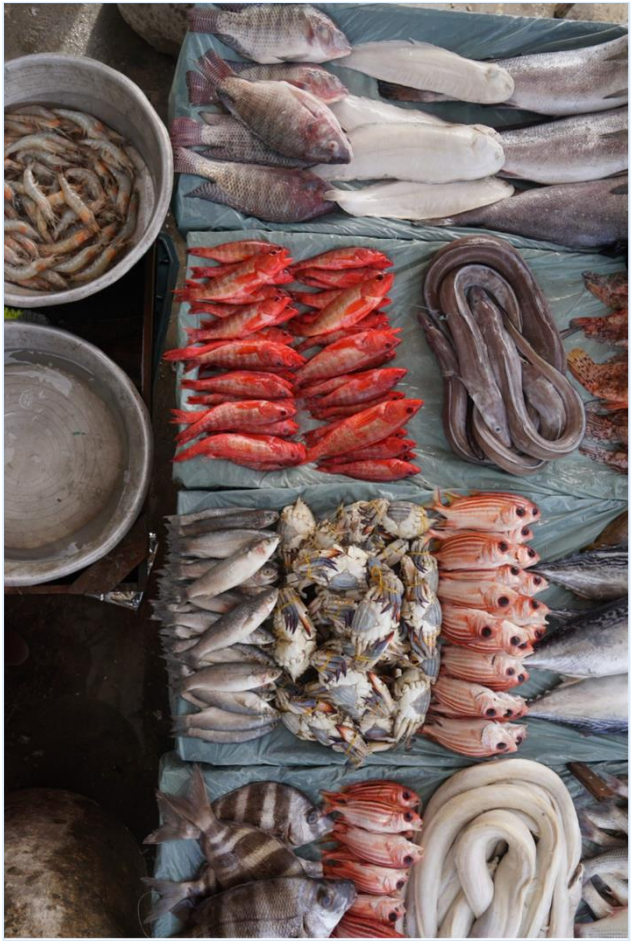
Image source: DGA. (2021). Dietary intakes compared to recommendations: percent of the U.S. population ages 1 and older who are below and at or above each dietary goal. *Dietary Guidelines for Americans, 2020–2025.* https://www.dietaryguidelines.gov/sites/default/files/2021-11/DGA_2020-2025_CurrentIntakesSnapshot.pdf

Optimizing Omega-3

- Current recommendations:
  - 450–500 mg/day—Academy of Nutrition and Dietetics
  - World Heath Organization (WHO) 250 mg/day
  - American Heart Association: 8–12 ounces of fatty fish/week, preferably different types
  - If at higher risk for cardiovascular disease: up to 1,000 mg/day often recommended

Image source: Seafood Nutrition Partnership. (2023). *Which Fish is the Richest in Omega-3s? (Per 4 Ounce Cooked Portion)* [Graphic]. https://www.seafoodnutrition.org/wp-content/uploads/2023/06/New-Omega-3-Seafood-Chart.pdf

Diversify Seafood Choices



- Use lesser-known varieties, such as:
  - Arctic char, lionfish, cobia
- Incorporate filter feeders into menus
  - Oysters, mussels, clams, and scallops
- Fish does not have to be a “center of the plate” protein
  - In many countries, it is consumed more like a vegetable

Image source: Shutterstock.

Sea Vegetables

- Definition: A vast, diverse group of edible marine algae and plants that grow in or near oceans, rivers, and lakes
  - Also called *seaweeds, sea greens, sea plants*
- There are over 10,000 types of seaweed across our oceans, though just a handful of edible varieties reach our plates in the US
- Though traditionally foraged, 96% of sea vegetables are cultivated today

Sources: Cherry, P., O'Hara, C., Magee, P., McSorley, E., & Allsopp, P. (2019). Risks and benefits of consuming edible seaweeds. *Nutrition Reviews*, *77*(5), 307–329. https://doi.org/10.1093/nutrit/nuy066
Image source: Shutterstock.

Nutritious Seaweed

- Sea vegetables are considered the world's most nutrient-dense foods
- Have been used for food and medicine for millennia in most coastal regions of the world
- Contain a variety of essential nutrients, including vitamin A, folate, omega-3 fatty acids (DHA/EPA) iron, iodine and magnesium
- A staple ingredient in the "Blue-Zone" Okinawan and Mediterranean diet patterns

Image source: Shutterstock.

Social and Ecological Impacts of Seaweed Farming

- Cultivation does not require arable land or freshwater
- In most cases, grown without fossil-fuel-based agricultural inputs (pesticides, fertilizers)
- Local context and conditions play a large role in socioecological impacts

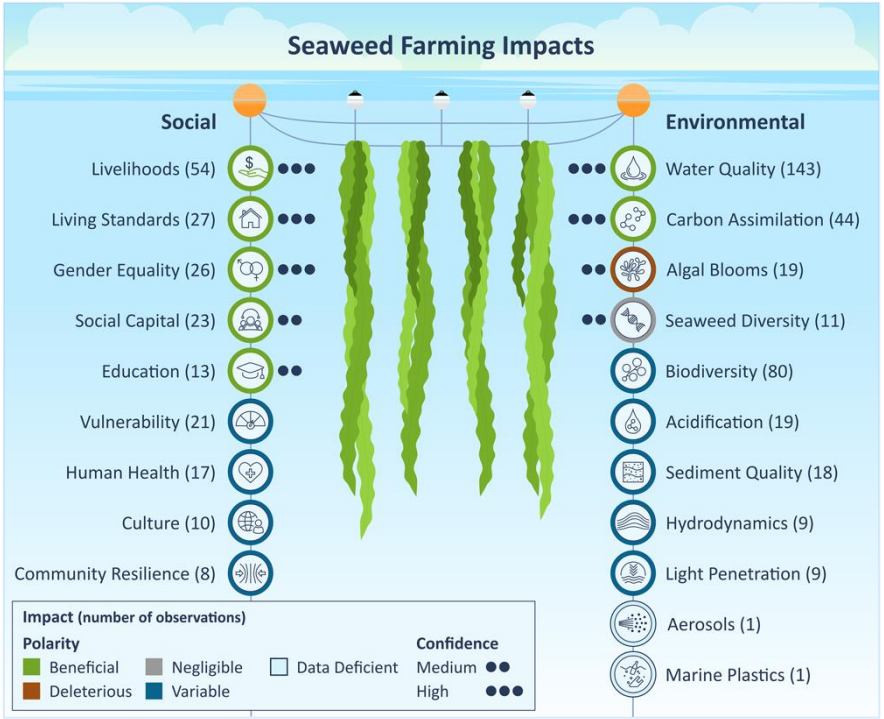


Image source: Spillias, S., Kelly, R., Cottrell, R. S., O'Brien, K. R., Im, R.-Y., Kim, J. Y., Lei, C., Leung, R. W. S., Matsuba, M., Reis, J. A., Sato, Y., Sempert, K., & McDonald-Madden, E. (2023). *Fig 1, Twenty social and environmental impact categories of seaweed farming as identified by our systematic review.* [Chart.] The empirical evidence for the social-ecological impacts of seaweed farming. *PLOS Sustainability and Transformation*, *2*(2). https://doi.org/10.1371/journal.pstr.0000042

Summary: Choosing Seafood for Health and Sustainability

Nutrition/health choices	Sustainability choices
► Higher in omega-3 fatty acids	► Lower greenhouse gas footprint, freshwater use, nutrient pollution
► Higher in micronutrients ► Zinc, calcium, iron, vitamin A, selenium	► Fewer chemicals and pesticides
► Low in mercury and pollutants	► Human rights and occupational concerns
► Note allergies and food safety	► Transportation and processing
► Healthy preparation/cooking methods and added ingredients	► Third-party certified for sustainability

Case Study 3

Sustainability Labels

Monterey Bay Aquarium
Seafood Watch

MARINE STEWARDSHIP COUNCIL

FARMED RESPONSIBLY
asc
CERTIFIED
ASC-AQUA.ORG
TM

Image sources: Courtesy of the Monterey Bay Aquarium; Marine Stewardship Council; Aquaculture Stewardship Council (ASC).

Preparation Methods are Important

- Cooking and preparation influence nutritional content
  - High heat may alter fatty acid and key vitamins
  - Breading and frying change fatty acid profile, reducing overall percent of omega-3 fatty acids

- Healthiest options include:
  - Bake
  - Grill or broil
  - Sauté
  - Poach or steam
  - *Sous vide*

Image source: Shutterstock.

Messaging Tips for Aquatic Foods

1. **Highlight** sourcing and safety
   - 79% of eaters say “safe to eat” is the most important criterion
   - Educate on best choices, transparent and sustainable sourcing, and honest evaluations of benefits and risks

2. **Showcase** culturally relevant recipes and ideas that save time
   - Share ideas that connect with your audience

3. **Compare to** land-based agriculture
   - Connecting aquatic foods to familiar, land-based food production examples can help paint a clearer picture of health and sustainability

Sources: Food + Planet. (n.d.). Explore our *toolkits!* Aquatic Foods. Retrieved November 24, 2025, from https://eataquaticfoods.org/toolkits; Image courtesy of Vanessa Stump, Food + Planet.

Blue Foods Toolkit—1

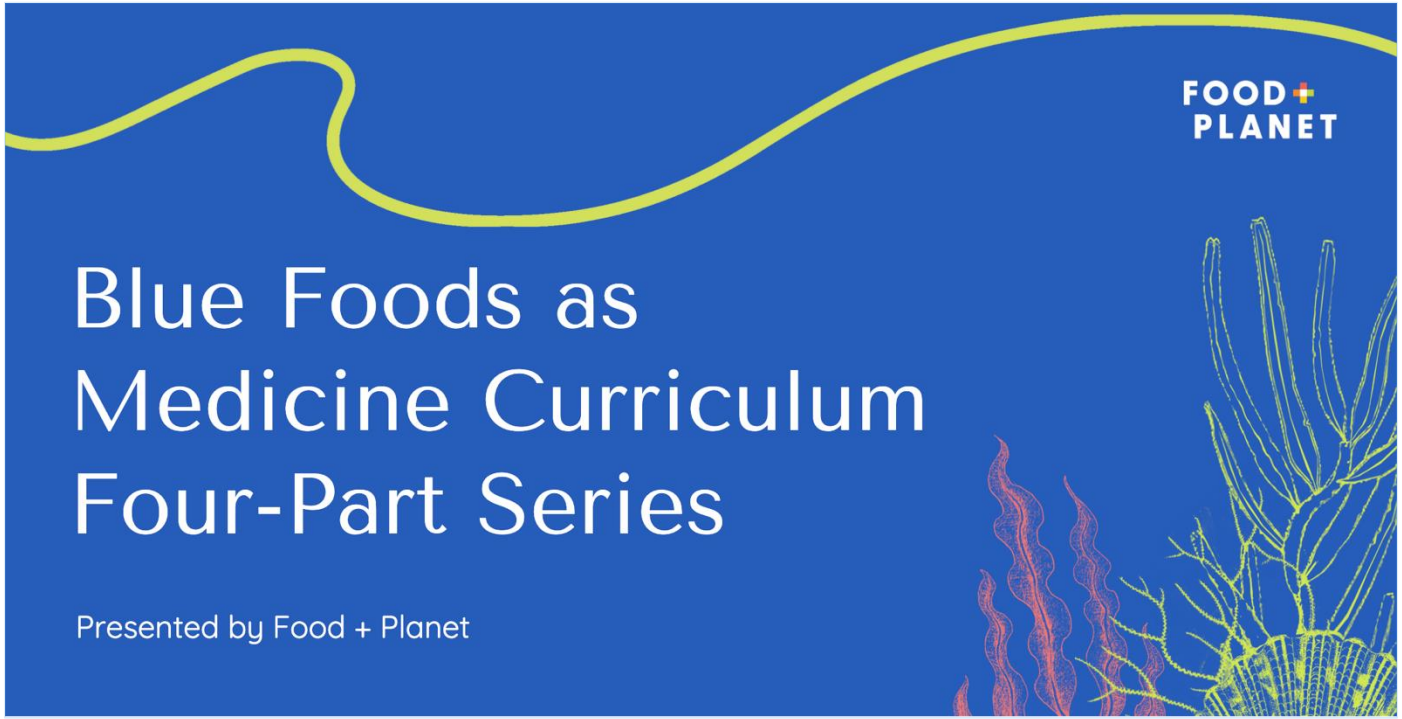


Image source: Courtesy of Food + Planet. (n.d.). *Blue Food as Medicine Curriculum Four-Part Series*. Aquatic Foods. https://eataquaticfoods.org/curriculum

Blue Foods Toolkit—2

Image source: Courtesy of Food + Planet. (2023). *Blue Food As Medicine Cookbook.* Eat Aquatic Foods. https://eataquaticfoods.org/cookbook

Discussion—2

- Consider the audience you work with most or will work with in the future
  - What values and beliefs might they hold that impact choices to consume aquatic foods?
  - What might be barriers to consuming more aquatic foods?

- Develop three messages to help consumers consider including more aquatic foods in their weekly meals
  - Consider health, sustainability, affordability, taste, and time restrictions

Key Points: Moving Towards Sustainable Seafood

- Seafood provides many important nutrients and is critically important for many low-income regions
- Fisheries and aquaculture can help meet rising demand only if managed sustainably
- Both are likely to be impacted by climate change
  - Rising sea levels, increasing water temperature, ocean acidification
- Governance and policy must balance demand, sustainability, and the food security needs for low-income coastal communities who rely on seafood for nutrition and livelihoods
- Dietitians and nutrition professionals have important roles communicating the advantages and nuances of aquatic food consumption and making them more accessible and familiar

Thank You!

Image source: Johns Hopkins Center for a Livable Future. Text is available from https://www.seafoodwatch.org/recommendations/download-consumer-guides/popular

Practice and Resources Booklet

About This Presentation

Produced by the Center for Teaching and Learning at the Johns Hopkins Bloomberg School of Public Health.

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