OUR SHARED SEAS

Global ocean data and trends for informed action and decision-making

2019 EDITION

OurSharedSeas.org

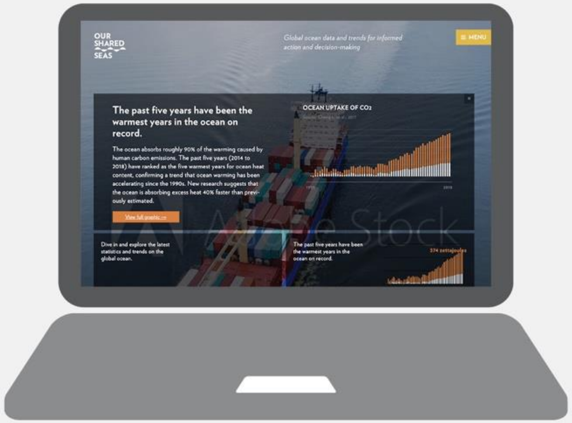
Report citation: CEA Consulting. 2019. "Our Shared Seas: Global ocean data and trends for informed action and decision-making."

Prepared by CEA Consulting, with the support of the David and Lucile Packard Foundation

the David & Lucile Packard FOUNDATION

CEA CONSULTING

OUR SHARED SEAS



About this project

While it is often said that the world is awash in data, informed decision-making can occur only when data are transparent and readily available to the stakeholders that need the information. Our Shared Seas is a website platform which seeks to roll up relevant ocean conservation data in a centralized, easy-to-use platform, providing authoritative data and sensemaking of ocean trends.

The purpose of this project is to aggregate ocean statistics and trends to support the marine conservation community—including funders, advocates, practitioners, and policymakers—in making better, faster, and more informed decisions. In 2017, the David and Lucile Packard Foundation commissioned CEA Consulting to prepare *Our Shared Seas: A 2017 Overview of Ocean Threats and Conservation Funding* as a primer on the primary ocean threats, trends, and solutions. As a second edition of the original narrative report, the 2019 edition takes the form of a website is which provides updated figures and share key data points in a format that is easy to digest and use for external purposes.

Visitors are welcome to download both individual charts directly from the site and PowerPoint decks for external use, provided that corresponding references are cited.

This deck serves as a companion piece to the Our Shared Seas website. Readers are encouraged to visit the website for additional data and analysis at www.OurSharedSeas.com.

OUR SHARED SEAS

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Actionable Insights and the *Executive Summary* are available online and as downloads.

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OUR SHARED SEAS

Climate Change

Global ocean data and trends for informed action and decision-making

Prepared by CEA Consulting, with the support of the David and Lucile Packard Foundation

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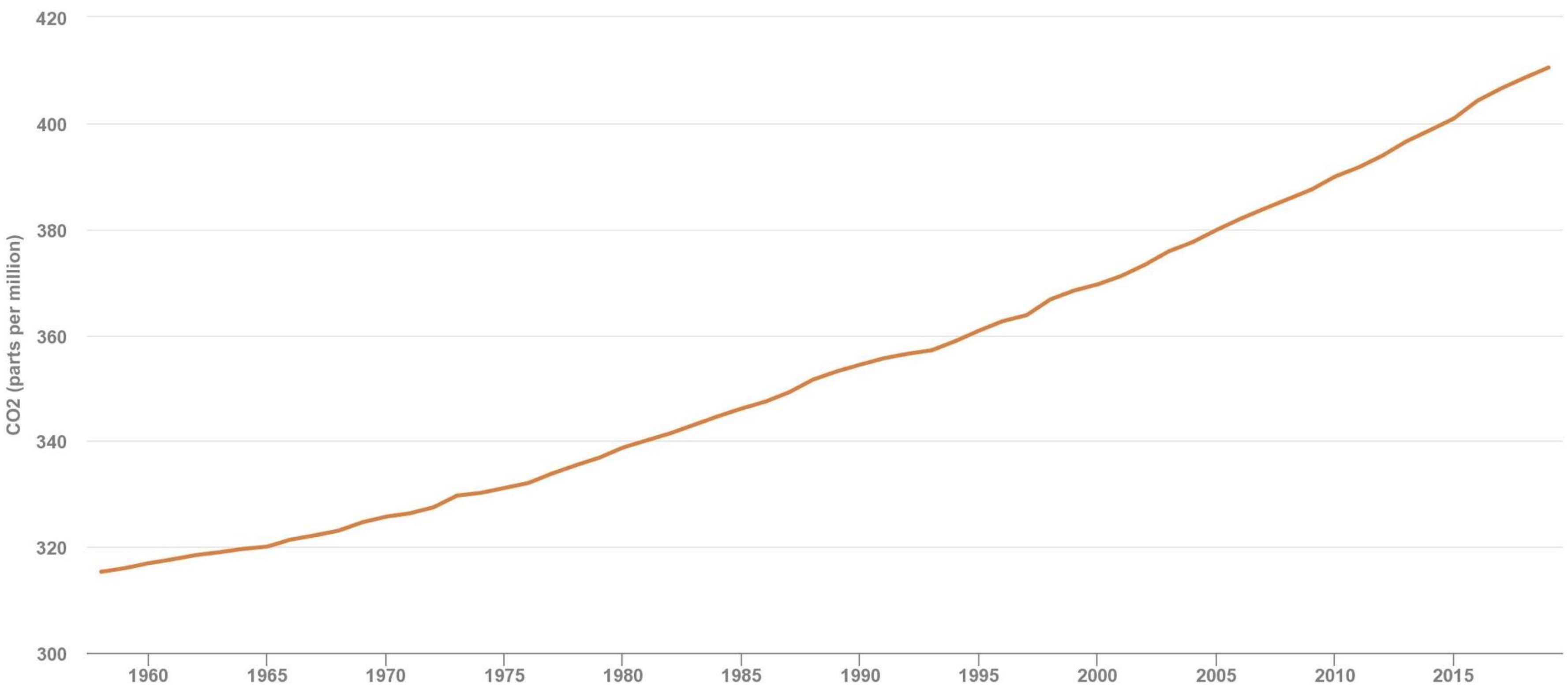
Global CO_2 emissions have risen steadily in recent decades. Between 2008 and 2017, fossil fuel CO_2 emissions increased at a rate of 1.5 percent per year. As of early 2019, CO_2 emissions had reached 410 parts per million (ppm).

Carbon dioxide (direct measurement)

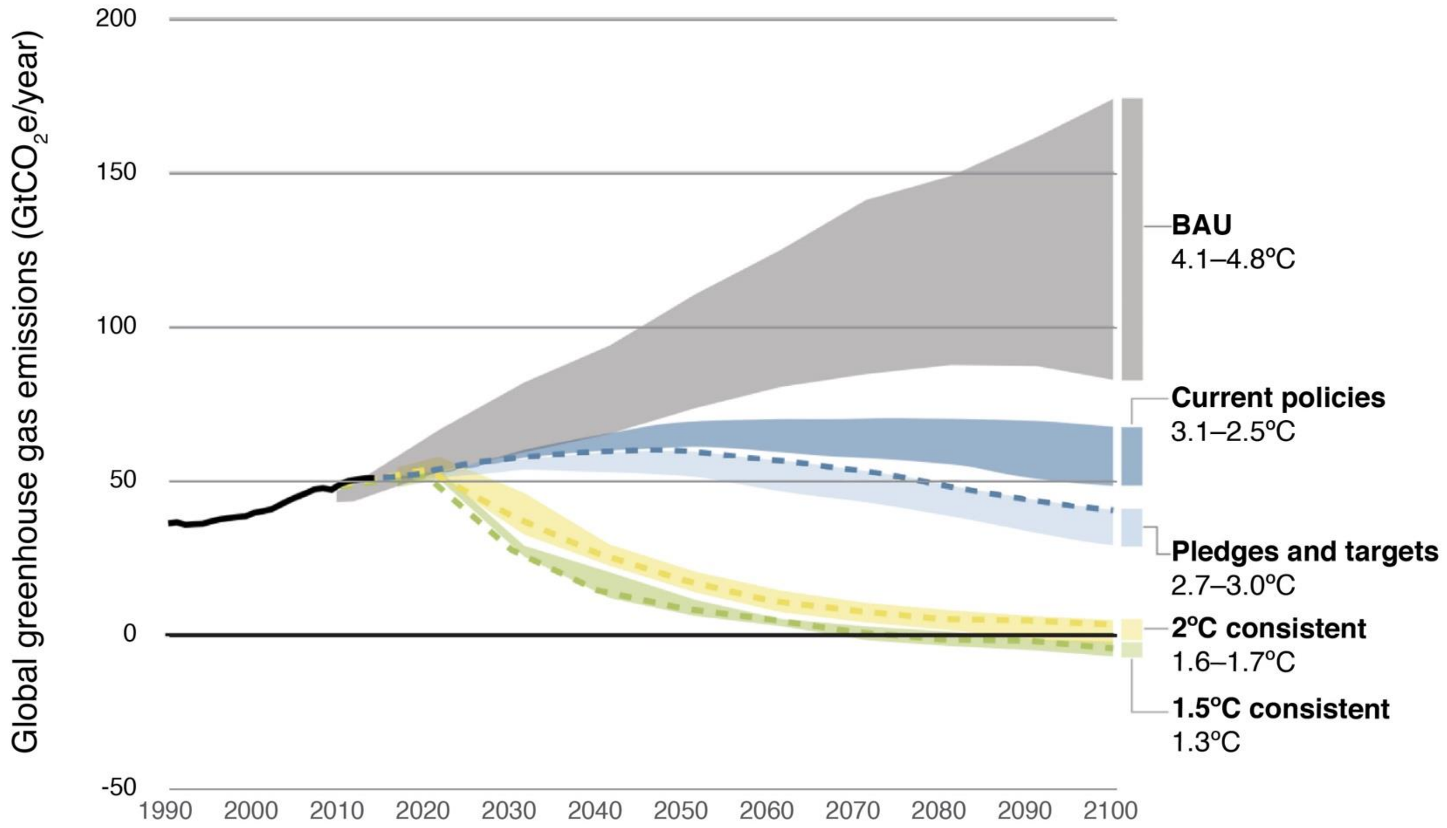


Source: "Global Climate Change: Evidence." NASA Global Climate Change and Global Warming: Vital Signs of the Planet. January 15, 2019. Accessed January 20, 2019. http://climate.nasa.gov/evidence/.

Current policies are expected to lead to warming of 3.3 degrees Celsius by 2100; under business-as-usual, warming is projected to reach over 4 degrees Celsius by 2100.

At current rates of warming, it is projected that the world will reach the 1.5-degree threshold between 2030 and 2052.

Greenhouse gas emissions: warming projected by 2100



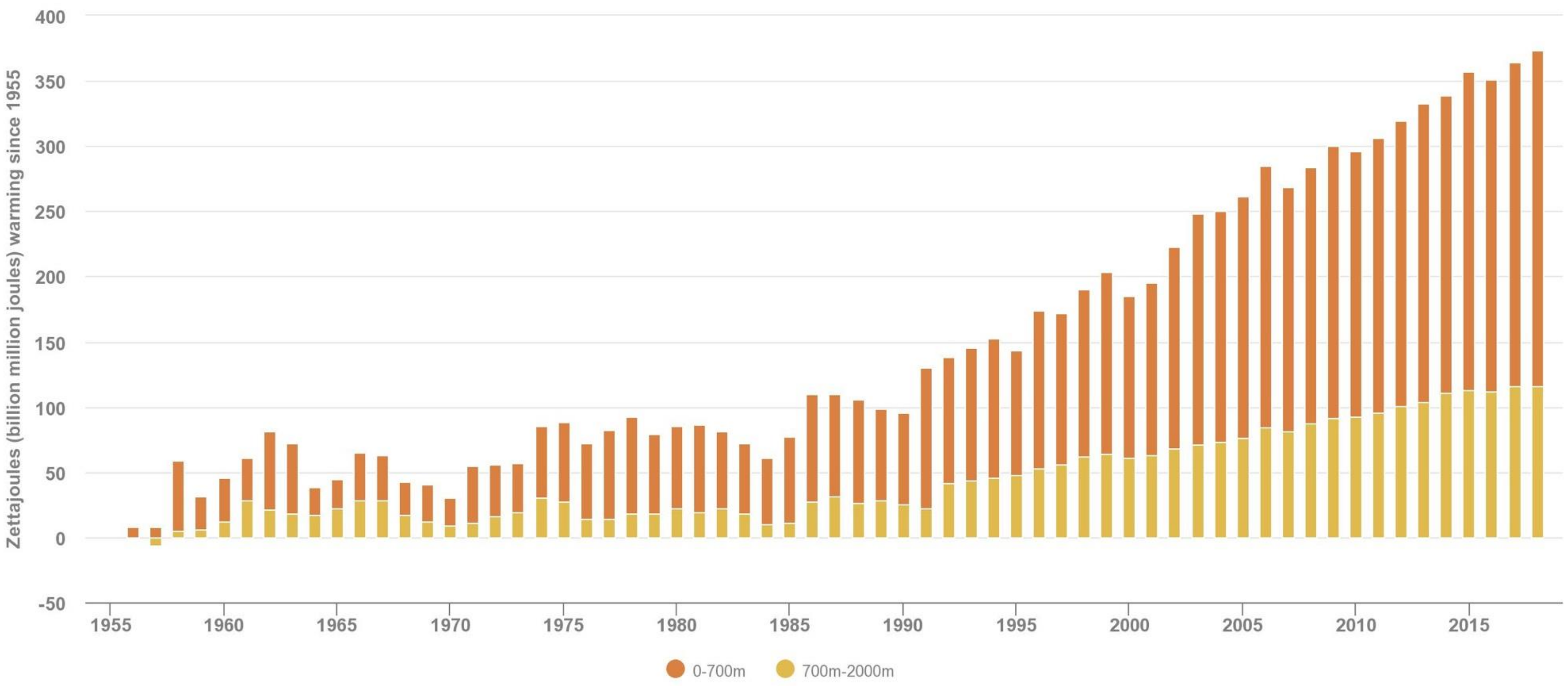
Expected global temperature increase by 2100 compared to pre-industrial levels implied by global emissions pathways for the following scenarios: BAU ('no-policy' or 'reference' scenario), current policies, current pledges and targets, and emissions compatible with warming of 1.5 degrees Celsius and 2 degrees Celsius, respectively. Ranges indicate uncertainty in emissions projections; dotted lines indicate median (50 percent) levels within these ranges.

Source: Adapted from Climate Action Tracker. "Warming Projections Global Update." December 2018. https://climateactiontracker.org/documents/507/CAT_2018-12-11_Briefing_WarmingProjectionsGlobalUpdate_Dec2018.pdf. (Accessed January 10, 2019.)

The year 2018 set a new record of ocean heating. The past five years (2014 to 2018) have ranked as the five warmest years for ocean heat content, confirming a trend that ocean warming has been accelerating since the 1990s.

New research suggests that the rate of ocean warming is much faster than previously predicted. A series of analyses indicate that the ocean is absorbing excess heat 40 percent faster than the IPCC estimated in its Fifth Assessment Report in 2013

Global ocean heat content

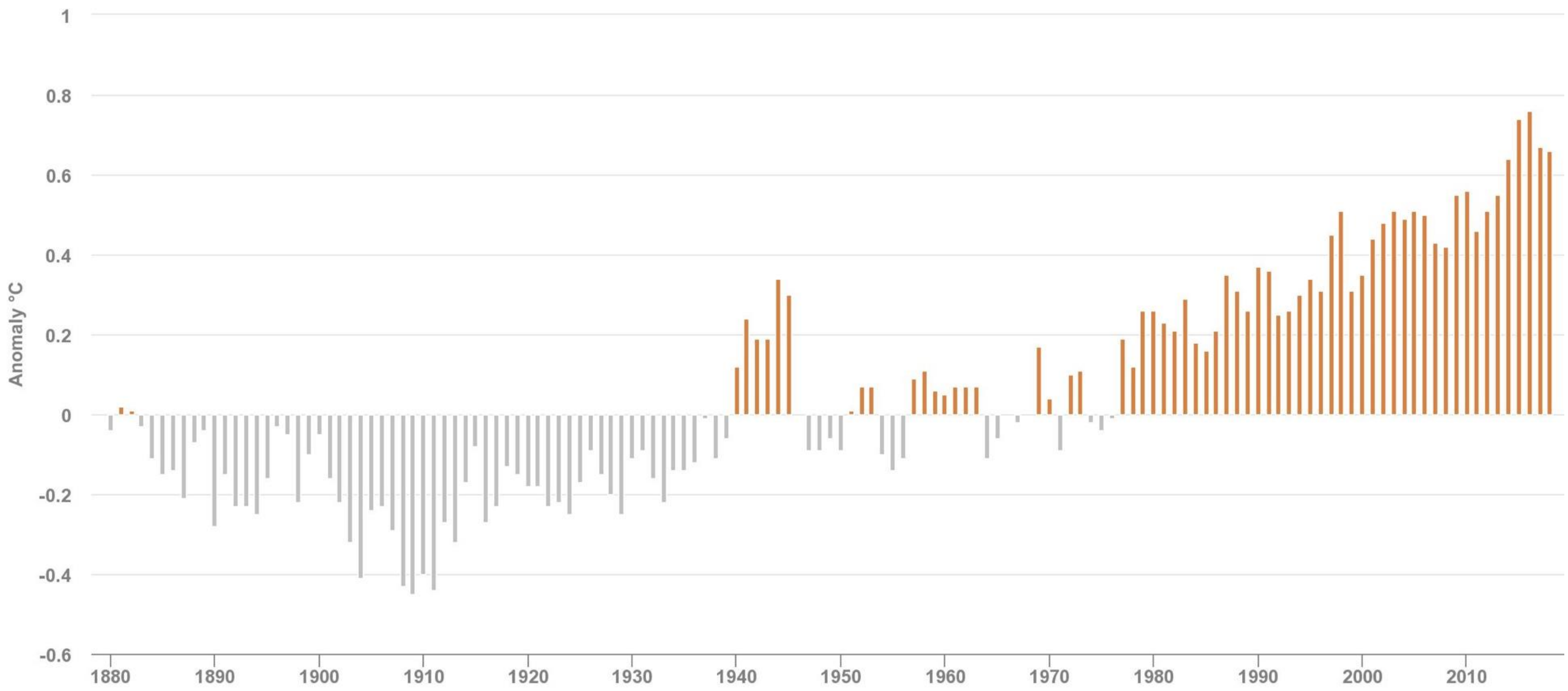


Source: Cheng L. et al. “Improved Estimates of Ocean Heat Content from 1960 to 2015.” *Science Advances* 3, no. 3 (March 2017): e1601545. https://doi.org/10.1126/sciadv.1601545; Cheng L. et al. “2018 Continues Record Global Ocean Warming.” *Advances in Atmospheric Science*, 36, no. 3, (2019: 249-252, Doi: 10.1007/s00376-019-8276-x.

The average global sea surface temperature—the temperature from the upper few meters of the ocean—has risen about 0.12 degrees Celsius per decade over the past 50 years, with a higher rate of warming in recent years.

These higher temperatures are contributing to: mass bleaching of coral reefs, die offs of other ecosystems with low thermal sensitivity (such as kelp and intertidal communities), shifts in fisheries stocks due to temperature, a reduction in algae productivity, and more frequent and intense extreme weather events.

Global ocean temperature anomaly



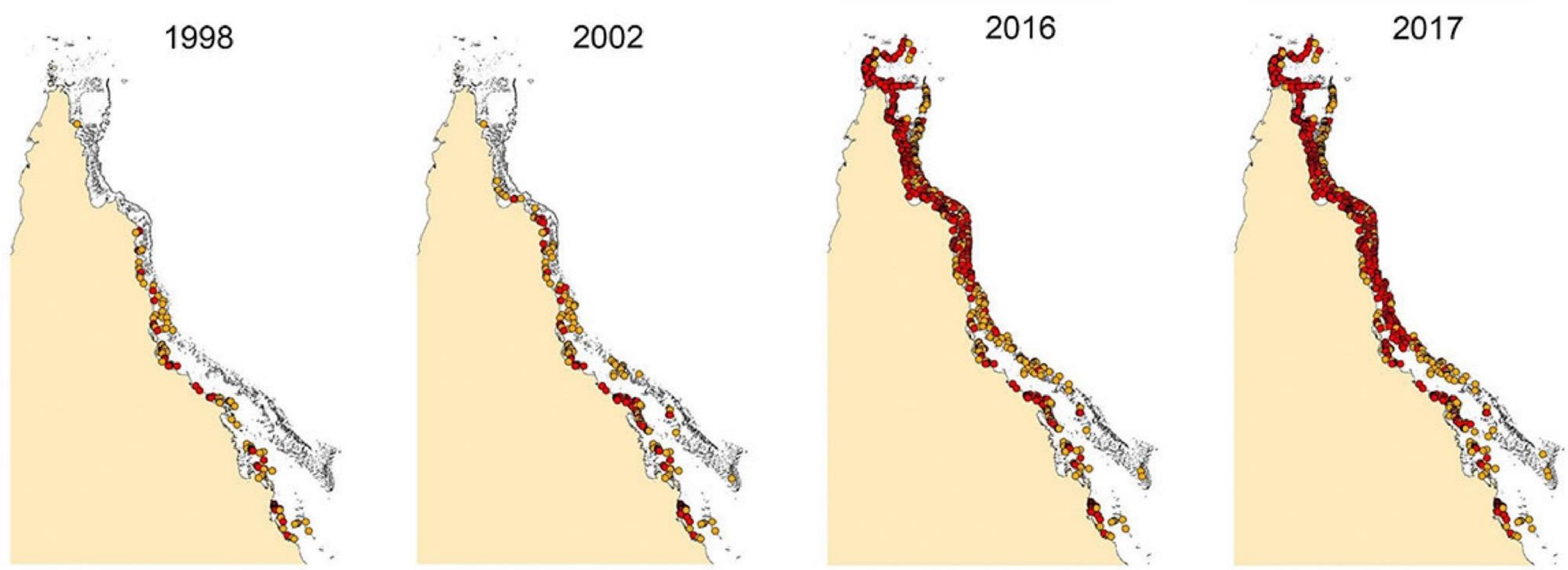
This graph shows how the average surface temperature of the ocean has changed since 1880.

Source: NOAA National Centers for Environmental Information. "Global Marine Data," updated February 2019. www.ncdc.noaa.gov/data-access/marineocean-data/extended-reconstructed-sea-surface-temperature-ersst. (Accessed February 10, 2019).

Globally, the annual risk of coral reef bleaching has increased from 8 percent in the early 1980s to 31 percent in 2016.

The time between recurrent events has also become too short to allow sufficient time for recovery. Whereas the time between recurrent severe bleaching events was 27 years in the early 1980s, this window is now only 6 years. (Typically it takes 10 to 15 years for the fastest-growing corals to recover from a severe bleaching event.)

Cumulative bleaching on the Great Barrier Reef



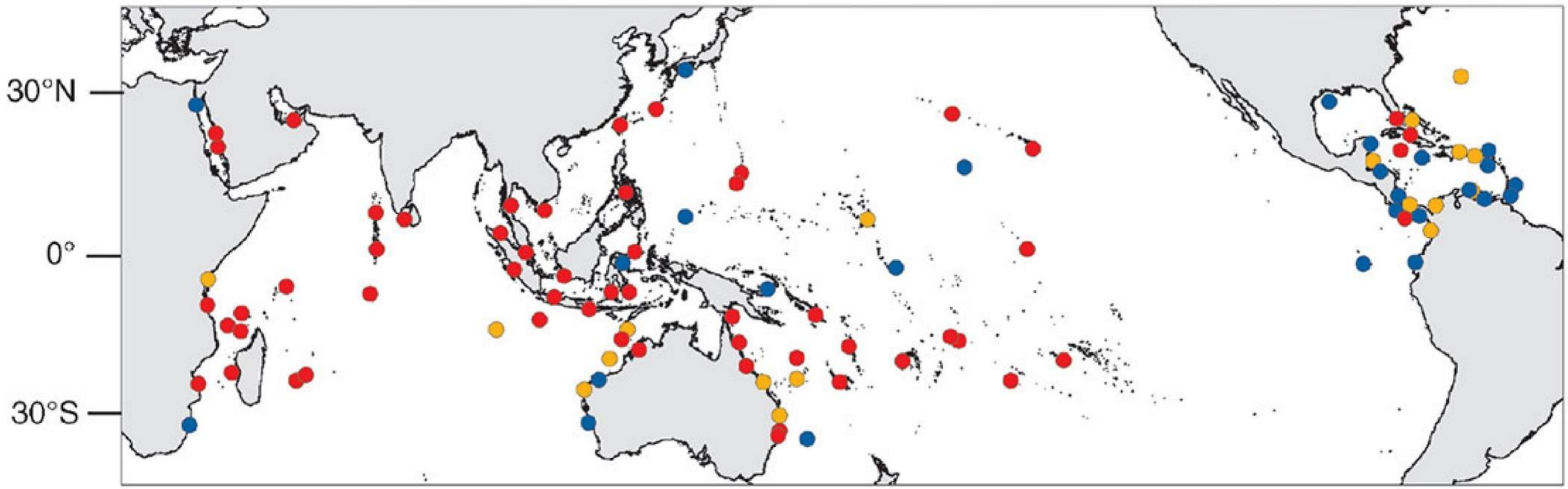
Each dot represents the most severe bleaching score recorded from 1998 to 2017 on individual reefs following each of four major beaching events, in 1998, 2002, 2016 and 2017. Successive maps include earlier bleaching records to illustrate the expanding cumulative footprint through time. Red (>60% of colonies bleached); Orange (30 to 60%).

Source: Hughes, T., J.T. Kerry, S.R. Connolly, A.H. Baird, C.M. Eakin, S.F. Heron, A. Hoey, M. Hoogenboom, M. Jacobson, G. Liu, M.S. Pratchett, W. Skirving, and G. Torda. “Ecological memory modifies the cumulative impact of recurrent climate extremes.” *Nature Climate Change* 9 (2018). doi.10.1038/s41558-018-0351.

An estimated 30-60 percent of coral reefs have died since preindustrial times.

Even if the goals of the Paris Climate Agreement are achieved (of limiting temperature to below 2 degrees Celsius), roughly 70 to 90 percent of current distribution of coral reef habitat will disappear by 2050. A failure to achieve the Paris Agreement will result in a near total loss of coral reefs by mid-century.

Global extent of mass bleaching of corals in 2015 and 2016



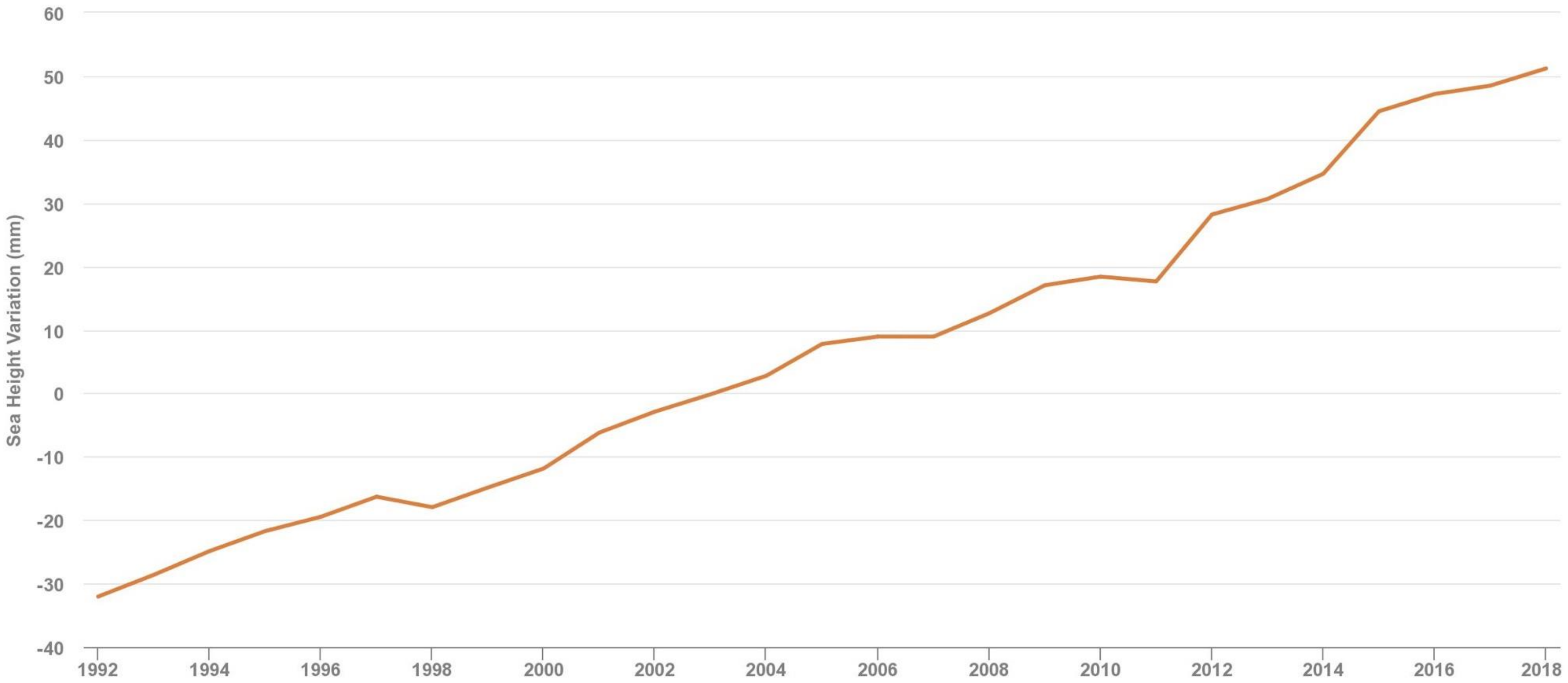
Symbols show 100 reef locations that were assessed. Red circles indicate severe bleaching affecting >30% of corals; orange circles indicate moderate bleaching affecting (less than) 30 percent of corals; and blue circles indicate no substantial bleaching records.

Source: Hughes, T. et al. “Spatial and temporal patterns of mass bleaching of corals in the Anthropocene.” *Science* 359 (2018): 80-83. DOI: 10.1126/science.aan8048.

The rate of global sea-level rise nearly doubled from 1.7 mm annually throughout most of the 20th century to 3.1 mm (0.12 inch) per year since 1993.

About one-third of the rise in global sea level has been caused by the thermal expansion of water. The increase in ocean heat in 2018 led to a 29.5 millimeter (1.2 inches) global mean sea-level rise above the 1981–2010 average. Sea-level rise is further exacerbated by melting of ice sheets in the polar regions.

Global sea level change (satellite observations)



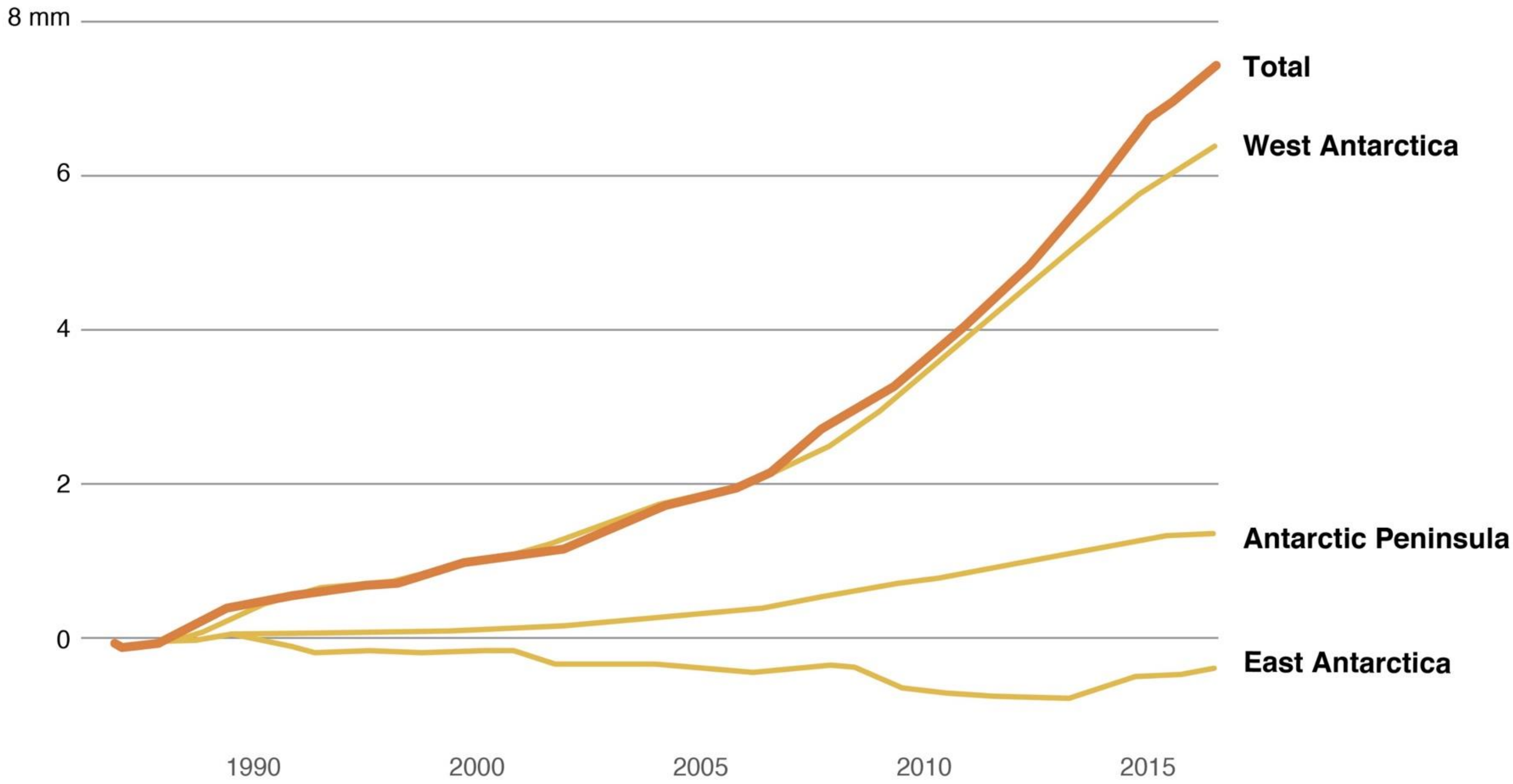
Note: The satellite data is averaged per year.

Source: Nerem, R. S., B. D. Beckley, J. T. Fasullo, B. Hamlington, D. Masters, and G. T. Mitchum. “Climate-change–driven accelerated sea-level rise detected in the altimeter era.” *PNAS* 115 (2018): 2022-2025. https://doi.org/10.1073/pnas.1717312115.

Since 2012, the amount of annual ice loss in Antarctica has tripled, increasing the global sea level by 3 millimeters (0.12 inch).

By 2100, global sea level could rise 65 centimeters (21 inches) if the rate of sea-level rise continues to accelerate at the observed rate; ice melt from Antarctica could account for nearly 25 percent of this rise.

Antarctic ice sheet contribution to global sea level



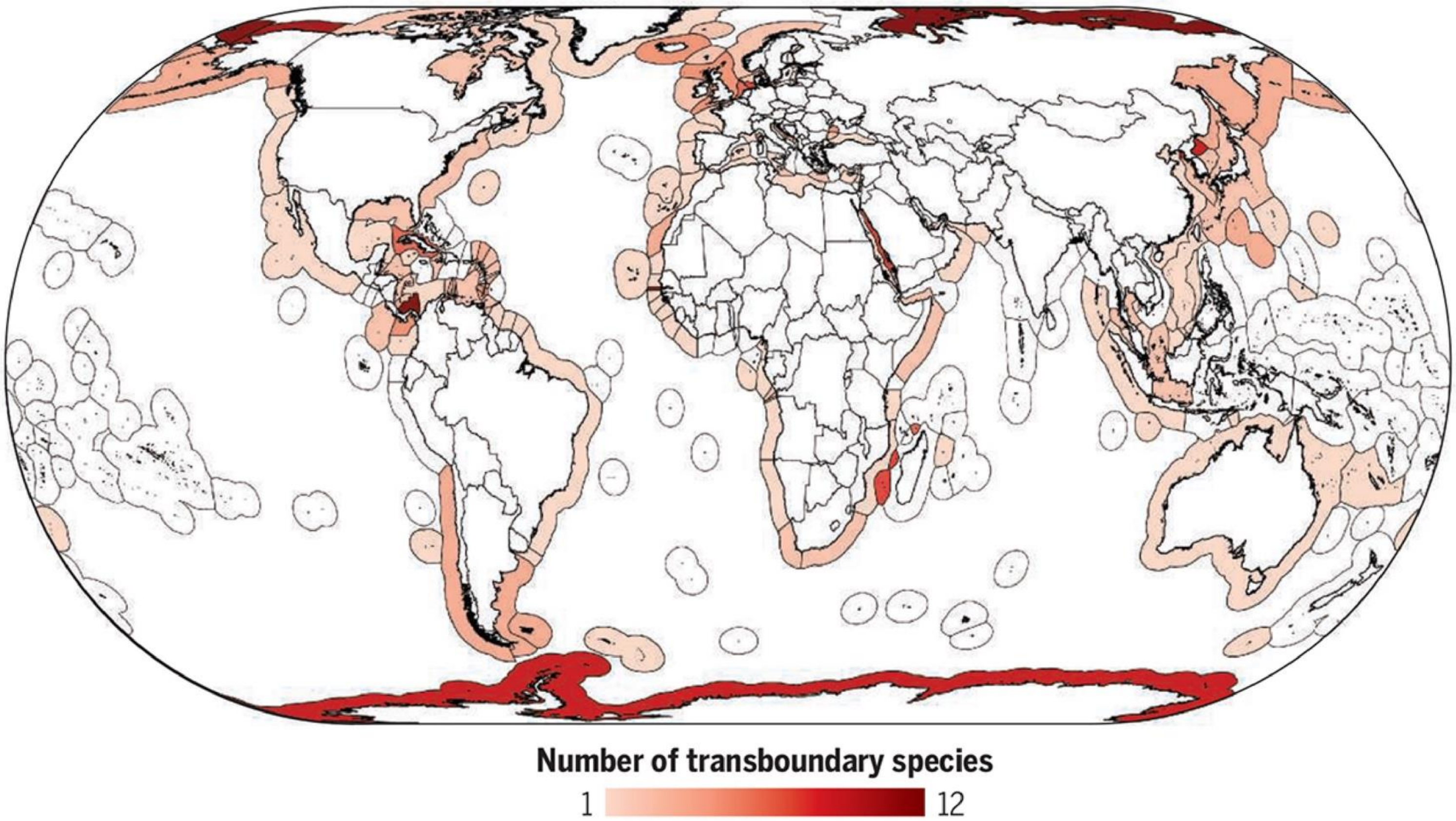
Adapted from Changes in the Antarctic ice sheet's contribution to global sea level, 1992 to 2017. Credit: IMBIE/Planetary Visions.

Source: NASA. "Ramp-up in Antarctic ice loss speeds sea-level rise." June 13, 2018, https://climate.nasa.gov/news/2749/ramp-up-in-antarctic-ice-loss-speeds-sea-level-rise/.

One study projects that new transboundary stocks will be present in ~30 percent of global EEZs by 2100.

As waters warm due to climate change, fish and other marine species are migrating into new territory, usually poleward, at a rate averaging 70 km (43 mi) per decade.

EEZs projected to contain one or more fishery stocks by 2100



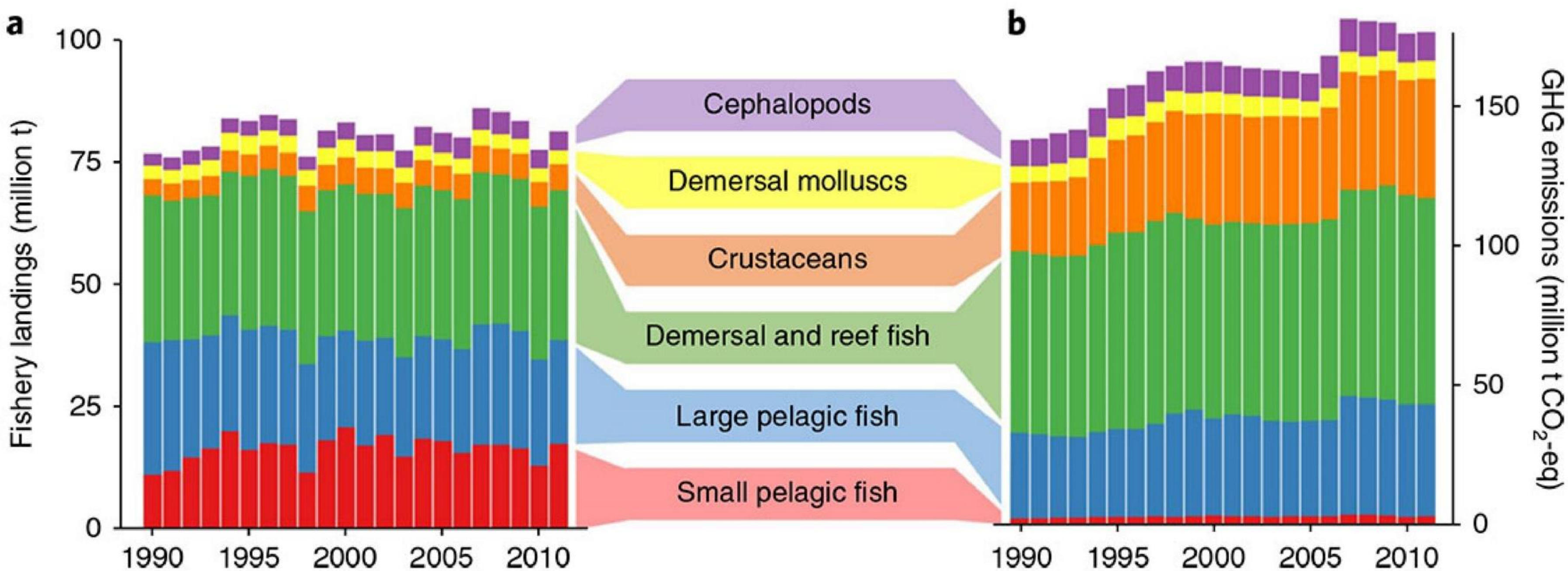
Compared to fishery distribution in 1950–2014. Projections represent an ensemble average across three models under the high emissions scenario (RCP 8.5).

Source: Pinsky, Malin L., Gabriel Reygondeau, Richard Caddell, Juliano Palacios-Abrantes, Jessica Spijkers, and William W. L. Cheung. "Preparing Ocean Governance for Species on the Move." *Science 360*, no. 6394 (June 15, 2018): 1189–91. https://doi.org/10.1126/science.aat2360.

Emissions from the global fishing industry increased by 28 percent between 1990 and 2011 while average emissions per ton of landed seafood product grew by 21 percent.

Increased harvest from fuel-intensive crustacean fisheries primarily drove this growth in emissions. Capacity-enhancing fuel subsidies and growth in distant water fishing have also contributed to the fishing sector's trend of increased emissions.

Global marine fishery landings and GHG emissions (1990-2011)



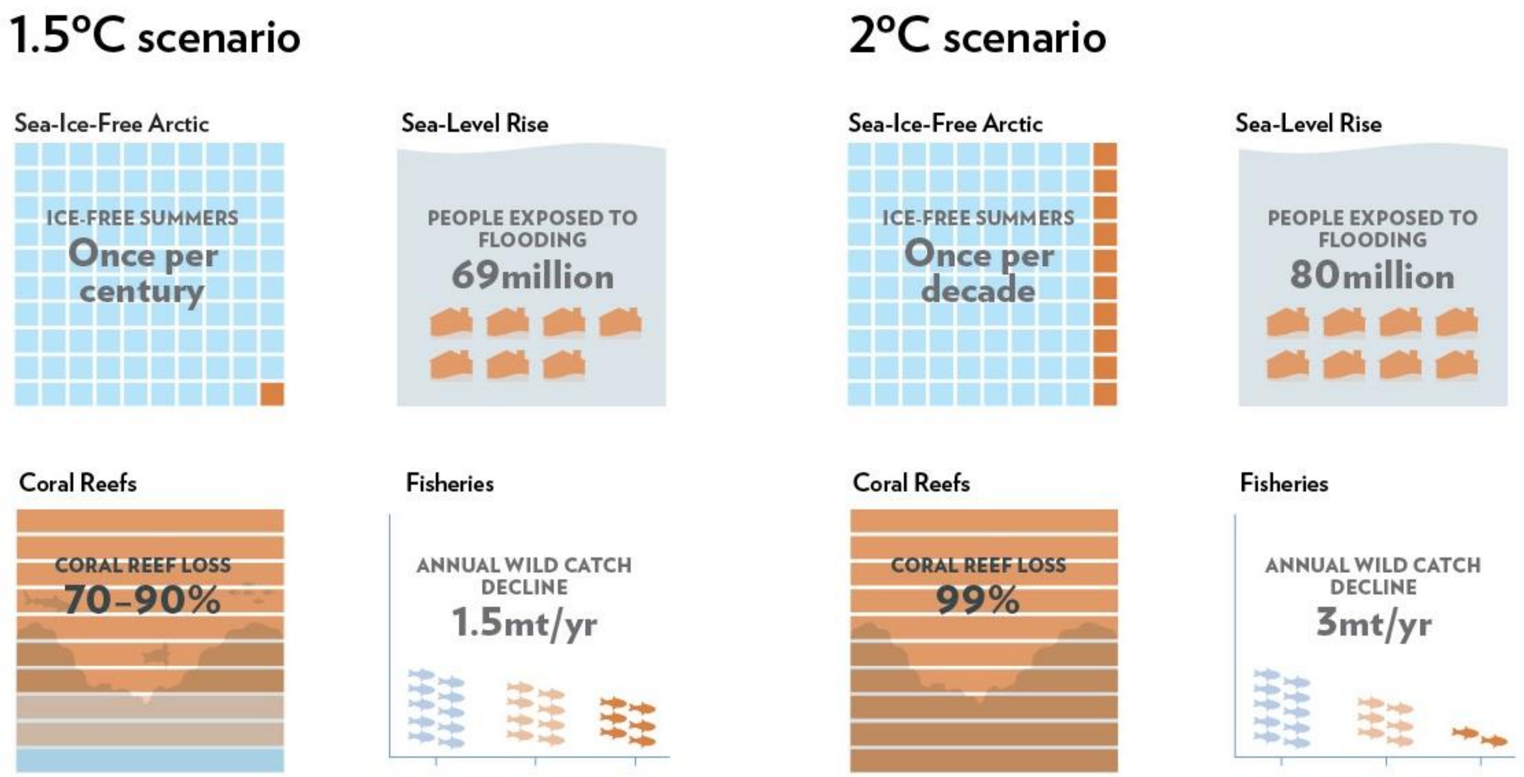
The chart is shown categorized by species groups: a) global marine fishery landings, and b) global GHG emissions from marine fisheries.

Source: Parker, Robert W. R., Julia L. Blanchard, Caleb Gardner, Bridget S. Green, Klaas Hartmann, Peter H. Tyedmers, and Reg A. Watson. "Fuel Use and Greenhouse Gas Emissions of World Fisheries." *Nature Climate Change* 8, no. 4 (April 2018): 333–37. https://doi.org/10.1038/s41558-018-0117-x.

A recent IPCC report examined the consequences of a future with warming of 1.5 or 2 degrees Celsius. While both scenarios would heavily impact the ocean, a half degree of warming will lead to vastly different futures for natural and human communities.

By 2100, Arctic summers could be ice-free once a decade in a world with 2 degrees of warming, or once a century under 1.5 degrees of warming. Nearly all of coral reefs could be irreversibly destroyed under 2 degrees of warming, or 10 to 30 percent may persist if warming is limited to 1.5 degrees Celsius.

Impacts associated with 1.5 and 2-degrees Celsius temperature increase

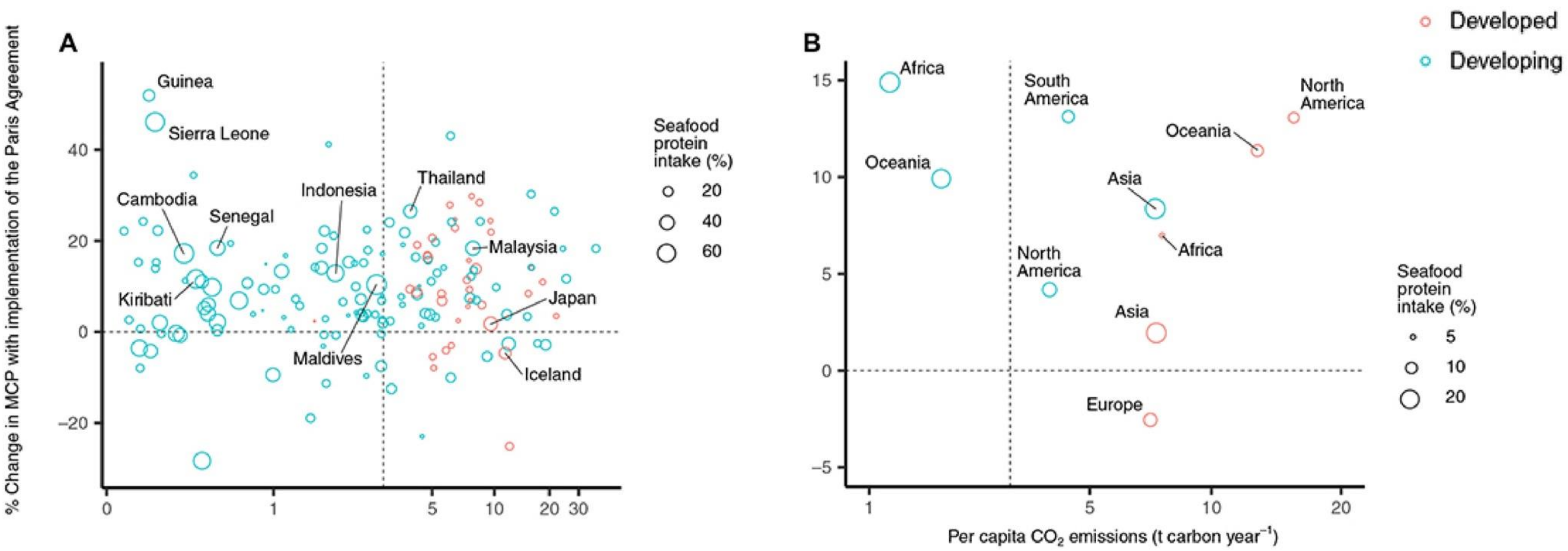


Source: IPCC. "Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty." [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 2018, 32 pp.

New research suggests that as compared to a high-emissions scenario of 3.5 degrees Celsius, achieving the Paris Agreement would result in significant benefits for ocean productivity, economies, and human communities.

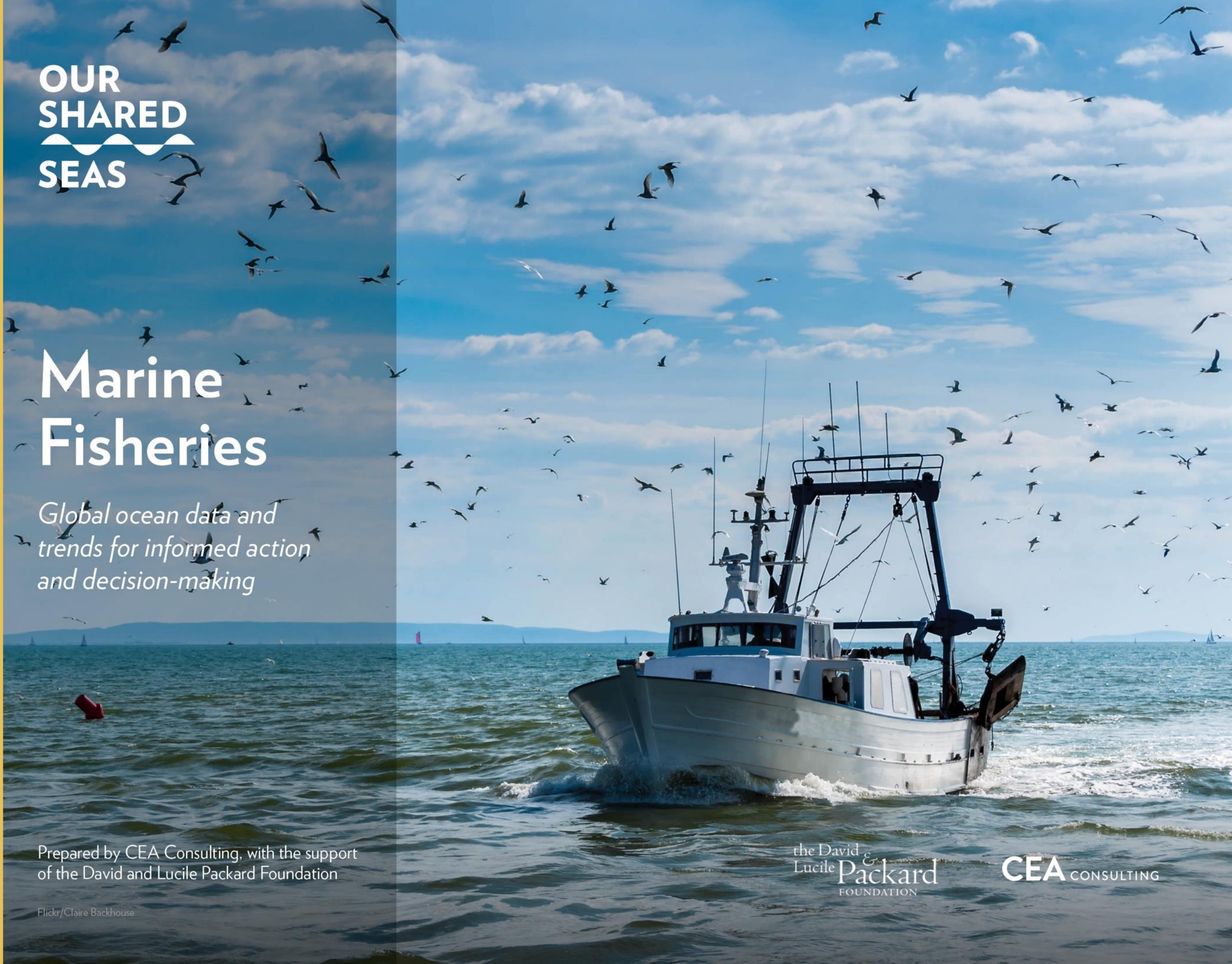
Limiting warming to 1.5°C could increase global fishers' revenues by USD 13.1 billion annually (due to higher fish biomass and ocean productivity), raise seafood workers' income by USD 10.6 billion, and reduce household seafood expenditures by USD 18.3 billion.

Projected gains in Maximum Catch Potential under Paris Agreement targets, by country and continent



Projected gains in Maximum Catch Potential (relative to the 2001–2010 period) if Paris Agreement targets are met (1.5°C relative to 3.5°C warming) and the 2015 CO_2 emissions by (A) country and (B) continent. Larger point size indicates a greater proportion of protein derived from seafood, while the vertical line represents the median per capita CO_2 emission levels. Note the log scale for CO_2 emissions.

Source: Sumaila, R. et al. "Benefits of the Paris Agreement to ocean life, economies, and people." Science Advances 5, no. 2 (2019). DOI: 10.1126/sciadv.aau3855.



OUR SHARED SEAS

Marine Fisheries

Global ocean data and trends for informed action and decision-making

Prepared by CEA Consulting, with the support of the David and Lucile Packard Foundation

Flickr/Claire Backhouse

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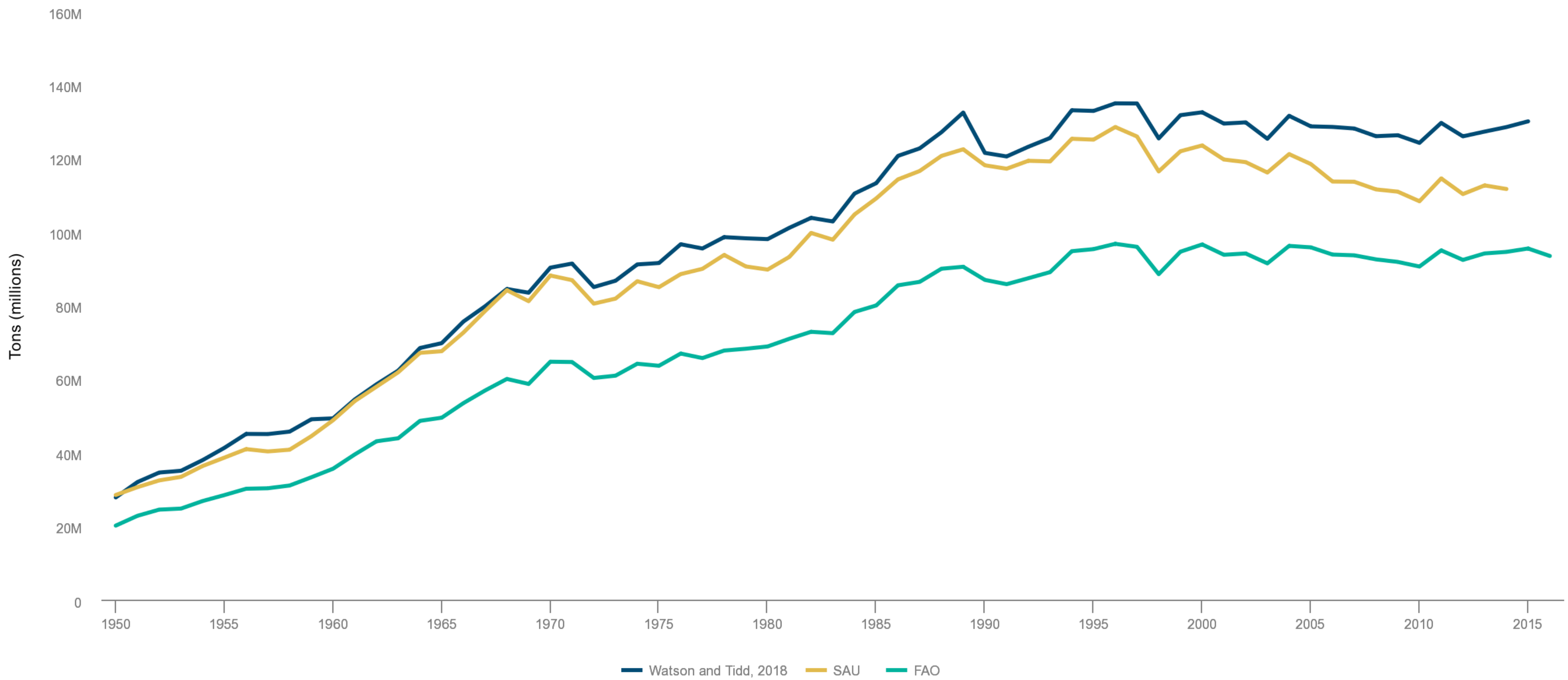
FAO reports that global landings were 93 million tons in 2016. Catch reconstructions place global landings roughly 30% higher than FAO's officially reported figures.

Statistics from FAO suggest landings have followed a roughly consistent level over the last 20 years. Catch reconstruction methodologies suggest that total global catch has been on a slight downward trajectory since the mid-1990s.

Comparison of global marine capture estimates (1950-2016)

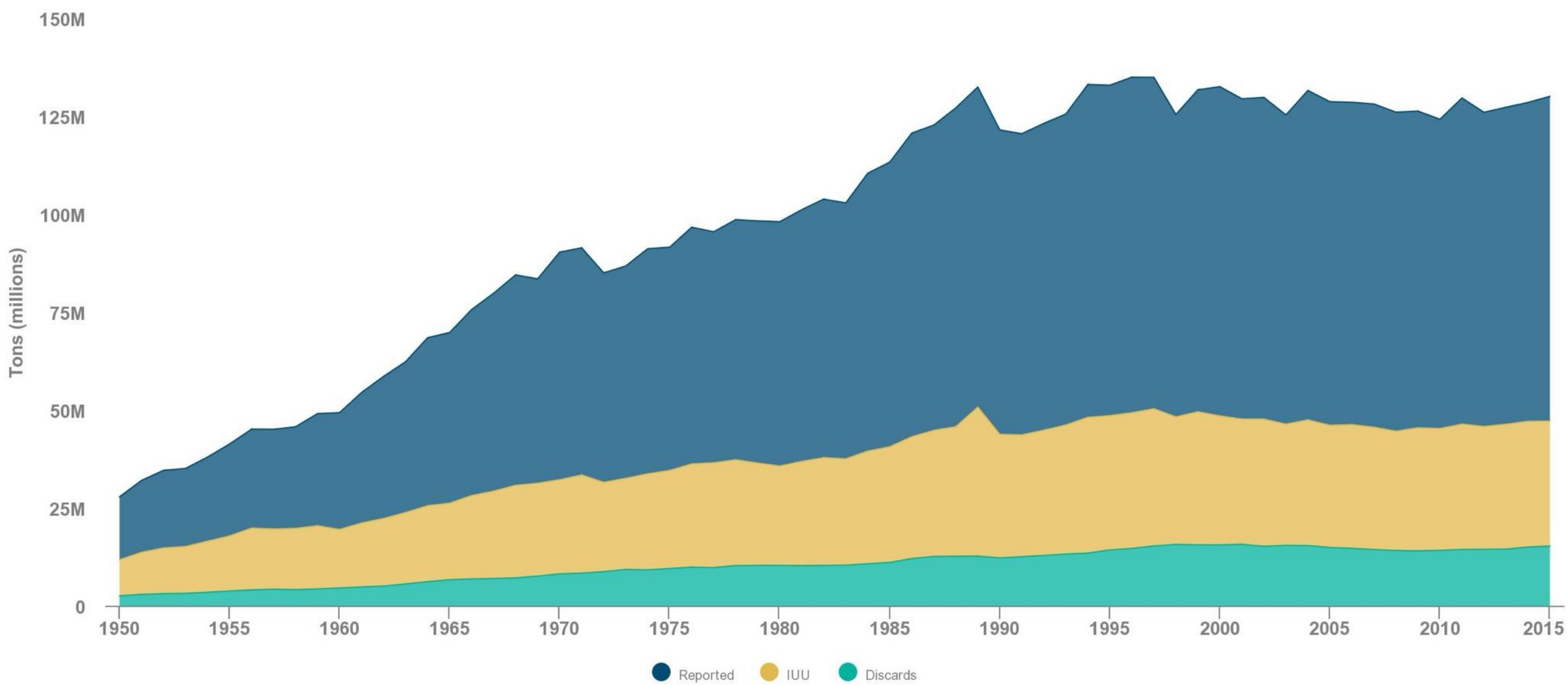


Source: FAO Fisheries and Aquaculture Department, FishStatJ - Software for Fishery Statistical Time Series, 2018; Pauly D. and Zeller D., editors. *Sea Around Us Concepts, Design and Data*, www.seaaroundus.org, 2015; Meta data from: Watson, Reg A., and A. Tidd. "Mapping Nearly a Century and a Half of Global Marine Fishing: 1869–2015." *Marine Policy* 93 (July 2018): 171–77. http://dx.doi.org/10.4226/77/5a65572655f73; http://data.imas.utas.edu.au/portal/search?uuid=ff1274e1-c0ab-411b-a8a2-5a12eb27f2c0

An estimated 20% of global fish catch, representing 11-26 million tonnes of landings is caught illegally, accounting for an annual economic loss of USD 10-23.5 billion.

Recent analysis by Watson and Tidd (2018) updated this figure, estimating that illegal and unreported fishing accounted for roughly 25% of landings in 2015 (32 MT). While these figures represent the best available global estimate, accurately determining the scale of IUU is a significant challenge, which is one reason for the wide confidence intervals.

Estimates of unreported catch estimates (1950-2016)

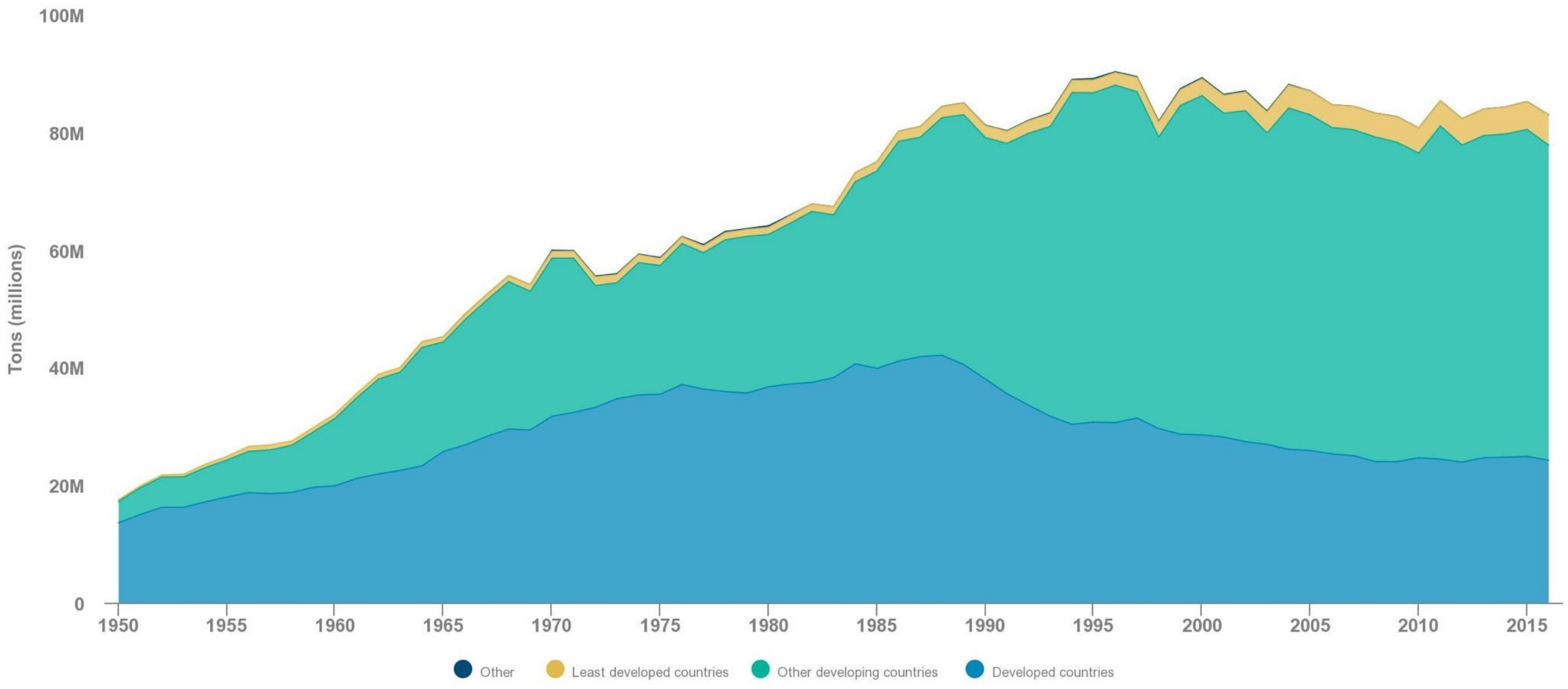


Source: Meta data from: Watson, Reg A., and A. Tidd. “Mapping Nearly a Century and a Half of Global Marine Fishing: 1869–2015.” *Marine Policy* 93 (July 2018): 171–77. http://dx.doi.org/10.4226/77/5a65572655f73; http://data.imas.utas.edu.au/portal/ search?uuid=ff1274e1-c0ab-411b-a8a2-5a12eb27f2c0.

As wild capture landings plateaued in recent decades, a major redistribution of catch has taken place between developed and developing economies.

Total landings in developed countries, primarily in North America and Europe, declined by a third since the late 1980s. Meanwhile developing economies (including China, Peru, and Russia) have seen consistent increases in catch—from representing 40% of global catch in 1980 to 65% in 2016

Catch by country economic classification

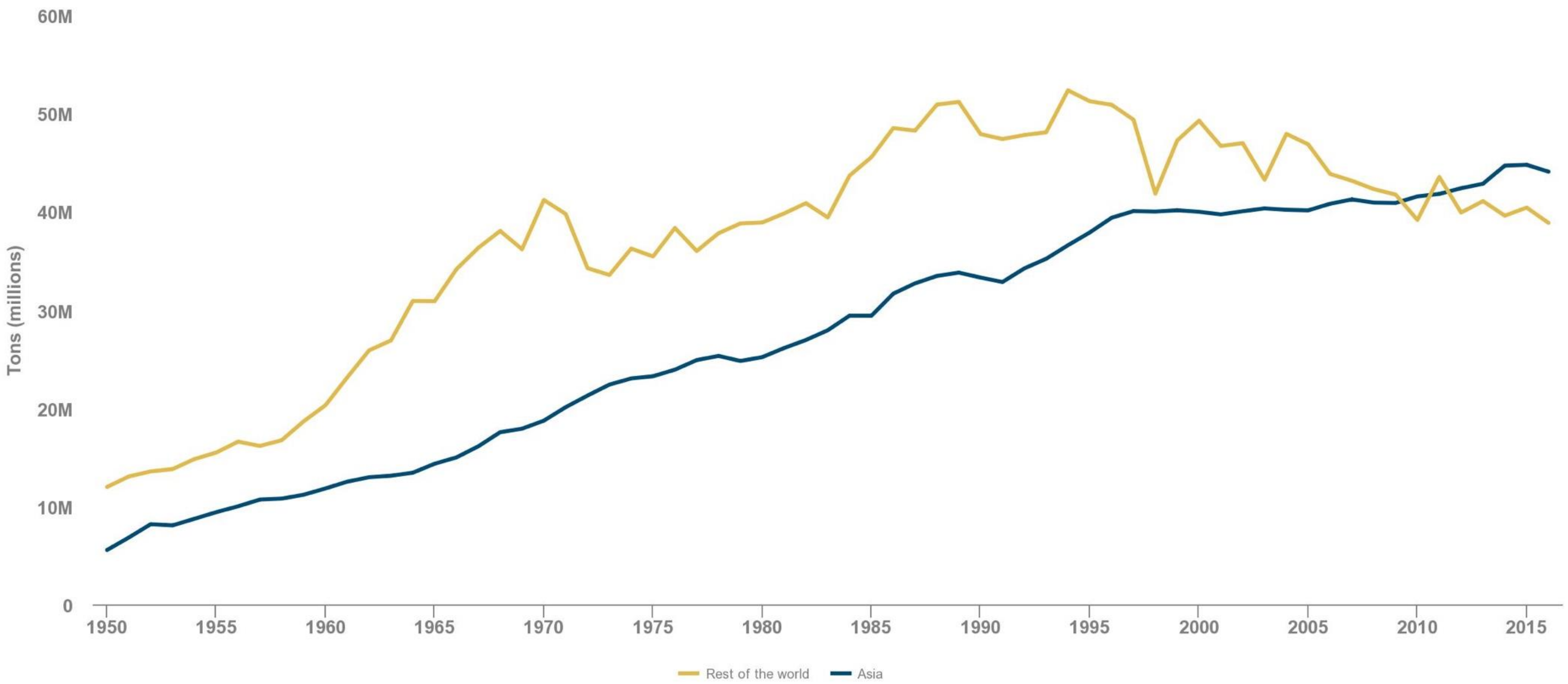


Source: FAO Fisheries and Aquaculture Department, *FishStatJ - Software for Fishery Statistical Time Series*, 2018, http://www.fao.org/fishery/statistics/software/fishstatj/en.

Regionally, Asia has experienced the most notable expansion in catch, with a nine-fold increase in landings since the 1950s.

Since 2012, wild capture landings by Asian countries have exceeded landings by the rest of the world combined. Recent research suggests that the continued high productivity of some Asian fisheries is at least partly driven by heavy fishing pressure and speciation, the shift in ecosystem composition toward smaller, more productive species.

Capture fisheries landings: Asia compared to the rest of the world

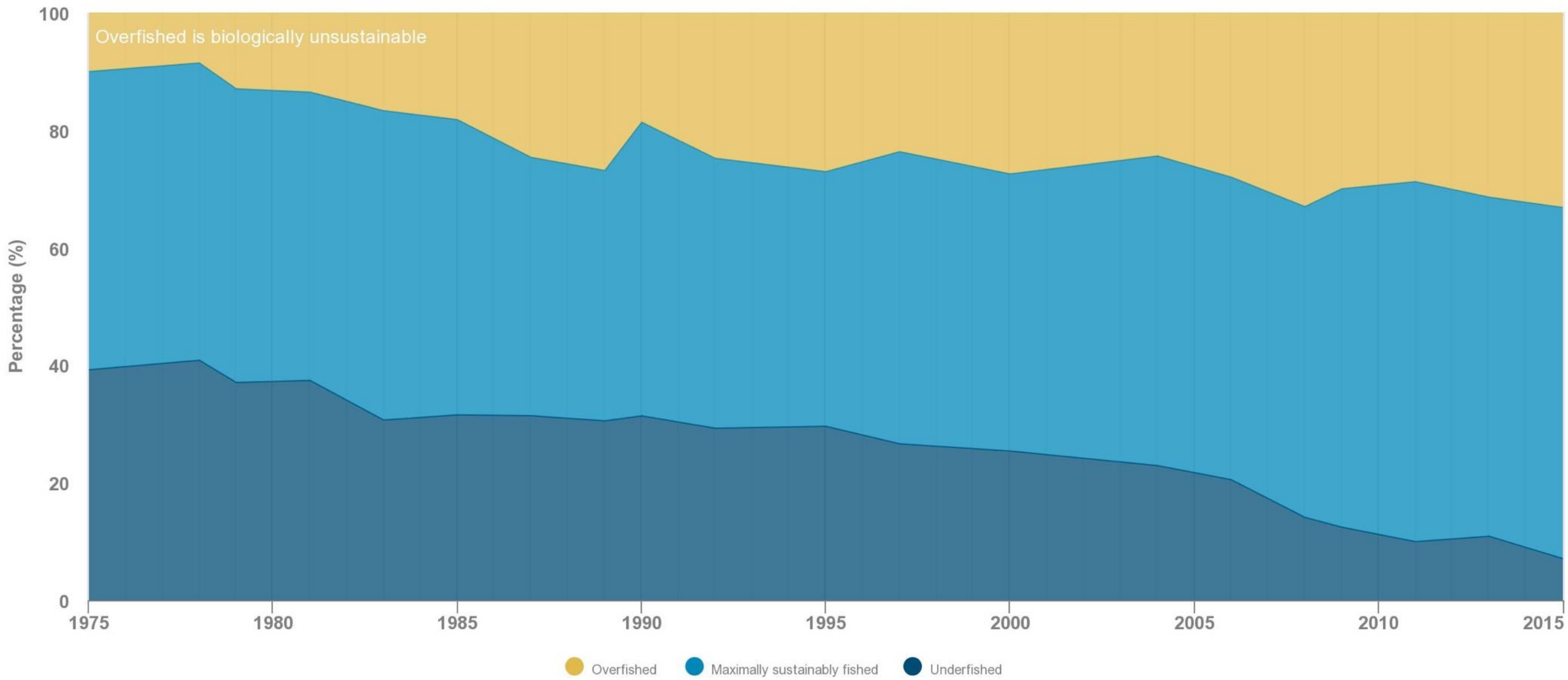


Source: FAO Fisheries and Aquaculture Department, *FishStatJ - Software for Fishery Statistical Time Series*, 2018, http://www.fao.org/fishery/statistics/software/fishstatj/en; Cao, Ling, Yong Chen, Shuanglin Dong, Arthur Hanson, Bo Huang, Duncan Leadbitter, David C. Little, et al. "Opportunity for Marine Fisheries Reform in China." *Proceedings of the National Academy of Sciences* 114, no. 3 (January 17, 2017): 435–42.

Official data from the FAO suggests that the status of global stocks is poor, ranking 33% of assessed major stocks as overfished in 2015.

FAO data indicate that the portion of overfished stocks has steadily expanded over time—from 10% of stocks in 1975 to 33% in 2015—but has slightly stabilized in recent years.[13] Most stocks remain unassessed, and more than half of monitored fisheries are depleted to the point of yielding little or no catch.

Global stock status according to FAO

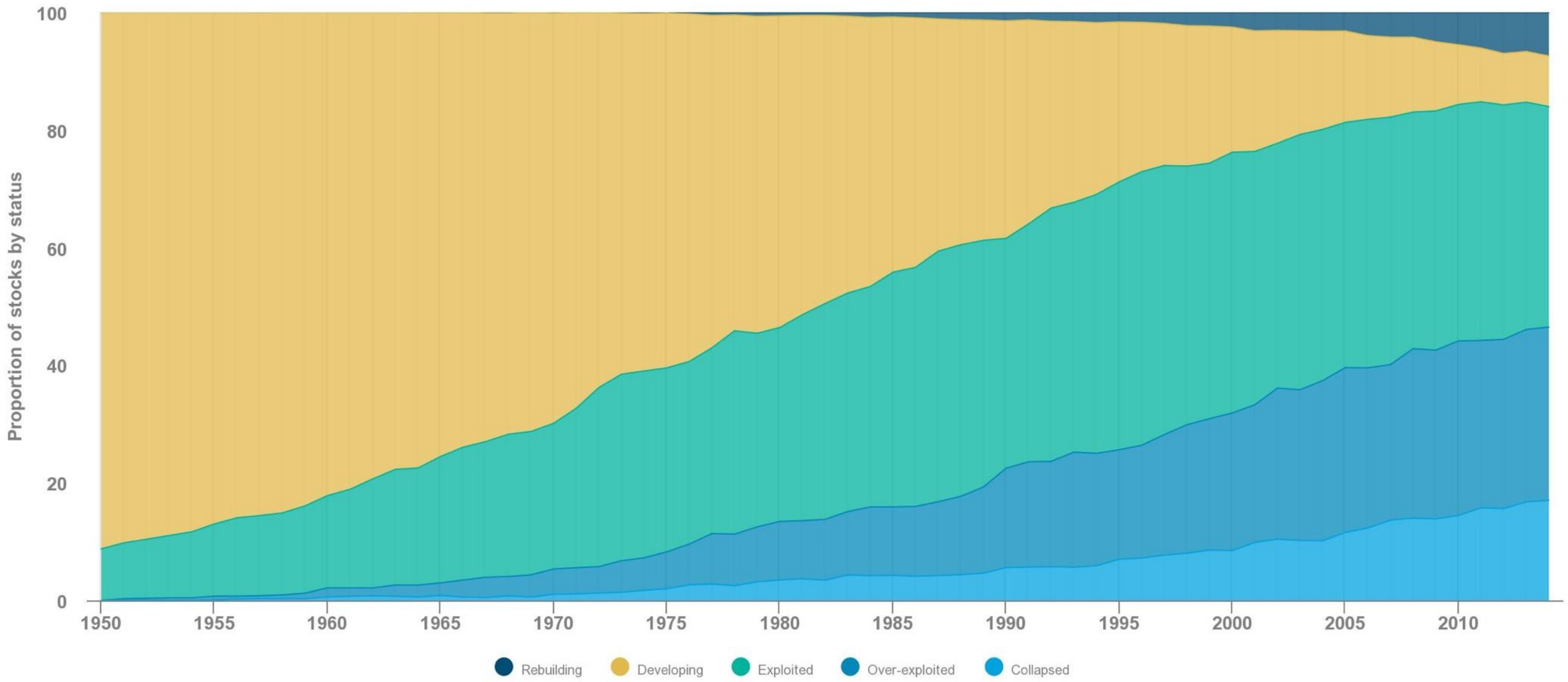


Source: FAO, ed. *The State of World Fisheries and Aquaculture 2018*. Rome, 2018.

Sea Around Us suggests that two-fifths of stocks (a slightly larger proportion than the FAO estimate) may be overfished or collapsed.

The Sea Around Us data, which considers both assessed and unassessed stocks, suggests that 40% of stocks were overexploited or collapsed in 2014, the most recent published year.

Proportion of stocks by stock status

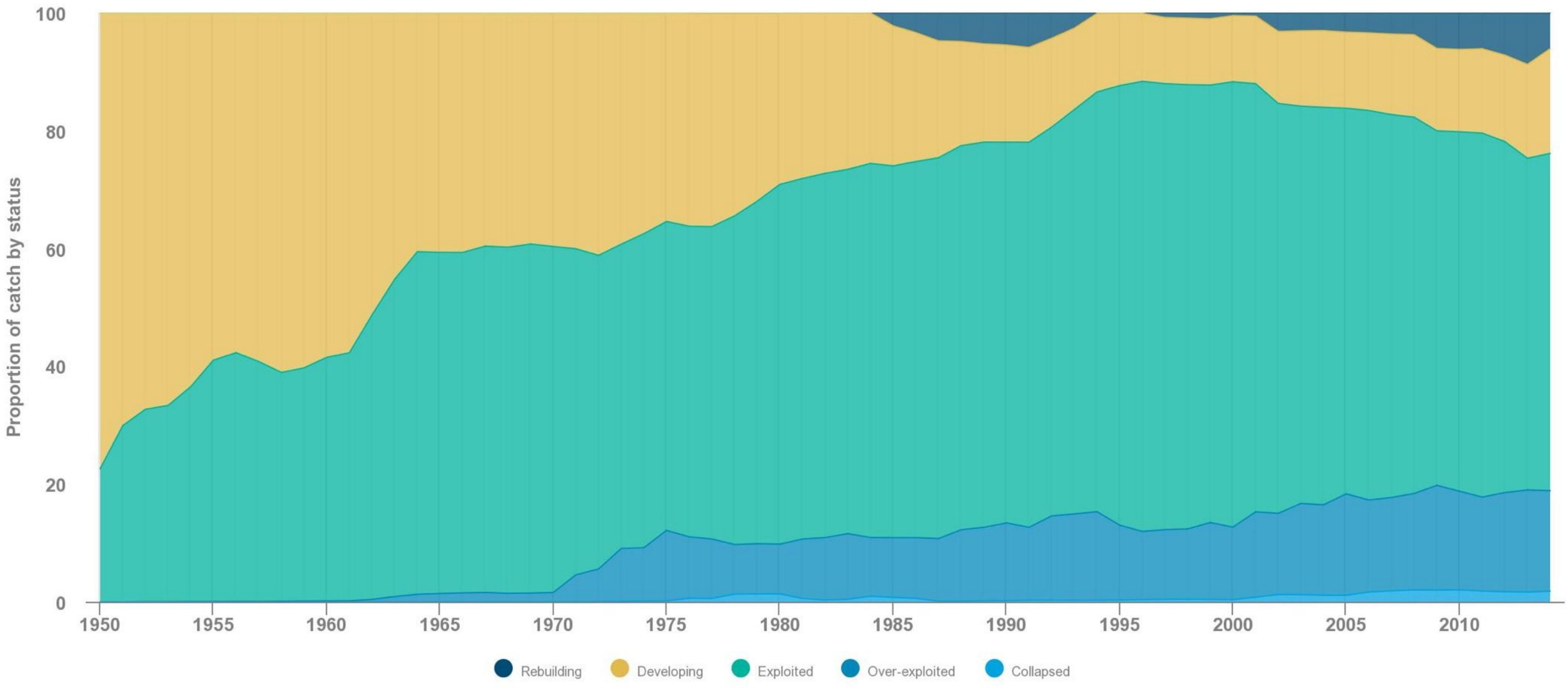


Source: Pauly D. and Zeller D., editors. *Sea Around Us Concepts, Design and Data*, www.seaaroundus.org, 2015.

The Sea Around Us data suggest that the proportion of stocks undergoing rebuilding has increased slightly in recent years.

As of 2014, 7.4% of stocks were classified as rebuilding; 8.6% as developing; 37% as exploited; 30% as overexploited; and 17% as collapsed.

Proportion of catch by stock status

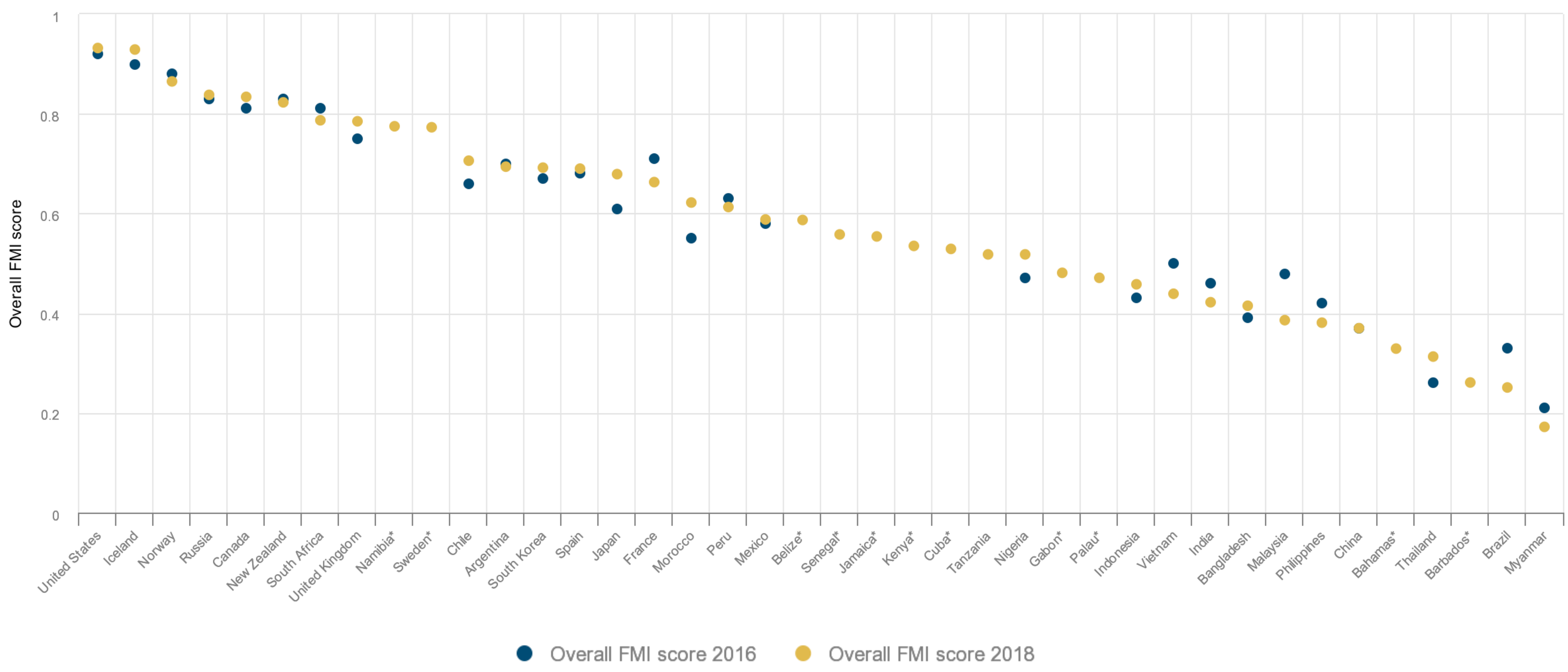


Source: Pauly D. and Zeller D., editors. *Sea Around Us Concepts, Design and Data*, www.seaaroundus.org, 2015.

The Fisheries Management Index (FMI), which uses expert surveys to rate management effectiveness, found substantial variation in management globally.

FMI scores continue to hold a strong positive correlation with GDP per capita and a negative correlation with capacity-enhancing subsidies. Between 2016 and 2018, there was relatively little change in the FMI scores of individual countries.

Fisheries Management Index (2016 and 2018)

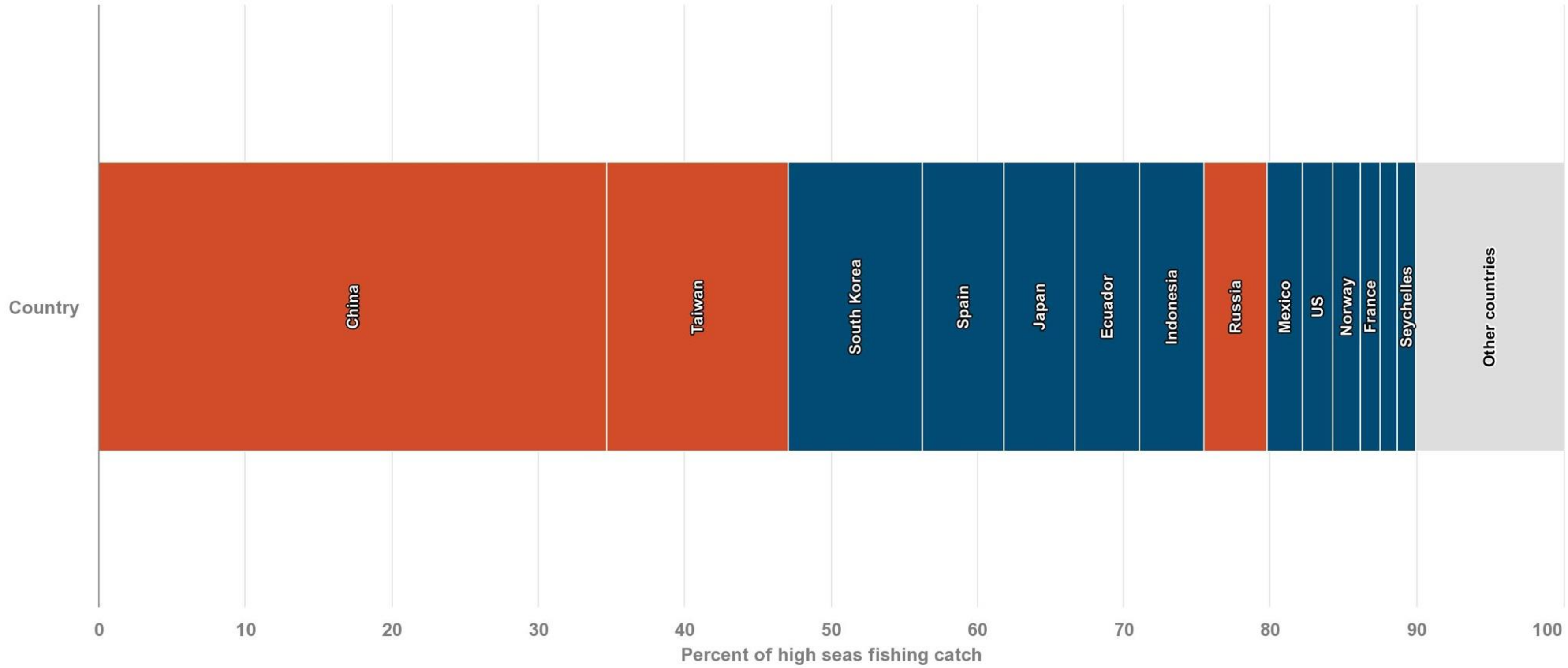


Countries without values for 2016 (indicated with an asterisk [*]) were not included in the baseline analysis.
Sources: Melnychuk, Michael C., E. Peterson, M. Elliott, and R. Hilborn. “Fisheries Management Impacts on Target Species Status.” *Proceedings of the National Academy of Sciences* 114, no. 1 (January 3, 2017): 178–83. https://doi.org/10.1073/pnas.1609915114; Melnychuk, M., C. Ashbrook, M. Pons, R. Hilborn. “Assessing the effectiveness and recent changes in fisheries management systems of 28 fishing nations with the Fisheries Management Index survey.” University of Washington. August 27, 2018.

For some countries that subsidize their high-seas fishing fleet—including China, Taiwan, and Russia—the government subsidies far exceed fishing profits.

This suggests that high-seas fishing, which accounts for 6% of global catch, would not be profitable at its current scale for these countries without subsidies. Unprofitable fisheries can be propped up by underreporting high-seas catch and by using unfair labor compensation (or no compensation), both of which contribute to IUU.

Net economic benefits of high-seas fishing

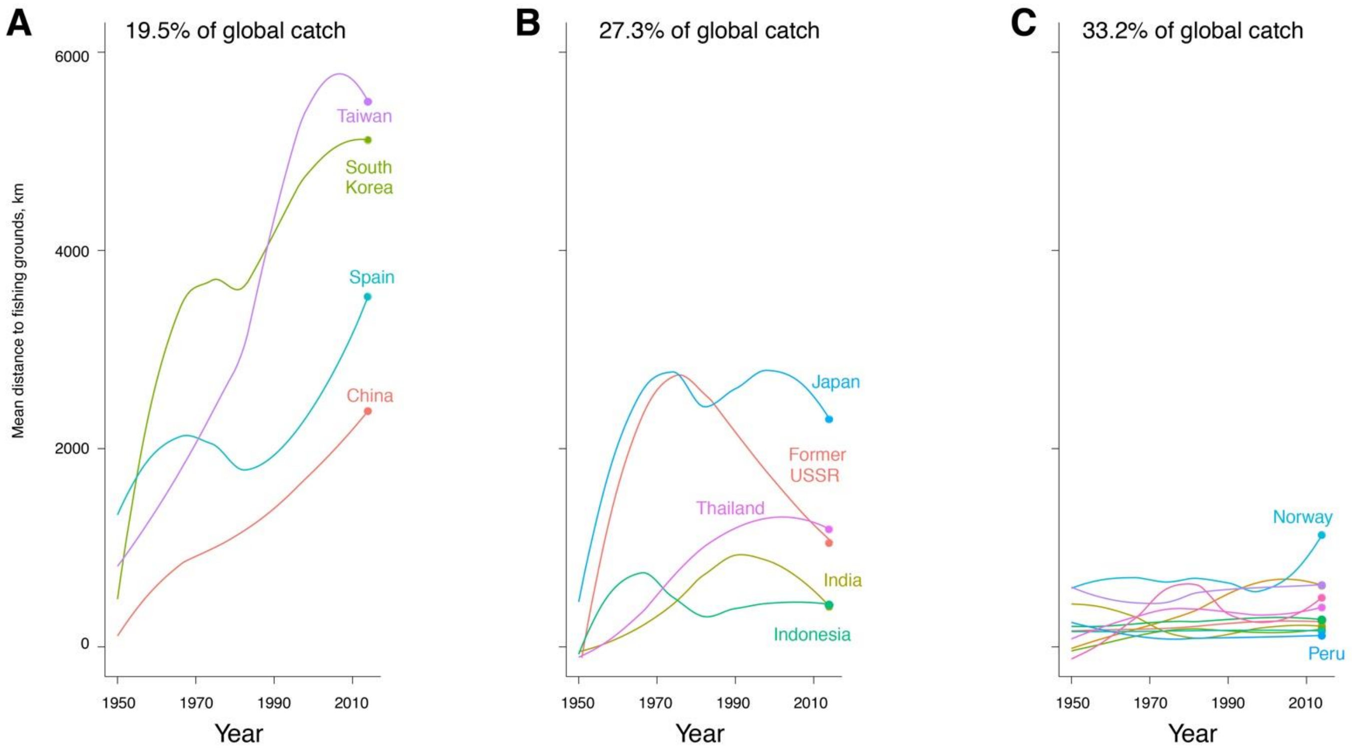


Source: Sala, Enric, J. Mayorga, C. Costello, D. Kroodsma, M.L.D. Palomares, D. Pauly, R. Sumaila, and Dirk Zeller. "The Economics of Fishing the High Seas." *Science Advances* 4, no. 6 (June 2018): eaat2504. https://doi.org/10.1126/sciadv.aat2504

Among the top 20 fishing countries, catches from the high seas and EEZs of other countries increased by more than 600% from 1950 to 2014.

The practice of distant-water fishing, defined as fishing in areas far removed from a country's domestic waters, has been dominated by a small number of countries in recent decades, particularly Taiwan, South Korea, Spain, and China.

Trends in the distance traveled to fish (1950-2014)



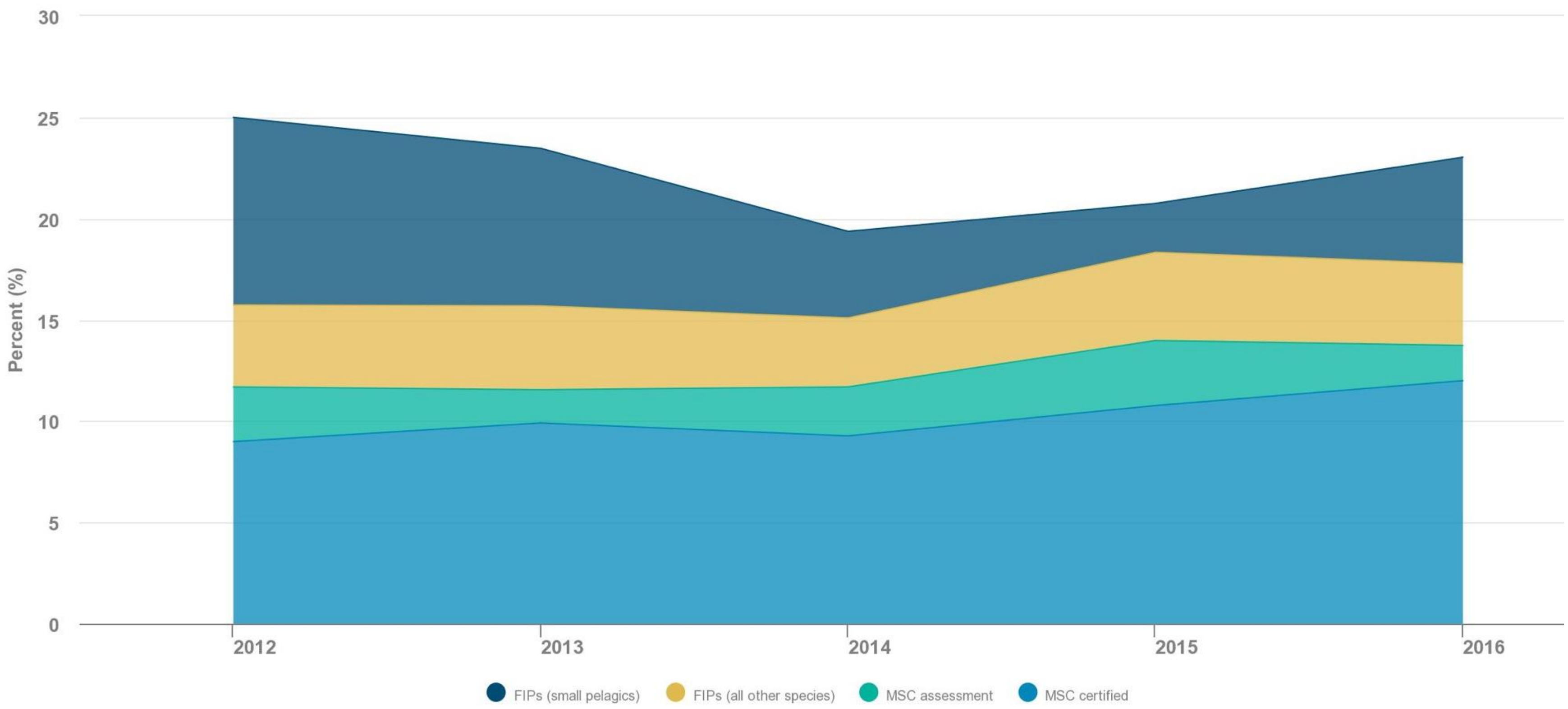
Mean distance to fishing grounds for the world's 20 largest industrial fishing countries (by tonnage) grouped by expansion history: a) rapid and continuous expansion; b) expansion followed by retrenchment; and c) limited expansion.

Source: Tickler, David, Jessica J. Meeuwig, Maria-Lourdes Palomares, Daniel Pauly, and Dirk Zeller. "Far from Home: Distance Patterns of Global Fishing Fleets." *Science Advances* 4, no. 8 (August 2018): eaar3279. https://doi.org/10.1126/sciadv.aar3279.

Between 2012 and 2016, the number of FIPs and MSC-certified fisheries has grown steadily, while the volume of certified landings slightly decreased.

The certified share of global landings dipped from 25% in 2012 to 23% in 2015.

Total landings by percent volume in FIPs and the MSC program (2012-2016)

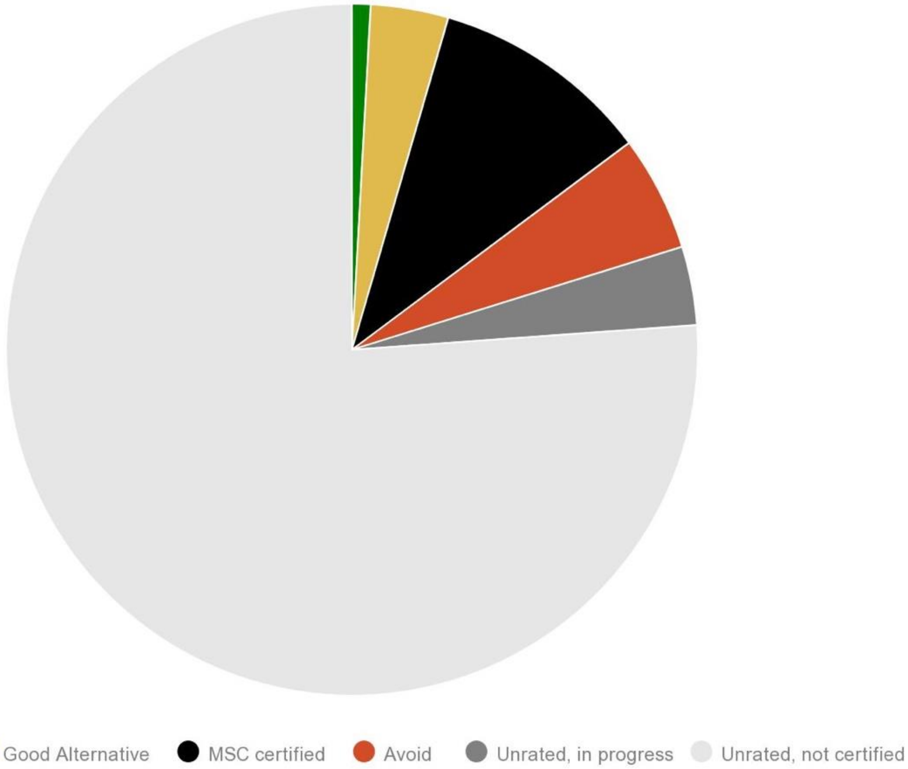


Source: California Environmental Associates, “Progress toward sustainable seafood – by the numbers.” Prepared for the David and Lucile Packard Foundation, 2017.

Among wild capture production in 2016, Seafood Watch rated 1% of production as "Best Choice," 3% as "Good Alternative," and 5% as "Avoid."

The Monterey Bay Aquarium's Seafood Watch ratings and eco-certifications have now been applied to about 20% of the total wild fisheries production.

Seafood Watch Ratings and eco-certification for wild fisheries production (2016)



The underlying production dataset is based on FAO landings, supplemented with NMFS data for U.S. fisheries and RFMO data for tuna fisheries. Production data is based on 2016 landings and includes forage fish/reduction fisheries. Ratings data shown here were last updated April 2019. Where there is overlap between Seafood Watch Ratings and eco-certified production, the volume of ratings was reduced by the amount of overlap to avoid double counting. For wild fisheries, eco-certified is classified as MSC certified, except for fisheries where the Risk Based Framework was used for Principle 1; additional information is available here. Source: Monterey Bay Aquarium Seafood Watch, Seafood Watch Ratings, data provided to CEA on April 16, 2019.

A new modeling analysis suggests that modern slavery is at high- to medium-risk of occurring in countries which account for 70% of global seafood production.

The analysis found that modern slavery in major fish-producing countries is driven primarily by a) national fisheries policy (i.e., a country's management to build and often subsidize distant water fishing fleets), and b) wealth and institutional capacity (i.e., large-scale unreported fishing, limited governance and enforcement capabilities, and low productivity fisheries).

Top 20 fishing countries categorized according to risk of modern slavery in fishing industry

High Risk	Medium Risk	Low Risk
39% of global catch	*31% of global catch*	*12% of global catch*
China	Chile	Iceland
Japan	India	Denmark
Russia	Indonesia	Norway
Spain	Malaysia	United States
South Korea	Mexico	
Taiwan	Morocco	
Thailand	Peru	
	Philippines	
	Vietnam	

Source: Tickler, D, Bryant, K, David, F, Forrest, J A, Gordon, E, Larsen, J J, Meeuwig, J, Oh, B, Pauly, D, Sumaila, U R and Zeller, D. "Common causes, shared solutions: The relationship between modern slavery and the race to fish." [undergoing review for publication].

OUR SHARED SEAS

Aquaculture

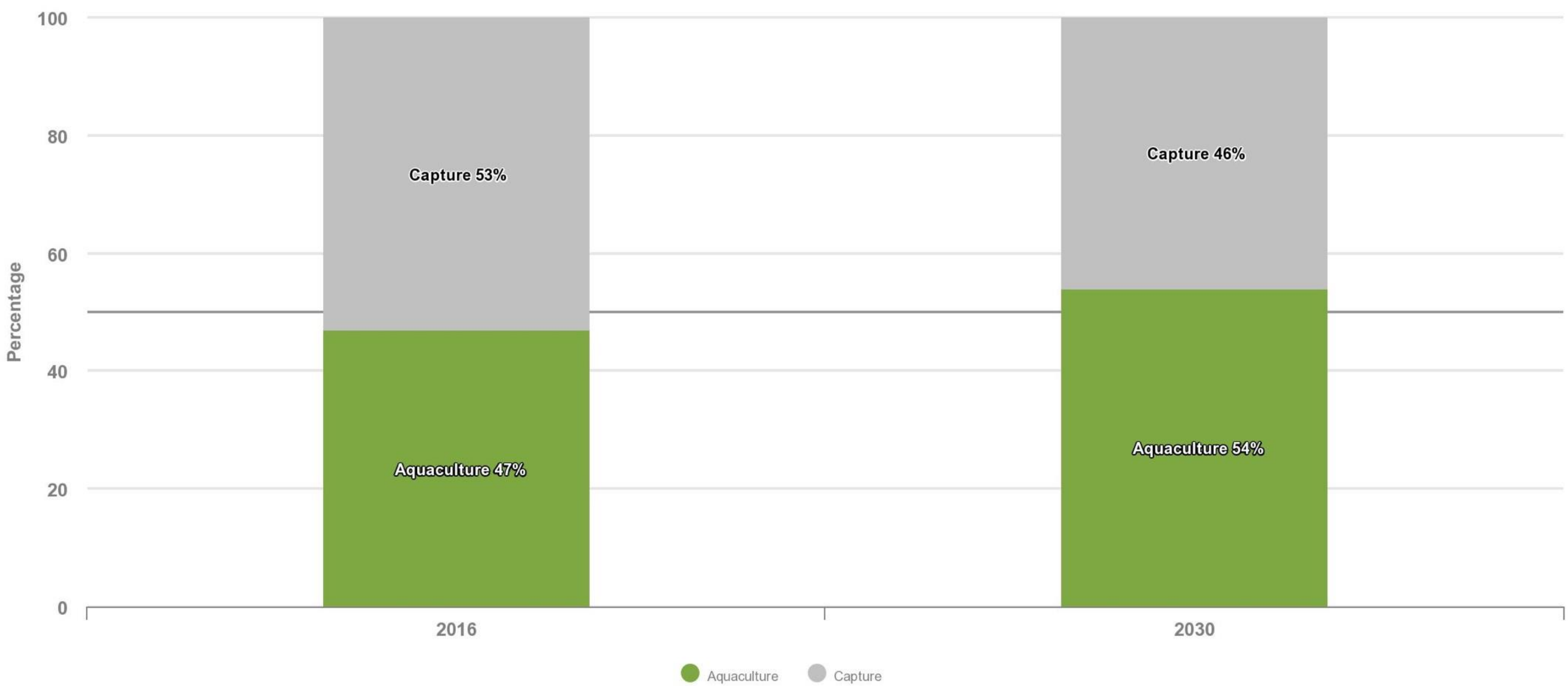
Global ocean data and trends for informed action and decision-making

Prepared by CEA Consulting, with the support of the David and Lucile Packard Foundation

As wild capture landings have plateaued since the mid-1990s, aquaculture has driven continued growth in global seafood production.

In 2016, aquaculture accounted for 47 percent of total landings, an increase from 26 percent in 2000. The sector is expected to account for 54% of seafood production by 2030.

Share of seafood production by source, 2016 (actual) and 2030 (projected)

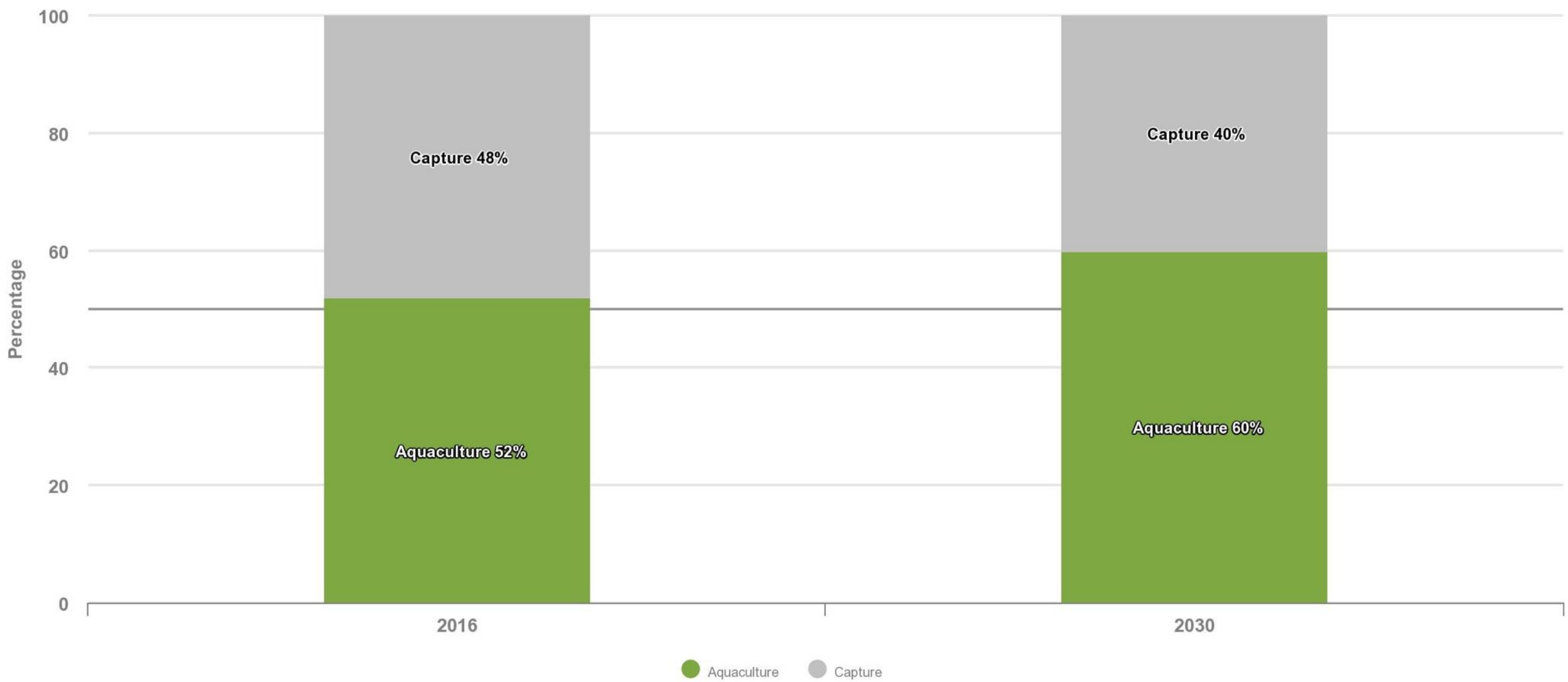


Source: FAO Fisheries and Aquaculture Department, FishStatJ - *Software for Fishery Statistical Time Series*, 2018.

The aquaculture sector reached a milestone in 2014 when, for the first time, it provided more fish for human consumption than capture fisheries contributed.

By 2030, aquaculture is projected to provide 60 percent of fish for human consumption.

Share of food fish for human consumption, by source

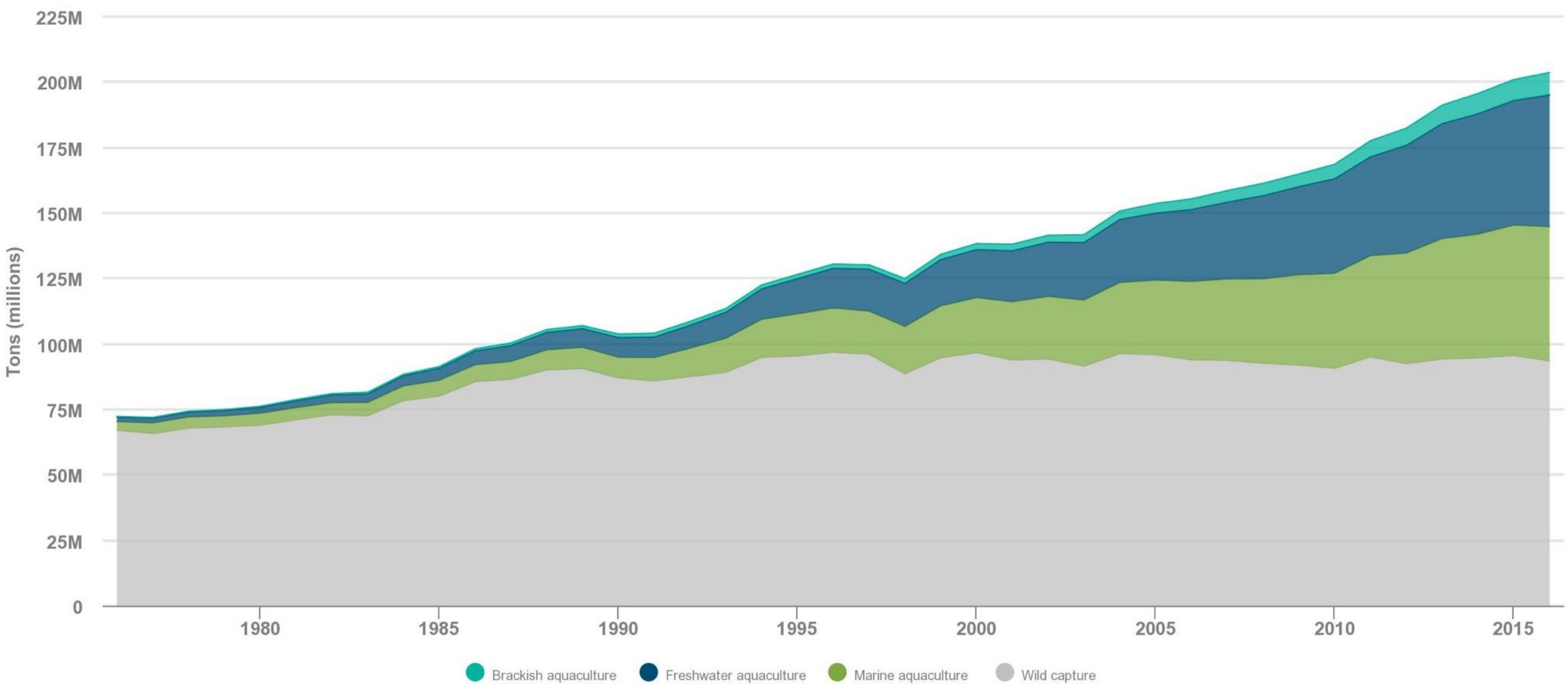


Source: FAO Fisheries and Aquaculture Department, FishStatJ - *Software for Fishery Statistical Time Series*, 2018.

Total aquaculture production in 2016 was 110 million tons, which included 80 million tons of food fish and shellfish, and 30 million tons of aquatic plants.

While aquaculture has continued to grow rapidly, the annual growth rate has tapered from the high rates of the 1980s and 1990s (10.8 and 9.5 percent, respectively). During the period 2001 to 2016, global aquaculture's annual growth rate was 5.8 percent.

Global aquaculture production as compared to wild capture production

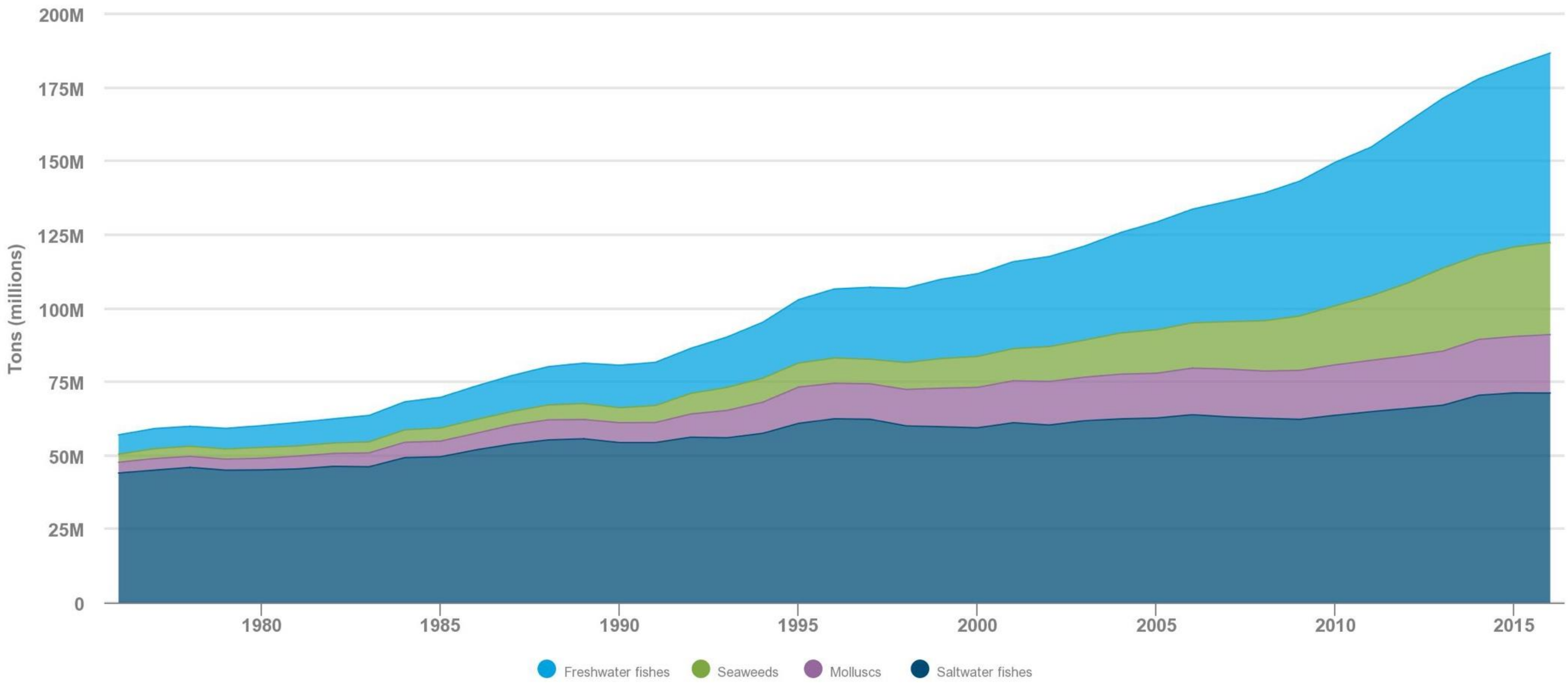


Source: FAO Fisheries and Aquaculture Department, FishStatJ - *Software for Fishery Statistical Time Series*, 2018.

By species group, freshwater fishes (particularly carp) accounted for 48 percent of aquaculture production in 2016.

Seaweed represented 27 percent of production, and molluscs another 15 percent. Saltwater fishes accounted for just 9 percent of global production.

Aquaculture production by species group

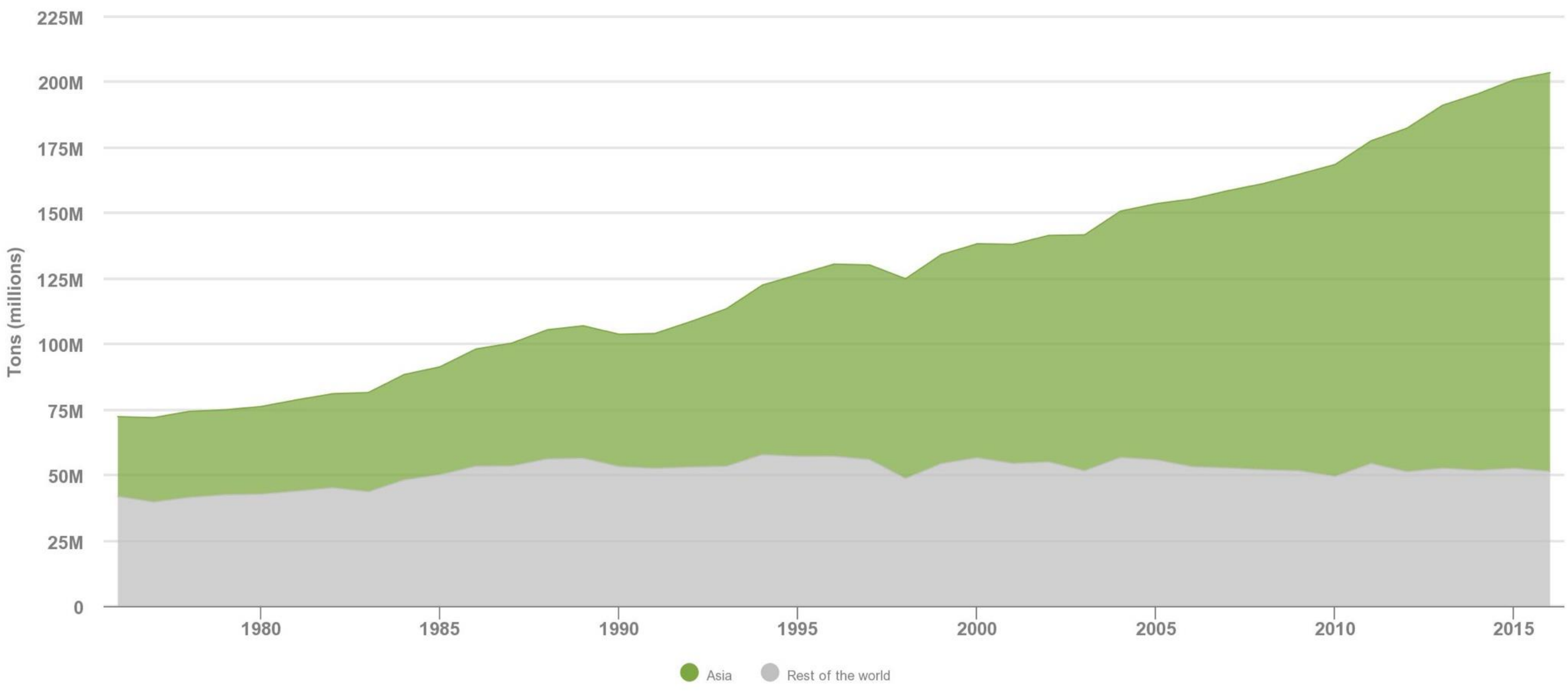


Source: FAO Fisheries and Aquaculture Department, FishStatJ - *Software for Fishery Statistical Time Series*, 2018.

Steady growth in Asia has continued to spur the continued expansion of the sector. The bulk of growth has come from China, Southeast Asia, and South Asia.

Since 1991, China has produced more farmed food fish annually than the rest of the world combined.

Aquaculture production in Asia compared to the rest of the world

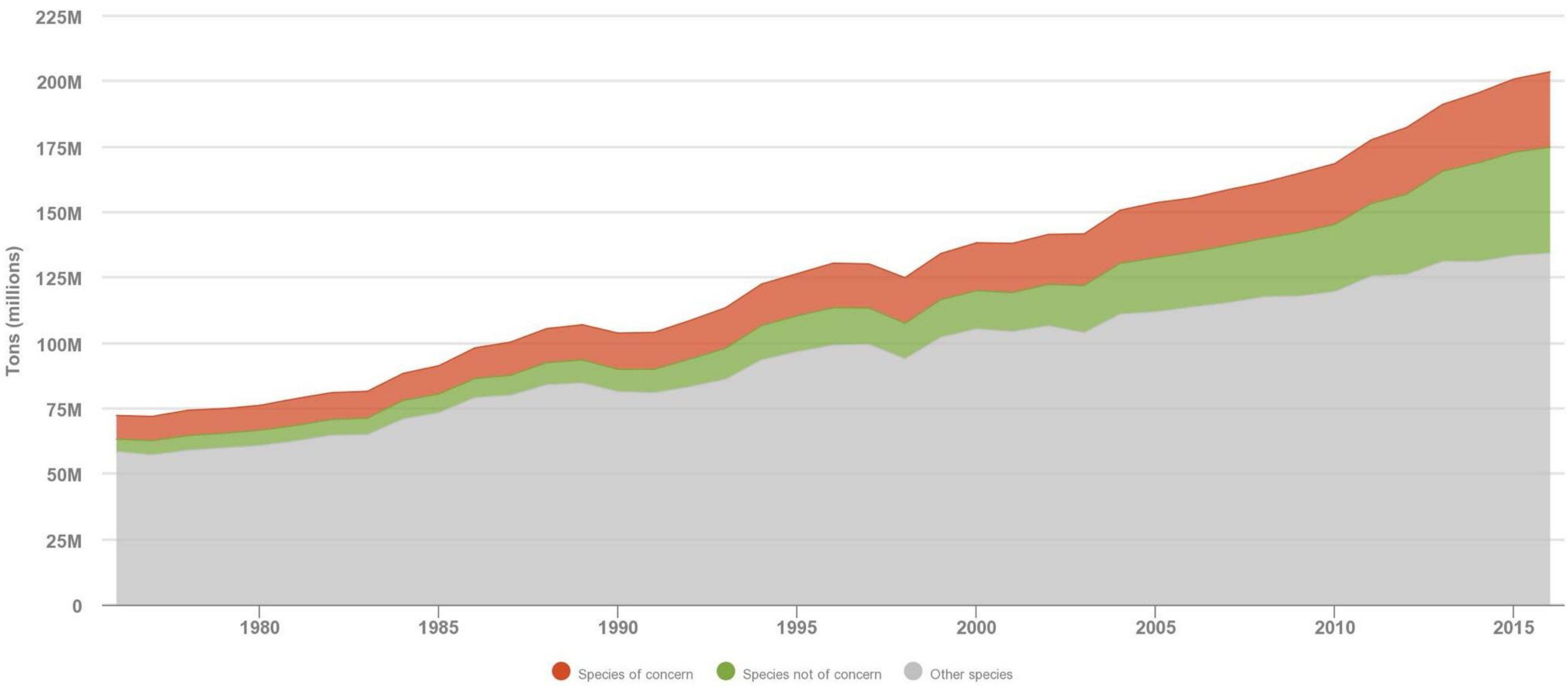


Source: FAO Fisheries and Aquaculture Department, FishStatJ - *Software for Fishery Statistical Time Series*, 2018.

Certain farmed species pose a greater threat in terms of dependency on feed inputs, freshwater use, disease introduction, biodiversity impacts, and other concerns.

These concerns are most concentrated in the production of marine finfish, diadromous fish (e.g., salmon, eel), and crustaceans such as shrimp. These species of concern made up approximately 13 percent of global aquaculture production in 2016.[7] This ratio has followed a slight upward trajectory in recent years, up from 11 percent of total production in 2000.

Aquaculture production by species of concern



Note: Species included on the list of aquaculture species of concern is based on expert judgement by California Environmental Associates. (List provided on following slide.)

Source: FAO Fisheries and Aquaculture Department, FishStatJ - *Software for Fishery Statistical Time Series*, 2018.

Aquaculture species of concern list

Aquaculture Species of Concern

•Amberjacks
•Atlantic salmon
•Ayu sweetfish
•Banana prawn
•Barramundi (Giant seaperch)
•Bastard halibut
•Chinese mitten crab
•Chinook salmon (Spring salmon, King salmon)
•Clearhead icefish
•Cobia
•Coho salmon (Silver salmon)
•Fleshy prawn
•Freshwater prawns, shrimps*
•Giant river prawn
•Giant tiger prawn
•Groupers*
•Indo-Pacific swamp crab
•JaJacks, crevalles*
•panese amberjack
•Japanese eel
•Japanese jack mackerel
•Japanese seabass
•Kuruma prawn
•Large yellow croaker
•Lefteye flounders*
•Longfin yellowtail
•Marine crabs*
•Marine Fishes*
•Metapenaeus shrimps*
•Milkfish
•Mullets*
•Obscure pufferfish
•Oriental river prawn
•Pacific bluefin tuna
•Penaeus shrimps*
•Pond smelt
•Porgies, seabreams*
•Portunus swimcrabs*
•Rainbow trout
•Red drum
•Righteye flounders*
•River eels*
•River prawns*
•Salmonoids*
•Silver seabream
•Snubnose pompano
•Sturgeons*
•Tiger pufferfish
•Tropical spiny lobsters*
•Trouts*
•Turbot
•White trevally
•Whiteleg shrimp
•Yellowfin tuna*

Aquaculture Species Groups Not of Concern

*•Brown seaweeds
•Red seaweeds
•Green seaweeds
•Mussels
•Pearls, mother-of-pearl, shells
•Sea-squirts and other tunicates
•Scallops, pectens
•Oysters
* not elsewhere identified*

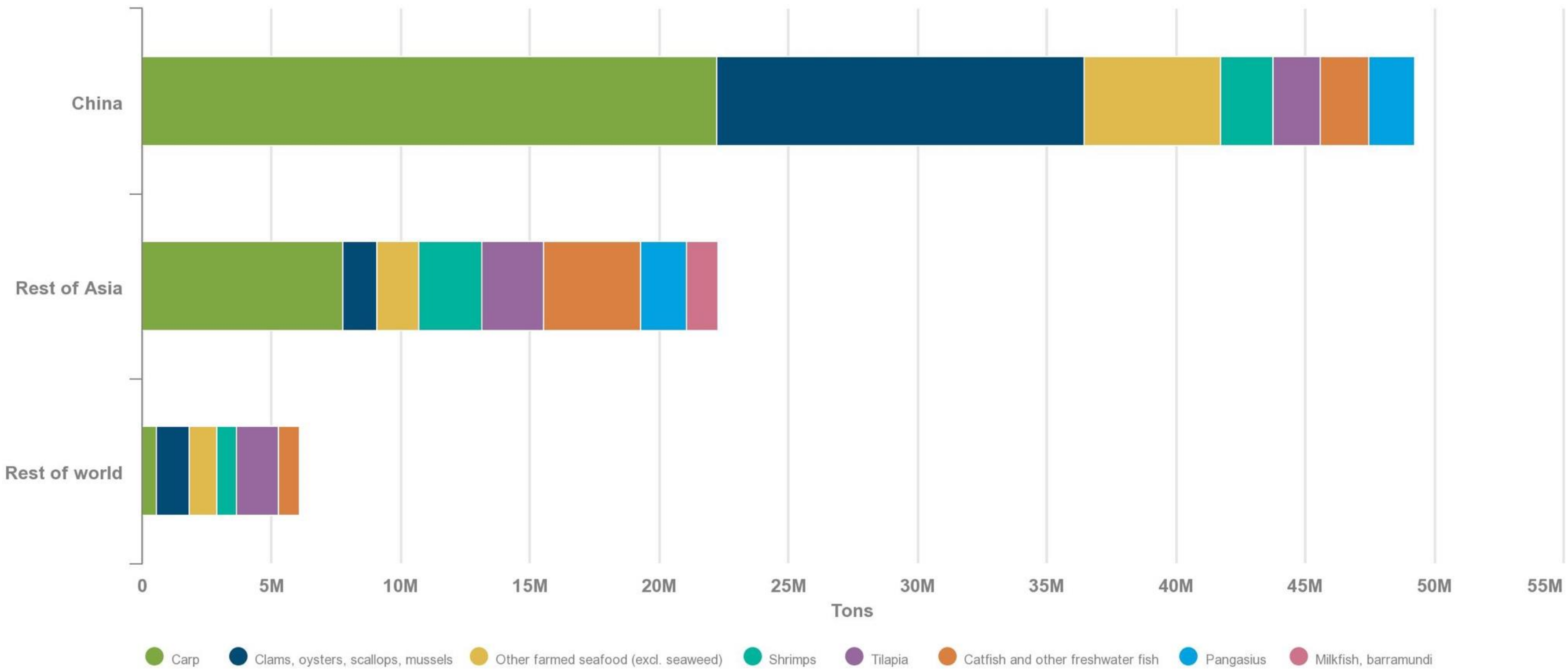
Note: Species included on the list of aquaculture species of concern is based on expert judgement by California Environmental Associates.

Source: FAO Fisheries and Aquaculture Department, FishStatJ - *Software for Fishery Statistical Time Series*, 2018.

From a trade perspective, shrimp, tilapia, salmon, and pangasius are the most internationally traded aquaculture species.

The share of aquaculture exported to Western markets is relatively small, as many countries (particularly China) retain a large share of aquaculture products for internal consumption. The portion of aquaculture which is traded to international markets tends to consist of high-value species.

Global aquaculture production, by geography and top species of production



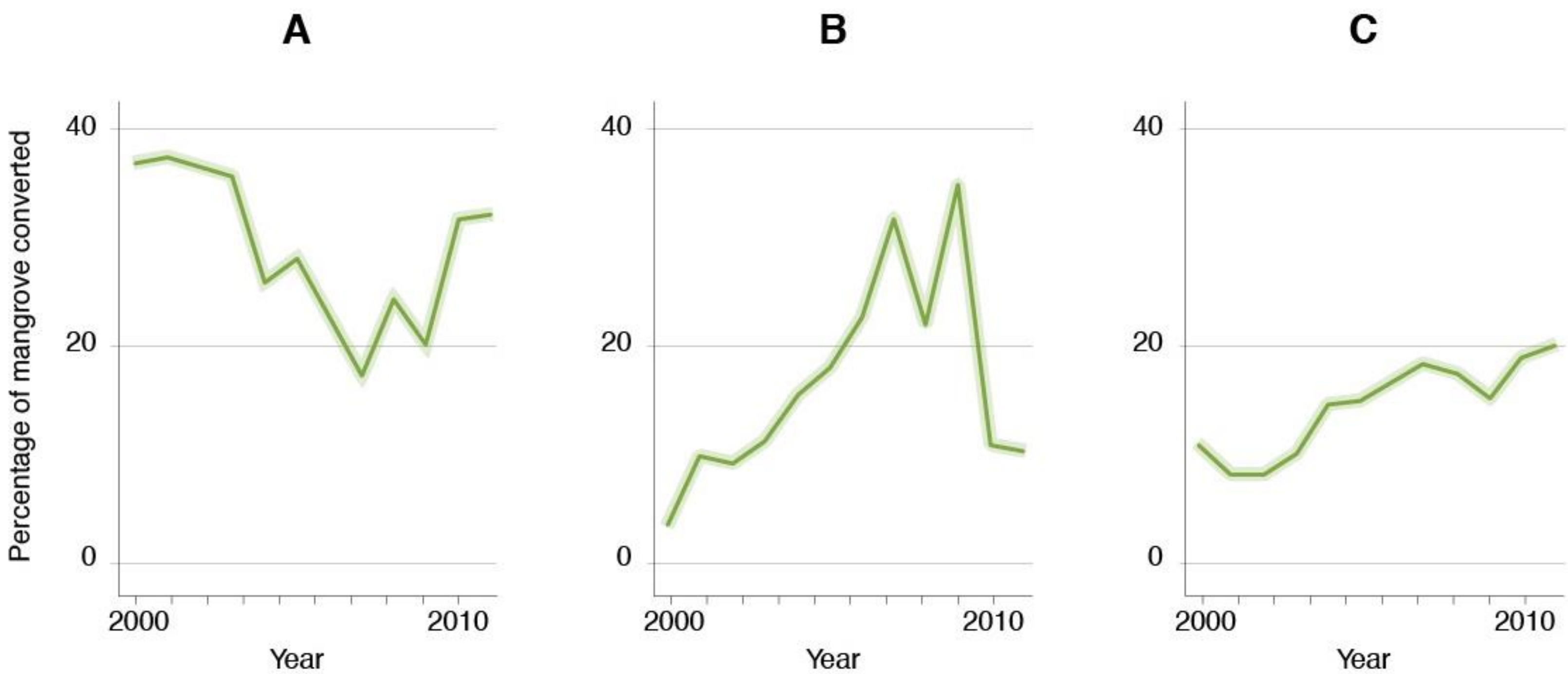
Note: China does not include Taiwan.

Source: FAO Fisheries and Aquaculture Department, FishStatJ - *Software for Fishery Statistical Time Series*, 2016; Trade Map, International Trade Center, https://www.trademap.org

While the rapid growth of aquaculture has contributed to income generation and food security, it has also led to several discrete environmental impacts.

During the rapid expansion period of tropical coastal aquaculture between 1980 to 1990, aquaculture accounted for roughly 54 percent of all mangrove deforestation in Southeast Asia.[9] A recent analysis found that the conversion of mangrove habitat to fish or shrimp ponds has followed a decreasing trendline: between 2000 and 2012, aquaculture accounted for about 30 percent of mangrove conversion in Southeast Asia.

Temporal trends in the conversion of mangrove habitats to aquaculture in SE Asia (2000-2012)



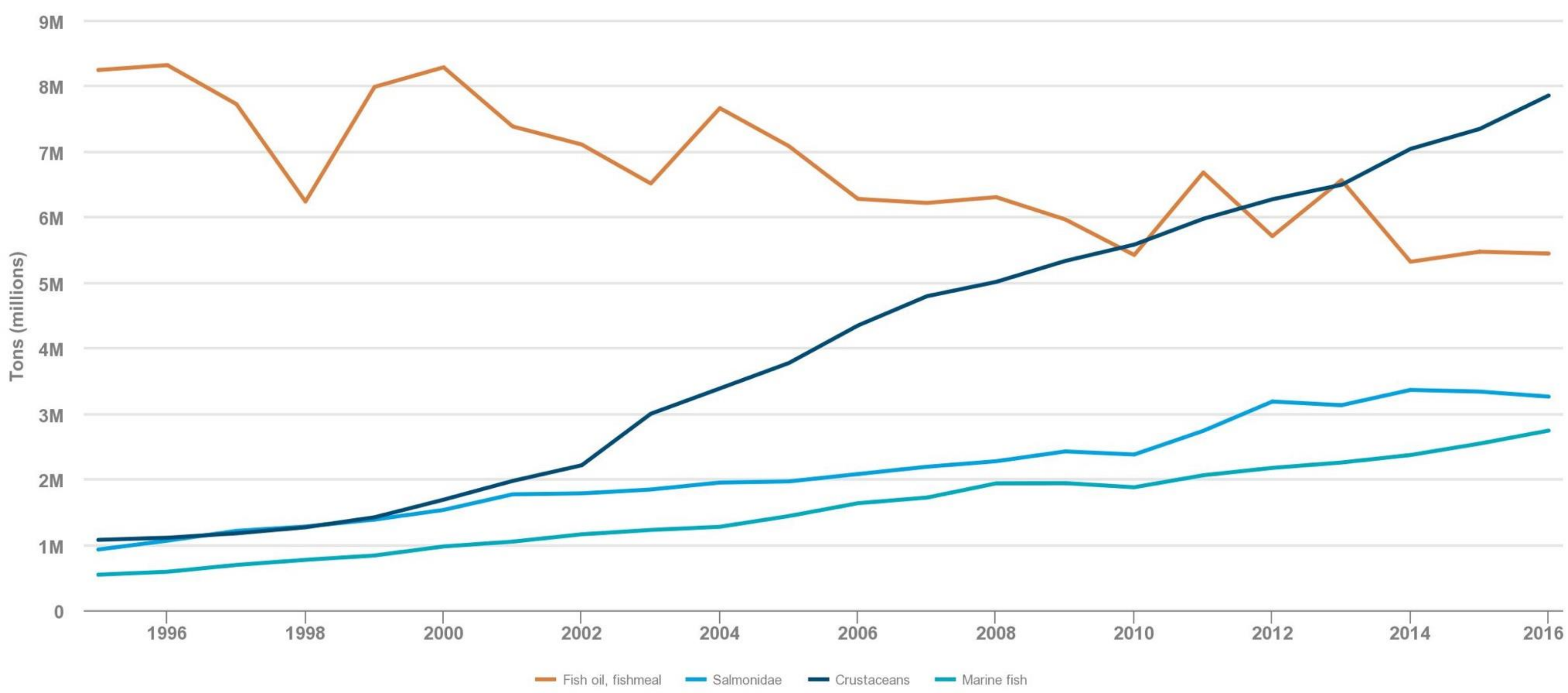
Temporal trends in the conversion of mangrove habitats to aquaculture (A), rice agriculture (B), and oil palm plantation (C), between 2000 and 2012. Dark green lines indicate error-corrected estimates of the proportional coverage of each land use. Light green shading indicates the standard error of the areal estimates.

Adapted from: Richards, Daniel R., and Daniel A. Friess. "Rates and Drivers of Mangrove Deforestation in Southeast Asia, 2000–2012." *Proceedings of the National Academy of Sciences* 113, no. 2 (January 12, 2016): 344–49. https://doi.org/10.1073/pnas.1510272113.

Another environmental concern unique to aquaculture is the sector's heavy dependence on wild fisheries for fishmeal and fish oil.

There is not definitive evidence indicating whether aquaculture is driving pressure on wild fisheries. However, inclusion rates of fishmeal and fish oil in aquafeeds have been declining steadily over the last few decades. In 2016, wild capture landings directed to fishmeal production had decreased to less than 15 million tons (from 30 million tons in 1994).

Total global production of fishmeal and main meal consuming species

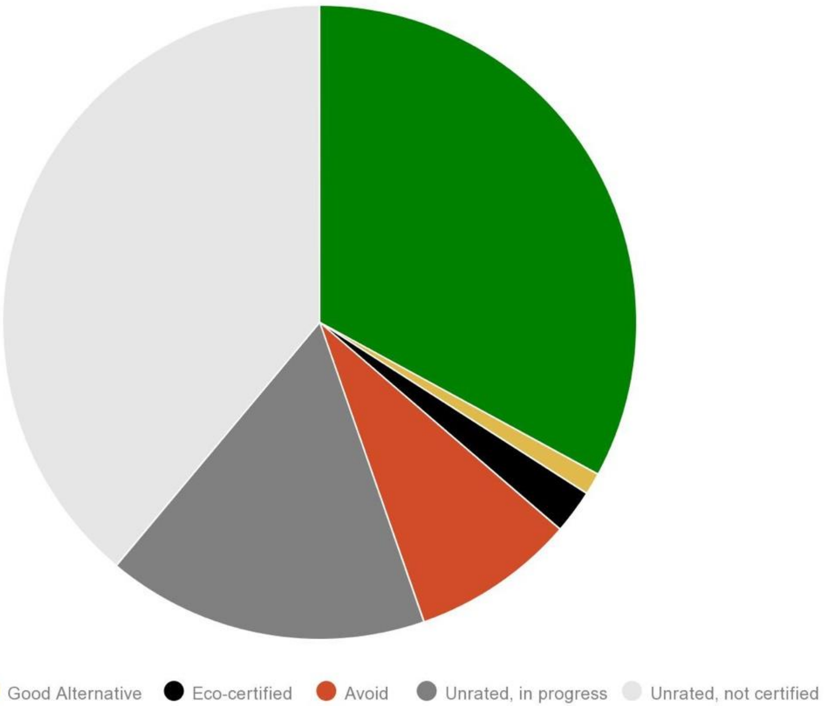


Source: FAO Fisheries and Aquaculture Department, FishStatJ - *Software for Fishery Statistical Time Series*, 2018

Among aquaculture production in 2016, Seafood Watch rated 33% of production as "Best Choice," 1% as "Good Alternative," and 8% as "Avoid."

The Monterey Bay Aquarium's Seafood Watch ratings and eco-certifications have now been applied to about 45% of total aquaculture production.

Seafood Watch Ratings and eco-certification for aquaculture production (2016)



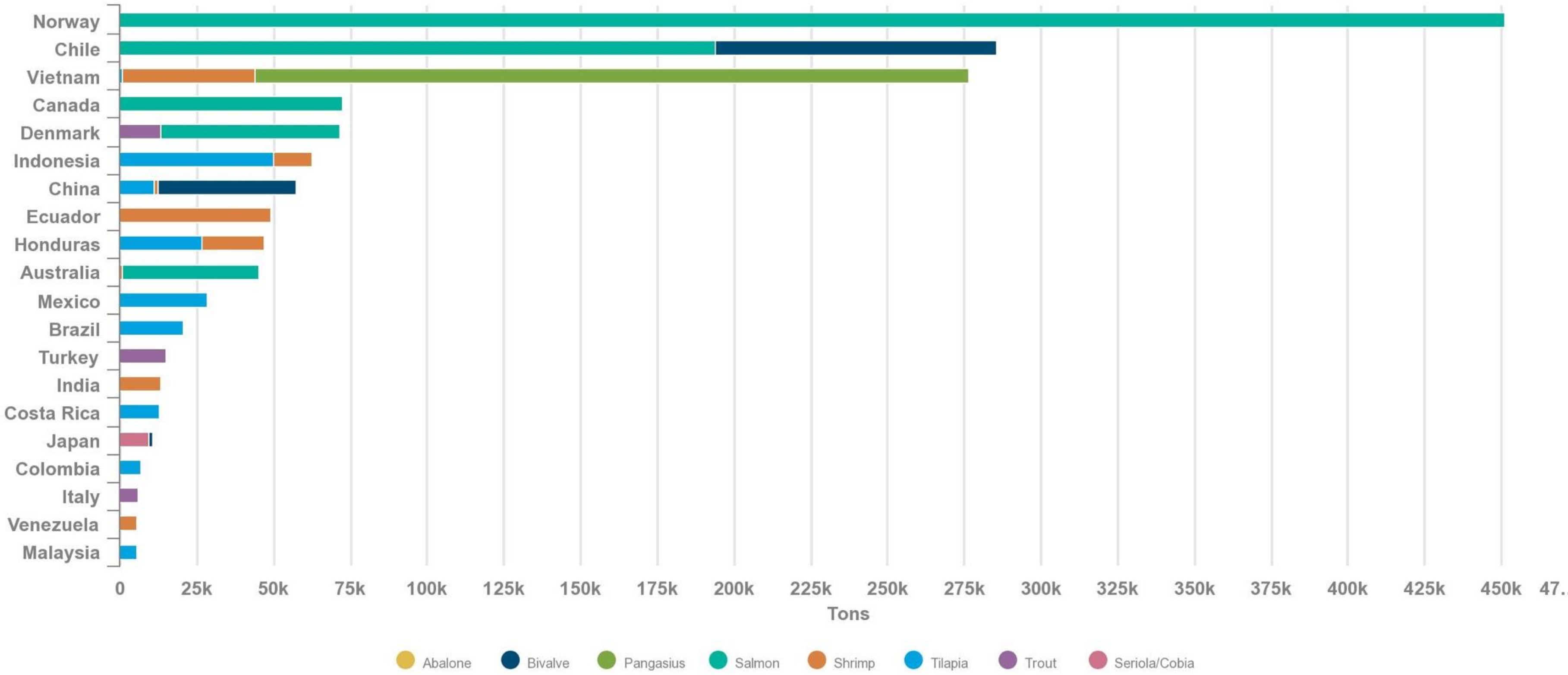
The underlying production dataset is based on FAO aquaculture landings for 2016; seaweeds are included. Ratings data shown here were last updated April 2019. Eco-certified is classified based on a Standard from Seafood Watch Ratings; additional information is available here. Seafood Watch recognizes some, but not all, ASC and GAA standards. Additional standards which are recognized include Naturland, Candian Organic, and Friends of the Sea.

Source: Monterey Bay Aquarium Seafood Watch, Seafood Watch Ratings, data provided to CEA on April 16, 2019.

Between 2014 and 2017, Aquaculture Stewardship Council (ASC) certifications quadrupled. Total certified product accounts for ~5% of total aquaculture production.

The three countries that account for the highest certified ASC volume are Norway (primarily salmon), Vietnam (primarily pangasius), and Chile (a combination of salmon and molluscs).

Certified volume by Aquaculture Stewardship Council (top 20 countries)



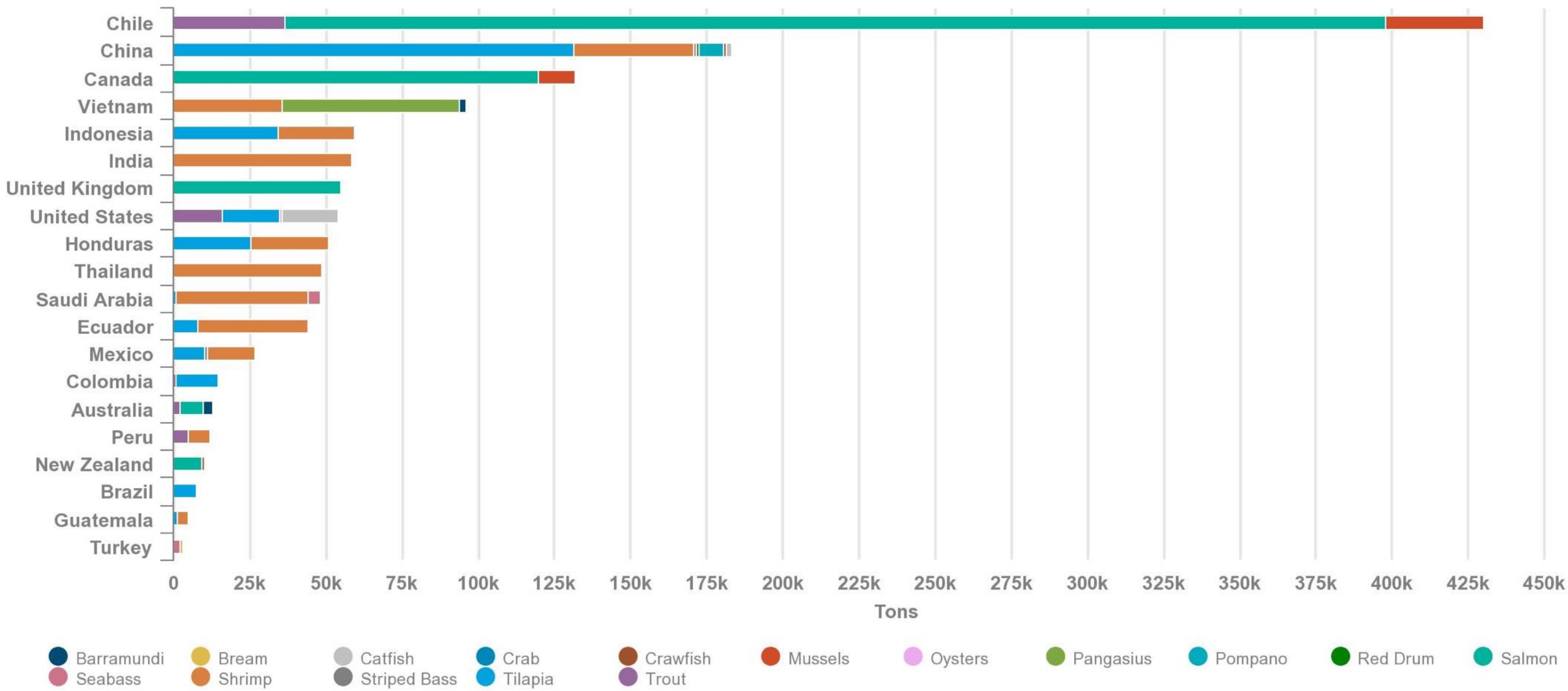
Note: China does not include Taiwan.

Source: Aquaculture Stewardship Council, personal communication, December 20, 2018.

Between 2014 and 2017, Global Aquaculture Alliance (GAA) certifications doubled. Total certified product accounts for ~5% of total aquaculture production

The three countries with the highest representation of certified volume by GAA are Chile (primarily salmon), Canada (mainly salmon), and China (principally tilapia).

Certified volume by Global Aquaculture Alliance (top 20 countries)



Note: China does not include Taiwan.

Source: Global Aquaculture Alliance, personal communication, December 20, 2018.

OUR SHARED SEAS

Seafood Trade

Global ocean data and trends for informed action and decision-making

Prepared by CEA Consulting, with the support of the David and Lucile Packard Foundation

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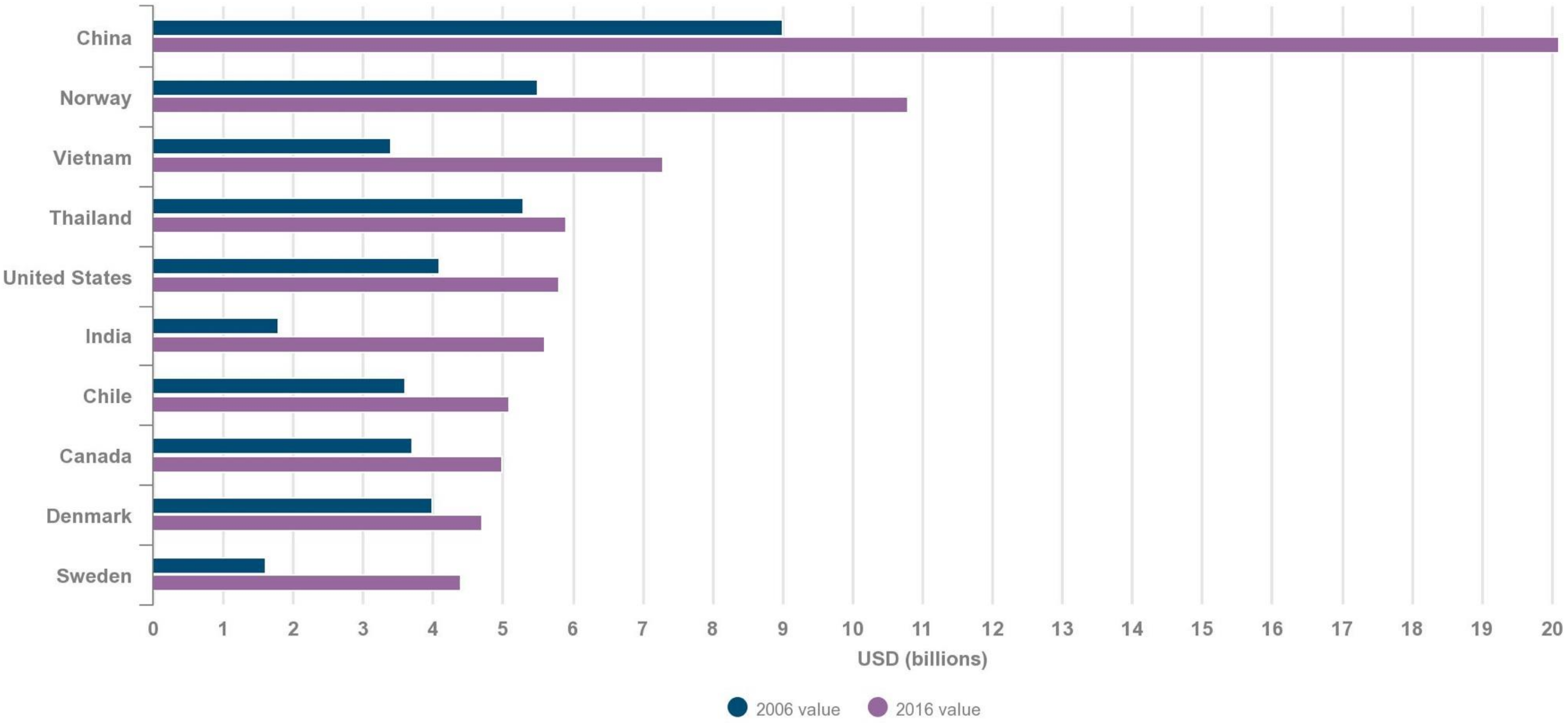
Seafood accounts for roughly 10 percent of the traded value of global agricultural products.

China has been the largest exporter of seafood since 2002. Other leading seafood exporters include Norway (primarily salmonid aquaculture as well as wild cod, herring, mackerel, and various whitefish and small pelagics) and Vietnam (driven by farmed catfish, shrimp, and trade of processed and re-exported products).

Top ten exporters of fish and fish products, by value (2006 vs. 2016)

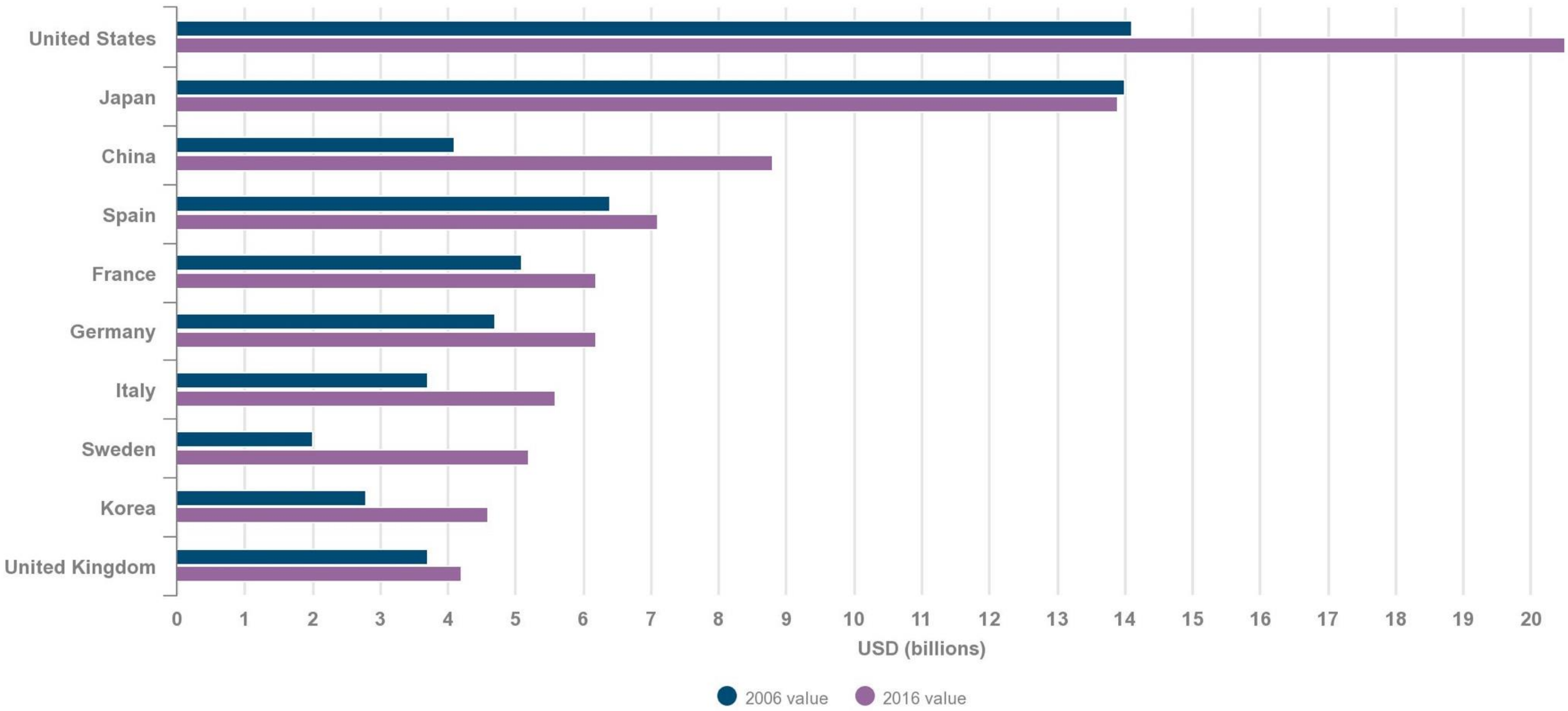


Sources: FAO, ed., *The State of World Fisheries and Aquaculture 2018*, Rome, 2018; Chatham House, 'resourcetrade.earth,' 2018. Accessed November 5, 2018. http://resourcetrade.earth.

The United States, Japan, and the European Union collectively accounted for 64 percent of the total value of seafood imports in 2016.

While China is the largest seafood importer by volume, it is the third largest importer by value, partly due to its practice of importing raw material, processing it, and exporting value-added products.

Top ten exporters of fish and fish products, by value (2006 vs. 2016)

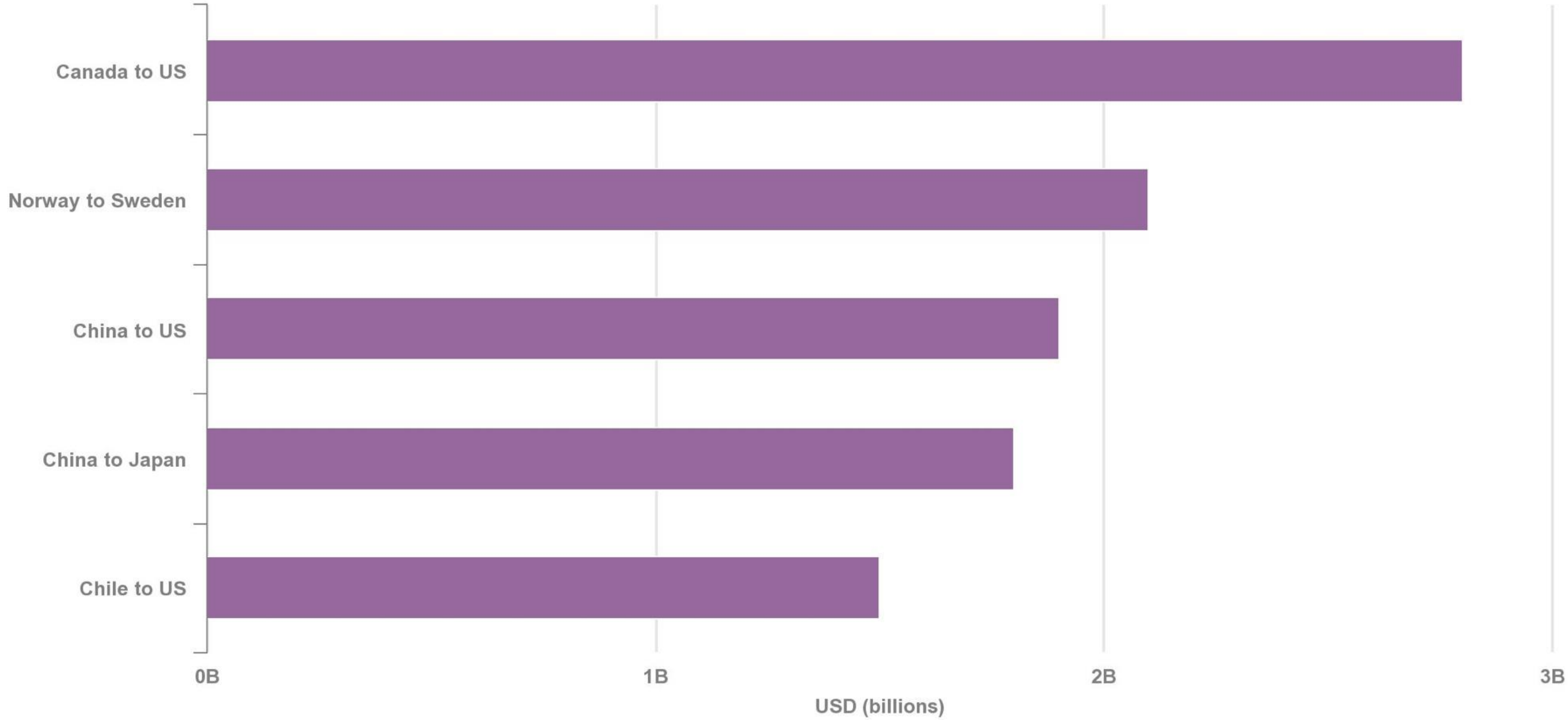


Sources: FAO, ed., *The State of World Fisheries and Aquaculture 2018*, Rome, 2018;

An important trend in global seafood trade has been the faster growth rate in exports from developing countries, as compared to developed countries in recent decades.

In 2016, exports from developing countries accounted for roughly 54 percent of the value and 59% of the volume of global seafood exports.

Top five seafood trade flows, by value (2016)

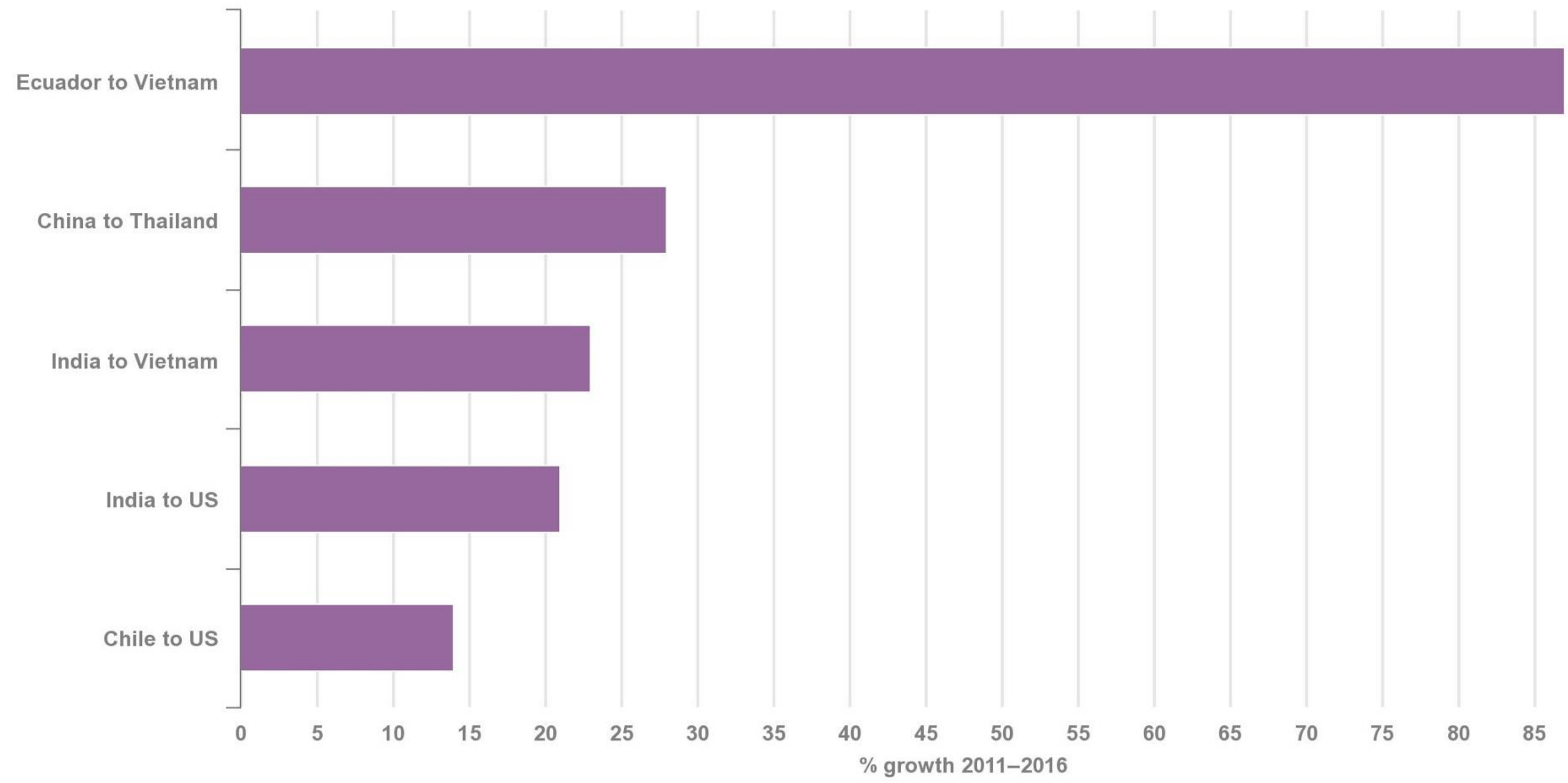


Sources: FAO, ed., *The State of World Fisheries and Aquaculture 2018*, Rome, 2018;

There are a variety of trends driving seafood trade among the fastest growing trade flows.

Farmed shrimp exported to Vietnam for processing is driving the flow between Ecuador and Vietnam. The flow between China and Thailand is driven by tuna exported to Thailand for processing. Trade from India to both Vietnam and the United States is primarily based on increased production of farmed shrimp in India.

Growth rate of fastest growing seafood trade flows (2011-2016)



Sources: FAO, ed., *The State of World Fisheries and Aquaculture 2018*, Rome, 2018;

OUR
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Pollution and Development

Global ocean data and trends for informed action and decision-making

Prepared by CEA Consulting, with the support of the David and Lucile Packard Foundation

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No area of the ocean is completely untouched by human impact.

The marine environment faces a broad range of human stressors from physical alterations (i.e., coastal habitat loss and changes in freshwater inputs), chemical alterations (i.e., eutrophication, plastic debris, and toxic contaminants) and direct effects on wildlife (i.e., invasive species, vessel strikes, and noise pollution). An attempt to rank ecosystem-level threats from human stressors emphasized the suite of threats associated with climate change, commercial fishing, coastal habitat destruction, and pollution.

Top ten exporters of fish and fish products, by value (2006 vs. 2016)

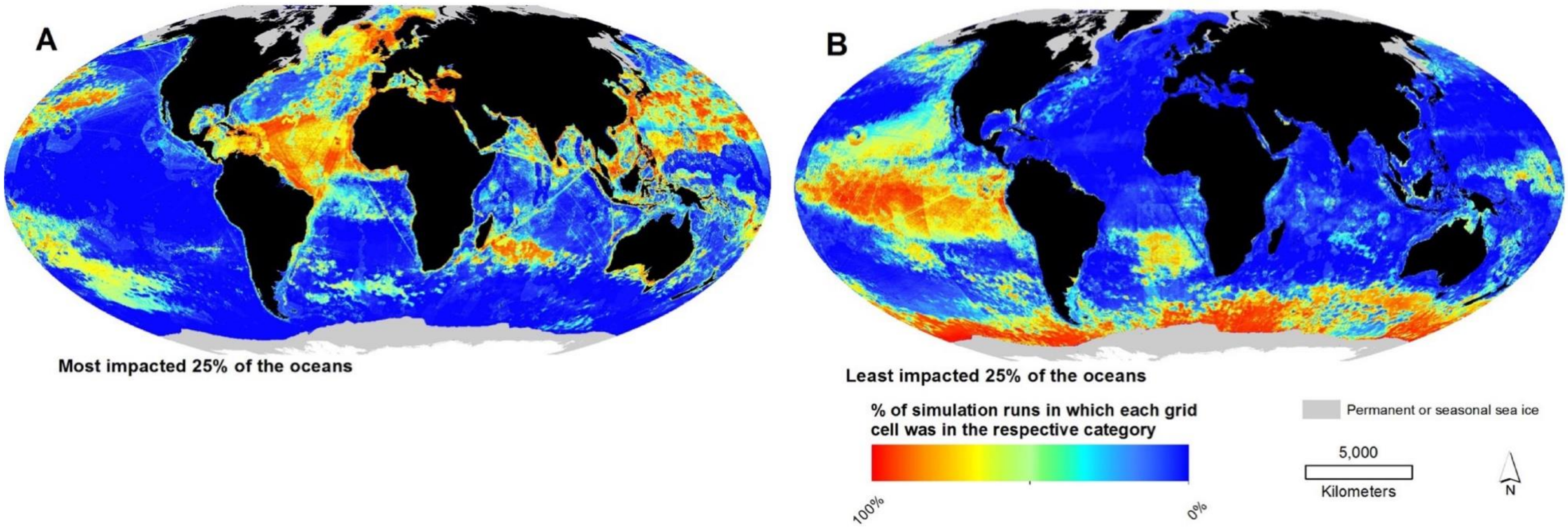
1.	Increasing sea temperature	11.	Nutrient input
2.	Demersal, destructive fishing	12.	Demersal, non-destructive fishing
3.	Organic, point-source pollution	13.	Acidification
4.	Hypoxia	14.	Species invasion
5.	Increasing sediment	15.	Nonorganic, point-source pollution
6.	Coastal development	16.	Recreational fishing
7.	Direct human disturbance	17.	Nutrient input, oligotrophic waters
8.	Organic, non-point source pollution	18.	Harmful algal blooms
9.	Coastal engineering	19.	Nonorganic, nonpoint-source pollution
10.	Sea-level rise	20.	Aquaculture

Source: Crain, C., B.S. Halpern, M.W. Beck, and C.V. Kappel. "Understanding and Managing Human Threats to the Coastal Marine Environment." The Year in Ecology and Conservation Biology 1162 (2009): 39–62.

A recent study identified hotspots of high and low human impact in the ocean.

Hotspots with consistently high human impacts include the Northeast Atlantic, the eastern Mediterranean, the Caribbean, the continental shelf off northern West Africa, offshore parts of the tropical Atlantic, the Indian Ocean east of Madagascar, parts of East and Southeast Asia, parts of the northwestern Pacific, and many coastal waters. Areas with consistently low human impacts were limited to a small number of remote places: the waters off Antarctica, the central Pacific, and in the southern Atlantic.

A) The most impacted 25% of the ocean and B) the least impacted 25% of the ocean

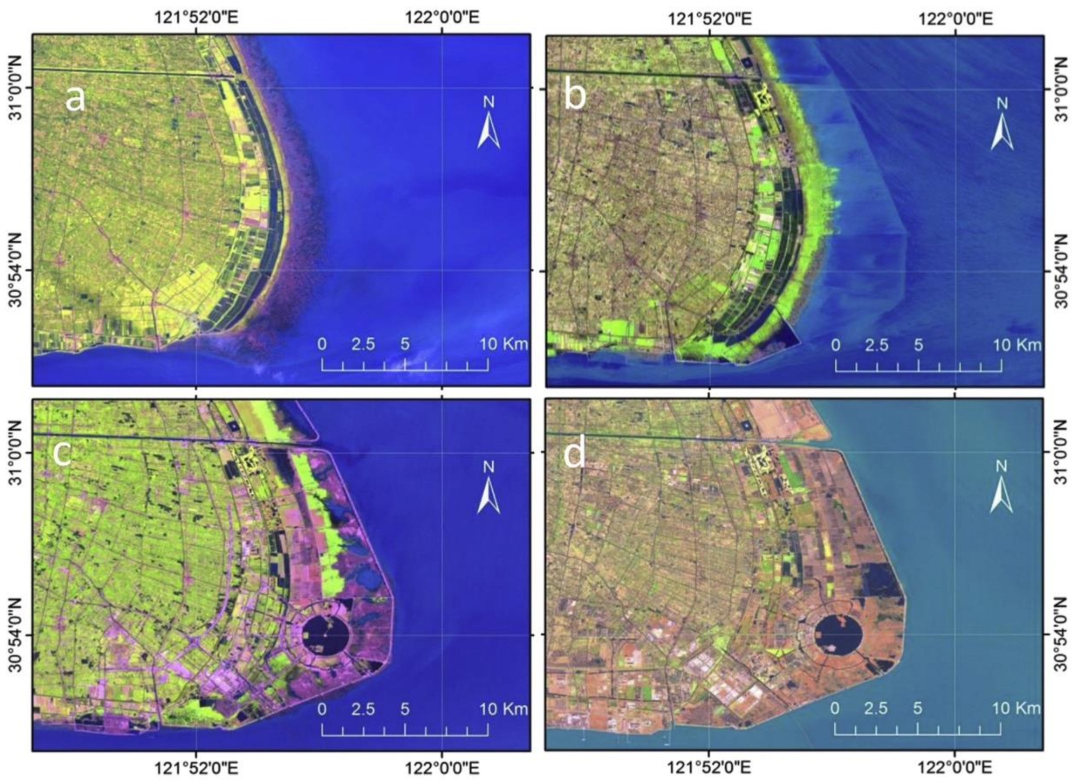


Stock, Andy, Crowder, L.B., Halpern, B.S., Micheli, F. "Uncertainty analysis and robust areas of high and low modeled human impact on the global oceans." *Conservation Biology* 32 (2018): 1368-1379. https://doi.org/10.1111/cobi.13141.

Human pressure on the marine environment is most acute along the world's coastlines.

From draining wetlands and clearing mangrove habitat, to filling in estuaries and hardening shorelines, the conversion of coastal ecosystems has made them one of the most modified and threatened ecosystems globally. In major coastal cities such as Hong Kong, Sydney, and New York, more than half of the shoreline is hardened. In coastal China, the trend of shoreline hardening increased sharply in the early 2000's, in close correlation with rising GDP per capita in the country.

Satellite imagery of coastal reclamation in Nahui shore near Shanghai, China

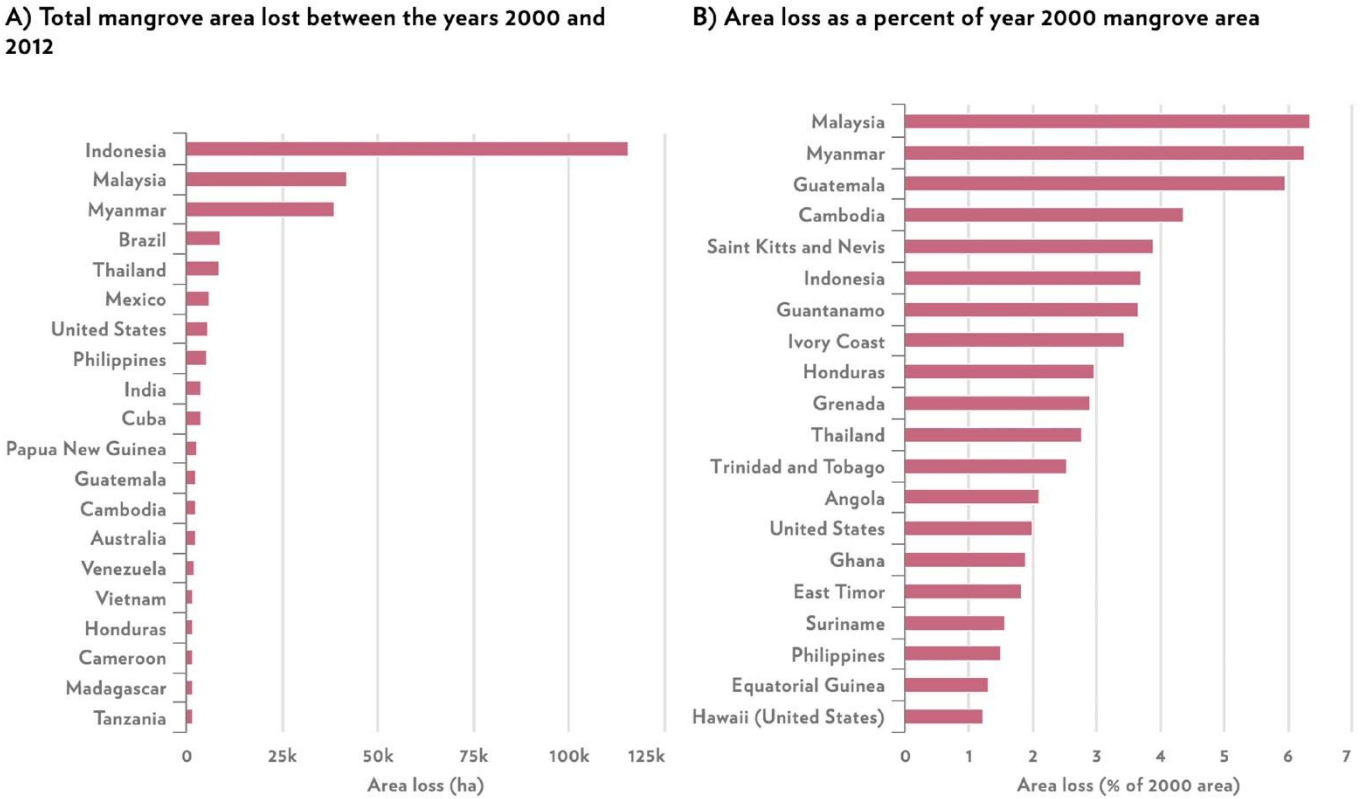


Source: Tian, B., W. Wu, Z. Yang, and Y. Zhou. "Drivers, Trends, and Potential Impacts of Long-term Coastal Reclamation in China from 1985 to 2010." Estuarine, Coastal, and Shelf Science 170 (2016): 83–90.

The expanding footprint of human development in the coastal zone has been evident in the loss of mangrove forests worldwide.

At least 35 percent of mangrove area was lost globally during the 1980s and 1990s alone. The rate of global mangrove deforestation has since declined significantly. While the rate of deforestation has stabilized or declined in many countries, Southeast Asia remains the epicenter of mangrove loss, with deforestation rates between 3.6 to 8.1 percent.

Mangrove area lost by top 20 countries (2000-2012)



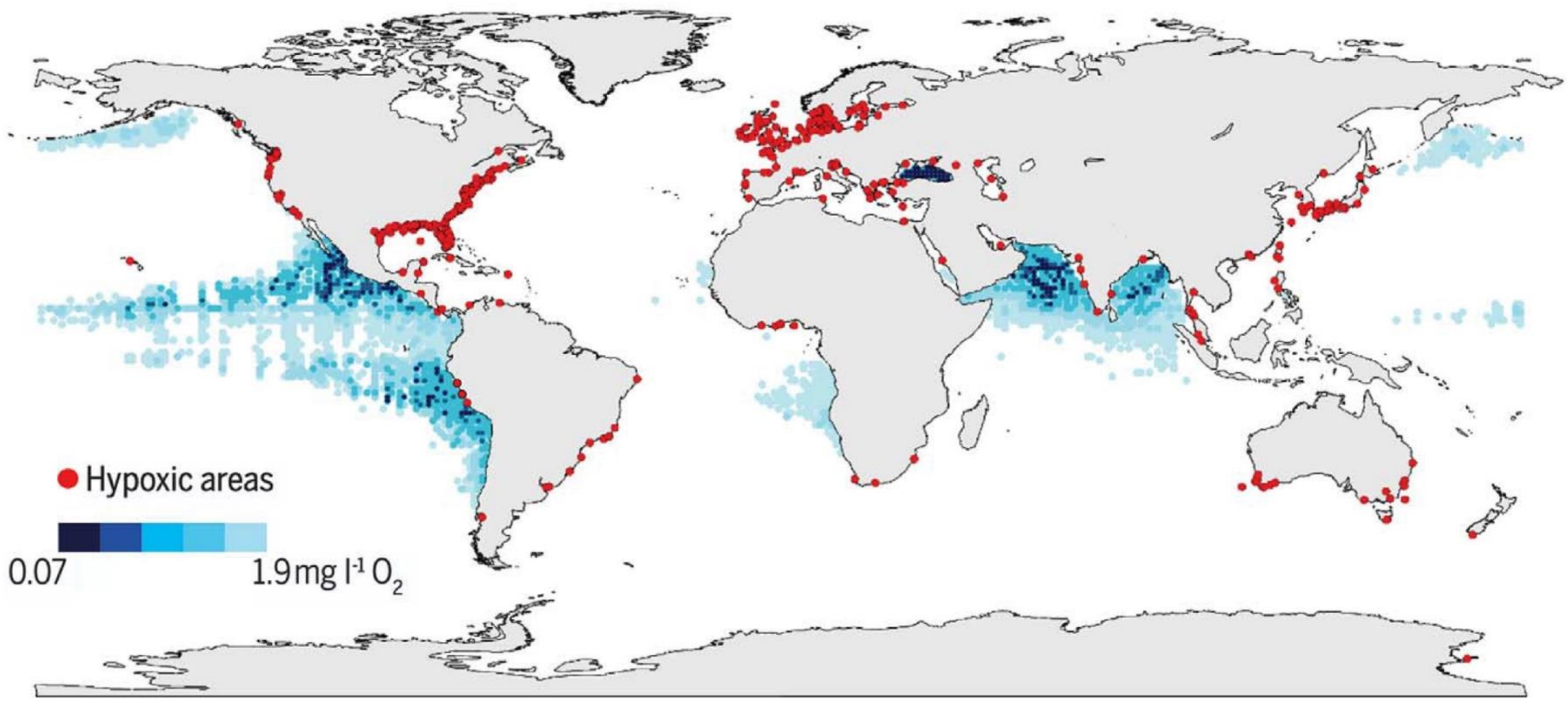
Top 20 nation rankings for (a) total mangrove area lost between the years 2000 and 2012, (b) area loss as a percent of year 2000 mangrove area.

Source: Sanderman, Jonathan, Tomislav Hengl, Greg Fiske, Kylen Solvik, Maria Fernanda Adame, Lisa Benson, Jacob J Bukoski, et al. "A Global Map of Mangrove Forest Soil Carbon at 30 m Spatial Resolution." *Environmental Research Letters* 13, no. 5 (2018): 055002. https://doi.org/10.1088/1748-9326/aabe1c.

The aggregate effect of all pollution on the marine environment is not fully known, but indicators suggest that it is likely worsening.

The most common form of pollution entering the marine environment is the large-scale input of nutrients (i.e., nitrogen, phosphorus), which can result in eutrophication and declining oxygen levels. Deoxygenation is one of the most consequential anthropogenic impacts on the ocean, given that oxygen decline can cause major changes in ocean productivity, biodiversity, and biogeochemical cycles. As a proxy for eutrophication, the number of marine "dead zones" or hypoxic sites has continued to increase in number and severity in recent decades.

Low and declining oxygen levels in the ocean and coastal waters

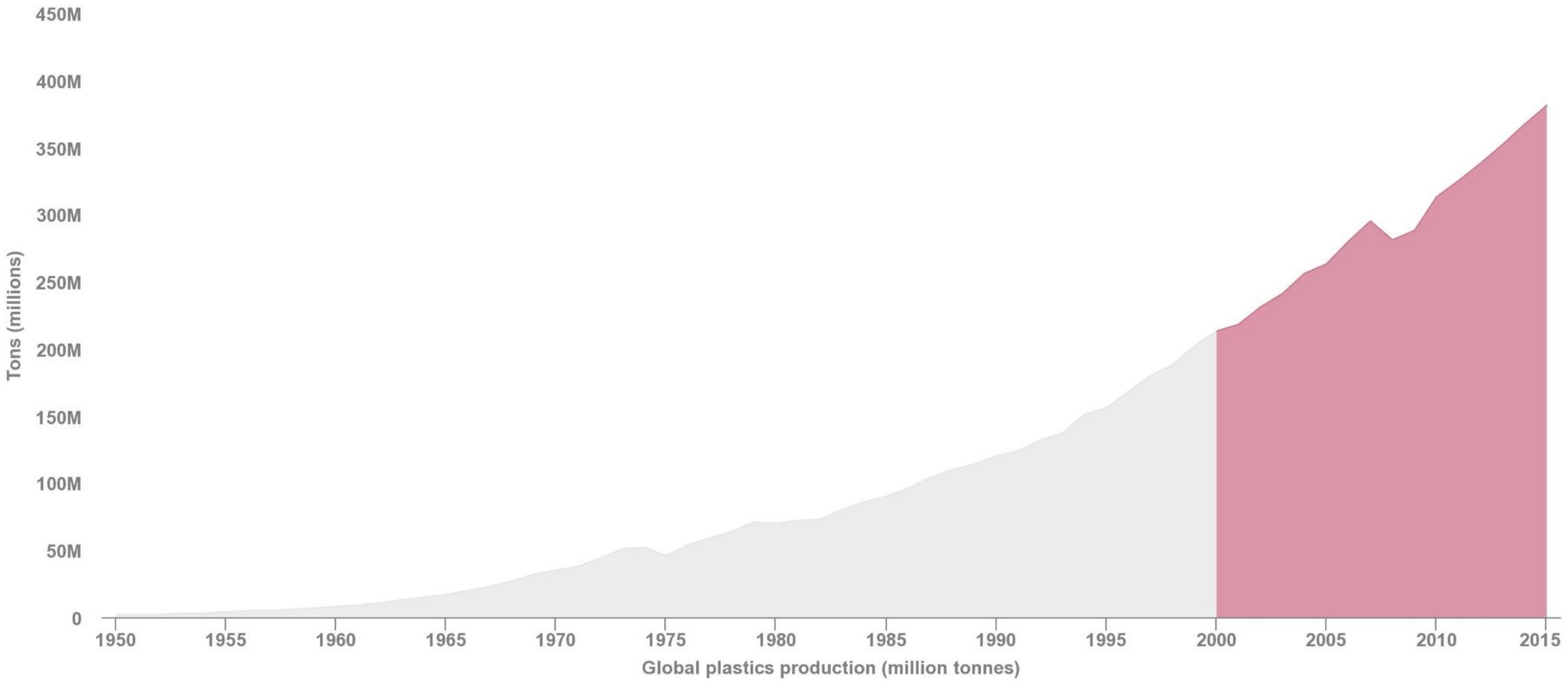


Source: Breitburg, Denise, L.A. Levin, A. Oschlies, M. Grégoire, F.P. Chavez, D.J. Conley, V. Garçon, et al. "Declining Oxygen in the Global Ocean and Coastal Waters." Science 359, no. 6371 (2018): https://doi.org/10.1126/science.aam7240.

Plastic debris accounts for the largest portion of marine pollution in the ocean by volume.

Roughly half of all plastic ever produced was made in the last 15 years. Global plastic production has increased nearly 200-fold, from 2 million tonnes in 1950 to 381 million tonnes in 2015. During 1950–2015, plastic production grew at a compound annual growth rate of 8.4 percent. Asia is the leading producer of plastic: nearly 50 percent of global production was in Asia in 2015, of which China accounted for almost 30 percent of production.

Global plastics production (1950-2015)

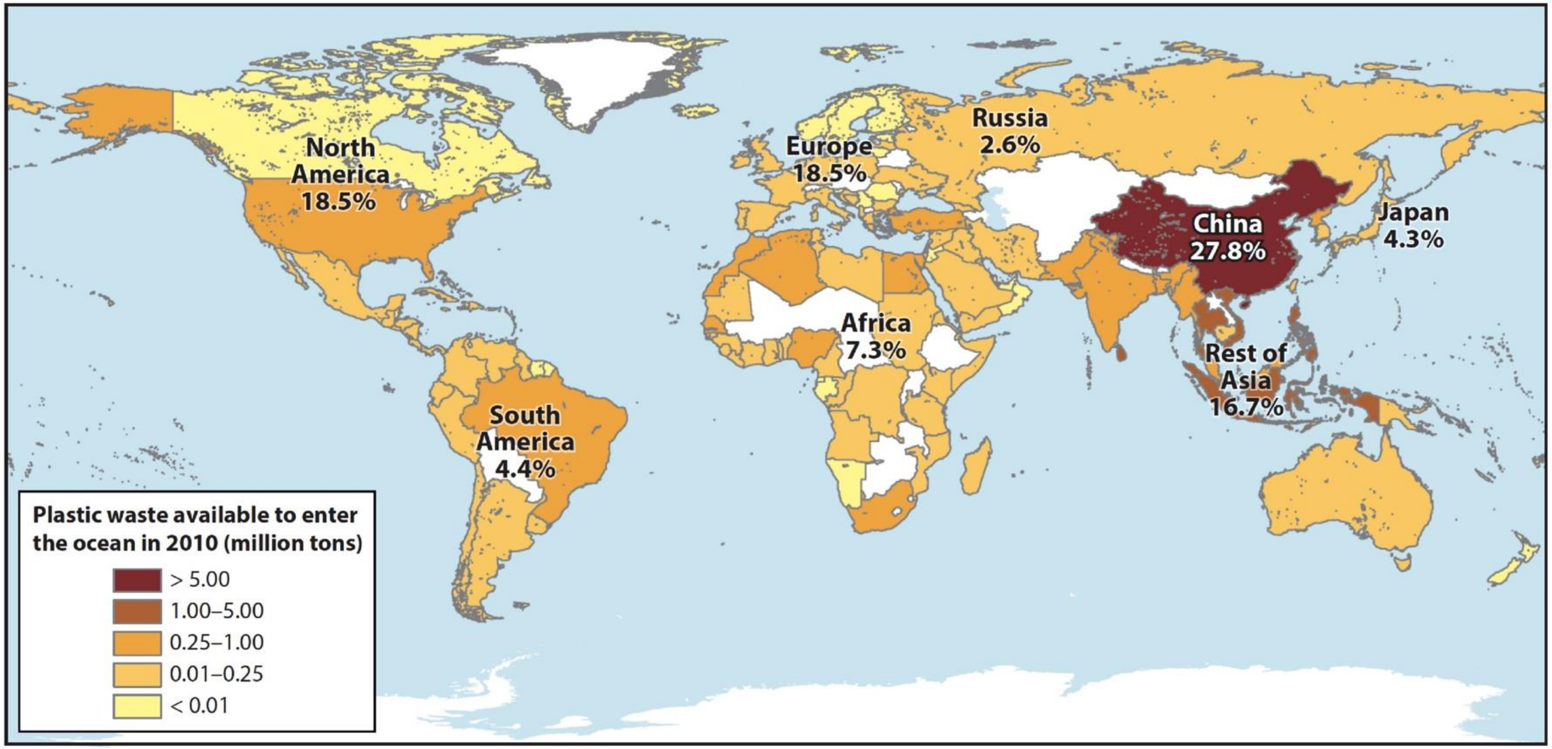


Source: Geyer, Roland, J.R. Jambeck, and K.L. Law. “Production, Use, and Fate of All Plastics Ever Made.” Science Advances 3, no. 7 (2017). https://doi.org/10.1126/sciadv.1700782.

The best available estimates suggest that 4.8 to 12.7 million metric tons of plastic waste enter the marine environment annually from land-based sources.

The extent and quality of waste management remains a key determinant in terms of which countries contribute the most significant plastic waste inputs per capita from land into the ocean. Over half of plastic entering the ocean comes from five rapidly growing economies—China, Indonesia, the Philippines, Thailand, and Vietnam. Interventions in these five countries could reduce global plastic-waste leakage by roughly 45 percentage over the next ten years.

Spatial patterns of plastic production and pollution

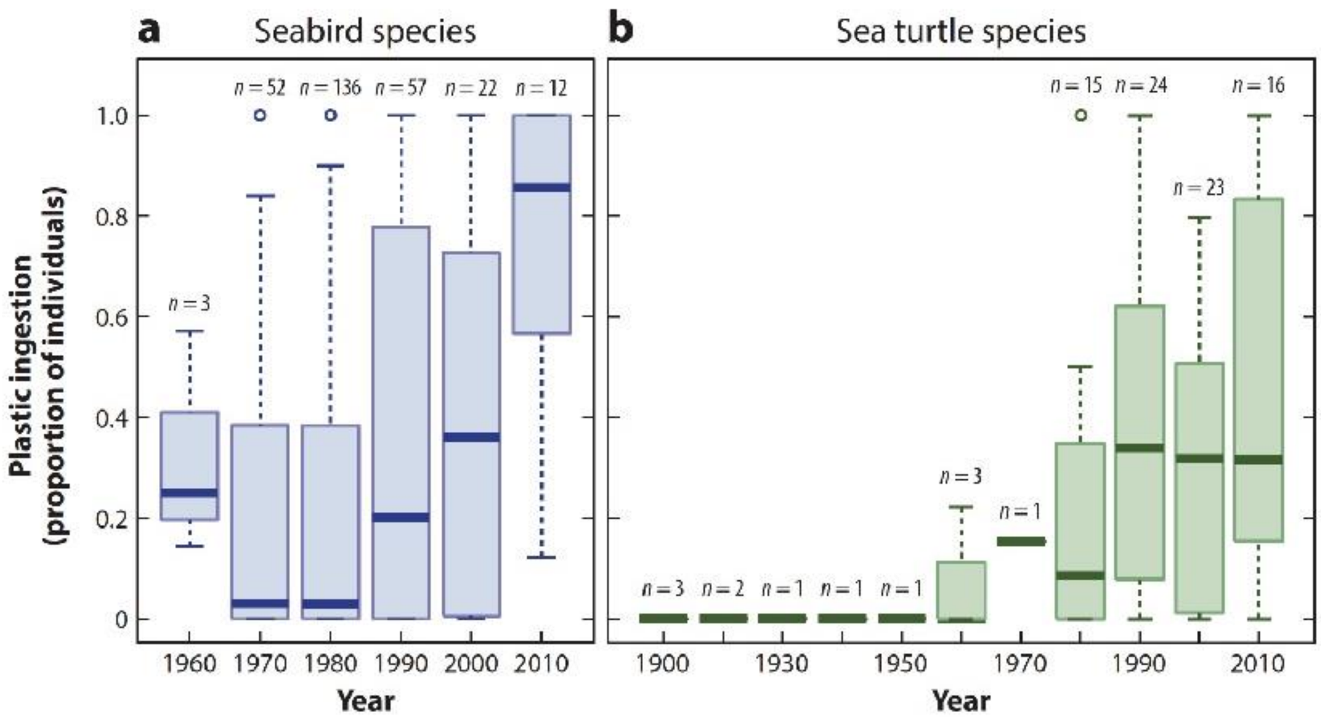


Source: Worm, Boris, H.K. Lotze, I. Jubinville, C. Wilcox, and J. Jambeck."Plastic as a Persistent Marine Pollutant." *Annual Review of Environment and Resources* 42, no. 1 (2017): 1-26. https://doi.org/10.1146/annurev-environ-102016-060700.

Entanglement and ingestion of plastic is one of the most commonly documented impacts of plastic pollution on marine life.

Notable increases in plastic ingestion have been documented in seabirds and marine turtles alike, with an annual rate of increase of 1.7 percent for seabirds and 0.7 percent for turtles in recent years. Researchers expect that both lethal and sublethal impacts from plastic ingestion will result in population-level changes among these marine species. While quantitative data remain limited at the global level, an expert survey suggests that among types of plastic pollution, marine mammals are most vulnerable to experience negative impacts from lost or intentionally discarded fishing gear ("ghost gear"), followed by plastic bags.

Increasing effects of plastic pollution on sea bird and sea turtle specie

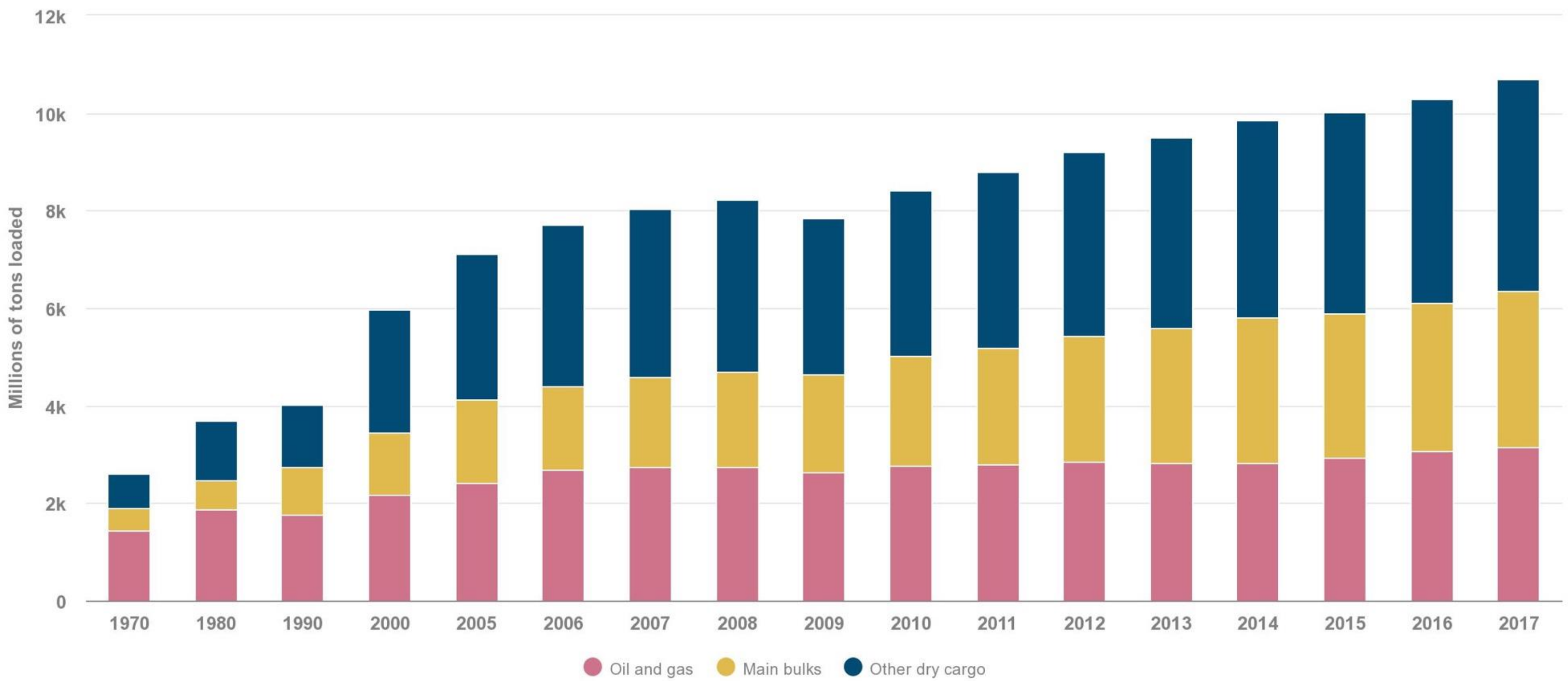


Source: Worm, Boris, H.K. Lotze, I. Jubinville, C. Wilcox, and J. Jambeck."Plastic as a Persistent Marine Pollutant." *Annual Review of Environment and Resources* 42, no. 1 (2017): 1-26. https://doi.org/10.1146/annurev-environ-102016-060700.

The volume of global maritime traffic continues to grow, with direct and indirect ramifications for the marine environment.

The global maritime industry has steadily increased in both the number of ships and in total shipping capacity. Seaborne trade increased by 4 percent to 10.7 billion tons in 2017, the fastest growth in five years. The level of industrial activity on the ocean is expected to increase in coming years. According to the OECD, ocean industries generated USD 1.5 trillion in economic activity in 2010; this amount is expected to double to USD 3 trillion in 2030.

Growth of international seaborne trade

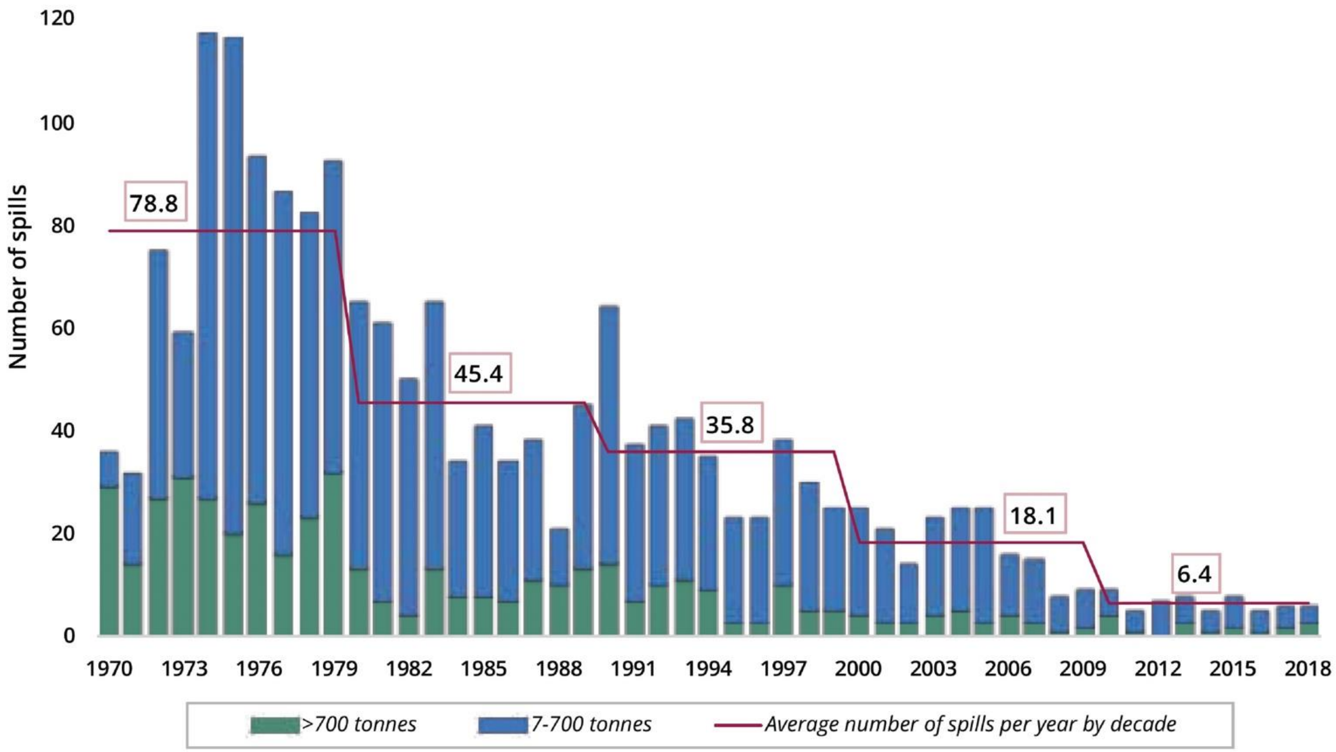


Source: UNCTAD. "Review of Maritime Transport 2018." UNCTAD/RMT/2018. Geneva, Switzerland, 2018.

Even as seaborne trade of oil has steadily increased in recent decades, available data indicate the number and size of oil spills from tankers have concurrently decreased.

In the 1970s, the annual amount of oil entering the marine environment from tankers was approximately 314,000 tons, through almost 80 spills per year. By the early 2000s, the average annual amount had decreased to roughly 21,000 tons, and just 6 spills per year.

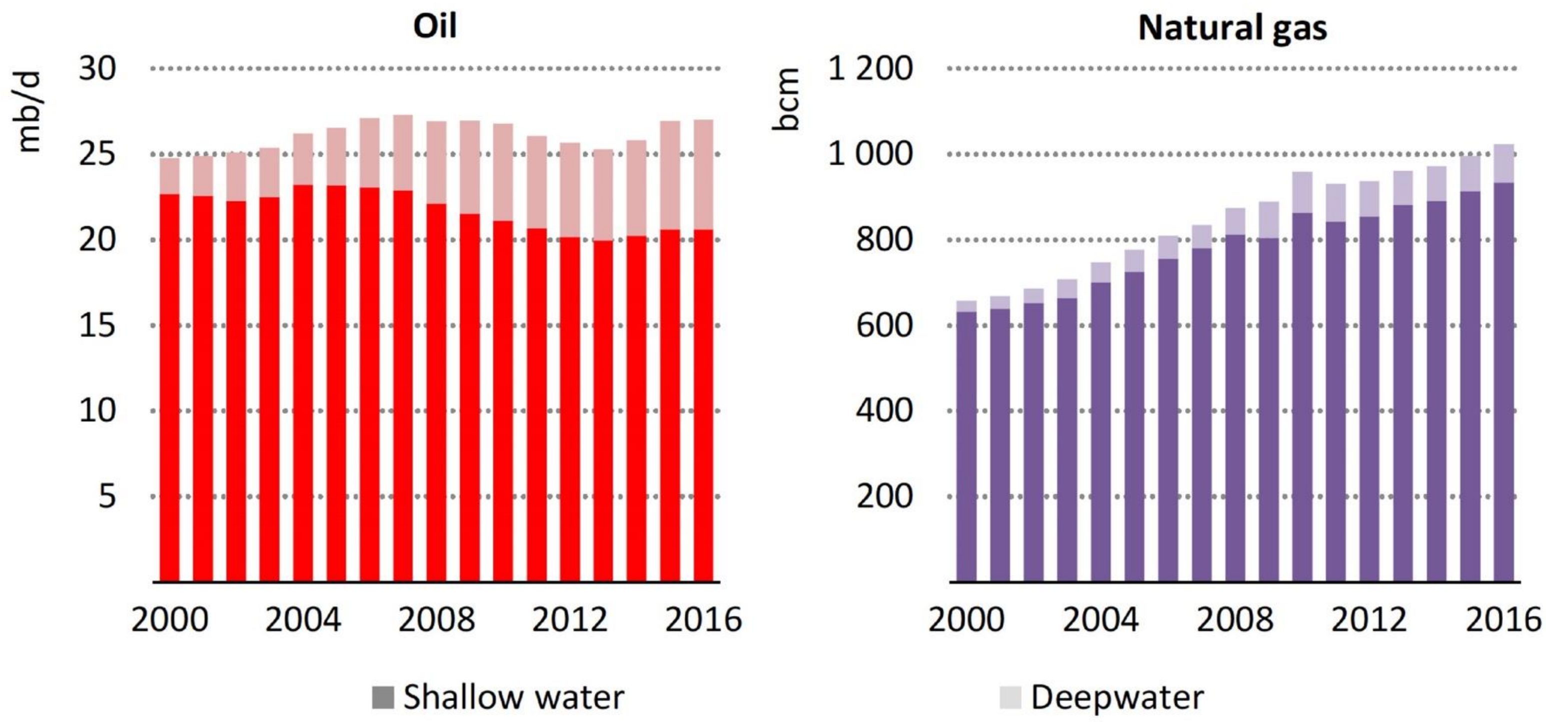
Number of oil spills (>7 tonnes)



Current trends suggest that offshore oil and gas production is slated to increasingly venture into deepwater and ultra-deepwater sectors.

As compared to newly discovered onshore fields, recently discovered offshore fields are about 10 times larger, which has provided an economic incentive for industry, in spite of high upfront costs and inherent environmental risk. Global offshore oil and gas production accounted for roughly one-third of total oil and gas output in 2016. Over the past decade, offshore oil production has remained steady, while offshore gas production has expanded by nearly 30 percent.

Global offshore oil and natural gas production by water depth



Source: International Energy Agency. “Offshore Energy Outlook” IEA: Paris, France. 2018.

OUR SHARED SEAS

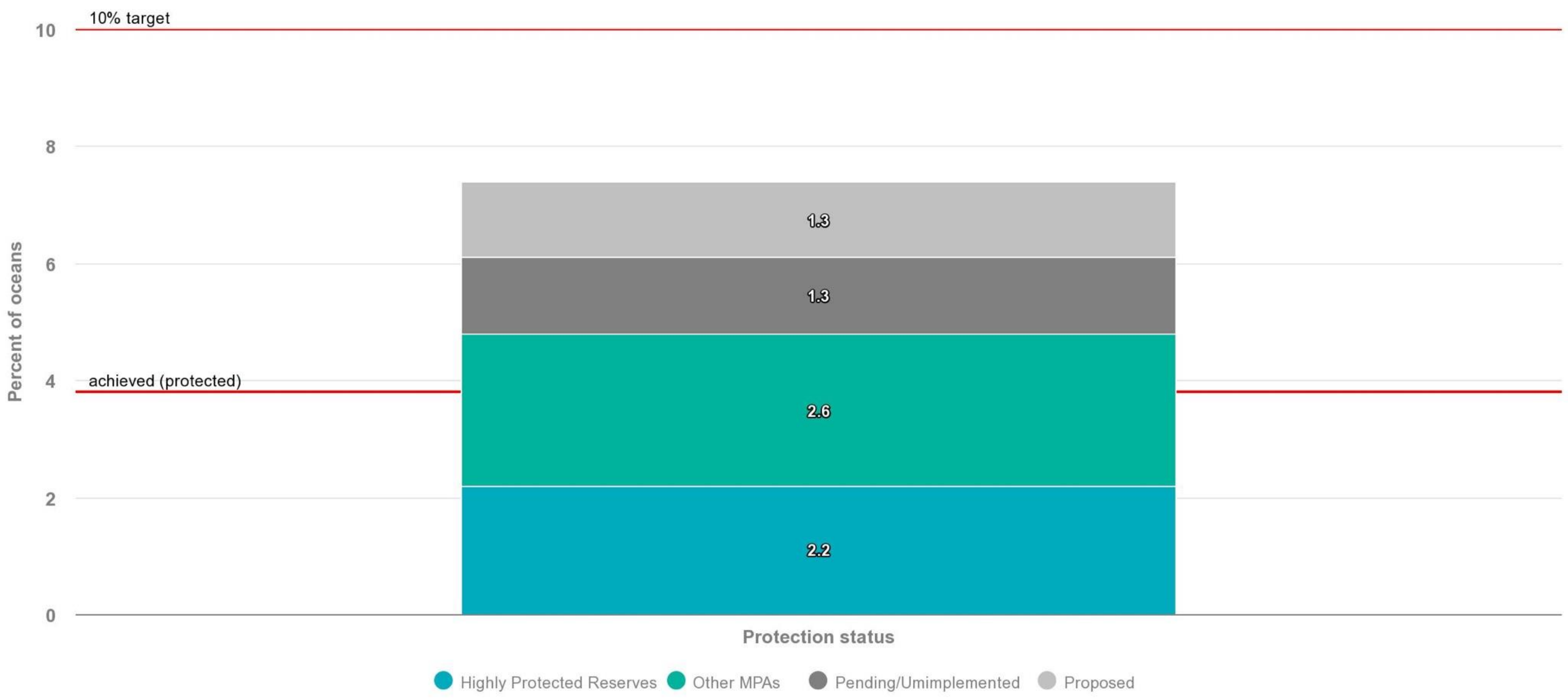
Marine Protected Areas (MPA)

Global ocean data and trends for informed action and decision-making

Prepared by CEA Consulting, with the support of the David and Lucile Packard Foundation

As of early 2019, 4.8 percent of the world's ocean was protected in implemented MPAs, meaning in force on the water.

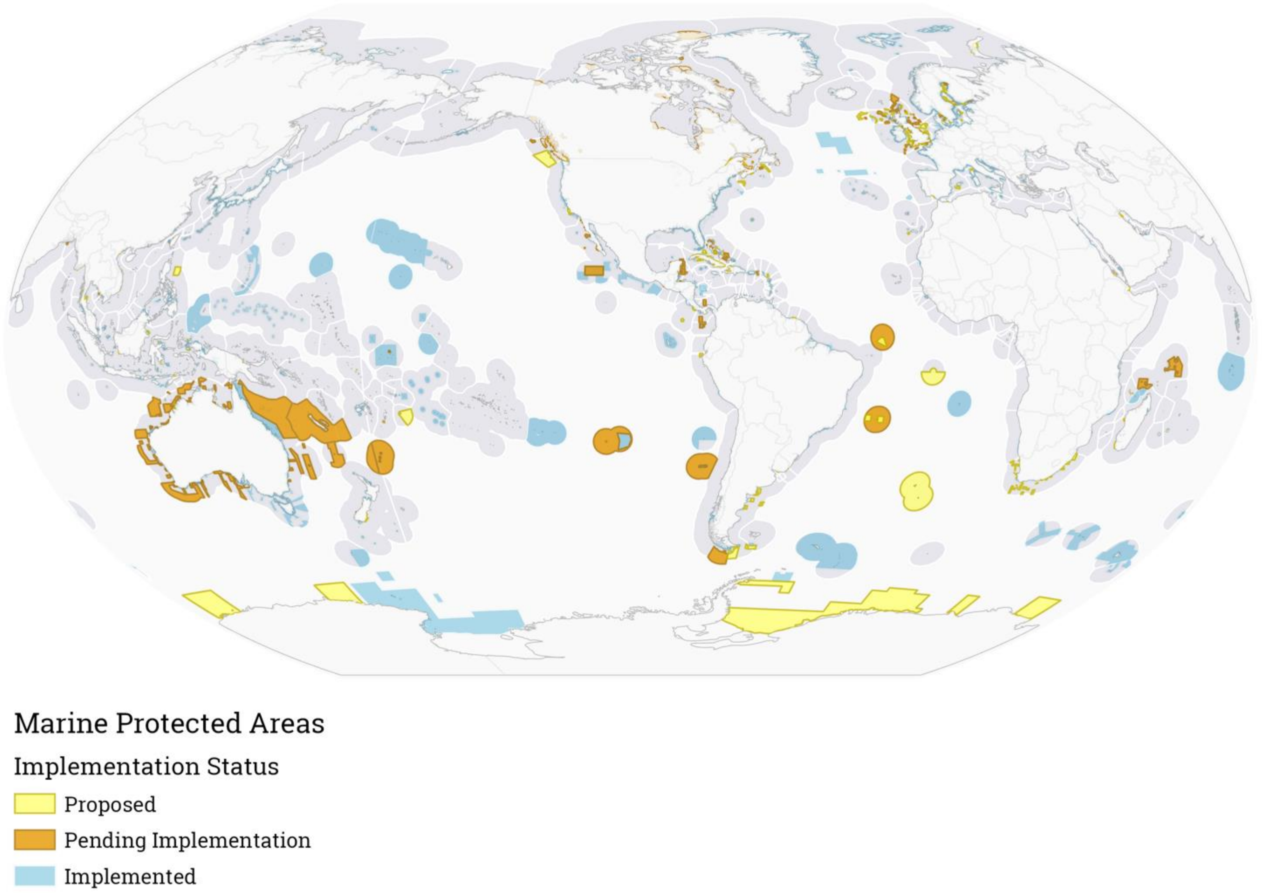
MPA progress toward Aichi Target 11



Source: Marine Conservation Institute, MPAtlas (Seattle, 2018), www.mpatlas.org.

Implementing proposed or officially announced MPAs would increase the overall level of protection to 7.4 percent of the ocean.

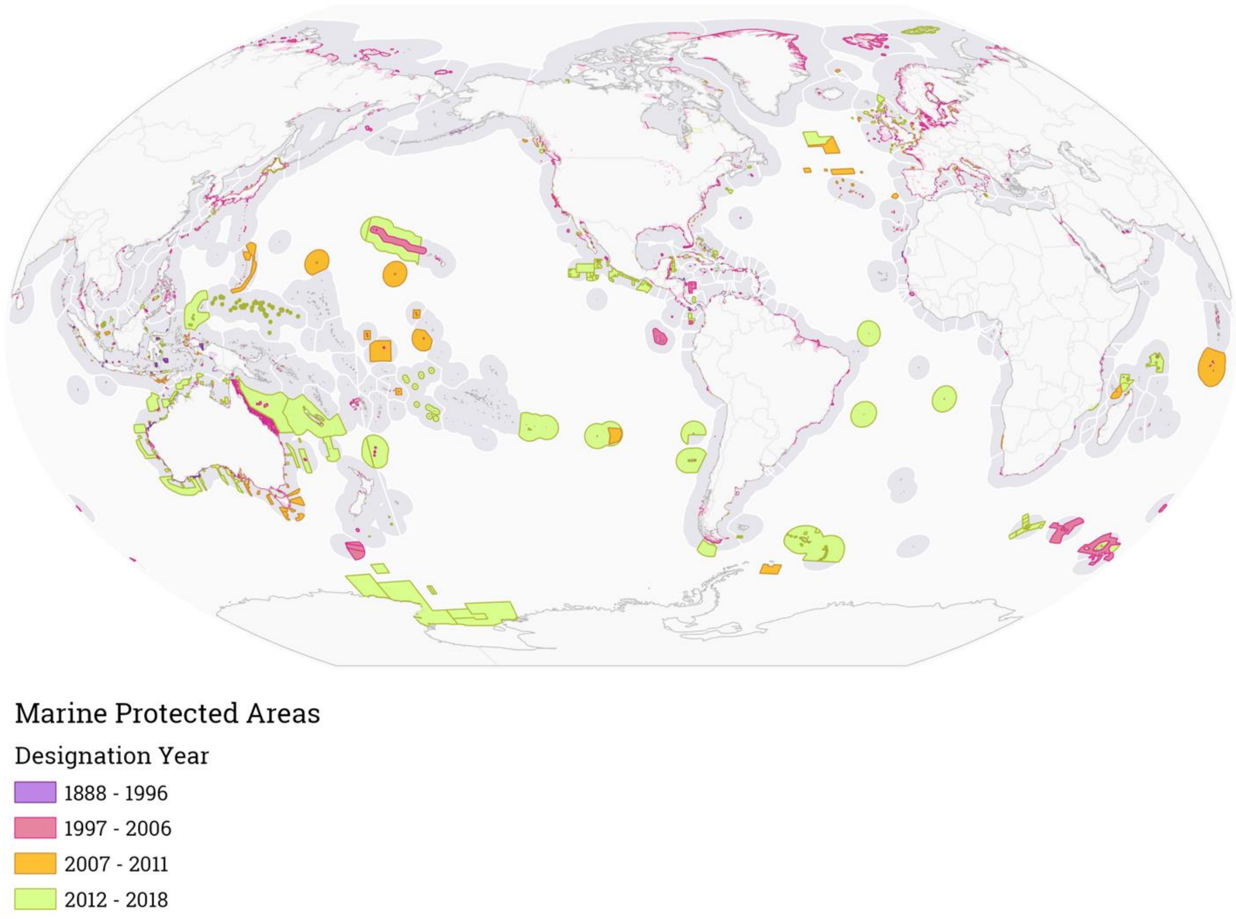
MPAs by implementation status



Source: Marine Conservation Institute, MPAtlas (Seattle, 2018), www.mpatlas.org.

The rate of MPA coverage has increased rapidly in recent years as governments race to meet coverage targets by 2020.

MPAs by recentness of implementation

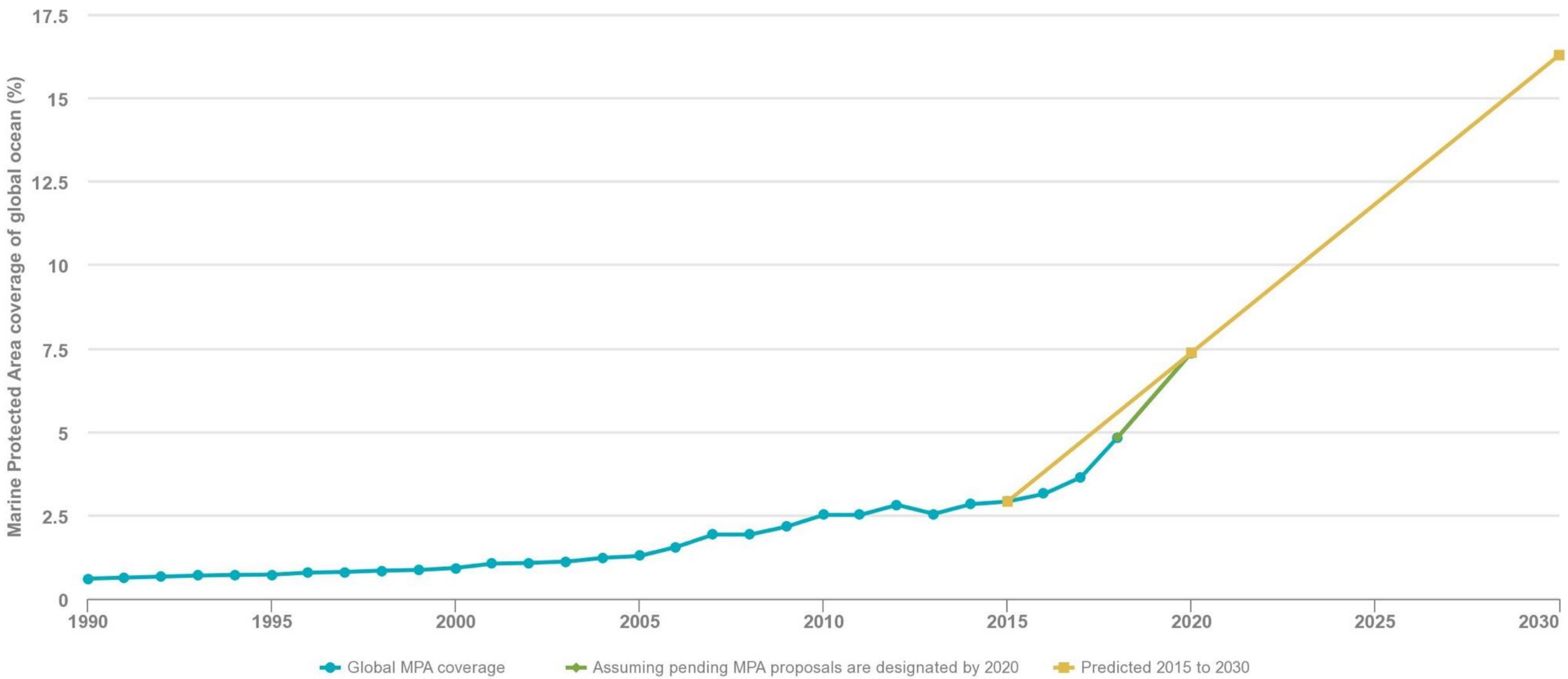


Source: Marine Conservation Institute, MPAtlas (Seattle, 2018), www.mpatlas.org.

According to current projections, MPA commitments are not on track to meet the 10 percent global target by 2020.

Although the global community may fall short of reaching the 10 percent target, several countries (e.g., Palau, United States, Great Britain) are poised to exceed the 10 percent protection target for areas within their EEZ.

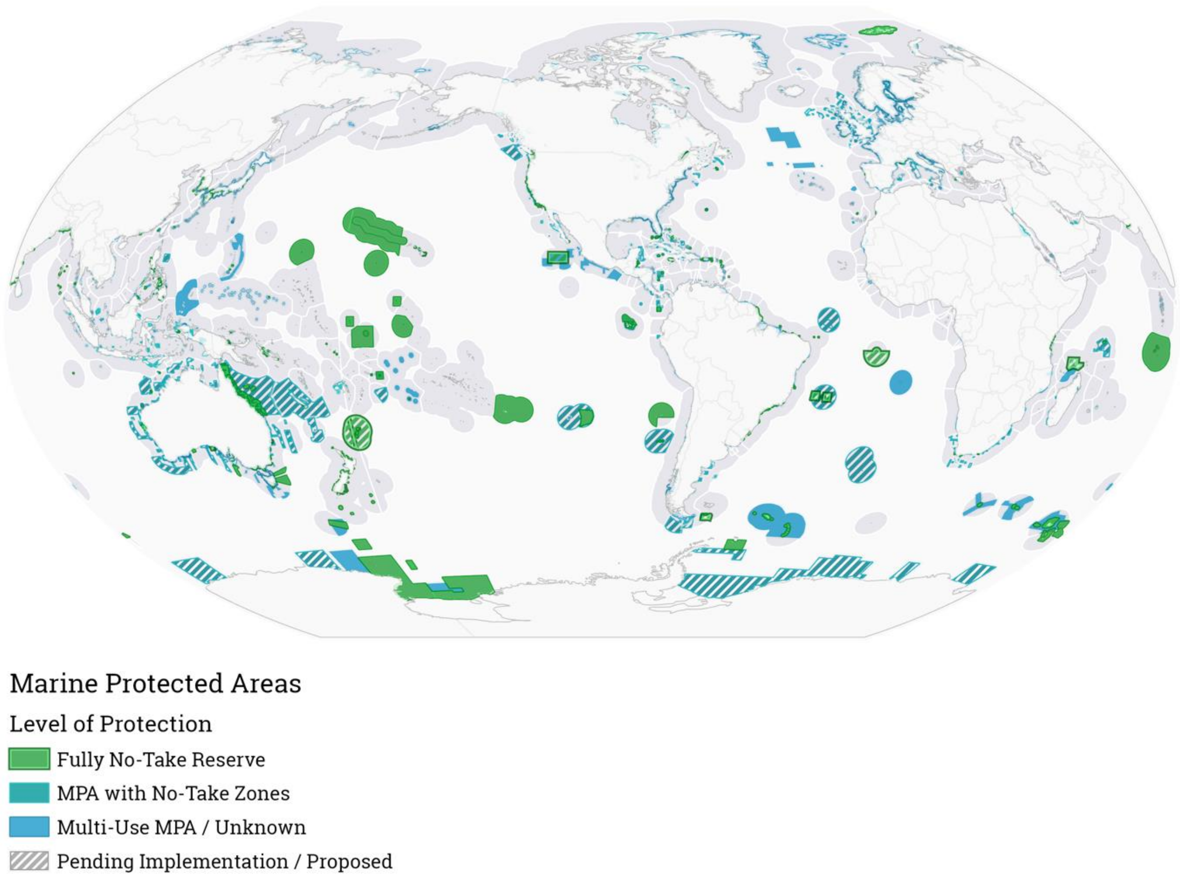
Scenarios of MPA progress toward global targets



Source: Marine Conservation Institute, MPAtlas (Seattle, 2018), www.mpatlas.org.

The past decade has seen a rise of large-scale marine reserves in remote areas, often with low levels of human density and commercial fishing.

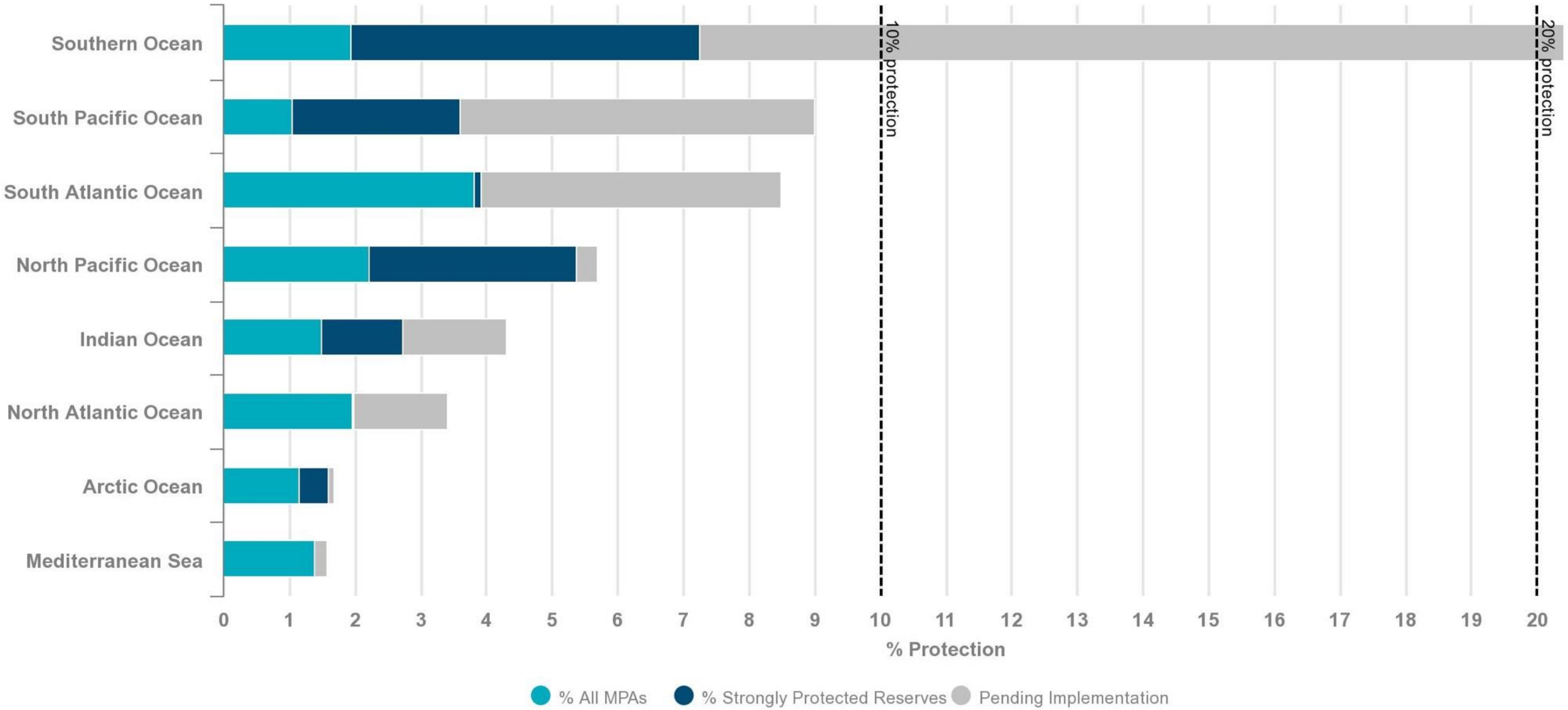
MPAs by protection level



Source: Marine Conservation Institute, MPAtlas (Seattle, 2018), www.mpatlas.org.

The Southern Ocean has the highest level of protection among all ocean basis, followed by the South Pacific Ocean and the South Atlantic Ocean.

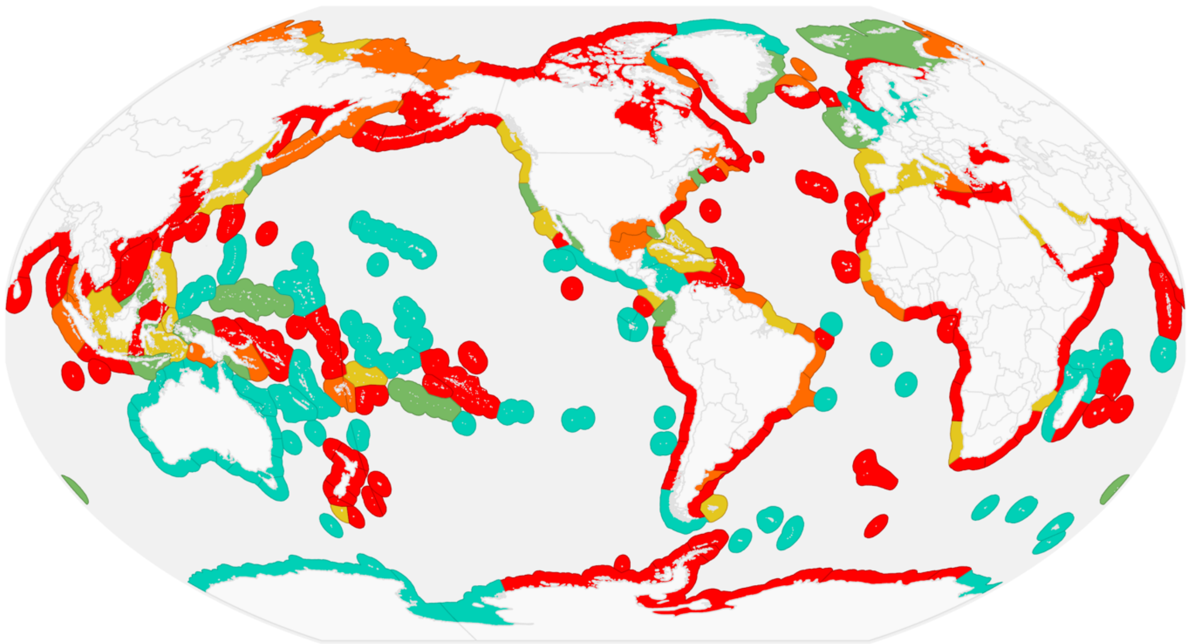
MPA coverage across ocean basins



Source: Marine Conservation Institute, MPAtlas (Seattle, 2018), www.mpatlas.org.

Most MPAs have low ecological connectivity and representation, partly due to the political capital required and intricacies of implementing large-scale systematic conservation planning processes.

MPAs by ecoregion

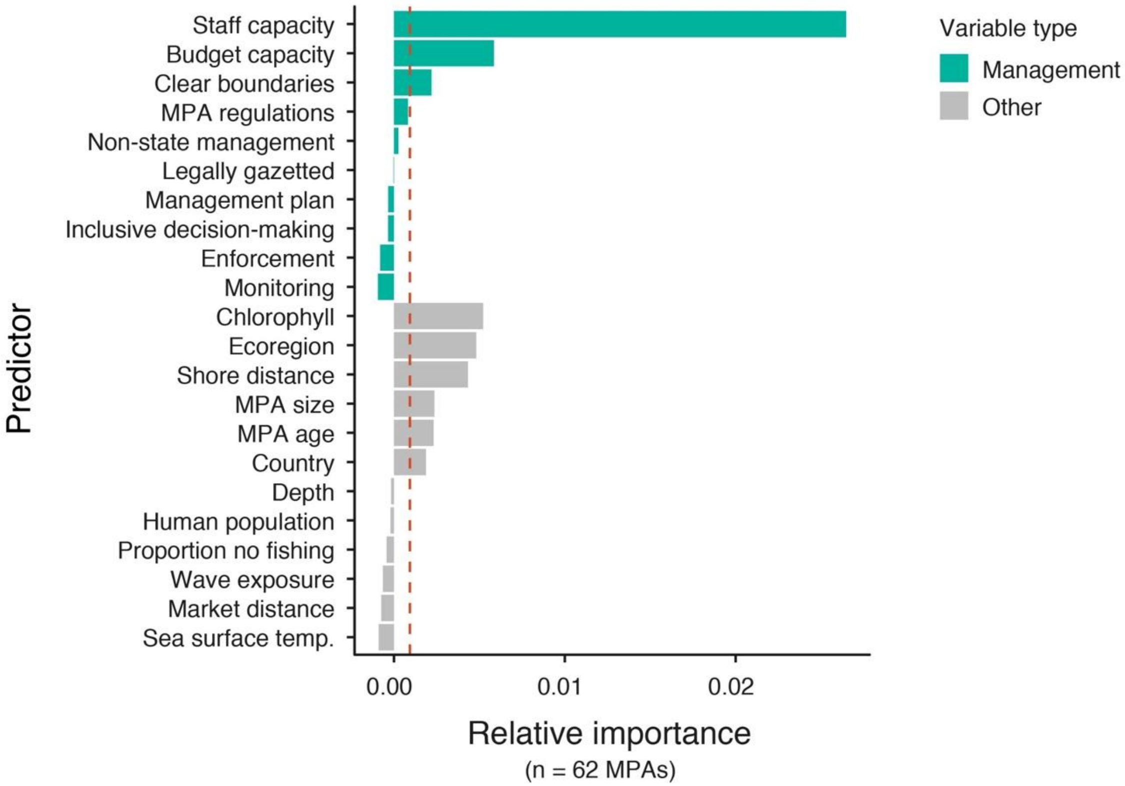


Source: Marine Conservation Institute, MPAtlas (Seattle, 2018), www.mpatlas.org.

A recent study suggests staff capacity and budget capacity are the strongest predictors in explaining fish biomass responses to MPA protection.

MPAs with adequate staff and budget capacity had fish recoveries which were nearly three times as large as those without adequate capacity.

Relationship between MPA management and ecological impact

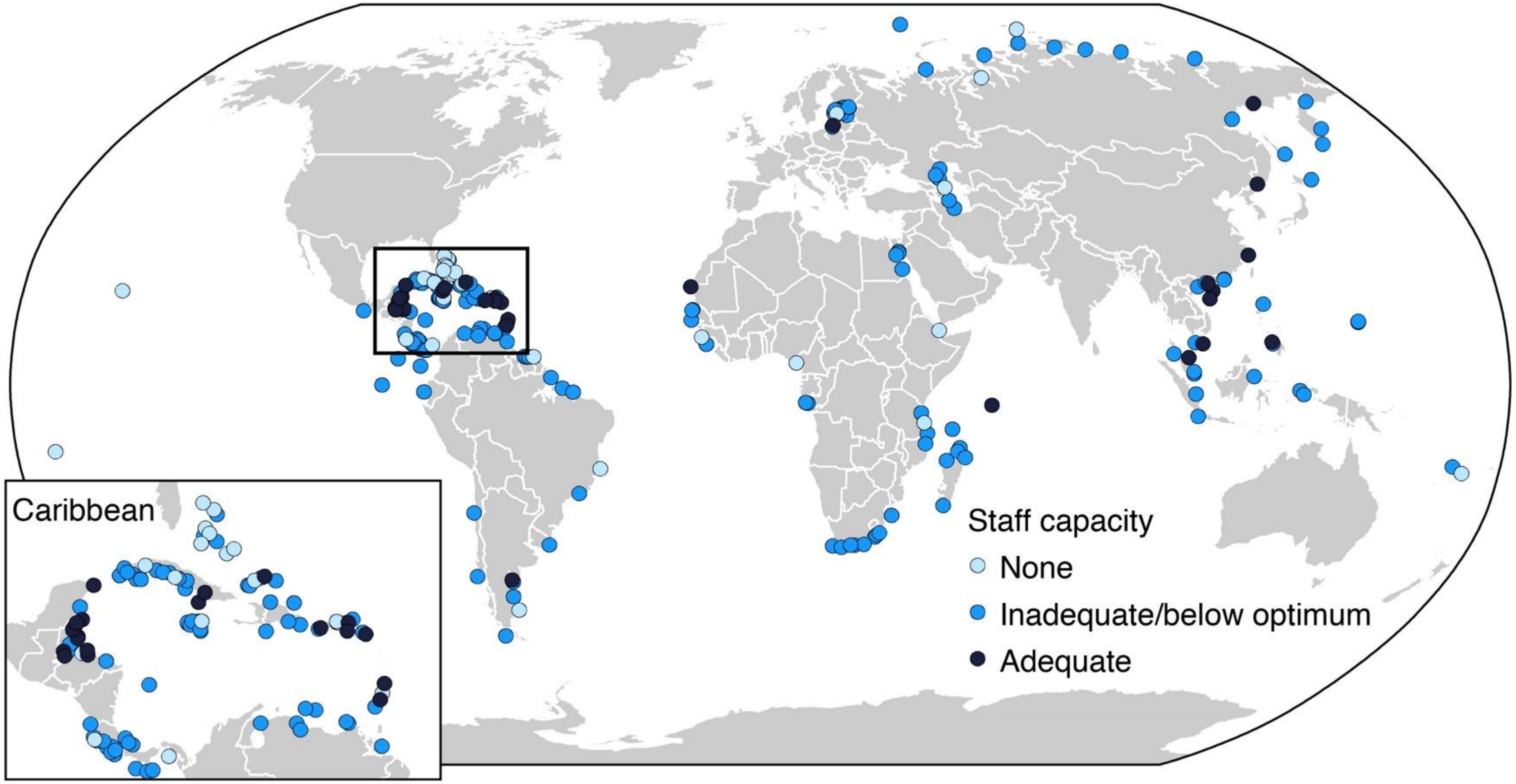


Source: Gill, D.A. et al. "Capacity shortfalls hinder the performance of marine protected areas globally." 2017. Nature (543): 665-671.

Only 35 percent of MPAs surveyed had a sufficient budget to manage their protected area, while only 9 percent had adequate staff capacity.

As anthropogenic pressures on marine resources increase, it is critical to ensure adequate capacity for MPA management, monitoring, and finance.

Reported level of MPA staff capacity



Source: Gill, D.A. et al. "Capacity shortfalls hinder the performance of marine protected areas globally." 2017. Nature (543): 665-671.

OUR SHARED SEAS

Funding

Global ocean data and trends for informed action and decision-making

Prepared by CEA Consulting, with the support of the David and Lucile Packard Foundation

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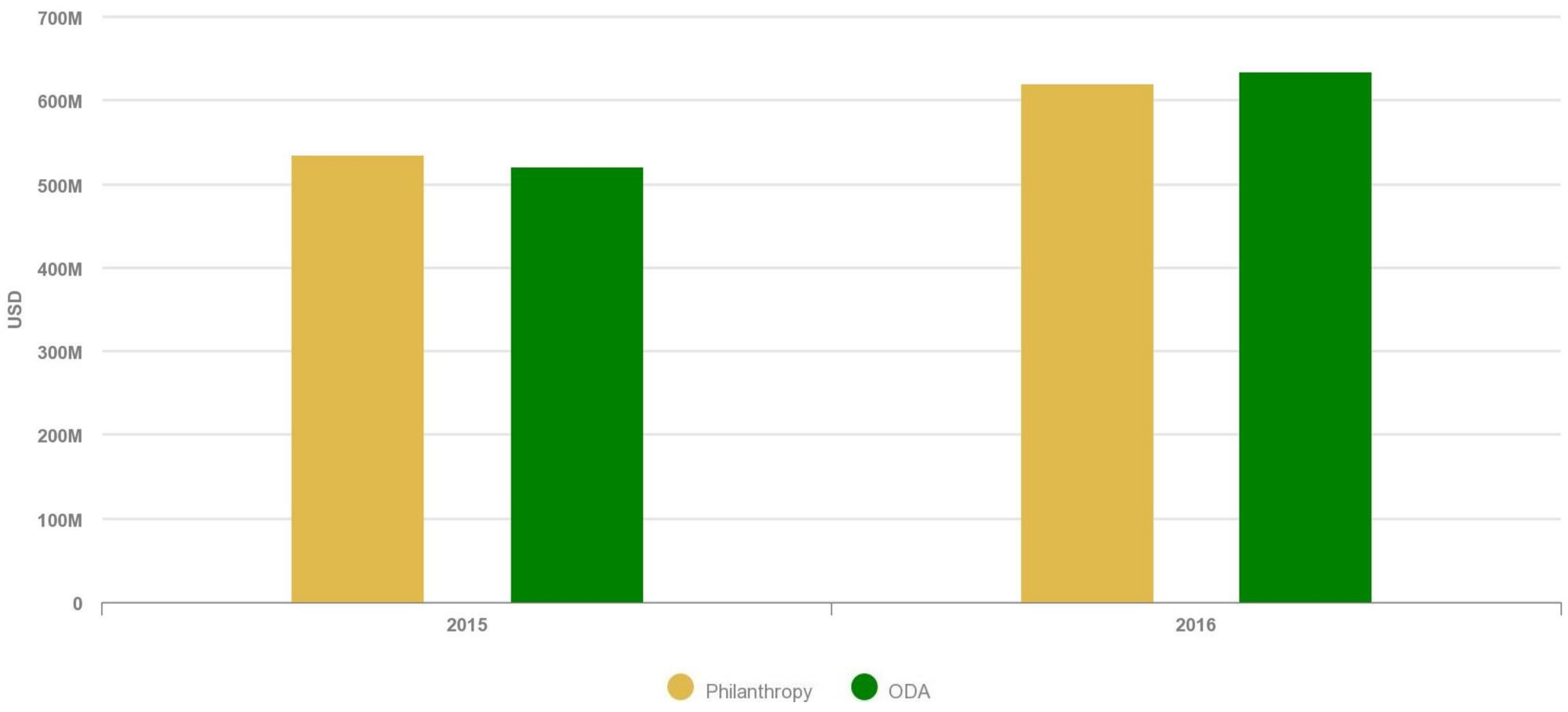
In recent years, philanthropic and development aid grantmaking for marine conservation have been roughly comparable in size.

Following a trend of overall growth in recent years, the philanthropic sector contributed an estimated USD 620 million in marine-related grants in 2016, while official development assistance (ODA) provided roughly USD 634 million in grantmaking.

Total ocean-related grants from philanthropic and ODA sources, 2015-2016 (in USD millions)

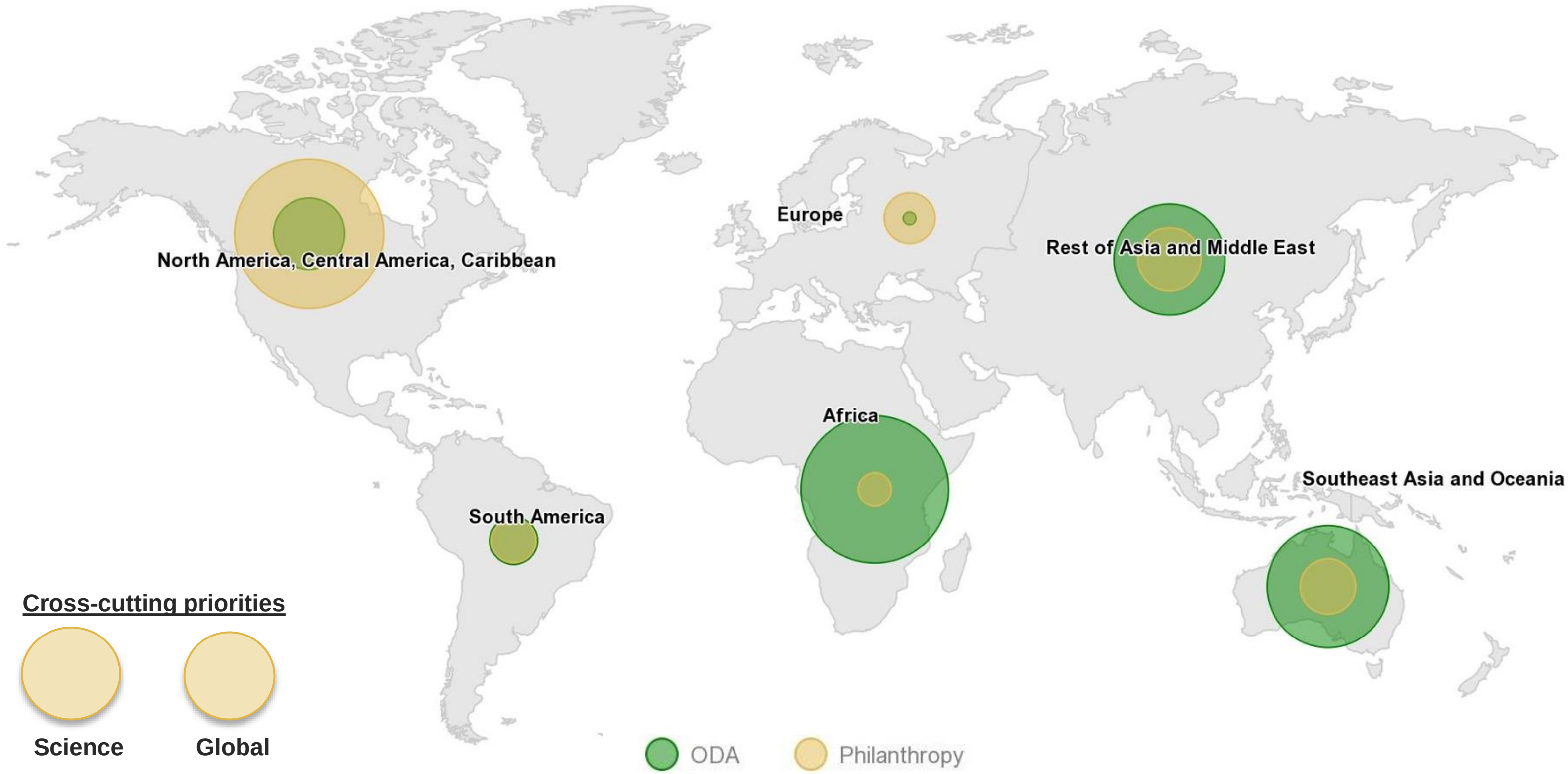


Source: Analysis by California Environmental Associates, 2018. Prepared for "Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making," 2019.

Though philanthropic and development aid grantmaking have been nearly equal in size, they have targeted different parts of the world.

Philanthropy has invested heavily in North America, as well as cross-cutting science and global initiatives. These priorities made up roughly 80% of funding during 2015-2016. ODA grantmaking has been directed primarily toward Africa, parts of Asia, and Oceania. These regions accounted for 86% of funding during 2015-2016.

Marine-related grantmaking from philanthropic and ODA sources, 2015-2016 (in USD millions)



Note: In this visual, Southeast Asia and Oceania are combined. The “Rest of Asia” circle includes non-Southeast Asia countries and the Middle East. Central American and the Caribbean are included in North America’s estimate. ‘Science’ refers to grants which encompass cross-cutting geographies and have a strong scientific research focus; examples include the Monterey Bay Aquarium Research Institute (MBARI) and Marine Microbiology Initiative (MMI).

Source: Analysis by California Environmental Associates, 2018. Prepared for “Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making,” 2019.

Philanthropy's top share of funding has been directed toward North America, followed by cross-cutting science and global initiatives. Given the sector's emphasis on poverty alleviation and economic development, ODA funding has been concentrated in Africa, parts of Asia, and Oceania.

Marine-related grantmaking from philanthropic and ODA sources, 2015-2016 (in USD millions)

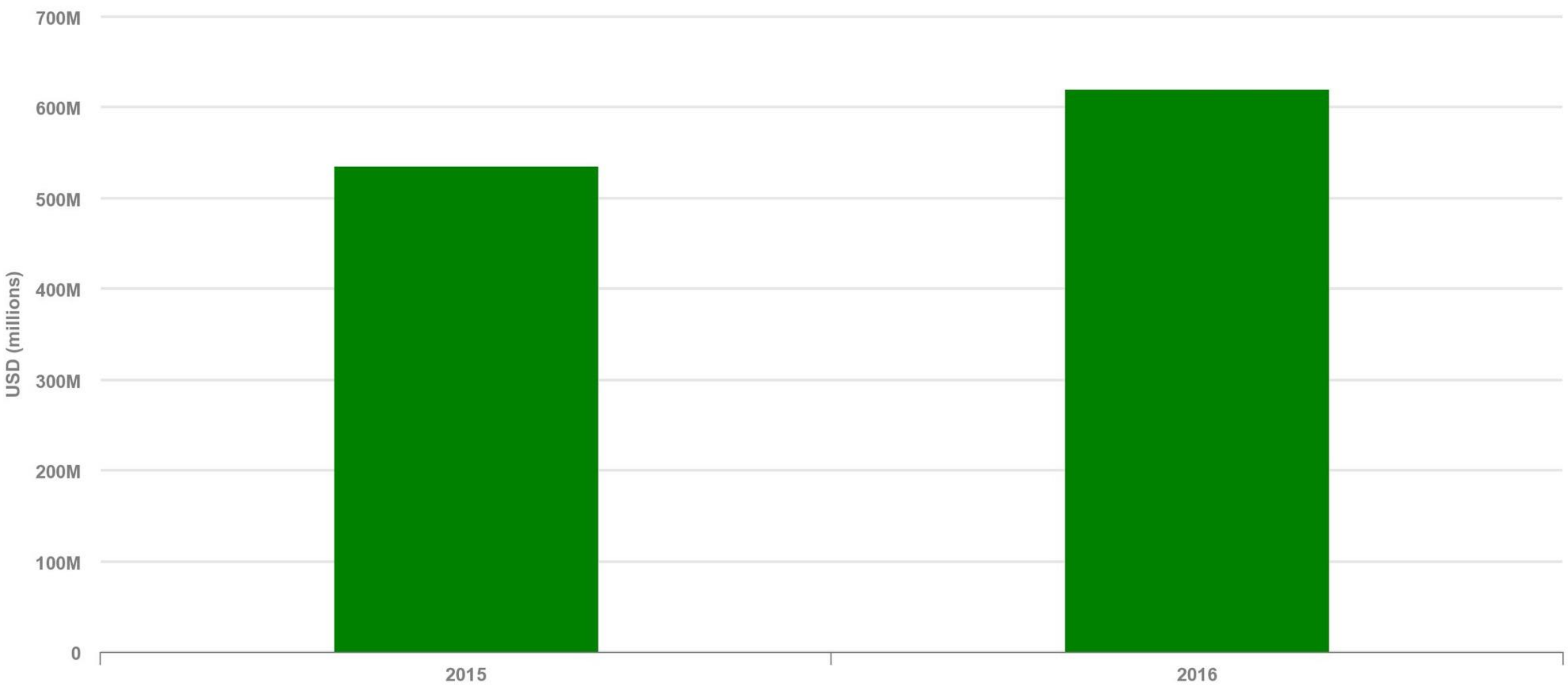
REGION/AREA	ODA FUNDING (M USD)	SHARE OF ODA FUNDING	PHILANTHROPIC FUNDING (M USD)	SHARE OF PHILANTHROPIC FUNDING
North America, Central America, Caribbean	$74	7.9%	$378	44.8%
South America	$31	3.3%	$27	3.2%
Europe	$7	0.8%	$34	4.0%
Rest of Asia and Middle East	$201	21.6%	$59	7.0%
Africa	$373	40.0%	$15	1.8%
Southeast Asia and Oceania	$246	26.4%	$42	5.0%
Global			*$137*	*16.3%*
Science			*$151*	*17.9%*
Total	**$932**		**$843**	

Source: Analysis by California Environmental Associates, 2018. Prepared for "Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making," 2019.

Ocean-related foundation funding was USD 621 million in 2016, representing a gradual increase driven by commitments from ongoing funders and new funders to the field.

Among all grantmaking in the United States, environmental funding represented less than 2% of all grantmaking in 2015. Of this proportion, ocean funding accounted for 7% of environmental funding.

Philanthropic ocean-related grantmaking, 2015-2016 (in USD millions)



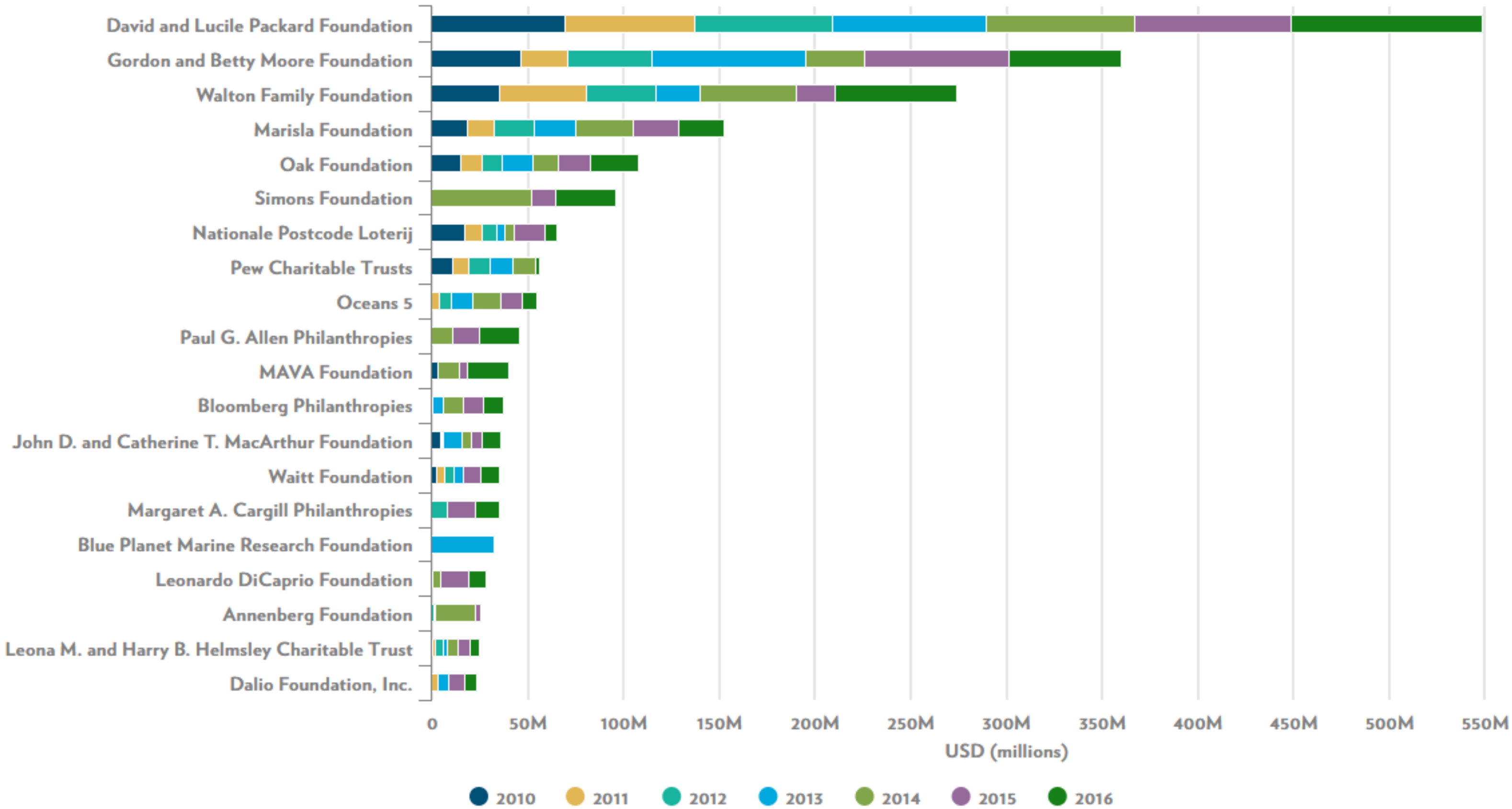
Note: The data in this chart includes grantmaking from the largest marine funders outside the United States, but it likely does not include the “longtail” of funding from non-U.S. foundations.

Source: Analysis by California Environmental Associates, 2018. Prepared for “Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making,” 2019.

During the 2010-2016 period, the top 20 foundation funders comprised 73% of all identified marine grantmaking.

The top five ocean funders—David and Lucile Packard Foundation, Gordon and Betty Moore Foundation, Walton Family Foundation, Marisla Foundation, and Oak Foundation—accounted for roughly 45% of all marine grants (by value).

Top 20 marine philanthropic funders, 2010-2016 (in USD millions)



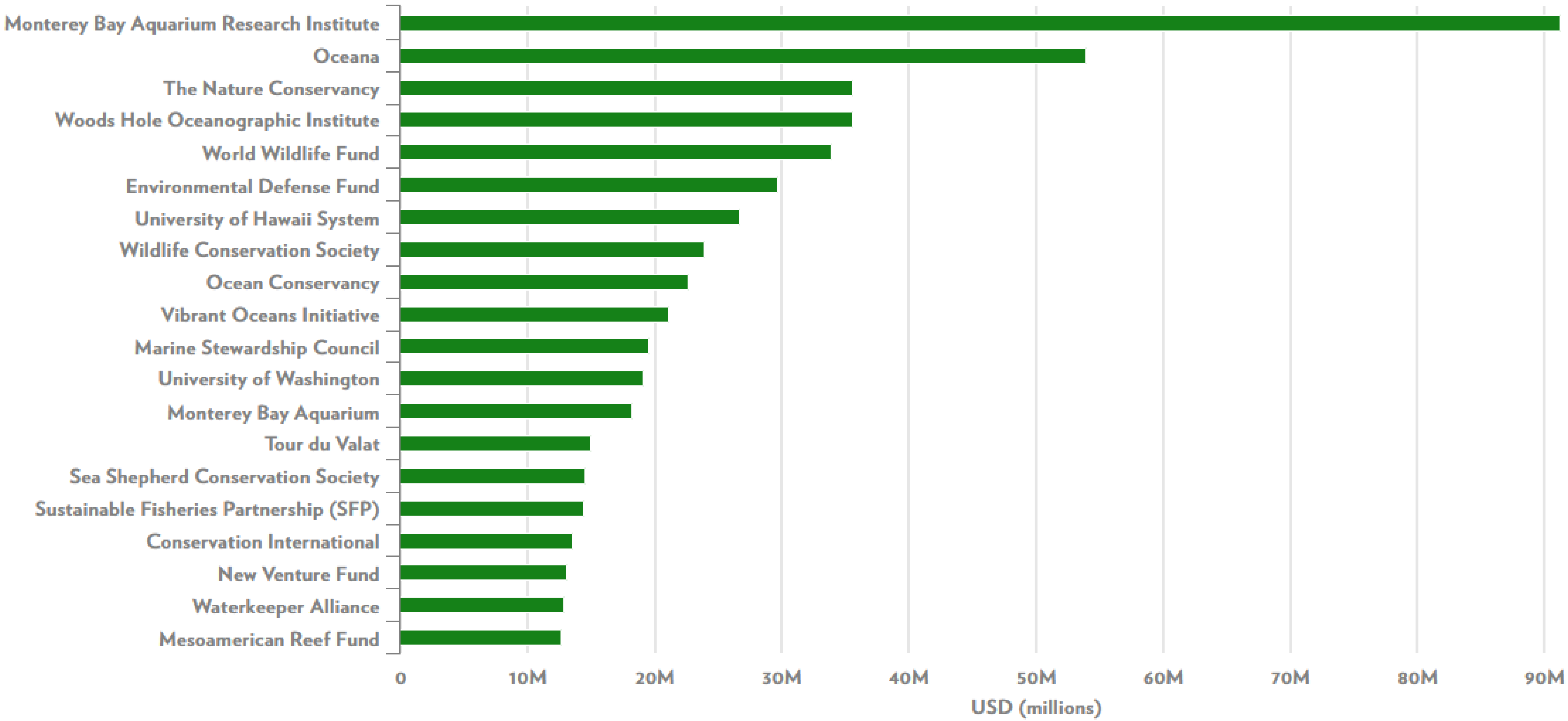
Note: The amount shown next to each bar indicates aggregate funding by foundation funding during the period 2010-2016.

Source: Analysis by California Environmental Associates, 2018. Prepared for “Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making,” 2019.

The top 5 NGO recipients of ocean-related philanthropic funding accounted for nearly 50% of funding among the top 20 recipients during 2015-2016.

These organizations included Monterey Bay Aquarium Research Institute (17% of funding among top 20 recipients), Oceana (10%), The Nature Conservancy (7%), Woods Hole Oceanographic Institute (7%), and World Wildlife Fund (6%).

Top NGO recipients of marine philanthropy, 2015-2016 (in USD millions)

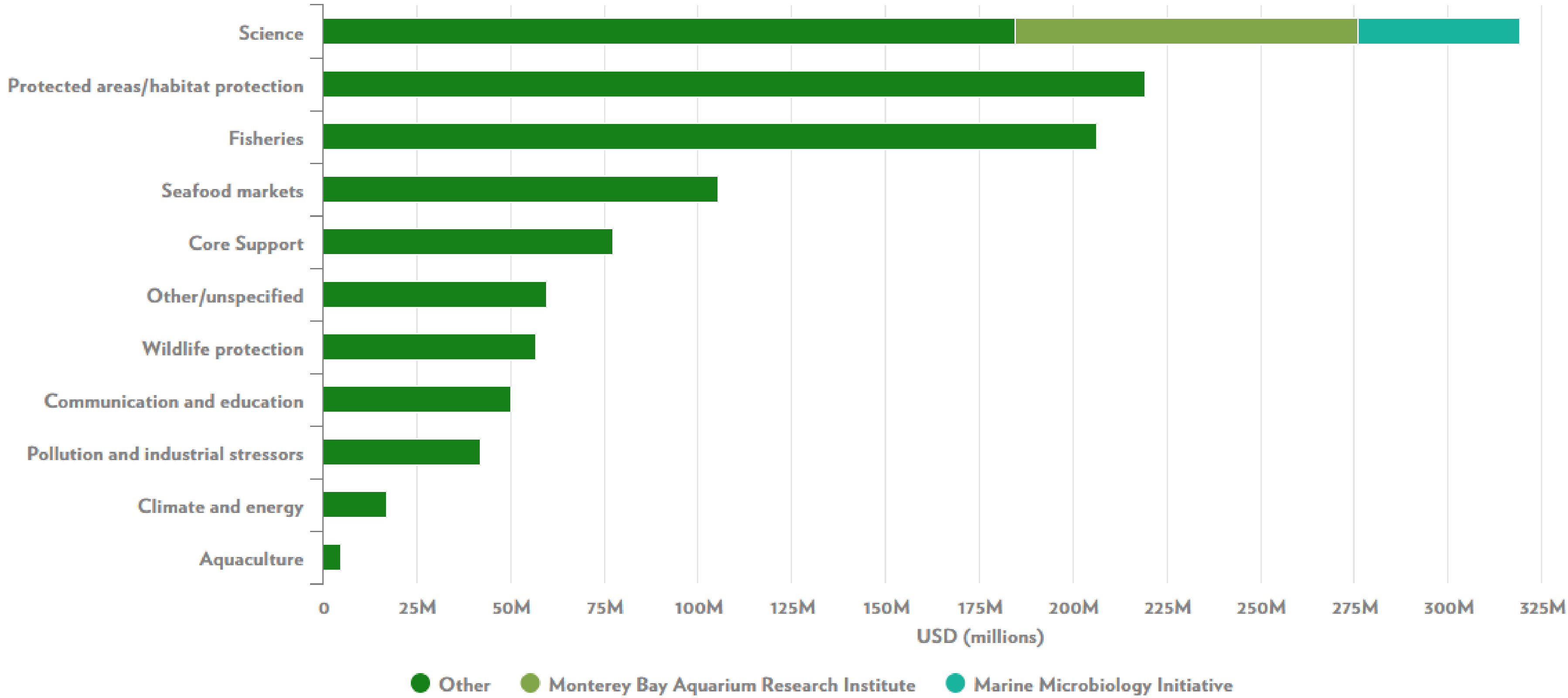


Note: The first phase of Vibrant Oceans Initiative was a collaboration between Oceana, Rare, and formerly EKO Asset Management (now Encourage Capital) based on a commitment from Bloomberg Philanthropies. Tour du Valat is a research institute based in France that focuses on the conservation of Mediterranean wetlands.

Source: Analysis by California Environmental Associates, 2018. Prepared for “Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making,” 2019.

Following a similar trend as in previous years, foundation grantmaking during 2015-2016 prioritized projects in science (28% of funding), protected areas and habitat protection (19%), and fisheries (18%).

Marine philanthropic funding by issue area, 2015-2016 (in USD millions)



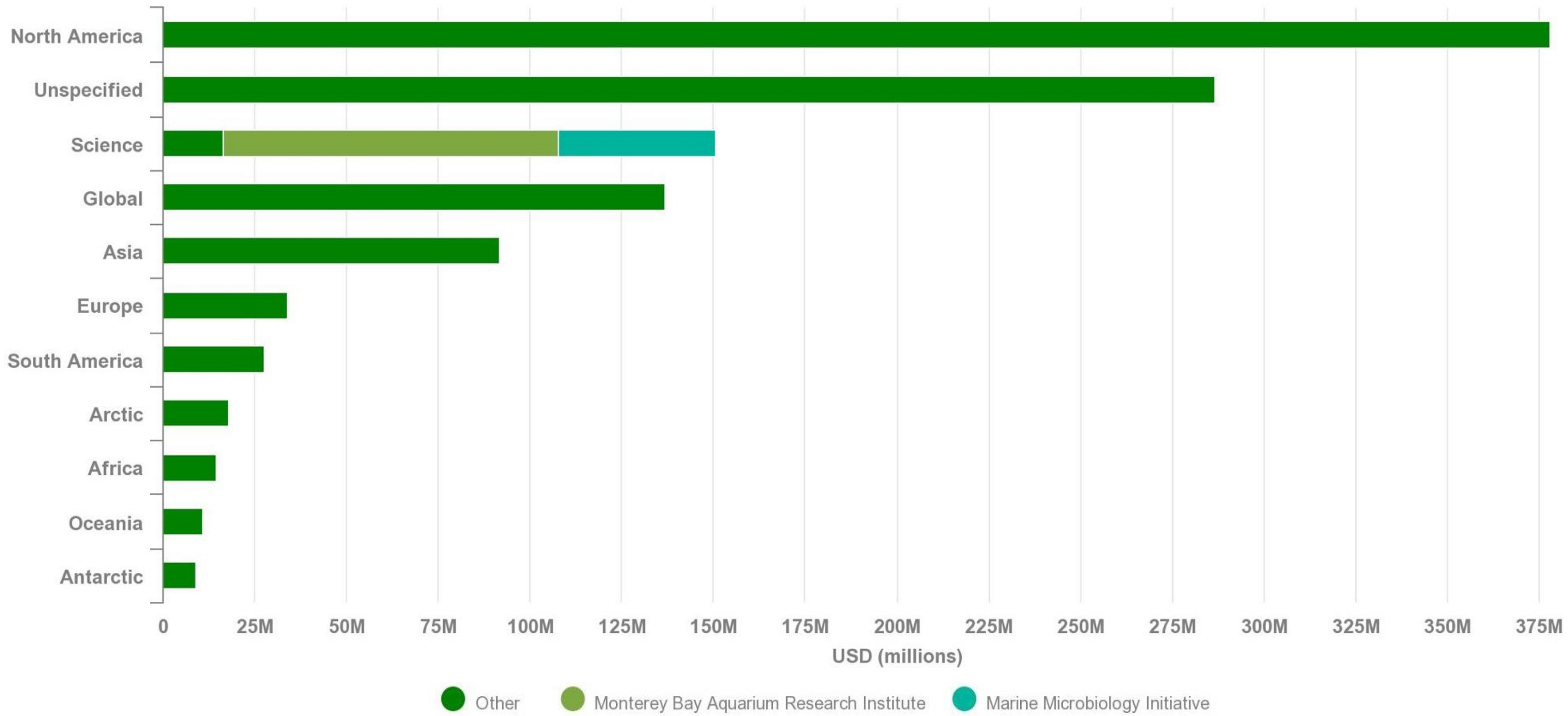
Note: As it relates to the 'science' category, two large grantmaking programs—the Packard Foundation's ongoing support for the Monterey Bay Aquarium Research Institute (MBARI) and the Moore Foundation's Marine Microbiology Initiative (MMI)—were differentiated in this analysis as they represent major institutional commitments with a strong focus on scientific exploration.

Source: Analysis by California Environmental Associates, 2018. Prepared for "Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making," 2019.

By issue area, North America was the largest regional recipient of marine funding, accounting for 33% of funding during 2015-2016.

At the country level, top recipients of philanthropic funding during this period were the United States, Mexico, Indonesia, Canada, and Belize.

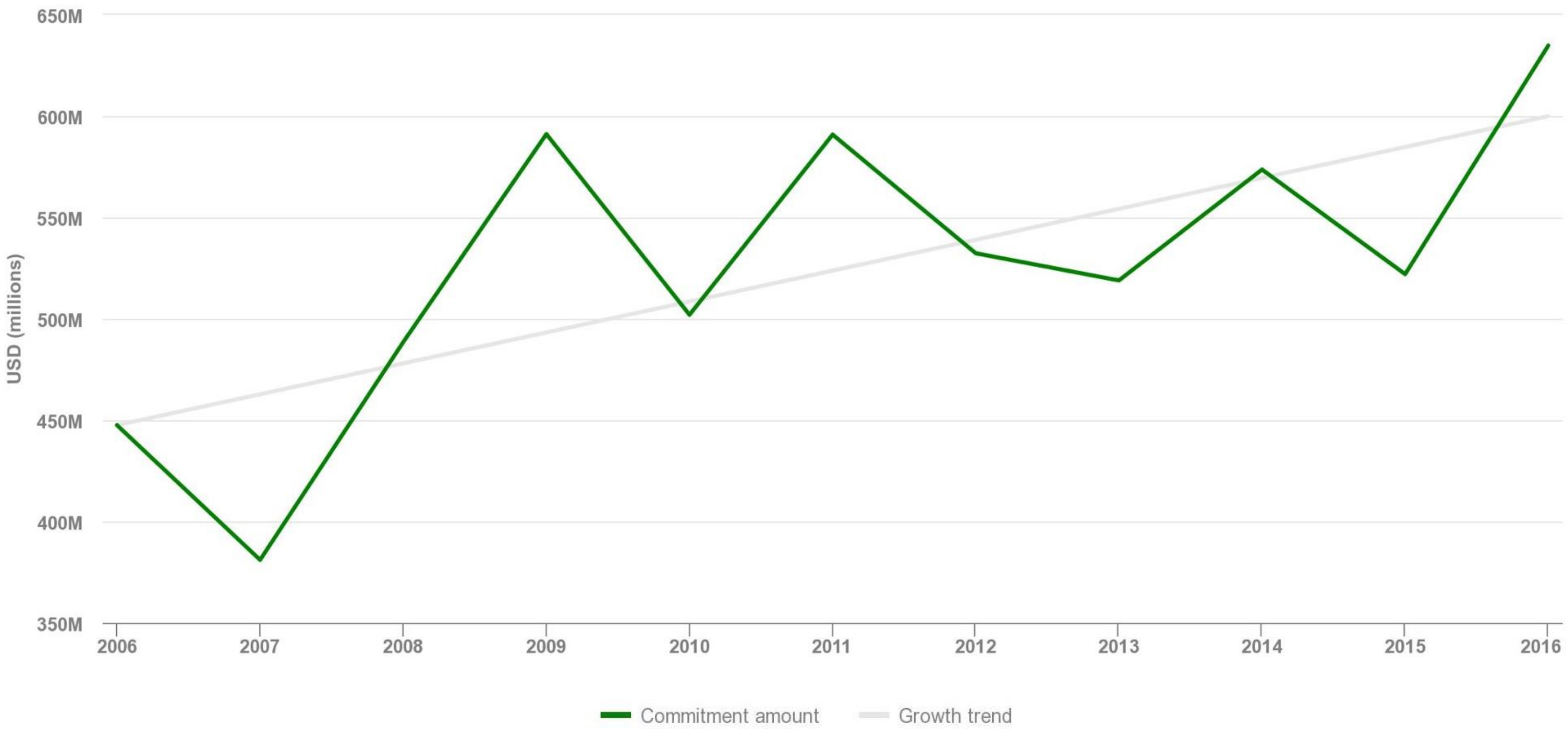
Marine philanthropic funding by region, 2015-2016 (in USD millions)



Source: Analysis by California Environmental Associates, 2018. Prepared for “Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making,” 2019.

Despite some fluctuations, marine-related ODA grants have followed an overall trend of growth in recent years, increasing from USD 447 million in 2006 to USD 635 million in 2016.

Trendline of marine ODA grant funding, 2006-2016 (in USD millions)

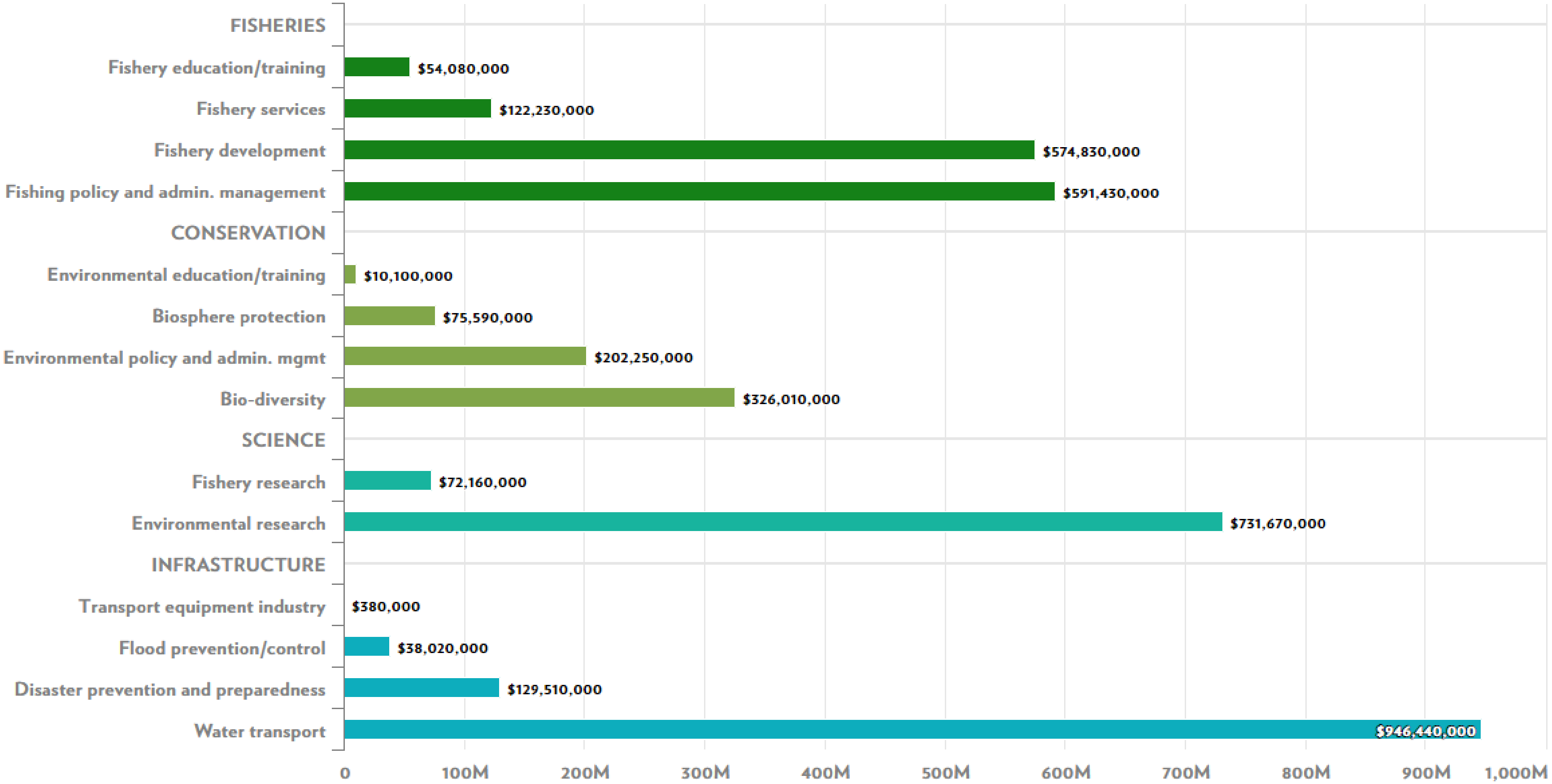


Note: This chart includes grants and excludes loans and export credits in order to enable an analogous comparison with philanthropic grant funding. This chart does include infrastructure-related grants.

Source: Analysis by California Environmental Associates, 2018. Prepared for “Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making,” 2019.

The proportion of fisheries-related funding as a share of all marine ODA funding was relatively stable during 2010-2016.

Marine ODA grant funding by purpose code, 2010-2016 (commitment amount, in USD millions)

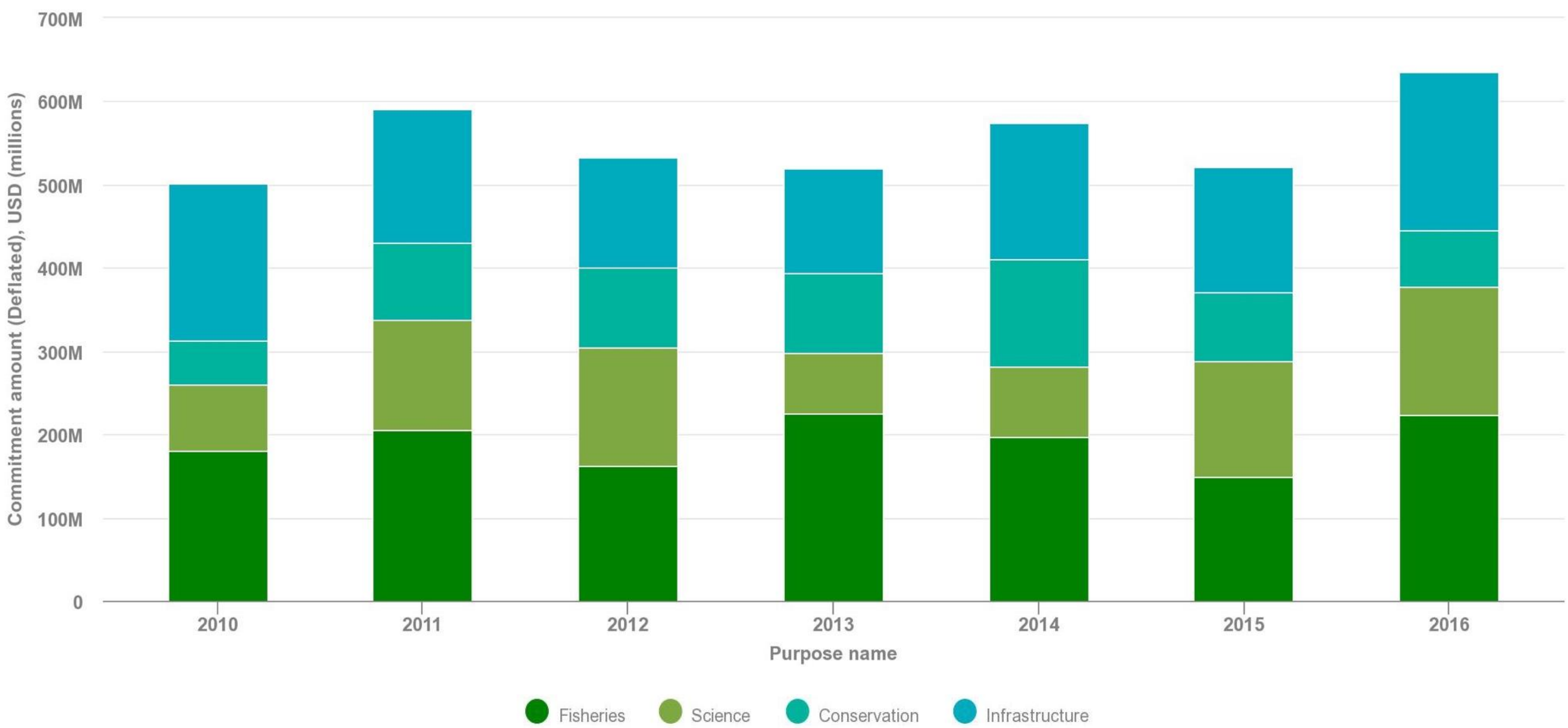


Note: Among flow types, this chart includes grants only. This chart does include infrastructure-related grants.

Source: Analysis by California Environmental Associates, 2018. Prepared for “Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making,” 2019.

Fisheries made up 35% of funding of all marine ODA funding during 2010-2016, followed by infrastructure (29%), science (20%), and conservation (16%).

Annual marine ODA grant funding by category, 2010-2016 (in USD millions)



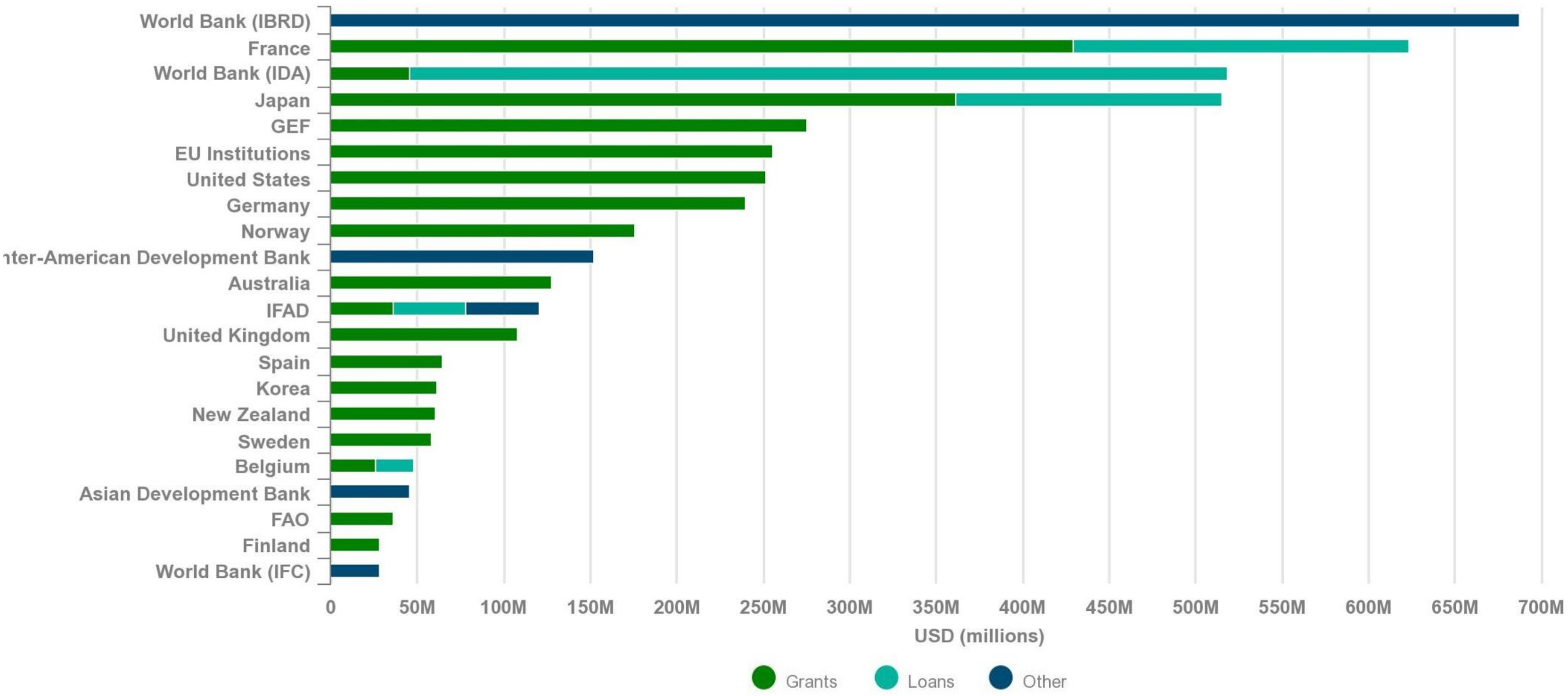
Note: Among flow types, this chart includes grants only. This chart does include infrastructure-related grants.

Source: Analysis by California Environmental Associates, 2018. Prepared for "Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making," 2019.

Considering all funding flows (grants, loans, export credits), the World Bank and France were the two leading funders of marine-related ODA during 2010-2016.

As the leading funder, the World Bank's International Bank for Reconstruction and Development (IBRD) provided USD 687 million to middle-income and creditworthy low-income countries during 2010-2016.

Leading donors of marine ODA funding, 2010-2016 (in USD millions)



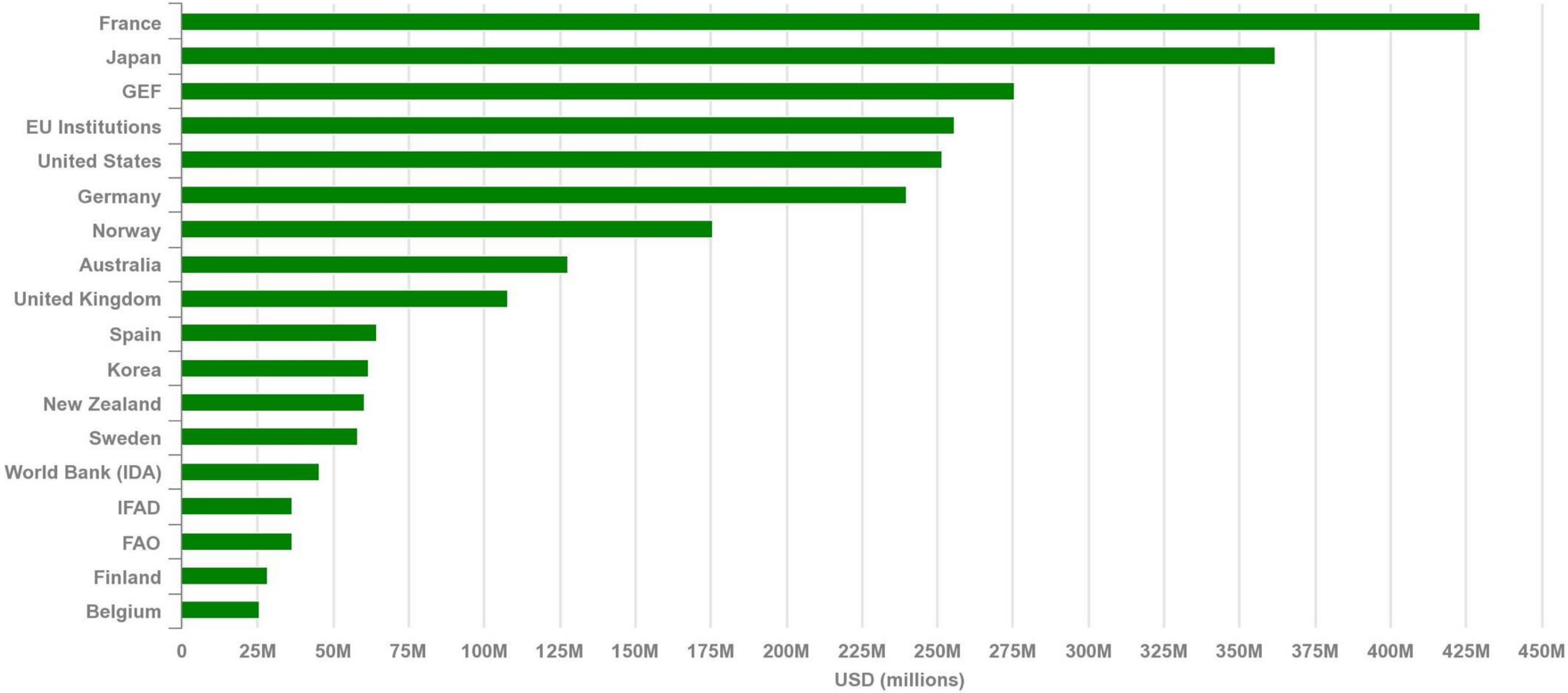
Note: This chart includes all flow types (i.e., grants, loans, export credits). Among purpose codes, the following categories are included: fisheries, conservation, and science. Infrastructure is excluded.

Source: Analysis by California Environmental Associates, 2018. Prepared for "Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making," 2019.

When grants alone are considered, the leading funders of marine ODA funding during 2010-2016 were France, Japan, and the Global Environmental Facility.

France contributed roughly USD 430 million in marine-related ODA grants during 2010-2016.

Leading donors of marine ODA grant funding, 2010-2016 (in USD millions)



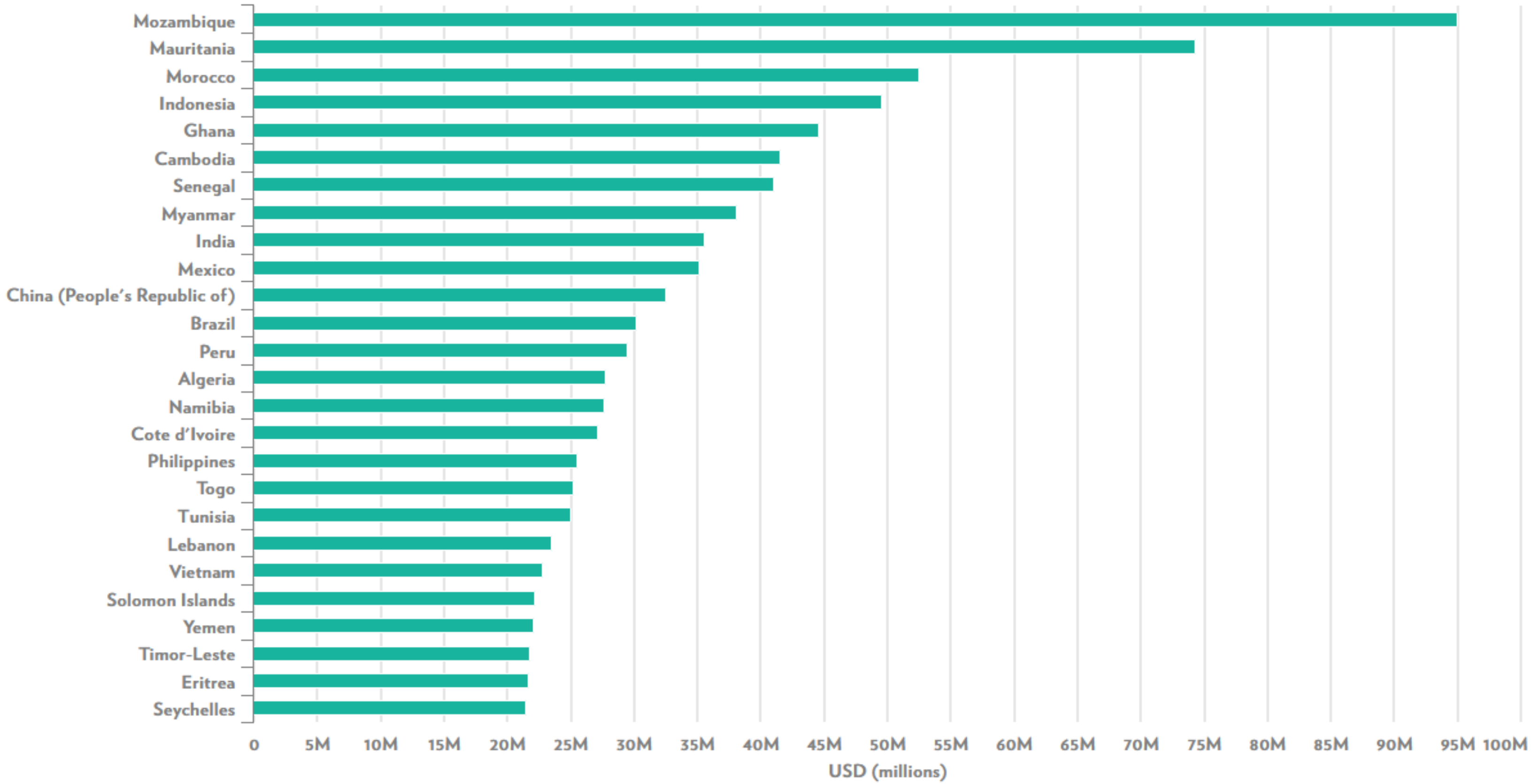
Note: This chart includes only grants; it excludes loans and export credits. Among purpose codes, the following categories are included: fisheries, conservation, and science. Infrastructure is excluded.

Source: Analysis by California Environmental Associates, 2018. Prepared for “Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making,” 2019.

At a country level, the main recipients of marine ODA grants are primarily located in Africa and Asia.

Mozambique and Mauritania received the largest share of funding at USD 95 million and USD 74 million, respectively, during 2010-2016.

Largest country recipients of marine ODA grants, 2010-2016 (in USD millions)

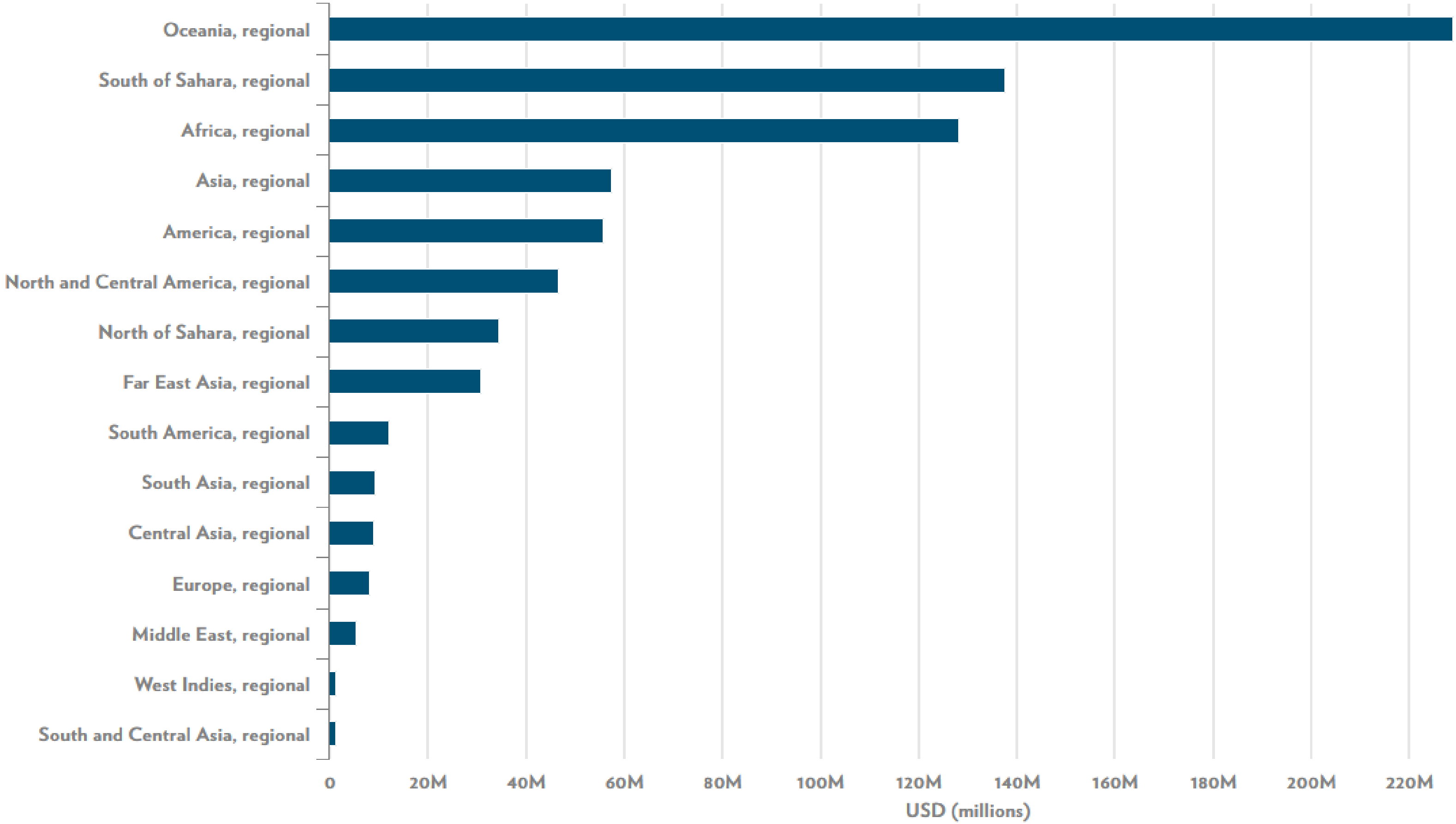


Note: ODA funding in the OECD database is categorized such that if a grant is provided to one country, it is attributed to that country. If a grant is provided to multiple countries, it is attributed to a region or subregion. This method is to avoid double counting. As such, the country and regional charts shown here should be interpreted as a corresponding set, rather than as two divisions of the same data. This chart includes grant-related flow types; it excludes infrastructure-related grants, as well as loans and export credits.

Source: Analysis by California Environmental Associates, 2018. Prepared for "Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making," 2019.

At the regional level, Oceania received the largest share of marine ODA funding during 2010-2016, at USD 229 million.

Largest regional recipients of marine ODA grants, 2010-2016 (in USD millions)



Note: ODA funding in the OECD database is categorized such that if a grant is provided to one country, it is attributed to that country. If a grant is provided to multiple countries, it is attributed to a region or subregion. This method is to avoid double counting. As such, the country and regional charts shown here should be interpreted as a corresponding set, rather than as two divisions of the same data. This chart includes grant-related flow types; it excludes infrastructure-related grants, as well as loans and exports credits.

Source: Analysis by California Environmental Associates, 2018. Prepared for “Our Shared Seas: Global Ocean Data and Trends for Informed Decision Making,” 2019.

the David & Lucile Packard FOUNDATION

The David and Lucile Packard Foundation is a private family foundation created in 1964 by David Packard (1912–1996), cofounder of the Hewlett-Packard Company, and Lucile Salter Packard (1914–1987). The Foundation provides grants to nonprofit organizations in the following program areas: Conservation and Science; Population and Reproductive Health; Children, Families, and Communities; and Local Grantmaking. The Foundation makes national and international grants and also has a special focus on the Northern California counties of San Benito, San Mateo, Santa Clara, Santa Cruz and Monterey. Today, the Packard Foundation's ocean investments are focused in six countries and on a suite of global strategies that together offer great potential for accelerating positive change. Learn more at www.packard.org.

CEA CONSULTING

Since 1984, California Environmental Associates (CEA) has supported the work of environmental foundations and nonprofits as well as sustainability-oriented businesses with in-depth research and analysis, program design and evaluation, and strategic planning. Learn more at www.ceaconsulting.com.

Please use the following citation when referencing this project as a body of work:

CEA Consulting. 2019. "Our Shared Seas: Global ocean data and trends for informed action and decision-making."