



Empty nets

How overfishing risks leaving investors stranded



The Fish Tracker Initiative investigates the role that financial institutions play in financing the trade in global fisheries, with the aim of aligning capital markets with sustainable fisheries management. Fish Tracker sits within Investor Watch, a non-profit company established in 2009 to align capital markets with the goal of social and ecological sustainability.

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Asia Research and Engagement (ARE)

Leading investors, banks, companies, and not-for-profits work with ARE to advance dialogue on sustainability and governance issues. ARE supports these organisations with a network of partners and researchers across Asia that provide in depth analysis of the financial relevance of sustainability and governance issues.

Sea Around Us

The Sea Around Us is a research initiative at The University of British Columbia (located at the Institute for the Oceans and Fisheries) that assesses the impact of fisheries on the marine ecosystems of the world, and offers mitigating solutions to a range of stakeholders.

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01

Overfishing is placing pressure on ocean ecosystems. 31% of fisheries are overfished. 58% cannot increase their catches sustainably

02

Aquaculture supplies half of the fish for human consumption, but relies on wild-catch for feed

03

Seafood accounts for 17% of animal protein consumed world-wide

04

228 companies on world stock markets have exposure to seafood production

05

Their combined seafood revenues of \$70.6 billion represent between 8% and 23% of reported global production volumes

06

Only 10% provide a publicly disclosed sustainability policy

07

Only 16% provide sufficient information for investors to identify the species harvested and their source, which means they can't evaluate environmental risks

08

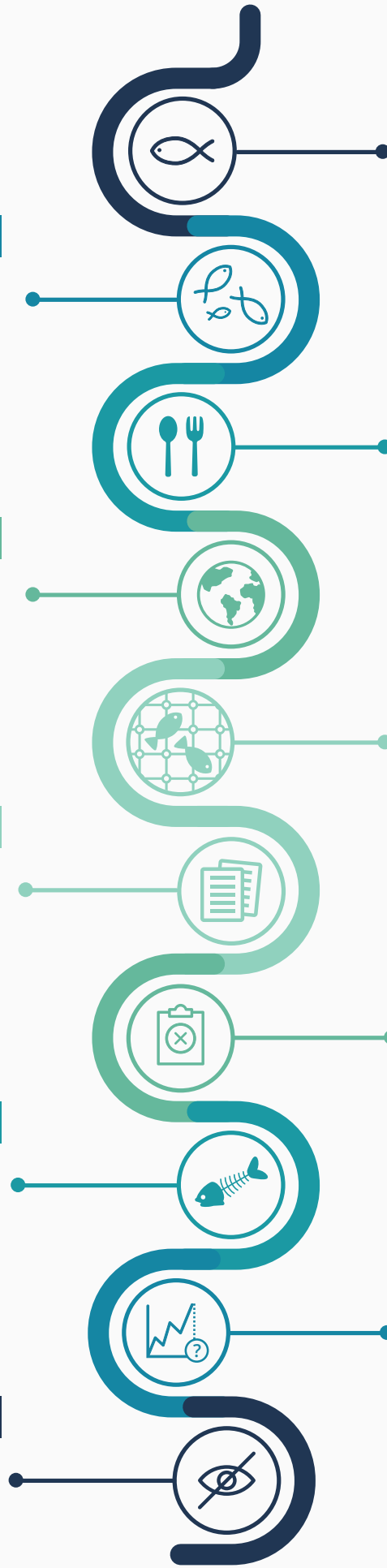
Of the 19 largest fishing companies by revenue, over 30% of their targeted stocks are overfished

09

Most companies have not confronted the threat they face from overfishing

10

Investors can look for better risk management through enhanced disclosure and stronger sustainability standards



Contents

Introducing the Fish Tracker Initiative	1
Executive Summary	3
01. Introduction	6
Performance and challenges	6
Risks from overfishing	9
The equity markets and fisheries	10
The listed seafood universe	11
02. Seafood sourcing and sustainability	14
Sustainability: how is the fishing conducted?	16
03. Understanding geographical exposure by market	18
Evaluating listed companies' share of fish production	19
Comparing market exposure and national production	22
04. Connecting revenues, fisheries and over fishing	24
Linking companies to fisheries	24
Assessing fishery health	26
Linking overfishing to visibility and sustainability	26
Assessing company exposure	27
Case Study: Yellow fin tuna in the Indian Ocean	29
Case Study: Sajodaerim Corporation	30
05. Towards a sustainable fishing sector	31
Seafood sustainability strategy	31
A financial disclosure framework for seafood	32
Connecting fish stock assessments to company revenues	32
Conclusion	33
Framework for Sustainable Seafood Disclosure	34
Recommendations by actor	35
The Fish Tracker Initiative: Next Steps	37
Appendix 1: Selecting listed companies with seafood production exposure	38
Appendix 2: Companies in the Global Listed Seafood Universe	41
Appendix 3: Estimating seafood revenues	44
Appendix 4: Sustainability of fish stocks	49
Appendix 5: Sustainability profiles of the top 10 seafood companies by revenue	52
Appendix 6: Case Study: Sustainable fishing: Menhaden and the Omega Protein Corporation	62
Appendix 7: Proposed strategies, sustainability policies and standards	65
References	68

Introducing the Fish Tracker Initiative

The purpose of this report is to begin the process of aligning the world's capital markets with the sustainable management of fisheries and aquaculture. This is the first output of the Fish Tracker Initiative and one, we hope, that will stimulate a range of activities to transform the relationship between those who provide capital and those in the sector who utilise it.

Our current model of finance continues to operate an extractive relationship with the planet that sustains us, failing to recognise critical ecological limits. In fisheries, with almost 90% of the world's fish stocks now fully fished or over fished, it is imperative those who invest in the sector act now to ensure it operates within planetary boundaries and stops depleting the natural resources on which it depends.¹

The Fish Tracker Initiative was established in 2016 to make the connections between capital markets and the state of the world's fisheries crystal clear. It drew inspiration from the Carbon Tracker Initiative which has brought new insights to the climate agenda by translating an abstract carbon budget into hard financial implications for investors in fossil fuel corporations, generating a new narrative of unburnable carbon, stranded assets and wasted capital in the process. Like Carbon Tracker, the aim of Fish Tracker is to reveal the financial implications that the science of breaching environmental limits has for investors in companies engaged in seafood production activity. And, like Carbon Tracker, Fish Tracker will operate as a financially rooted think-tank, pooling the expertise of seasoned financial market professionals with environment, industry and scientific experts.

Until now, the links between the crisis in global fisheries and the investment community have not been clearly drawn. This report presents the first-ever quantitative assessment of the exposure to seafood across the companies listed on the world's stock markets. Other asset classes also carry exposure to sustainability risks in the world's oceans – but shareholders in publicly listed companies can expect both that the companies in which they invest should be transparent and that they should respond to the legitimate concerns of their beneficial owners. Seafood represents a particular challenge for this kind of analysis; as a sector it is complex, opaque, lacking in available data and heterogeneous.

We are delighted to work with our partners, Asia Research and Engagement (ARE), which has provided the core analysis that underpins this report, and The Sea Around Us, which has provided detailed technical inputs. Finally, we would like to thank our expert advisory committee for their guidance, encouragement and counsel.

Time is not on our side. To avoid the impending catastrophe in our marine environment, we need to re-wire our financial system at a scale and speed not experienced to date. We hope this first report from the Fish Tracker Initiative provides practical insights and inspiration to finance and fisheries professionals alike, so that each of us can play our part in this essential transformation.

Mark Campanale
Chair, the Fish Tracker Initiative

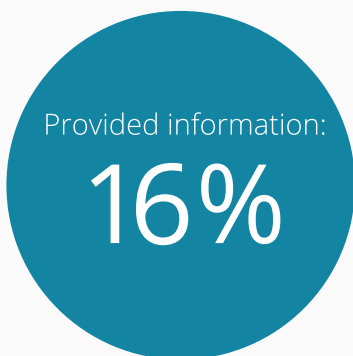
Key Findings



There are 228 companies listed on the world's stock markets with exposure to seafood production, with seafood revenues of \$70.6 billion.

We have identified the first global universe of listed companies with seafood activities that can be exposed to sustainability risks, including from over-fishing.

We estimate that their combined seafood revenues of \$70.6 billion represent between 8% and 23% of reported global production volumes.



Only 16% of these listed seafood companies provide sufficient information for investors to understand sourcing and product mix.

The ability of investors to evaluate the materiality of environmental risks for these 228 companies is constrained by a lack of information.

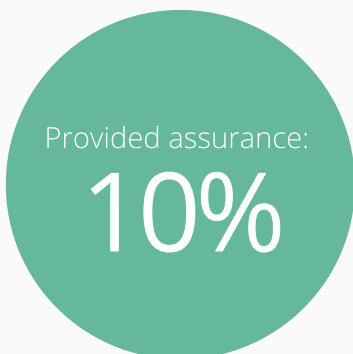
Poor disclosure from the companies means that investors cannot identify sources of seafood. We found that only 16% of companies provide enough information for investors to properly understand sourcing and product mix.



Eleven out of 19 companies with the most significant fishing exposure have direct links to fisheries where there is overexploitation.

Despite the disclosure challenges, we were able to link 19 of the companies with the most significant fishing exposure to many of their sources.

We found that 11 out of these 19 had links to fish stocks where overfishing was occurring.



Only 10% of companies provide assurance to investors and customers through a publicly disclosed sustainability policy.

Considerable work is still required to integrate sustainability management into corporate practice. Despite growing risks associated with seafood production, we found that only 10% of companies provided assurance to investors and customers through a publicly disclosed sustainability policy. The good news is that a growing number of large companies have begun to take steps on the journey.

Executive Summary

The world's oceans are one of mankind's most important shared resources, providing a critical source of protein. But there is increasing scientific evidence that marine seafood resources are being overexploited, leading to the risk that key fisheries could collapse, with associated environmental, social and economic impacts.

The Fish Tracker Initiative sought to better understand the role of listed companies in seafood extraction, to help identify opportunities and risks for investors with exposure to the sector.

This has resulted in the creation of **the first universe of listed companies with exposure to seafood production activities, numbering 228 companies with consolidated seafood revenues of \$70.6 billion according to our estimates.**

Poor transparency, poor policies

Disclosure among these companies is poor. **Only 16% of these listed seafood companies provide sufficient information for investors to understand the sourcing of the fish and the product mix.** This constrains the ability of investors to evaluate the materiality of environmental and social risks for these 228 companies.

Similarly, **only 10% of companies provide assurance to investors and customers through a publicly disclosed sustainability policy.** Considerable work is still required to integrate sustainability management into corporate practice in the sector. The good news is that a growing number of large companies have begun to take steps on the journey.

We also sought to understand the geographical distribution of seafood revenues for listed companies, and the share of fish production that these companies account for. **Seafood revenues are highly concentrated in a small number of stock markets:** Japan, Norway, Thailand, Chile, and South Korea account for over 77% of total estimated listed company seafood revenues, with Japan alone accounting for 46% of the total.

However, listed companies account for a minority of fish production - we believe between 8% and 23% of global production volumes in 2014. Private firms, local fisherman and individuals conduct the majority of fishing, farming and processing activity.

Fishing companies at risk

Limited disclosure by seafood companies makes it highly challenging to accurately link company production and revenue figures to national and global seafood production figures. It is also difficult to draw connections between individual company revenues from seafood and fisheries that are over-fished or at risk of overexploitation.

To overcome these challenges, we used vessel registrations filed with Regional Fisheries Management Organisations. We were able to link the 19 companies with the highest direct fishing revenues to many of their sources. **11 out of 19 companies with the most significant fishing exposure have direct links to fisheries where there is current overexploitation.**

These findings highlight sustainability risk exposure in the seafood sector, alongside insufficient evidence of good management.

The sustainable seafood opportunity

There is growing global demand for seafood with limited supply, creating major opportunities for profitable investment in the sector. Yet these profits will only be realised if resources are managed with long-term sustainability considerations in mind.

Investors need to better understand the sustainability of fish stocks and hence revenues of companies with seafood exposures. Our research has found poor levels of voluntary disclosure and inadequate regulatory requirements. The sector needs to embrace sustainability policies and frameworks for adequate disclosure.

Policies and disclosure

Investors have a long-term interest in ensuring that the companies in which they invest are sustainably exploiting the fisheries on which they depend. To do so, investors should ask **companies to adopt sustainability policies and practices that address the suite of environmental and social challenges faced by the sector.**

Such policies include commitments to remove illegal, unreported and unregulated fishing from seafood value chains, to adopt certification and traceability practices, and to introduce appropriate labour standards. These steps are set out in this report, and we note that all the suggested policies steps are being followed by at least some of the companies on the global listed seafood companies list.

Investors and companies in the sector would benefit from improved levels of disclosure. **The Task Force on Climate-related Financial Disclosures offers a framework for disclosure that might be adapted to the seafood sector.**

It provides a framework for disclosure focusing on governance, strategy, risk management, and metrics and targets, all of which are applicable to the seafood sector.

Recommendations

The report provides recommendations for various actors at the intersection between oceans and capital markets to support a transition to sustainable seafood. Our recommendations focus on three areas: sustainability policy, transparency, and linking fisheries to company revenues.

Investors: Encourage companies to adopt strategies for sustainable seafood, taking account of risks and opportunities, and linking scientific assessments of fish stock health to company revenues. There would be a significant benefit for industry to create a broader standard for disclosure of these policies and timelines, ideally in a consultative process with a broad array of stakeholders.

Financial regulators: Ensure relevant listing rules require companies to provide material public disclosure on sustainability issues, including exposure to fisheries resources and their status of exploitation.

Seafood industry regulators: Incorporate investor and lender perspectives in the design and implementation of policies for sustainable seafood, and promote improved reporting of fisheries data.

Civil society organisations: Aggregate sustainability policy efforts, and further develop fisheries methodologies developed during Fish Tracker's research.

Next steps

This first report provides an overview of seafood exposure in equity capital markets, with a focus on fishing related risks. The Fish Tracker Initiative will explore further areas in future reports, including: deepening wild-catch fisheries analysis, extending analysis to aquaculture; reviewing downstream activities, with more detail on processing; and broadening the financial analysis through considering the seafood sector's use of debt.

01. Introduction

Highlights

- Strong demand for seafood creates a potentially attractive opportunity for investors. However, the sector faces significant sustainability risks, notably from fisheries facing overexploitation
- We have constructed the first universe of publicly listed companies to assist equity investors assess unmanaged sustainability risks within the seafood sector
- We have identified 228 companies with consolidated seafood production and processing revenues of \$70.6 billion

Oceans are a critical source of protein and the demand for seafood is set to increase, outpacing human population growth as growing prosperity allows more people to meet their nutritional needs with seafood. At the same time, ocean health and the fisheries that support seafood production are under severe pressure, notably from overfishing and other unsustainable practices.

Greenhouse gas emissions are exacerbating the environmental challenges to the world's oceans. The oceans are not only warming due to climate change, but they are also absorbing around a quarter of carbon emissions, leading to ocean acidification. This adds pressure to fisheries and aquaculture as well as to ocean biodiversity more broadly.

Performance and challenges

Strong demand for seafood has the potential to create strong returns for shareholders. The ten largest aquaculture companies with a five-year total shareholder return figure available on Bloomberg recorded an average return of 422%, while the ten largest fishing companies recorded an average return of 84% - this compares with 78% for the MSCI World Index. The sample sizes are small, making it hard to draw general conclusions. Nevertheless, the stark performance gap points to differences in the underlying business models, with tougher growth and greater risks for the fishing companies.

Table 1 presents some of the challenges, including overfishing, human rights, disease management, and broader governance issues.

Table 1: Examples of value destruction in seafood

Issue	Example	Description
Overfishing	Atlantic Cod	One of the best examples of the economic impact of overfishing remains the case of Atlantic cod caught off Newfoundland, where the stock collapsed following significant overfishing, affecting fishers and their associated communities. The value of landings declined from a 1987 peak of \$980 million (in 2010 US dollars) to \$20 million eight years later. Production has not recovered and revenues from this fishery have not exceeded \$100 million since 1999.
Overfishing	China Tuna Industry	China Tuna Industry tried to float on the Hong Kong Stock Exchange in September 2014. Greenpeace wrote a letter to the stock exchange outlining significant overfishing risks regarding the company. The offering was subsequently withdrawn by the company.
Disease	Shrimp - Thailand	Where farms are sited too near each other, diseases can spread. This created major problems for the Thai shrimp industry, beginning in 2011. Production fell from 630,000 tonnes in 2011 to under 300,000 tonnes in 2014.
Disease	Salmon - Chile	Atlantic salmon production in Chile faced significant disease problems, with production falling from 390,000 tonnes in 2008 to 120,000 tonnes in 2010, leading to a reduction of farm-gate value of more than \$1 billion. The fishery has subsequently recovered.
Human rights	Thai seafood	In 2015, the EU issued a 'yellow card' warning to Thailand relating to human rights issues in the seafood industry, noting failings in its legal framework and its monitoring, control and traceability systems. Without improvement, the next step is a red card, which would ban Thailand from exporting seafood to the EU, its biggest export market.
Overleverage	Pacific Andes	Pacific Andes International Holdings, Pacific Andes Resources Development, and China Fishery Group had share trading suspended in November 2015 following court orders to appoint provisional liquidators to China Fishery Group. This began a long period of bankruptcy proceedings from which the company has yet to emerge. Among the many factors involved was the volatility of the stocks of Peruvian anchoveta, following a strong El Niño, and concerns of overfishing.
Financial reporting	Pescanova	The company claimed revenues of €1.67 billion in 2011 and profits of €50 million. However, at the end of 2012 it failed to file its annual report on time. The shares were suspended and the company filed for bankruptcy. A forensic audit found the company had significantly overstated its previous revenues and was in fact loss-making. It had also hidden significant debts. Following restructuring and a write down of €2 billion of its €3.6 billion debt, shares in the company started trading again in June 2017.
Governance	Mozambique tuna bond	In 2013, Mozambique's state-owned fishing company, Ematum, borrowed \$850 million from two international banks to finance an expansion of its fishing fleet. These debts were securitised and sold as "tuna bonds". However, the company spent some of the money on patrol boats and drones and failed to develop a commercial enterprise, and subsequently defaulted. The Mozambique government had guaranteed the bonds, but was not able to make payments. Following refinancing, the country defaulted again on payments in 2017.

Source: various news reports

Definition: Aquaculture and fishing

Throughout the report, we use aquaculture and fishing to describe a range of activities.



Aquaculture, also known as aquafarming or fish farming, is the farming of fish and other marine animals, including shellfish as well as algae and aquatic plants. This includes cultivation in fresh water or seawater and in self-contained or closed systems, or in open systems where water moves freely between the aquaculture facility and the environment.

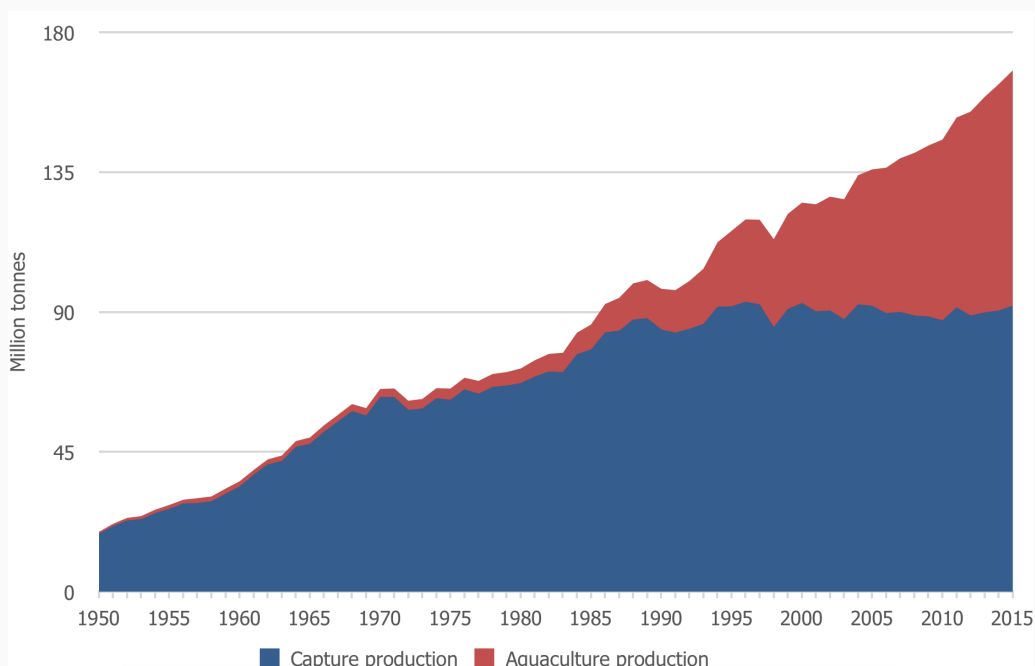


Fishing describes the harvesting of fish from a wild fishery. The terms wild-catch, wild-caught and wild-capture also relate to this production activity. This activity may occur in fresh water or in the ocean, either around coasts within exclusive economic zones or on the high seas, which is ocean beyond the jurisdiction of any country.

Risks from overfishing

Overfishing and damaging fishing practices present a significant challenge to ocean ecosystems and the fishing industry. According to the UN Food and Agriculture Organization (FAO), wild marine capture peaked more than 20 years ago in 1996 at 86.4 million tonnes and has declined since then.^{2,3} As Figure 1 shows, aquaculture has accounted for the recent growth in seafood production.

Figure 1: World capture fisheries and aquaculture production

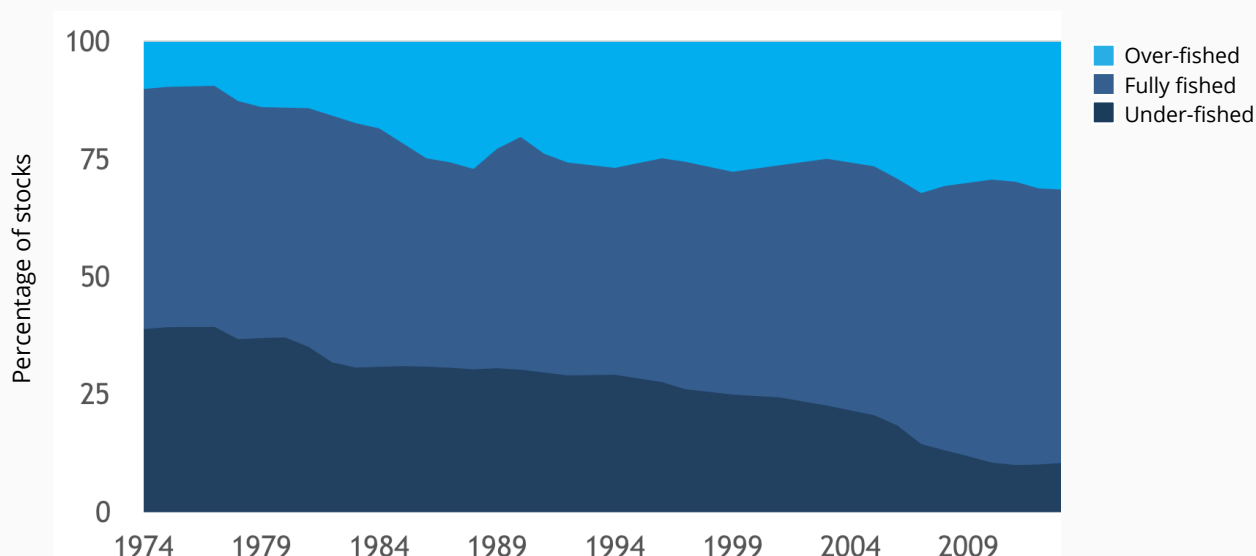


Source: FAO^{3,4}

The FAO reports that 31% of fisheries are overfished and a further 58% are fully fished, up from 10% and 51% respectively in 1974.¹ This is leading to declines in fishery productivity; if fisheries were allowed to recover, then were managed to produce the optimum economic yield, they would generate around \$80 billion more each year, according to the World Bank.⁵

Aquaculture also relies, in part, on wild-caught fish to feed farmed fish. This indirectly draws on fisheries and presents a long-term risk to the industry.⁶

Figure 2: Global trends in the state of world marine fish stocks since 1974



Source: Adapted from FAO¹

The short-term pressure to increase production rather than adopt longer-term, value-maximising strategies is a major problem, particularly for wild-catch fisheries beyond the 200-mile limit of countries' exclusive economic zones. Here it is harder to enforce regulation and co-ordinate disparate parties. This can create incentives to exploit resources quickly – before a competitor does – rather than patiently working to develop a fishery.

For some species, such as bluefin tuna, scarcity has resulted in a price premium, compensating fishers for the extra effort they must exert to find fish. In many other cases, overfishing has simply led to declines in fish stocks and the destruction of economic value.

Definition: Overfishing, over-fished and fully-fished



Overfishing refers to a current rate of fishing which produces a harvest larger than that required to allow the fishery to operate at maximum sustainable yield (see following text box).

Over-fished describes the state of a fishery when its biomass has dropped below a prescribed threshold – we have defined the threshold as that required to produce maximum sustainable yield.

An over-fished fishery may be recovering or may continue to experience overfishing, and so become further depleted.

Fully-fished refers to the state of a fishery when no additional increases in yield are possible without compromising future yields.

The equity markets and fisheries

This report surveys seafood production from an equity capital markets perspective, with a focus on fishing. It aims to help investors identify unmanaged sustainability risks for companies in their portfolios. Overfishing is a major issue, but it is only one of the challenges companies face. Poor disclosure of the risks from overfishing or sustainability more broadly mean that investors may be over-valuing – or, indeed, undervaluing – the companies involved.

Fishing companies face the clearest risks where they target over-fished stocks. This is most obvious in the event of a collapse in the fish stocks involved. There are also risks present, as well as issues of performance, where a fish stock is below the maximum sustainable yield and so below the optimum in terms of the financial return generated. Companies may be able to redeploy their boats to other fisheries or reconfigure them to fish other species, but such switching comes at a cost and is not always possible, given the declining number of under-fished fisheries available.

Our research aims to help investors in seafood through:

- Identifying which listed companies have exposure to seafood production and processing;
- Setting out the state of transparency regarding sustainability issues within the sector; and
- Providing insight into links between listed companies and overexploited fisheries.

Definition: Maximum sustainable yield



Maximum Sustainable Yield (MSY) is the largest yield or catch that can be taken from a fishery over an indefinite period. MSY is considered an upper limit for fishery management, as opposed to a target level. When fished at this level, a population is able to breed at its maximum rate.

MSY is the most widely accepted and, in terms of data, the most available method of assessing environmental limits for fisheries. Existing data sets mean that estimates for MSY are available for many of the world's fisheries.

Where a fish stock's biomass is below MSY then, theoretically, it can only be exploited at below optimum levels over the long term. Conversely, if a stock's biomass is at MSY, it can be exploited at optimum levels. If a stock's biomass is above MSY and it is being under-fished, then surplus stock is available.

This study has adopted MSY as the most appropriate assessment measure of fish stock sustainability because it is the most widely accepted measure of the sustainability of fish stocks and because MSY assessments have direct implications for fishery economics.

The listed seafood universe

Our starting point was the creation of a universe of listed companies with seafood production and processing activities. We used this to estimate total listed seafood revenues and understand their geographical distribution. We selected companies involved in the harvesting and processing of fish.

Fishing, aquaculture and processing have different types of risks. Consequently, we assessed each company to determine the split of seafood revenue by source. We used four categories:

- Direct fishing, where the company owns or controls the vessels;
- Third-party fishing, where the company sources wild-caught fish from another party;
- Direct aquaculture, where the company owns the farms; and
- Third-party aquaculture, where the company sources the farmed seafood from another party.

Figure 3 shows the primary seafood activities captured in the activities of companies in the universe. We included consumer-related seafood revenues only when they were pure-play seafood companies or when companies had consumer revenues alongside upstream activities. Consequently, the significant seafood revenues from supermarkets and restaurants were generally excluded. We have set out the process for generating the list in Appendix 1, the full list of companies in Appendix 2 and the revenue estimation process in Appendix 3.

Figure 3: Seafood activities



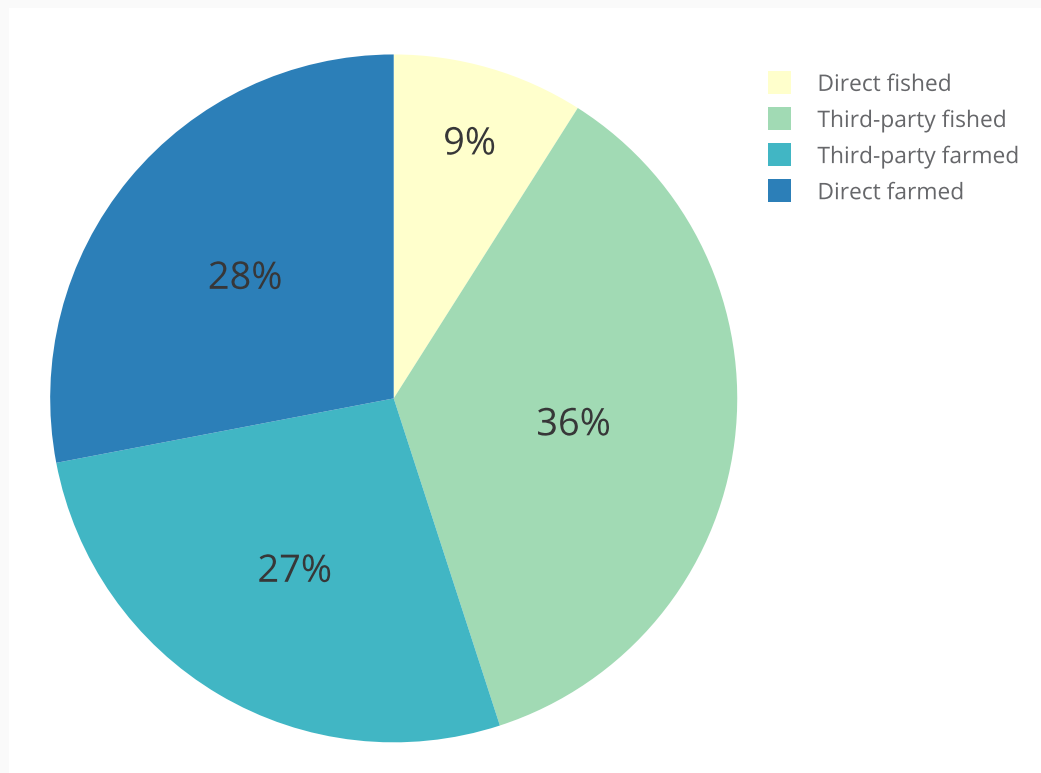
We identified a total of 218 distinct business groups with exposure to seafood production and processing, comprising 228 listed companies, with a combined market cap of \$518 billion as of June 2017. We estimate that these companies had combined, and consolidated, seafood revenues of \$70.6 billion over the 2015-16 financial year, out of total revenues of \$473 billion.

Table 2: The global listed seafood universe: key statistics

Criteria	Value
Companies covered	228
Total market cap all companies	\$518 billion
Total revenues for all companies	\$473 billion
Estimated consolidated seafood revenues	\$70.6 billion
Number of companies with direct fishing revenues	43
Number of companies with fishing associated revenues	162
Fishing associated revenues	\$32.0 billion
> Of which direct fishing	\$6.5 billion
> Of which third-party fishing	\$25.5 billion
Aquaculture associated revenues	\$38.7 billion
> Of which direct aquaculture	\$19.7 billion
> Of which third-party aquaculture	\$18.9 billion
Note 1: While there are 228 listed companies, we identified that 10 of these had a parent in the group, consequently we present estimates of consolidated revenues.	
Note 2: The revenue elements do not sum due to rounding	

The lack of disclosure makes it difficult to accurately estimate seafood revenues. It is even harder to link revenues to sources – whether wild-caught or aquaculture and whether own-harvested or sourced from third parties (see Appendix 3 for the full approach and Section 4, where we cover revenue transparency). Consequently, these numbers should be used as a broad context for assessing risks and opportunities and not considered as precise set of estimates.

Figure 4: Proportion of fishing and farmed revenues



Estimated direct fishing revenues totalled \$6.5 billion, which was 9% of overall seafood revenues. This compares to direct aquaculture revenues, which we estimated at \$19.7 billion, or 28% of the total. More broadly, we estimated fishing associated revenue (wild-caught from own or third-party operations) at 45% and aquaculture associated revenues (direct farmed or third-party farmed) at 55% of the total.

02. Seafood sourcing and sustainability

Highlights

- To understand the sustainability of seafood revenues, investors need information on **where** companies are sourcing their fish and **how** they are fishing
- We could identify species and sources from just 16% of the companies in our universe of listed seafood companies, relating to 18% of the overall revenues – this lack of information prevents investors from independently confirming that seafood is from sustainable sources
- We found that only 10% of the companies in our universe, accounting for 21% of total seafood revenues, disclosed a detailed sustainability policy. This means that few companies provide assurance to investors that their sources of seafood are sustainable

In the current context of chronic over-fishing and growing sustainability risks in aquaculture, the best way for investors to assess sourcing risks at seafood companies is through independently verifying the sustainability of the major sources of supply of the companies in which they invest.

We used the questions in the box below to determine whether listed companies in our universe provided enough information to perform this assessment. We described a company as providing revenue disclosure by source only when the answer was “yes” for each of the applicable questions.

Assessing seafood company transparency



We assessed a seafood company as providing transparency on its sources of supply if we could answer “yes” for each of the following applicable questions:

All companies:

- Does the company provide a figure for seafood revenues?

Fishing:

- In which FAO areas are target fish captured?
- Is more granular data (smaller areas) for capture locations disclosed?
- Is the list of species provided?
- Does the company provide specific names for species where the common name could relate to several different species?

- Does the company provide revenue figures for all main species?

Farming:

- Does the company disclose where the farms are located?
- Does the company disclose what species are farmed?
- Does the company provide revenue figures for all main species?

Third-party sourcing for processing:

- Does the company disclose the proportions of revenues from third-party sources?

The results are summarised by country in Table 4. Overall, just 16% of the companies in our universe, accounting for 18% of the overall revenues, provided enough information to fully assess sourcing risks related to seafood revenues.

In line with broader trends in sustainability disclosure, companies listed on developed market exchanges – such as those in Norway, Canada, Australia and Iceland – tended to have higher levels of transparency and were more likely to have sustainable seafood policies in place.

The exceptions were Japan and South Korea, where different traditions of shareholding and corporate governance have historically placed less of an emphasis on public disclosure. Vietnam provides an exception in the opposite direction as many of the companies operate single-species aquaculture companies, providing farm locations.

In many cases, revenue disclosure was so poor it was not possible to identify key species sold. Without legal or regulatory disclosure requirements, aggregate data combining species sold, catch area and quantities may be treated as commercially sensitive and not disclosed, even when the individual items sold are fully traceable for the consumer.

There were further complications for companies with multiple business activities. Often there was no clear breakdown of seafood revenues. We adopted a range of estimation processes to tackle the various cases, as provided in Appendix 3. There are also significant obstacles for international investors in that many companies provide far less information in English than in their home language.

We have included a more detailed assessment for the top ten seafood companies in Appendix 5.

Table 3: Revenue visibility for the top 15 countries, by revenues and by number of companies

Country	Consolidated seafood revenues (\$m)	Companies	Revenues with source visibility (\$m)	Percent	Companies with source visibility	Percent
Japan	32,699	40	0	0%	0	0%
Norway	9,308	11	6,732	72%	7	64%
Thailand	6,570	9	215	3%	1	11%
Chile	3,055	11	1,110	36%	3	27%
South Korea	2,864	12	0	0%	0	0%
China and Hong Kong	2,858	18	269	9%	2	11%
Vietnam	2,116	25	1,174	55%	5	20%
Canada	1,419	3	1,419	100%	2	67%
US	1,330	7	323	24%	3	43%
Denmark	1,314	1	0	0%	0	0%
Indonesia	1,238	9	0	0%	0	0%
South Africa	936	5	0	0%	0	0%
Australia	534	7	513	96%	5	71%
Iceland	493	2	222	45%	1	50%
Greece	478	4	0	0%	0	0%
Sum of top 15	67,213	164	11,977	18%	29	18%
Total study	70,618	228	12,617	18%	37	16%

Sustainability: how is the fishing conducted?

Investors also need to see that the companies in which they invest have comprehensive policies to address material sustainability factors. These include exposures to risks facing specific fish stocks as well as a broader suite of issues that can create social tensions and reputational problems. We used the questions in the text box to determine whether companies have a publicly disclosed sustainable seafood policy. We described a company as having a sustainable seafood policy only when the answer was “yes” for each of the applicable questions.

Sustainability policies in the seafood universe



A seafood company was deemed to have adopted a sustainable seafood policy if we could answer “yes” for each of the following applicable questions:

- Does the company refer in its disclosures to use of sustainable sourcing standards, such as those developed by the Aquatic Stewardship Council or the Marine Stewardship Council?
- Does the company include commitments to use these standards across all its operations (sourcing and/or production)?
- Does the company have a commitment to traceability?
- If the policy does not cover 100% of sourcing, does the company provide a clear explanation for the gap in coverage (e.g. because certified products are not available in a region, or because no relevant standard has yet been developed for a particular species)?

Only 22 (10%) of the companies in our universe, generating 21% of total seafood revenues, met these criteria. In many cases, the policies were not yet fully implemented, implying a far lower proportion of activities that actually met sustainability standards. Overall the companies provided very limited assurance to investors or to stakeholders that they are managing material sustainability risks. Nevertheless, some companies are engaging in new initiatives to improve sustainability performance such as the SeaBOS initiative (see boxed text below).

Table 4: Sustainability disclosure for top 15 countries, by revenues and by number of companies (2016 or latest available reporting)

Country	Consolidated seafood revenues (\$m)	Companies	Revenues with policy disclosure (\$m)	Percent	Companies with policy disclosure	Percent
Japan	32,699	40	1,119	3%	1	3%
Norway	9,308	11	6,536	70%	6	55%
Thailand	6,570	9	1,948	30%	1	11%
Chile	3,055	11	0	0%	0	0%
South Korea	2,864	12	0	0%	0	0%
China and Hong Kong	2,858	18	0	0%	0	0%
Vietnam	2,116	25	871	41%	3	12%
Canada	1,419	3	956	67%	1	33%
US	1,330	7	1,217	91%	2	29%
Denmark	1,314	1	1,314	100%	1	100%
Indonesia	1,238	9	0	0%	0	0%
South Africa	936	5	149	16%	1	20%
Australia	534	7	331	62%	2	29%
Iceland	493	2	0	0%	0	0%
Greece	478	4	0	0%	0	0%
Sum of top 15	67,213	164	14,439	21%	18	11%
Total study	70,618	228	15,085	21%	22	10%

The SeaBOS initiative

www.keystonedialogues.earth



Seafood Business for Ocean Stewardship (SeaBOS) is an initiative with the aim of leading a global transformation towards sustainable seafood production and a healthy ocean.

SeaBOS arose from the first Keystone Dialogue, where eight of the world's largest seafood companies met to discuss their concern about the current and future state of the ocean. The dialogue built on a unique analysis by the Stockholm Resilience Centre exploring the role of transnational corporations in shaping marine ecosystems.

The ambition of SeaBOS is to enable these "Keystone Corporations" to be forces for good, contributing to a resilient planet with marine ecosystems continuing to produce food of high quality for present and future generations.

Although SeaBOS supports enhanced sustainability by some of the world's largest seafood companies, we did not register company membership of SeaBOS as the same as a full policy in this analysis. However, we note that, as the companies involved take further steps, this will support an increase in sustainability reporting.

03. Understanding geographical exposure by market

Highlights

- Seafood revenues for listed companies are highly concentrated in certain stock markets
- The top five stock markets are Japan, Norway, Thailand, Chile and South Korea. These account for over 77% of total listed company seafood revenues; Japan alone accounts for 46% of the total
- Listed seafood companies account for between 8% and 23% of world fish production of 167.2 million tonnes

Listed company seafood revenues are highly geographically concentrated, with the largest market, Japan, making up 46% of the total and the top five markets comprising 77% of the global total, although they only account for 36% of the total number of companies.

Emerging markets are prominent in the list, making up eight of the top 15 countries and accounting for \$20 billion in revenues from 93 companies. These represent 30% of the top 15 country revenues and 57% of the number of companies.

Asia dominates the revenues statistics, even if Japan is excluded, highlighting the importance of investors and banks in this region for better capital allocation to the industry and as important stakeholders in the drive for sustainable seafood.

Companies based in emerging Asian markets have a much lower average turnover than their Japanese peers. For example, Vietnam has 25 listed companies of which only eight have seafood revenues above \$50 million. Ten companies, mostly small processing and import-export companies procuring raw supplies from third parties, have revenues below \$10 million. The 17 companies based in China and Hong Kong, meanwhile, are much larger and only one company has revenues below \$50 million.

Table 5: Top five countries for listed seafood revenues (2016 or latest available reporting)

Country	Seafood revenues	Companies	Percent of companies with source visibility	Percent of companies with sustainability policy
Japan	32,699	40	0%	3%
Norway	9,308	11	64%	55%
Thailand	6,570	9	11%	11%
Chile	3,055	11	27%	0%
South Korea	2,864	12	0%	0%
Sum of top 5	54,496	83	14%	10%
Total study	70,618	228	17%	10%

Evaluating listed companies' share of fish production

We also sought to place listed seafood revenues in context by comparing revenues from our universe with global seafood production figures. This proved hard to do, however. Companies in the universe typically do not provide volume-related data, while global seafood industry value estimates have different bases to the ones used to derive the listed company seafood revenue figure. Furthermore, it is impossible to match company production and distribution to national production or consumption data: many companies produce in one region and sell in a different one, both of which may be different from the region in which they are headquartered or listed.

Consequently, the research sought to identify an upper and lower limit for the underlying production volumes. We estimated underlying production from the listed seafood companies as lying between 13.6 million tonnes and 38.0 million tonnes. This represents between 8% and 23% of global production volumes in 2014. It will only be possible to provide a full analysis of production volumes when companies disclose better information.

First, total global first-sale value was estimated by combining the global aquaculture value calculated by FAO of over \$160 billion with a Sea Around Us estimate of the global landed catch value of wild-caught fish of \$151 billion. The total value of \$311 billion relates to the total production volume of 167.2 million tonnes in 2014.¹

The listed company seafood revenue figure of \$70.6 billion is 23% of this global figure. However, company revenues include significant value-added processing that is not present in the estimate of global production first-sale value.

1. Here, fisheries are deemed to include fishes, crustaceans, and molluscs and thus excludes reptiles, mammals, and other miscellaneous invertebrates and marine animal products.

Consequently, there is a reasonable argument that the underlying production volumes represented by the seafood revenue figure will be lower than this share of global production. In other words, the production volumes underlying their combined revenues should be less than 38.0 million tonnes, calculated as 23% of the world production of 167.2 million tonnes.

In order to factor processing and other value-added activities into the seafood value figures, we used an approach developed by Andrew Dyck and Rashid Sumaila of the University of British Columbia.⁷ This paper used an input-output model to identify the overall economic effects of the fisheries industry. It analysed the contributions of fisheries to various sectors, expressing its conclusions as multipliers of the initial production revenue. The multipliers varied by country, with an average global multiplier of 2.8.

If this multiplier is broadly similar for aquaculture, we can apply the average global multiplier to the global production value derived above of \$311 billion. The result is a measure of the contribution of seafood to the global economy of \$871 billion.

The company seafood revenues of \$70.6 billion are 8% of this figure. Applying this proportion to global seafood production suggests that the listed seafood companies' underlying production has a lower boundary of 13.6 million tonnes. However, the economic multiplier factors in many more types of economic activity than that undertaken by listed companies included in our seafood revenue estimates. Consequently, the share of underlying production volumes from the companies should be higher than this proportion of the value of seafood. Thus, we come to a range of 8-23% of world production from our universe of 228 companies.

In the following table, we applied the above analysis to the 15 markets with the highest listed company seafood revenues. This produced ranges of implied underlying production.

Table 6: Estimated underlying production accounted by listed seafood companies

Country	Number of companies	Implied range of production (million tonnes)
Japan	40	3.6 - 10
Norway	11	0.9 - 2.9
Thailand	9	1.5 - 3.2
Chile	11	0.3 - 0.8
South Korea	12	0.5 - 1.4
China & Hong Kong	18	0.5 - 1.7
Vietnam	25	0.4 - 1.3
Canada	3	0.1 - 0.5
US	7	0.2 - 0.7
Denmark	1	0.2 - 0.7
Indonesia	9	0.4 - 0.6
South Africa	5	0.3 - 1.0
Australia	7	0 - 0.1
Iceland	2	0.1 - 0.3
Greece	4	0 - 0.1
Sum of Top 15	164	9 - 25.3
Total study	228	13.6 - 38

Differences in value-added processing, in the value of species harvested and sales to pricier markets (in US dollar terms) also explain the varying relationship between revenues and estimated underlying production. For example, in our coarse estimation, the production by Thai companies appears 20% to 30% higher than their Norwegian peers, even though their aggregate turnover is only one third that of the Norwegian firms. Similarly, South Korea's production range is higher than Chile's, but it generates slightly lower revenues.

Comparing market exposure and national production

There is limited comparability between national production figures and the estimated production for the listed companies, many of which have both production and revenues in external markets. Nevertheless, we have included the figures to provide a sense of the scale of production for listed companies in the global context.

Five of the top 10 markets in terms of listed seafood revenues are also found in the ranking of the top 10 countries in terms of overall production: China, Japan, Norway, the USA and Vietnam. Overall, however, the ranking and components are strikingly different.

Table 7 presents the 2014 global fish production data provided by the FAO. This shows that China is by far the largest producer, with over 60 million tonnes, followed by Indonesia and India, each producing some 10 million tonnes. Japan – which has the largest equity market exposure to seafood revenues – ranks only seventh, with 4.3 million tonnes.

Table 7: The 10 largest fish producing countries, 2014 (million tonnes)

	Fished	Inland	Farmed	Total
China	14.8	2.3	45.5	62.6
Indonesia	6	0.4	4.3	10.7
India	3.4	1.3	4.9	9.6
Vietnam	2.7	0.2	3.4	6.3
USA	5	0	0.4	5.4
Myanmar	2.7	1.4	1	5
Japan	3.6	0	0.7	4.3
Russia	4	0.2	0.2	4.4
Norway	2.3	0	1.3	3.6
Peru	3.5	0	-	3.6
Sum of top 10	48.1	5.9	61.5	115.5
Global	81.5	11.9	73.8	167.2

Source: Adapted from FAO^{4,5}

The overall total is primarily different because private firms, local fisherman and individuals conduct the majority of fishing and farming activity and subsequent processing. Much of this production will not enter the supply chains for listed companies.

China is the largest example, simply because of the huge scale of the production activity that is not listed. Myanmar also illustrates the point: it is ranked sixth, with a total of 5 million tonnes produced, but it is absent from our list derived from listed company revenues as it remains a frontier market with respect to equity capital markets. Similarly, Indian and Russian seafood companies have not developed a significant independent presence in the public capital markets relative to their national production.

A further important source of difference is that our estimations attribute all revenues to the country in which the company is headquartered or where it conducts its principal activity. However, many companies harvest and produce overseas, breaking the link between the location of production activity and where the revenues are recorded in our estimation. For example, through its subsidiaries, Austevoll catches large amounts of Peruvian anchoveta for its fishmeal and fish oil production. However, we attributed these revenues and the implied production to Norway, where the parent is located.

This comparison shows that looking at the challenges of seafood sustainability through a capital markets lens can provide a different perspective to the country or species approaches, which are often used to understand fisheries sustainability.

04. Connecting revenues, fisheries and overfishing

Highlights

- Only six out of 19 companies with the most significant direct fishing activities provided sufficient information to determine the revenue contribution from their major fisheries
- Consequently, we analysed vessel registrations with regulators, finding 17 out of 19 companies with significant fishing activities have links to overexploited fisheries
- Exposure to overfishing ranged from 0% to 100% with an average of 13% for the 19 companies
- Just five of the 19 disclosed policies to address overfishing and other sustainability risks

A central question for investors is whether portfolio companies are fishing from overexploited fisheries. Where companies have significant catch from areas where overfishing is occurring, there is a risk that a decline in fish stocks will lead to a collapse in revenues. Even before losses are incurred from over-fished or collapsed stocks, companies that target over-fished stocks face substantial reputational risk.

Linking companies to fisheries

We analysed 19 of the companies with the highest direct fishing revenues for their links to overexploitation. This group had combined direct wild-caught revenues of \$5.0 billion.

To evaluate the outlook for fishing company revenues, investors need to understand which fisheries their fish come from. However, only six of the 19 companies assessed provided complete information on their fisheries (species name and fishing area).

Table 8: Overfishing exposure for leading wild-catch fishing companies (2016 or latest available reporting)

Company name	Country	Direct fishing revenues (\$m)	Proportion of stocks overfished (%)	Proportion of stocks with overfishing (%)	Revenue by source	Sustainability policy
Dongwon Industries	South Korea	677	35	9	N	N
Austevoll Seafood	Norway	664	44	22	N	N
Empresa Pesquera Eperva	Chile	569	40	0	N	N
Nippon Suisan Kaisha	Japan	347	19	0	N	N
Oceana Group	South Africa	292	21	0	N	N
Sajo Industries	South Korea	278	35	9	N	N
Omega Protein	US	276	0	0	Y	Y
Kyokuyo	South Korea	230	30	20	N	N
HB Grandi	Iceland	222	0	25	Y	N
Sajodaerim	South Korea	217	36	14	N	N
Clearwater Seafoods	Canada	214	40	0	Y	N
Avi	South Africa	149	47	33	N	Y
Sapmer	France (Réunion)	143	33	33	N	Y
Shanghai Kaichuang Marine	China	133	43	14	Y	N
Aker	Norway	117	0	0	Y	Y
Silla	South Korea	114	67	67	N	N
Sea Harvest Seafood	South Africa	111	25	0	N	Y
Sanford	New Zealand	106	9	9	Y	N
Grupo Herdez	Mexico	102	100	0	N	N

The main challenge was that companies used common names for the species they fished. In most cases, companies also used very broad geographical descriptions of sourcing. This created ambiguity over the species targeted and the fishery location, and thus fish stocks targeted. For example, nine of the 19 companies were engaged in tuna fishing – Dongwon Industries, Grupo Herdez, Kyokuyo, Sajo Industries, Sanford, Sapmer, Silla, Shanghai Kaichuang Marine and Sajodaerim. Some companies disclosed the tuna species. However, several companies simply reported ‘tuna’, in which case we assumed the major commercial tuna species (skipjack, yellowfin, albacore, bigeye and bluefin). Nevertheless, it was possible in many cases to infer the fisheries using general locations and common species names, where the species targeted were fundamentally restricted to specific areas.

We used the company disclosure to indicate a range of likely fisheries for each company and checked vessel registrations at Regional Fisheries Management Organisations (RFMOs) for those fisheries. This allowed us to infer strong associations between companies and target fisheries. In this manner, we linked a total of 97 fisheries to the 19 companies.

However, the companies typically did not provide volume or revenue information relating to the fisheries and this information is typically not available from RFMOs. Consequently, it was generally not possible to understand the relative importance of the fisheries to the companies.

Assessing fishery health

We used two measures of fishery health to assess the 97 fish stocks: biomass indicators, to assess whether current biomass is at or exceeding that required for maximum sustainable yield; and fishing mortality indicators, which consider current catch levels relative to sustainable exploitation rates.

28 fisheries had a healthy biomass indicator, while 26 were over-fished. Fishing mortality indicators showed 45 fisheries were currently experiencing healthy exploitation, and 12 fisheries were subject to overfishing.

Appendix 4 explains the methodology used to assess fishery health in detail.

Linking overfishing to visibility and sustainability

Table 8 shows the summary results for the 19 companies, expressed as the proportions of fisheries overfished or experiencing overfishing. The table also shows availability data for revenue by source and whether there was a detailed sustainability policy.

Only two companies, Omega Protein and Aker, had exposure only to fisheries with healthy biomass and no overfishing. For this reason, and for the fact that it is a strongly performing direct-fishing company, in appendix 6 we explore the case of Omega Protein. The remaining 17 companies all had significant exposure to overfished stocks. The average proportion of overfished fisheries was 33% for the 19 companies. The average proportion of fisheries at which overfishing was occurring was 13%.

Until companies provide more information, it will not be possible to calculate the volume of fish they are catching from each stock or their revenue mix from healthy versus overexploited stocks. As a result, we have to rely on an unweighted proportion of fisheries to have a sense of the scale of risks a company may face. Notably, companies can suffer reputation issues even where the levels of revenue associated with a particular fishery are very low. Consequently, investors should seek greater visibility over the links between revenue and fisheries to be able to more accurately assess the environmental and economic sustainability of investee companies.

Assessing company exposure

Table 9 provides further detail for the fishery assessments, showing for each company the proportion of fish stocks it targeted that have sustainable biomass and fishing mortality. 17 of the 19 companies were exposed to at least some over-fished stocks. 11 of the 19 were generating revenues from fisheries where overfishing is currently taking place. There were also significant levels of uncertainty, given that there is not sufficient information to assess the sustainability of 55 fisheries. Six companies, Austevoll, Empresa Pesquera Eperva, Clearwater, Sapmer, Silla and Grupo Herdez, were not exploiting any stocks that were clearly healthy.

We have also included the case study of Sajodaerim to illustrate a full company level assessment.

Table 9: Summary of stock health of top 19 wild-catch companies

Company	Stocks by biomass status (%)			Stocks by fishing mortality status (%)		
	Healthy Biomass	Uncertain	Overfished	Healthy Exploitation	Uncertain	Overfishing
Dongwon Industries	30	35	35	48	43	9
Austevoll Seafood	0	56	44	22	56	22
Empresa Pesquera Eperva	0	60	40	40	60	0
Nippon Suisan Kaisha	38	44	19	75	25	0
Oceana Group	43	36	21	86	14	0
Sajo Industries	30	35	35	48	43	9
Omega Protein	100	0	0	100	0	0
HB Grandi	40	60	0	40	20	40
Sajodaerim	29	36	36	21	64	14
Kyokuyo	30	40	30	30	50	20
Clearwater Seafoods	0	60	40	0	100	0
Avi	20	33	47	27	40	33
Sapmer	0	67	33	0	67	33
Shanghai Kaichuang Marine	29	29	43	43	43	14
Aker	100	0	0	100	0	0
Silla	0	33	67	0	33	67
Sea Harvest Seafood	50	25	25	50	50	0
Sanford	36	55	9	64	27	9
Grupo Herdez	0	0	100	0	100	0

Source: ISSF⁸, CCAMLR⁹, FishSource¹⁰⁻¹³, RAM Legacy Database¹⁴, South African Government¹⁵, Icelandic Government¹⁶⁻¹⁹, New Zealand Government^{20,21}, New South Wales Government²², Canadian Sources^{23,24}, Chilean Government²⁵, Seafood Watch²⁶⁻²⁸, US Government²⁹⁻³¹

Case studies

As illustrations of the methodology developed to link companies, fisheries and overfishing here we provide two case studies.

First, we provide a case study focusing on one fish stock, where five companies are fishing and where the analysis shows, on the current trajectory, fish stocks will continue to be depleted putting long term company revenues, and investor yields, at risk. Next we offer a case study on the company Sajodaerim as an illustration of the detailed fish stock analysis that has been undertaken on a company-by-company basis and where overfishing and exploitation of over-fished stocks have been identified.

Case Study: Yellowfin tuna in the Indian Ocean

Yellowfin tuna in the Indian Ocean is managed by the the Indian Ocean Tuna Commission (IOTC). Its most recent evaluation put the spawning stock biomass as below that which would yield maximum sustainable yield, and states that overfishing is continuing to occur.

We identified five listed companies with vessels registered to this fishery – Dongwon Industries, Kyokuyo, Sajo Industries, Sajodaerim Corporation and Sapmer. It is likely that other publicly traded companies in the listed seafood universe also fish or source from this stock.

Current catches are just above MSY, indicating minor overfishing. However, when compared with the already depleted biomass of the stock, the fishing mortality is much higher than levels that would allow the stock to rebuild (Table 10), and thus biomass continues to decline. Our assessment provides a more negative outlook than that reported by the IOTC, but is based on total biomass rather than spawning stock biomass.

If the IOTC intervenes, catches will have to be reduced in the coming years to rebuild the biomass to a sustainable level to maximise future catches. Therefore, companies that source tuna from this fishery can expect to see their revenues from Indian Ocean yellowfin decline in the near future. If action is not taken, the stock could be further depleted, jeopardising long-term yields.

Table 10: Fishing indicators of yellowfin tuna in the Indian Ocean

Biomass indicator	Calculated B / B_{MSY}	Reported SSB / SSB_{MSY}
Over-fished	0.4	0.89
Fishing indicator	Calculated F / F_{MSY}	Reported F / F_{MSY}
Overfishing	2.6	1.1

Source: ISSF ^{8,32}

Case Study: Sajodaerim Corporation

Sajodaerim Corporation, a South Korean fishing group, fishes cod in the North Pacific and tuna in the Indian and Pacific Oceans. While Sajodaerim reports ‘tuna’ fishing in the central Pacific Ocean, the company has tuna vessels registered in three RFMO regions, which cover the entire Pacific Ocean and the Indian Ocean. Consequently, we reviewed all the major tuna species overseen by these three RFMOs.

Sajodaerim’s cod fishery is assumed to be Pacific cod caught in the Northwest Pacific Ocean, as South Korea has fishing agreements to fish in Russian waters in this ocean basin. We thus treated this FAO area as the stock and evaluated it using the CMSY method.

On this basis, we found that Sajodaerim has substantial exposure to stocks that are over-

fished and, in some cases, overfishing is continuing. Out of 14 fisheries, five were overfished and overfishing is continuing in two cases. Detailed results are set out in Table 11.

However, the differences in model outputs also indicated significant uncertainties. Five of the biomass assessments were uncertain and for nine fisheries there was uncertainty over whether there was overfishing (this is partly linked to uncertainty over the status of the biomass). Notably, the company has the most vessels registered in the Eastern Pacific Ocean (managed by the IATTC), where two out of three tuna stocks are overfished.

Table 11: Detailed company fish stock analysis for Sajodaerim Corporation

Common name	Region	Biomass Indicator	Calculated	Reported	Fishing Mortality Indicator	Calculated	Reported
			B/B _{MSY}	SSB/SSB _{MSY}		F/F _{MSY}	F/F _{MSY}
Skipjack tuna	WCPFC	Uncertain	0.72	2.56	Uncertain	2.35	0.45
Albacore	South WCPFC	Healthy Biomass	1.21	2.22	Healthy exploitation	0.77	0.52
Albacore	North WCPFC	Healthy Biomass	1.27	2.22	Healthy exploitation	0.6	0.52
Yellowfin tuna	WCPFC	Uncertain	0.32	1.24	Uncertain	3.89	0.72
Bigeye tuna	WCPFC	Overfished	0.5	0.77	Overfishing	2.46	1.57
Bluefin tuna	WCPFC	Overfished	0.87	0.026	Uncertain	0.53	NA
Skipjack tuna	IATTC	Uncertain	0.49	1.01	Uncertain	3.49	0.99
Yellowfin tuna	IATTC	Overfished	0.92	0.95	Uncertain	1.08	0.98
Bigeye tuna	IATTC	Overfished	0.94	0.96	Uncertain	1.08	0.95
Skipjack tuna	IOTC	Uncertain	0.98	1.59	Uncertain	1.14	0.62
Albacore	IOTC	Healthy Biomass	1.2	1.8	Healthy exploitation	0.84	0.85
Yellowfin tuna	IOTC	Overfished	0.4	0.89	Overfishing	2.6	1.11
Bigeye tuna	IOTC	Uncertain	0.77	1.29	Uncertain	1.01	0.76
Pacific cod	FAO 61	Healthy Biomass	1.11	NA	Uncertain	0.86	NA

05. Towards a sustainable fishing sector

Highlights

- Seafood companies can reduce risk, drive long-term performance, and deliver improved environmental, social and governance outcomes through implementing sustainability policies transitioning to sustainable seafood
- We present a framework for companies to disclose to investors how they can capture benefits and avoid risks in the transition to sustainable seafood, based on the recommendations of the Task Force on Climate-related Financial Disclosure
- Linking the health of fish stocks to company revenues can provide investors with a new source of information to reduce risk and drive performance
- Investors, financial regulators, seafood companies, policymakers and civil society all have a role to play in the transition to a sustainable seafood sector

The findings of this work reveal significant unmanaged issues. Inaction may support short-term profitability, but overfishing continues and disease risks grow, thus diminishing the long-term economic potential for many companies. Investors and companies can play a stronger role in better management of seafood production, particularly fisheries, supporting resources with better economics that will benefit all parties.

Seafood sustainability strategy

Given the wider suite of sustainability issues facing the seafood sector and brought into focus through this report, companies and investors should address risks related to fishing and aquaculture in the context of their broader business strategy. In Appendix 7, we set out various activities that investors should look for, which are based on similar proposals in the 2011 report *The Future of Fish in Asia*.³³

These range from ensuring research and development and capital expenditure is directed towards developing sustainable business lines, and to developing traceability and certification standards for their sourcing. Investors will also want to ensure companies are safeguarding their reputation, particularly in relation to labour standards.

We note that all of these steps are being followed by at least some of the companies on the global listed seafood companies list. There are different, sometimes conflicting views of both appropriate company performance standards and the extent to which investors should push companies to meet them. Nevertheless, if seafood production is to be sustainable and ensure steady returns, then companies will need to adopt business strategies that incorporate most, if not all, of the suggested steps.

A financial disclosure framework for seafood

Our research has demonstrated that companies are not providing sufficient information for investors to assess material sustainability issues relating to seafood.

Consequently, we propose the framework below to support companies in their efforts to report to investors. This is based on the model recommended by the Task Force for Climate-related Financial Disclosure (TCFD). It focuses on governance, strategy, risk management, and metrics and targets.

We believe this framework could be developed into a commonly accepted standard, ideally through a consensus-driven process, led by industry and involving a broad range of stakeholders.

Connecting fish stock assessments to company revenues

Assessment of the risks posed by overfishing is essential if investors are to make informed decisions about how to deploy capital. By supporting companies to causally link fish stock assessments to revenues investors can get visibility of these risks. This process will produce data and insight that can then inform their decision making.

Investors and regulators may want to utilise the methodologies used in this work to assist companies and relevant stakeholders connect fish stock assessments to company revenues.

Conclusion

This report identified 228 listed companies with exposure to seafood production and processing activities with a combined market cap of \$518 billion and consolidated seafood revenues of \$70.6 billion.

These companies face significant risks relating to seafood and provide little transparency or assurance to investors. Only 16% provided sufficient information for investors to understand the sourcing of the fish and the product mix. This constrains the ability of investors to evaluate the materiality of environmental and social risks. Similarly, only 10% of companies provide assurance to investors and customers through a publicly disclosed sustainability policy.

Investors have a direct interest in addressing these issues. We hope that the methodologies, frameworks and recommendations provided in this report will help them to do so.

Governance

Companies can assure investors that senior decision-makers are considering sustainability by answering the following questions in their disclosure:

- How does the board oversee seafood sustainability risks and opportunities?
- How does management assess and manage sustainability risks and opportunities in the seafood business?

Strategy

Companies can assure investors that sustainability is appropriately factored into company strategy by addressing the following questions in their disclosure:

- What are the key sustainability risks and opportunities the company has identified over the short, medium and long term?
- How resilient is the company's strategy to significant declines in fish stocks or restrictions from regulators to manage fisheries from which the company sources fish?
- How do these risks and opportunities affect the company's strategy and financial planning?

Risk Management

Companies can assure investors that risk management processes appropriately consider sustainability by addressing the following questions:

- What are the company's processes for identifying and assessing sustainability risks?
- How are the processes for identifying, assessing and managing these risks integrated into the organisations overall risk management?
- What are the company's processes for managing these risks?

Metrics & Targets

Companies can provide assurance to investors that they are on track with sustainability management through disclosing appropriate metrics and targets. Of particular importance are the sources of seafood, including their underlying health, the volumes sourced, and the link to revenues. Broader questions companies might address include:

- What metrics does the company use to assess the identified risks and opportunities in line with strategy and risk management processes?
- How far has the company gone in linking revenues back to the sources of seafood?
- What are the targets used to steer the company away from risks and towards opportunities?

Recommendations by actor

Developing a widely applicable set of sustainability standards and a commonly accepted disclosure framework for the sector as part of a transition to sustainable seafood will require the involvement of a wide range of stakeholders, including seafood companies, investors, regulators, policymakers, and civil society groups. We recommend that:

Investors

Sustainability Policy

- Formulate an investment strategy for sustainable seafood, covering capital allocation, company engagement and policy dialogue
- Incorporate seafood sustainability assessments into financial analysis for relevant companies
- Engage with portfolio companies to improve management of seafood sustainability risks and opportunities

Transparency

- Identify companies with direct exposure to fishing, aquaculture and processing and those that operate downstream, such as food retail, restaurants, catering companies, hotels, airlines and pharmaceutical companies
- Engage with portfolio companies to improve seafood sustainability disclosure, including governance, strategy, risk management and metrics and targets

- Encourage relevant stock exchanges and capital market regulators to ensure adequate corporate disclosure relating to production and sourcing



Linking fisheries to revenues:

- Utilise the methodologies presented in this work to help companies and relevant stakeholders to connect fish stock assessments to company revenues

Financial Regulators

Sustainability Policy

- Support investor-industry engagement by facilitating dialogue related to sustainable seafood practices and performance

Transparency

- Ensure that relevant listing rules require companies to provide material public disclosure and price sensitive information, such as information related to seafood sourcing, including risks to long-term supply and the related management approach
- Ensure that authorities properly enforce listing rules related to material public disclosure and price sensitive information which, in the case of seafood, includes transparency over sources and management approaches to long-term supply risks



Linking fisheries to revenues:

- Ensure listing rules require that companies report exposure to fisheries resources and their status of exploitation where relevant
- Ensure listing rules require companies to provide evidence that exploited stocks are subject to accepted management regimes

Companies

Sustainability Policy

- Formulate strategy that takes account of sustainability related risks and opportunities, and implement appropriate systems of metrics and targets to execute the strategy

Transparency

- Ensure that boards have sufficient expertise to meet disclosure obligations and understand the relevant sustainability risk management challenges
- Report fisheries-related assets in sufficient detail to allow appropriate evaluation methods

Linking fisheries to revenues:

- Meet disclosure obligations in a substantive way, providing sufficient information to allow investors to link revenues back to sources

Seafood industry policymakers

Sustainability Policy

- Incorporate investor and lender perspectives in the design and implementation of policies for sustainable seafood
- Encourage financial innovation to ensure capital flows to companies with a commitment to sustainable seafood

Transparency

- Incorporate improved reporting of fisheries data associated with specific companies into policy development

Linking fisheries to revenues:

- Require companies to report their landings and estimated value (if processed directly) or first-sale value

Civil society organisations

Sustainability Policy

- Aggregate sustainability policy efforts, across civil society, to provide a coherent and comprehensive resource for the finance and fisheries sectors

Transparency

- Coordinate civil society efforts aimed at improving transparency and traceability, in particular those using electronic catch documentation, focusing on the potential for interoperable data

Linking fisheries to revenues:

- Further develop the methodology developed during Fish Tracker's research, exposing it to extensive peer review
- Make efforts to improve data related to single species, specifically biomass levels, spatially and as time series, where possible linked to beneficial ownership/ company activity



The Fish Tracker Initiative: Next Steps

This report provides a baseline from which institutional investors and other key stakeholders in the financial system can work towards sustainable seafood.

The first priority for the Fish Tracker Initiative will be to work with investors and banks, companies, analysts, regulators, scientists, academia and civil society to discuss and implement this report's recommendations.

We also plan to extend the work across five main areas:

Strengthening wild-catch fisheries analysis

We will deepen the analysis so that it includes, for instance, data available on illegal, unreported and unregulated fishing.

Extending analysis to aquaculture

We will carry out detailed analysis of aquaculture activity by publicly listed companies, building an investment universe and assessing performance.

Extending analysis to processing & retail

We will extend the analysis to cover the entire fisheries' value chain, which will expand the potential for engagement with institutional investors.

Focusing on non-equity finance in capital structures

We will explore the dynamics in debt financing, both in terms of bond issuance and bank lending, engaging a broader set of finance providers.

Collaborating to share data

We will work with a wide set of organisations to improve data protocols so that information can be broadly shared and used.

Concern is rising about the economic, social and environmental consequences of poor environmental practice across fishing and aquaculture. The financial dimension provides a new way of making progress towards sustainable seafood and the preservation of our oceans.

We invite you to join us on this journey.



Appendix 1: Selecting listed companies with seafood production exposure

We identified companies with seafood exposure through constructing a long list of companies from critical sectors from Bloomberg and then progressively selecting and refining the search. We checked the list against other available lists of seafood companies. The objective was to identify companies with fishing, aquaculture, or processing activities.

Constructing the long list

We derived a long list of companies involved in seafood in the following way:

1. We used the equity screening tool provided by Bloomberg to filter companies of interest. Starting with a universe of 378,162 companies, we first limited our research to actively traded companies, yielding 68,506 matches.
2. We then filtered this set by sector, capturing relevant food-producing and agricultural products companies combining three different classification systems:
 - The Bloomberg Industry Classification Standard (BICS), selecting the sub-sectors Agricultural Producers, Agricultural Products Wholesalers, Food Products Wholesalers and Packaged Food Manufacturing (2,578 results);
 - The Global Industry Classification Standard (GICS), selecting the sub-sectors Food Products, and Food & Staples Retailing (2,109 results); and
 - The Industry Classification Benchmark (ICB), selecting the sub-sector Food Producers (2,560 results).
3. We downloaded these three lists from Bloomberg together with their description field. We merged the lists, removing duplicate results. The resulting set yielded 3,057 companies.
4. We created a list of keywords related to seafood and searched for matches in the Bloomberg description field for each company. We selected those companies that incorporated at least one keyword, for a total of 1,420 companies.

5. The next selection involved reading each description to exclude false positives, where the description included the precise text of the search term, but the business was not strongly related to seafood. For example, “sea” included companies producing food seasonings and agriculture businesses undertaking research & development activities. The final list was reduced to 285 companies.
6. We compared this set of companies with other published lists of large seafood companies (including the Intrafish and Undercurrents annual reports) as well as other companies otherwise known to operate seafood business lines. This resulted in 11 unique additions, for a total of 296 companies. As we undertook the detailed research phase to establish company revenues, we found that on closer inspection some of these companies did not have seafood production exposure or were not actively traded. This resulted in a list of 242 companies.
7. Of these 242, further examination found that 14 companies had either been suspended or had a market capitalisation of zero. We excluded these companies, to create the list of 228 listed companies. Of these, 10 companies were subsidiaries of other companies within the universe, resulting in a list of 218 distinct businesses with seafood revenues.

There are two possible gaps in this process and we welcome feedback and suggestions for any companies we may have missed.

First, we may have overlooked companies that are in the principal sectors and have a seafood business, but one which is not significant enough in relation to the whole business to be mentioned in the Bloomberg description. We looked at a sample of 29 large businesses of this type to confirm whether they had seafood businesses to have a sense of how many companies we may have missed. This approach found only three relevant businesses. Mitsubishi has a domestic Japanese seafood business, which is small in relation to the entire business, but large in absolute terms for the seafood sector. Similarly, Nestlé produces fish and seafood products for consumers as part of its pet food operations. The Norwegian company ORKLA has one of Europe’s larger fish oil businesses, but this only represents around 1% of its total business. This process increased our confidence that we had not missed many businesses where seafood was both a significant proportion of the total revenues of a company and a large business in an absolute sense.

The second possible gap relates to companies not assigned by Bloomberg to the principal sectors that have significant seafood subsidiaries. While we used the Intrafish and Undercurrent lists to help locate these businesses, it is possible that we will have missed some others.

A word about numbers

The following table shows approximate numbers of companies at each point in the selection process. Aside from a few minor additions, each row is a subset of the rows above.

Table 12: Summary of companies identified at stages of creating the fisheries universe

Stage	Number of companies
Bloomberg actively traded companies	68,506
Publicly listed companies in selected sectors	3,057
Descriptions include a relevant word (including false positives)	1,420
Listed companies with relevant seafood involvement	242
Actively traded listed companies with seafood activities	228
Distinct seafood businesses	218

Source: Bloomberg

Appendix 2: Companies in the Global Listed Seafood Universe

Country	Company
South Africa	African Equity Empowerment Investments Limited
Japan	Ahjikan Co Ltd
Norway	Aker ASA
Japan	Albis Co Ltd
Philippines	Alliance Select Foods International Inc
Canada	Alta Natural Herbs & Supplements Ltd
Bangladesh	Aman Feed Ltd
Vietnam	An Giang Fisheries Import & Export JSC
Vietnam	Anvifish JSC
Finland	Apetit OYJ
UK	Aquatic Foods Group PLC
Thailand	Asian Seafoods Coldstorage PCL
UAE	ASMAK International Fish Farming Holding Co PJSC
Croatia	Atlantic Grupa
Norway	Atlantic Lumpus AS
Australia	Atlas Pearls and Perfumes Limited
Norway	Austevoll Seafood ASA
Peru	Austral Group SAA
Chile	Australis Seafoods SA
South Africa	AVI Ltd
Vietnam	Bac Lieu Fisheries JSC
China	Baiyang Investment Group Inc
Norway	Bakkafrost P/F
Bangladesh	Beach Hatchery Ltd
Switzerland	Bell AG
Vietnam	Bentre Aquaproduct Import and Export JSC
Namibia	Bidvest Namibia Ltd
Cyprus	Blue Island PLC
Chile	Blumar SA
Malaysia	Borneo Aqua Harvest Bhd
US	Borneo Industrial Fishery Corp Inc
South Africa	Brimstone Investment Corp Ltd
Vietnam	Cadovimex Seafood Import-Export & Processing Jsc
Vietnam	Camau Frozen Seafood Processing Import Export Corp
Jamaica	Caribbean Producers Jamaica Ltd
Malaysia	CCK Consolidated Holdings BHD

Country	Company
Indonesia	Central Proteina Prima Tbk PT
Philippines	Century Pacific Food Inc
Sri Lanka	Ceylon Grain Elevators PLC
China	CGN Nuclear Technology Development Co Ltd formerly China Dalian International Cooperation Group Holdings
Thailand	Charoen Pokphand Foods PCL
Singapore	China Fishery Group
Singapore	China Kangda Food Co Ltd
South Korea	China Ocean Resources Co Ltd
Japan	Chubu Suisan Co Ltd
Japan	Chuo Gyorui Co Ltd
South Korea	CJ Seafood Corp
Australia	Clean Seas Seafood Ltd
Canada	Clearwater Seafoods Inc
China	CNFC Overseas Fishery Co Ltd
Hong Kong	CP Pokphand Co Ltd
Vietnam	Cuu Long Fish JSC
China	Dahu Aquaculture Co Ltd
Japan	Daisui Co Ltd
Japan	Daito Gyorui Co Ltd
China	Dalian Tianbao Green Foods Co Ltd
China	Dalian Yi Qiao Sea Cucumber Co Ltd
Kuwait	Danah Al Safat Foodstuff Co KSC
Turkey	Dardanel Onentas Gida Sanayi A.S
Jamaica	Derrimon Trading Co Ltd
Indonesia	Dharma Samudera Fishing Industries Tbk PT
Oman	Dhofar Fisheries & Food Industries Co
South Korea	Dong Won Fisheries Co Ltd
South Korea	Dongwon F&B Co Ltd
South Korea	Dongwon Industries Co Ltd
Indonesia	Dua Putra Utama Makmur Tbk PT
Chile	Duncan FOX SA
Chile	Empresa Pesquera Eperva
Chile	Empresas AquaChile SA
Chile	Empresas Copec SA
Japan	Feed One Co Ltd
Indonesia	FKS Multi Agro Tbk PT

Country	Company
India	Flora Corp Ltd
Belgium	Floridienne SA
UAE	Foodco Holding PJSC
US	Foodfest International 2000 Inc
China	Foshan Haitian Flavoring and Food Co., Ltd
Australia	Freedom Foods Group Ltd
Germany	FRoSTA AG
China	Fujian Tianma Science & Technology Group Co Ltd
US	G Willi-Food International Ltd
Greece	Galaxidi Fish Farming SA
Bangladesh	Gemini Sea Food Ltd
Japan	Global Food Creators Co Ltd
Peru	Gloria SA
Poland	Graal SA
Norway	Grieg Seafood ASA
Mexico	Grupo Herdez SAB de CV
Japan	Hagoromo Foods Corp
Vietnam	Halong Canned Food JSC
South Korea	Hansung Enterprise Co
Japan	Hayashikane Sangyo Co Ltd
Iceland	HB Grandi
Japan	Higashimaru Co Ltd
Canada	High Liner Foods Inc
Vietnam	Hoang Long Group
Japan	Hohsui Corp
Hong Kong	Hong Kong Food Investment Holdings Ltd
Singapore	Hosen Group Ltd
Switzerland	Huegli Holding AG
Vietnam	Hung Hau Agricultural Corp
Vietnam	Hung Vuong Corp
Australia	Huon Aquaculture Group Ltd
Iceland	Iceland Seafood International hf
Japan	Ichimasa Kamaboko Co Ltd
Romania	International Caviar Corp SA Calan
Vietnam	International Development & Investment Corp
Indonesia	Inti Agri Resources Tbk PT
Chile	Invermar SA
Vietnam	Investment Commerce Fisheries Corp
Japan	ITochu Corp
Indonesia	Japfa Comfeed Indonesia Tbk PT
Saudi Arabia	Jazan Development Co
Turkey	Karsusan Karedeniz SU Urunleri Sanayii AS
Turkey	Kerevitas Gida Sanayi ve Ticaret AS
Vietnam	Khanh Hoa Seafoods Exporting JSC
Thailand	Kiang Huat Seagull Trading Frozen Food PCL

Country	Company
Thailand	Kuang Pei San Food Products PCL
Japan	Kyokuyo Co Ltd
Norway	Leroy Seafood Group ASA
Taiwan	Lian HWA Food Corp
Australia	MARETERRAM Ltd
Brazil	Marfrig Global Foods SA
Norway	Marine Harvest ASA
Japan	Marubeni Corp
Japan	Maruha Nichiro Corp
Japan	Maruichi Co Ltd
Japan	Maxvalu Kyushu Co Ltd
Vietnam	Mekong Fisheries JSC
Iraq	Middle East Producing & Marketing - Fish
Japan	Mitsubishi Corp
Japan	Mitsui & Co Ltd
Chile	Multiexport Foods SA
Australia	Murray Cod Australia Ltd
Russia	Nakhodka Active Marine Fishery Base PJSC
Vietnam	Nam Viet Corp
Bangladesh	National Feed Mill Ltd
Japan	Natori Co Ltd
Switzerland	Nestle SA
Israel	Neto Malinda Trading Ltd
Israel	Neto ME Holdings Ltd
US	New Global Energy Inc
New Zealand	New Zealand King Salmon Investments Ltd
Vietnam	Ngo Quyen Processing JSC
Japan	Nichimo Co Ltd
Japan	Nichirei Corp
Japan	Nihon Seima Co Ltd/The
China	Ningbo Tech-Bank Co Ltd
Japan	Nippon Suisan Kaisha Ltd
Greece	Nireus Aquaculture SA
US	Nomad Foods Ltd
Norway	Norway Royal Salmon ASA
South Africa	Oceana Group Ltd
Singapore	Oceanus Group Ltd
Singapore	Old Chang Kee Ltd
Oman	Oman Fisheries Co
US	Omega Protein Corp
Switzerland	Orior AG
Norway	Orkla ASA
Japan	OUG Holdings Inc
South Korea	Oyang Corp
Hong Kong	Pacific Andes International Holdings Ltd

Country	Company
Singapore	Pacific Andes Resources Development Ltd
Greece	Perseus SA
Spain	Pescanova
Chile	Pesquera Camanchaca SA
Peru	Pesquera Exalmar SAA
Chile	Pesquera Iquique-Guanaye
US	Pingtang Marine Enterprise Ltd
Estonia	PR Foods AS
Vietnam	Proximex Vietnam Jsc
Malaysia	QL Resources Bhd
Serbia	Ribarsko gazdinstvo ad Beograd
India	Ruia Aquaculture Farms Ltd
Russia	Russian Aquaculture PJSC
Thailand	S Khonkaen Foods PCL
Vietnam	Sagiang Import Export Corp
South Korea	Sajo Industries Co Ltd
South Korea	Sajo Seafood Co Ltd
South Korea	Sajodaerim Corp
Norway	Salmar ASA
New Zealand	Sanford Ltd/NZ
Vietnam	Sao Ta Foods JSC
France	Sapmer
Japan	Satoh & Co Ltd
Saudi Arabia	Saudi Fisheries Co
Denmark	Schouw & Co
Norway	Scottish Salmon Co Plc/The
South Africa	Sea Harvest Seafood Co
New Zealand	SeaDragon Ltd
Vietnam	Seafood JSC No 4
Thailand	Seafresh Industry PCL
Indonesia	Sekar Bumi Tbk PT
Indonesia	Sekar Laut Tbk PT
Poland	Seko SA
Greece	Selonda Aquaculture SA
China	Shandong Homey Aquatic Development Co Ltd
China	Shandong Oriental Ocean Sci-Tech Co Ltd
China	Shandong Zhonglu Oceanic Fisheries Co Ltd
China	Shanghai Kaichuang Marine International Co Ltd
China	Shanghai Laiyifen Co Ltd
Taiwan	Shin Tai Industry Co Ltd

Country	Company
Japan	Shinyei Kaisha
South Korea	Silla Co Ltd
South Korea	Silla SG Co Ltd
US	Sino Agro Food Inc
Chile	Sociedad Pesquera Coloso
Japan	Sojitz Corp
Thailand	Surapon Foods PCL
Australia	Tassal Group Ltd
Taiwan	Tekho Marine Biotech Co Ltd
Sri Lanka	Tess Agro PLC
Thailand	Thai Luxe Enterprises PCL
Thailand	Thai Union Group PCL
Japan	Tohto Suisan Co Ltd
Japan	Tokyo Ichiban Foods Co Ltd
China	Tongwei Co Ltd
Taiwan	Tosei Seafoods Co Ltd
Japan	Toyo Suisan Kaisha Ltd
Vietnam	Travel Investment & Seafood Development Corp
Thailand	Tropical Canning Thailand PCL
Japan	Tsukiji Uoichiba Co Ltd
Taiwan	Uni-President Enterprises Corp
India	Uniroyal Marine Exports
Japan	Uoki Co Ltd
Japan	Uoriki Co Ltd
Vietnam	Viet Nam Seaproducts JSC
Vietnam	Viet Nhat Seafood Corp
Vietnam	Vinh Hoan Corp
Indonesia	Wahana Pronatural Tbk PT
India	Waterbase Ltd
Poland	Wilbo Seafood SA
Israel	Willi Food Investments Ltd
South Korea	WooSung Feed Co Ltd
Malaysia	Xian Leng Holdings BHD
Japan	Yokohama Gyorui Co Ltd
Japan	Yokohama Maruuo Co Ltd
Japan	Yokohama Reito Co Ltd
Japan	Yonkyu Co Ltd
India	Zeal Aqua Ltd
China	Zhanjiang Guolian Aquatic Products Co Ltd
China	Zoneco Group Co Ltd (formerly Zhangzidao Group Co Ltd)



Appendix 3: Estimating seafood revenues

Seafood Revenues

Definition

We defined seafood revenues as any revenue from the sale of seafood and seafood-related products where the company has responsibility for harvesting, processing or manufacture. We did not include supermarket or restaurant revenues unless they were directly related to the company's own harvested produce and processing.

For the purposes of calculation, we typically included in the estimation other fish or marine products that are not directed to feed or human consumption – for example the capture or breeding of rare fish for aquariums.

Methodology

Where possible, we used company-provided figures derived from the latest annual report for sales of seafood products. When estimating seafood revenues, we used the methods in the following table. When using segment revenues, the sum of segments is often higher than the total revenues (because consolidation eliminates inter-segment sales), in estimating seafood or fishing revenues we would make an approximation to ensure that the estimations for the company did not exceed total revenues.

For fish feed, we typically assumed that all the ingredients were fish, even though there would typically be other vegetable ingredients.

Table 13: Scenarios for estimating seafood revenue

No.	Scenario	Methodology
A	All the company's revenues derive from seafood	Use the revenue figure from the consolidated income statement
B	The company has multiple product lines, including some products that are seafood but this is not discussed as a distinct business unit	<ol style="list-style-type: none"> 1. Check whether the company provides revenue for seafood products 2. If there is no seafood revenue breakdown, then assume all product lines are equally weighted and multiply total revenues (from the consolidated income statement) by the proportion of seafood product lines
C	There is a distinct business unit/segment/subsidiary that only sells seafood products	<ol style="list-style-type: none"> 1. Check whether the company provides seafood revenues, which are often in the segmental analysis in the annual report 2. If the company does not provide segment revenues for seafood, then check whether the subsidiary has a separate annual report that provides seafood revenues 3. If there is no company seafood revenue source, estimate seafood revenues by assuming all business units are equally weighted and divide the total revenues (from the consolidated income statement) by the number of business units
D	The company has a business unit/segment/subsidiary that sells both seafood and non-seafood products	<ol style="list-style-type: none"> 1. Check whether the company provides seafood revenues 2. If not, check whether the subsidiary has a separate annual report that provides seafood revenues 3. If there is no seafood breakdown, then check whether the revenues for the business unit are available. If so, then use an estimation based on proportion of products that are seafood, applied to the revenues for the business unit 4. If the revenue of the business unit is not available, then estimate it <ol style="list-style-type: none"> i) The first approach is to check whether there other relevant segmental information is available e.g. net assets or a profit line, and assume the business unit revenues are in the same proportion to total revenues as one of these line items. If there is no segmental information, then assume all business units are equally weighted ii) Subsequently estimate the proportion of the business unit's seafood sales using the proportion of total number of products that are seafood, applied to the estimated business unit revenues

Fishing Revenues

Definition

Direct fishing revenue: we defined this as the subset of seafood revenues harvested from wild sources, where the company or a subsidiary has used owned or leased equipment to harvest the seafood. We included revenues from wild catch at subsidiaries and associates in “own” wild-caught.

Third-party fishing revenue: we defined this as the subset of seafood revenues harvested from wild sources, where a third party harvested the seafood and the company procured the raw materials.

Fishing-associated revenue: we defined these as all seafood revenues where the seafood was harvested from wild sources, whether harvested by the company or procured from a third party – i.e. the sum of direct fishing revenue and third-party fishing revenue.

Methodology

Where possible, we used company provided figures for direct fishing and third-party fishing revenues. Our preferred source was the latest annual report, but if this did not provide sufficiently detailed information, we would use other company sources. When using segment revenues, we included inter-segment sales and did not adjust for any potential related margin on such sales.

Where we had to estimate fishing revenues, we first determined which scenario was applicable on the bases of the table below i.e. whether it had seafood from its own fishing operations, third-party fishing, own-aquaculture operations, or third-party aquaculture. It was not always possible to determine the scenario directly from the available disclosure and we used inferences from descriptions of assets and the type and nature of each company’s products to guide the choice of scenario. There were some companies from the long list that we excluded during this process as they had no seafood revenues or only had food retail/catering-related revenues.

We then used the assumptions relating to the scenario as set out in the following table to determine fishing and third-party fishing revenues. In some cases, there was a compelling reason to use a different assumption, in which case we recorded the process used. In some cases, fish quantities were available, rather than revenues. With these we estimated seafood revenues using unprocessed fish prices available at www.fis.com.

There were some scenarios that were borderline between direct fishing and third-party fishing. We included cases that referenced sharefishers, for example, where there had been financial support for boat acquisition, as third-party sources, though they share similar characteristics to direct fishing. For exclusive third-party contractual relationships (typical in Japan) we included these under direct fishing, rather than third-party fishing.

We recorded revenues in reported currencies and converted to US dollars where no figure was available. For the conversion, we used the average of the average monthly exchange rate from the local currency for the 12 months of the relevant financial year.

Table 14: Scenarios for determining direct fishing and direct aquaculture revenue

Scenario	Own fished	Third party fished	Own farmed	Third party farmed	Estimation method
A	X	0	0	0	All seafood revenues are fishing revenues
B	0	X	0	0	All seafood revenues are third party fishing revenues
C	X	X	0	0	Estimate by splitting seafood revenues equally between fishing revenues and third party fishing revenues
D	X	0	Z	Z	In this case, there are either own farmed or third party farmed, but not both. Estimate fishing revenues by dividing seafood revenues by two, unless there is a reason to attribute a lower portion to one or the other
E	0	X	Z	Z	In this case, there are either own farmed or third party farmed, but not both. Estimate third party fishing revenues by dividing seafood revenues by two, unless there is a reason to attribute a lower portion to one or the other
F	X	X	Z	Z	In this case, there are either own farmed or third party farmed, but not both. Estimate each of fishing revenues and third party fishing revenues by dividing seafood revenues by three
G	X	0	X	X	In this case, there are farmed fish and third party farmed fish. Estimate fishing revenues by dividing seafood revenues by three
H	0	X	X	X	In this case, there are farmed fish and third party farmed fish. Estimate third party fishing revenues by dividing seafood revenues by three
I	X	X	X	X	In this case, there are farmed fish and third party farmed fish. Estimate each of fishing revenues and third party revenues by dividing seafood revenue by four

X Refers to confirmed or inferred seafood revenues from this source

Z Indicates that there is either own farmed, or third party farmed, but not both

Calculating total seafood and fishing revenue

We calculated the seafood and fishing associated revenue figures as the sum of the company-level revenue figures after adjusting for double counting due to the presence of several parent/subsidiary pairs in the list. We did not try to adjust for double counting that could arise if one company sold raw materials to another for processing.

We did not try to model the effect on oceans from aquaculture in this study, although many forms of aquaculture have an ocean footprint as much of the feed for aquaculture comes from wild-caught fish. Fish feed may be wild-caught as a primary product – for example ocean harvest krill – or as a by-product from processing, or as bycatch where the fishing effort is primarily directed at another species and other non-target fish are turned into fish feed. In some cases, such as ranching of tuna, the young are captured from the wild and raised in pens, which again means there is an on-going reliance on ocean stocks.



Appendix 4: Sustainability of fish stocks

We assessed the sustainability of fish stocks using both published data and previously established catch-based indicators of fish stocks. The fishery evaluations used the Catch-Maximum Sustainable Yield (CMSY) model. For the model inputs, we used reported landings data from project partner the Sea Around Us, alongside reported data from relevant RFMOs, as well as biomass data from RFMOs and those collected in the RAM Legacy database.¹⁴

We compared our findings with stock assessments and fishery evaluations by the relevant fisheries management organisation. In many cases, the RFMO assessments used spawning stock biomass (SSB: the weight of a fish stock when they are old enough to spawn), as opposed to overall biomass. We relied on both sources to confirm the status of a fish stock's biomass and fishing mortality status. We used the CMSY method to evaluate the most recent data, especially as some full stock assessments are only conducted every few years (e.g. the last full stock assessment estimate for yellowfin tuna in the Western Central Pacific is from 2012).

We assigned indicators as follows:

Biomass indicator:

- Overfished – our assessment showed biomass at less than B_{MSY} and the reported stock assessment showed their biomass measure at less than B_{MSY}
- Uncertain – one, but not both, assessments indicated biomass at less than B_{MSY}
- Healthy Biomass – both assessments showed biomass above B_{MSY}

Fishing mortality indicator:

- Overfishing – both our assessment and the reported stock assessment showed mortality measures at greater than mortality at maximum sustainable yield
- Uncertain – one, but not both, assessments showed a mortality measure exceeding mortality at maximum sustainable yield
- Healthy exploitation – both assessments showed mortality below the rate at maximum sustainable yield

Catch-based MSY Indicators

We used methods provided in Froese et al. (2016) to estimate MSY levels for all the fisheries covered in this study.³⁴ This method estimates MSY based on target species' biological parameters, catch levels and known abundance information where available. This method is applicable to fisheries with limited abundance data, and can therefore be applied to all fisheries. We used the available catch data for a given geographic region to define the stock and used available supplementary information on the species and abundance levels to inform the Catch-MSY (CMSY) and associated Bayesian state-space implementation of the Schaefer model (BSM) calculations.^{34,35} Where possible, the results of the above methods were compared to any other existing research on the abundance and appropriate catch levels of these fisheries.

This method relies on assumed prior evaluations of the fish stocks under analysis. Specifically, it requires an estimated range of the maximum intrinsic rate of population increase ('r') and an estimate of the unexploited stock size ('k'), determined through multiple estimates of the stock size throughout the time series where catch data is available.³⁴ We used FishBase estimates of r, and determined k through the estimation methods suggested by Froese et al. (2016), and relying on existing stock and exploitation data.³⁴ We used relevant stock biomass data where possible including stock information collated in the RAM Legacy database.¹⁴

Stock and catch evaluation

We employed several common indicators to evaluate the results of stock assessments. First, we evaluated the current biomass level (B or BCURRENT) in relation to the biomass that would achieve maximum sustainable yields (B_{MSY}). If the value of B/B_{MSY} is greater than 1, the biomass is not overfished or overexploited. Alternatively, if the value of B/B_{MSY} is less than 1, the fish stock is overfished.

Similarly, we evaluated the current fishing mortality (F) compared to that needed to achieve MSY (F_{MSY}). When F/F_{MSY} is greater than 1, fishing mortality is exceeding levels needed to achieve MSY and thus overfishing is occurring. When F/F_{MSY} is less than 1, overfishing is not occurring. The difference between these two measures is that B/B_{MSY} evaluates whether the biomass is overfished, whereas F/F_{MSY} evaluates whether overfishing is currently occurring.

Table 15: Biomass (B) and fishing mortality (F) indicators used to determine the health of fisheries stocks in relation to MSY levels (B_{MSY} and F_{MSY} , respectively).

	$F/F_{MSY} < 1$	$F/F_{MSY} > 1$
$B/B_{MSY} > 1$	Healthy State	Overfishing (fish biomass is being depleted but is not below B_{MSY})
$B/B_{MSY} < 1$	Over-fished (fish biomass is depleted)	Over-fished and overfishing (fish biomass is depleted and is being depleted further)

Comparing Maximum Economic Yield with Maximum Sustainable Yield

The fishing effort and mortality to achieve Maximum Economic Yield (MEY) is known to occur at a point below that for MSY. For this reason, MEY is often promoted as a more precautionary approach to fisheries management. The enhanced returns are primarily because where fish are more abundant, less fishing effort is required to catch them, resulting in lower costs and a higher overall economic yield. Fisheries management policies applied at a global level to achieve MEY would result in much higher returns than the current state of fish stocks.^{5,36}

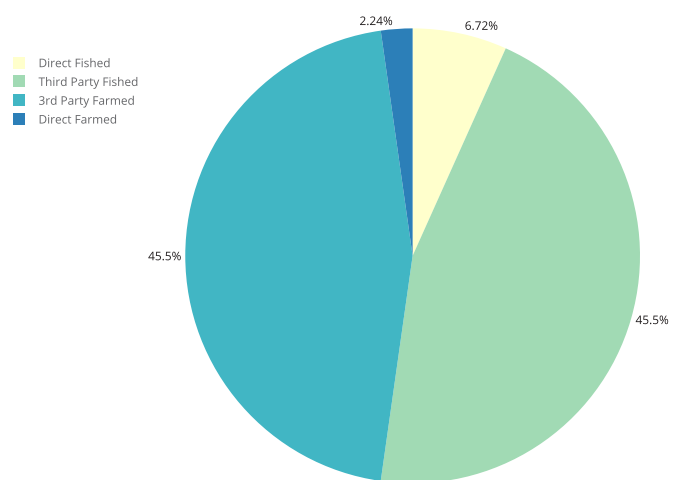
Complete calculations of MEY require intensive data collection for assessment of the stock as well as the price inputs and outputs of the fishery under study. Policymakers often avoid this problem through using broadly applicable rules to estimate MEY knowing that it occurs at a fishing mortality lower than MSY. For example, the Australian government, which manages federal fisheries according to the MEY principle, has set MEY values at 1.2 times the biomass that would achieve MSY (i.e., $B_{MEY} = 1.2 * B_{MSY}$). Other approaches estimate B_{MEY} at between 1.2 and 1.6 of B_{MSY} depending on the target species and economics of the fisheries studied.³⁶ We therefore follow these approaches and use the working hypothesis that the biomass levels needed to achieve MEY for the fisheries under study lie in the range of 1.2 to 1.6 times B_{MSY} .

Appendix 5: Sustainability profiles of the top 10 seafood companies by revenue

To provide greater granularity, we constructed brief sketches of the sustainability profile of the Top 10 listed seafood companies by revenue.

Maruha Nichiro

Seafood revenues:
\$7.5 billion



Revenue disclosed by source?
No

Farmed and fished quantities and values
Not available
We made assumptions for all relevant segments

Fish species and geography
Disclosure of main species sold and sourcing regions

Revenue breakdown by species and geography
Not available

Estimations
As there was little transparency we had to use assumptions and estimation processes to provide the breakdown of sources

Policy on sustainability?
No

Fishing
Not available

Farming
Not available

Third-party procurement
Not available

Facilities
Environmental management policy in place

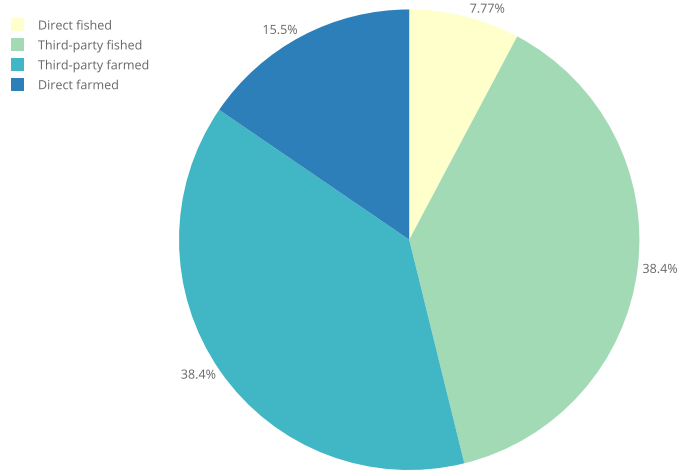
Comment
We could not find relevant sourcing policy in English on the company's website relating to production or sourcing standards

Maruha Nichiro is participating in the SeaBOS initiative

Nippon Suisan Kaisha

Seafood revenues:

\$4.5 billion



Revenue disclosed by source?

No

Farmed and fished quantities and values

Direct fishing and aquaculture revenues disclosed
We made assumptions for relevant value-added activities

Fish species and geography

Disclosure of main species sold and sourcing regions

Revenue breakdown by species and geography

Not available

Estimations

We resorted to estimations to exclude activities with significant revenues unrelated to seafood

Policy on sustainability?

No

Fishing

Testing phase of precision seafood harvesting fishing method.

Farming

Development of "complete aquaculture" cycle and targeting ASC certification

Third-party procurement

Not available

Facilities

Environmental management policy in place

Comment

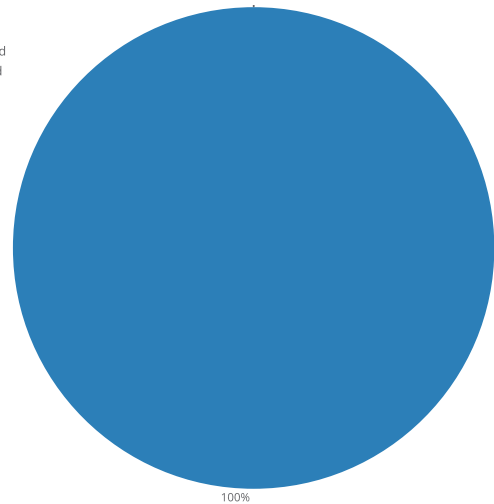
We found comments relating to some policy areas in English on the company's website

Nippon Suisan is participating in the SeaBOS initiative

Marine Harvest

Seafood revenues:
\$3.9 billion

Direct Fished
Third Party Fished
3rd Party Farmed
Direct Farmed



Revenue disclosed by source?

Yes

Farmed and fished quantities and values

Harvest tonnage and average price to benchmark disclosed

Fish species and geography

Farm sites and regions disclosed

Revenue breakdown by species and geography

Average price to benchmark by species and region disclosed

Estimations

Marine Harvest is an Atlantic salmon aquaculture company. All revenues were assumed originating from its farmed produce

Policy on sustainability?

Yes

Fishing

Not applicable

Farming

Fish feed sourced from suppliers adhering to sustainable practices

Third-party procurement

Not available

Facilities

Comprehensive sustainable operation management policy in place

Comment

The company aims to achieve 100% ASC certification by 2020, up from 38% of its sites in 2016

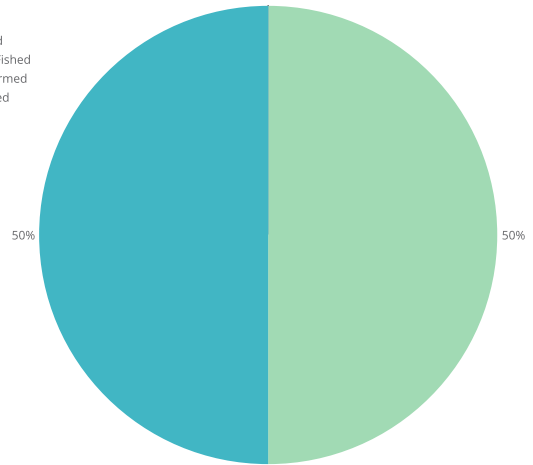
Marine Harvest is participating in the SeaBOS initiative

Thai Union

Seafood revenues:

\$3.8 billion

Direct Fished
Third Party Fished
3rd Party Farmed
Direct Farmed



Revenue disclosed by source?

No

Farmed and fished quantities and values

Not available

Fish species and geography

The company indicates fishing region of main species and countries with aquaculture operations

Revenue breakdown by species and geography

Not available

Estimations

As there was little transparency we had to use default assumptions to estimate the breakdown of sources.

Policy on sustainability?

Yes

Fishing

Not applicable

Farming

Not applicable

Third-party procurement

Targeting raw material traceability and higher proportion in certified species

Facilities

Emission, waste and water reduction policies disclosed

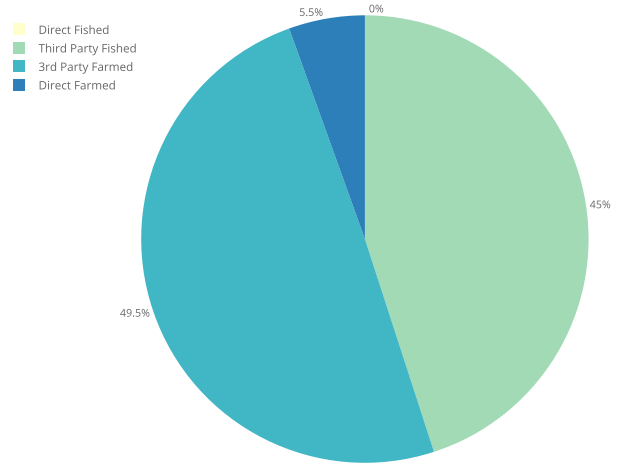
Comment

The company's objectives are disclosed through its global sustainability strategy "SeaChange"

Thai Union is participating in the SeaBOS initiative

OUG Holdings

Seafood revenues:
\$3 billion



Revenue disclosed by source?

No

Farmed and fished quantities and values

Not available

We made assumptions for all relevant segments

Fish species and geography

Not available

Revenue breakdown by species and geography

Not available

Estimations

As there was little transparency we had to use a set of assumptions to provide the breakdown of sources

Policy on sustainability?

No

Fishing

Not applicable

Farming

Not available

Third-party procurement

Not available

Facilities

Not available

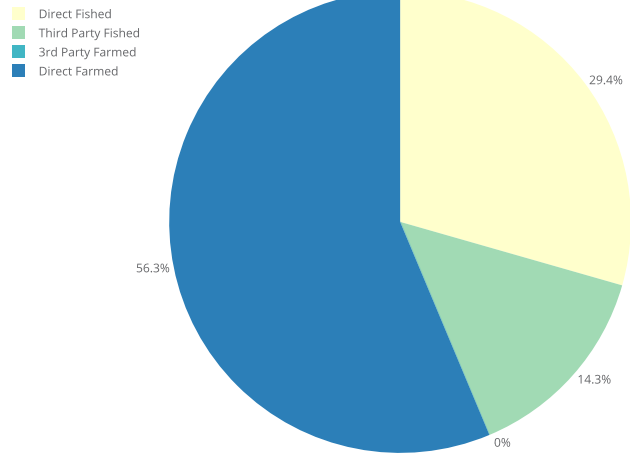
Comment

We could not find relevant sourcing policy in English on the company's website relating to production or sourcing standards

Austevoll Seafood

Seafood revenues:

\$2.3 billion



Revenue disclosed by source?

Yes

Farmed and fished quantities and values

Tonnage of farmed species disclosed

Tonnage of wild caught species in part disclosed

Fish species and geography

Main species sold and sourcing regions disclosed

Revenue breakdown by species and geography

Not available

Estimations

Some assumptions on Austevoll's subsidiaries were necessary to provide the breakdown of sources

Policy on sustainability?

Yes

Fishing

Policy in place

Farming

Policy in place, including sourcing fish feed from suppliers adhering to sustainable practices

Third-party procurement

Policy in place

Facilities

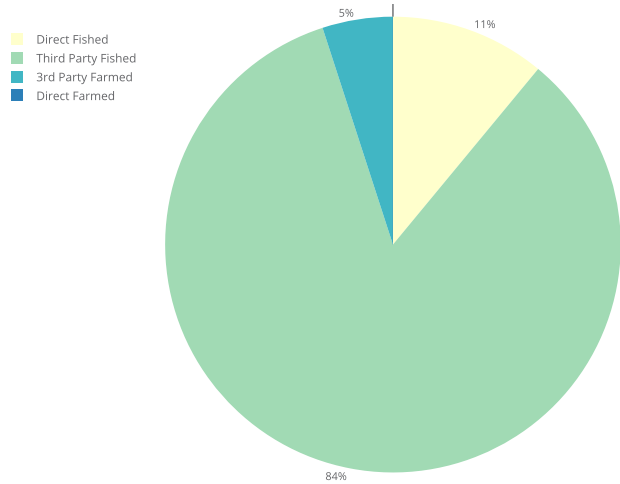
Policy in place

Comment

The company has detailed policy covering major sourcing and production issues

Kyokuo

Seafood revenues:
\$2.2 billion



Revenue disclosed by source?

No

Farmed and fished quantities and values

Not available

Fish species and geography

Generic geographic disclosure

Farmed tuna sales announced to begin in 2017

Revenue breakdown by species and geography

No details on tuna subspecies

Estimations

As there was little transparency we had to use assumptions and estimation processes to provide the breakdown of sources

Policy on sustainability?

No

Fishing

Appears to be domestic MSC certification, but only some international

Not clear if there is a comprehensive policy

Farming

There is relevant policy for the tuna farms

Third-party procurement

Limited discussion of chain of custody certification

Facilities

Environmental management policy in place

Comment

We found some relevant policy in Japanese, but not a comprehensive policy

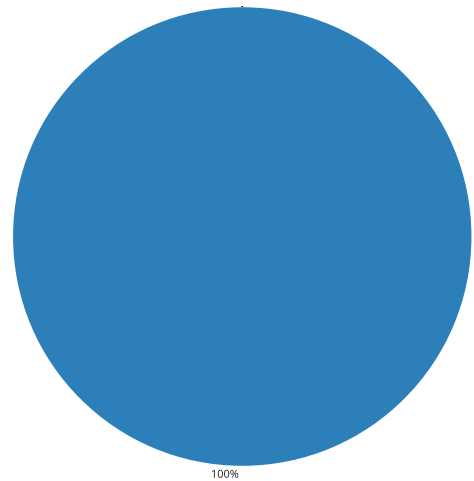
Kyokuyo is participating in the SeaBOS initiative

Charoen Pokphand Foods

Seafood revenues:

\$1.9 billion

Direct Fished
Third Party Fished
3rd Party Farmed
Direct Farmed



Revenue disclosed by source?

No

Farmed and fished quantities and values

Tonnage harvested not available

Fish species and geography

Primarily shrimp farming; fish species farmed not specified

Partial disclosure of aquaculture locations

Revenue breakdown by species and geography

Not available

Estimations

The company's aquaculture segment is the only seafood-related business

Policy on sustainability?

Yes

Fishing

Not applicable

Farming

Policy disclosed

Third-party procurement

Not applicable

Facilities

Policy disclosed

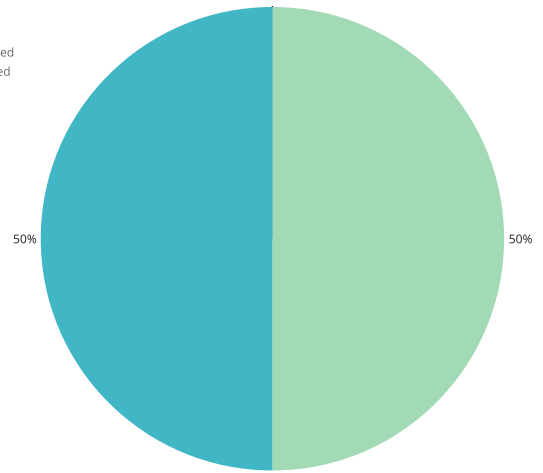
Comment

Charoen Pokphand Foods is participating in the SeaBOS initiative

Chuo Gyorui

Seafood revenues:
\$1.8 billion

Direct Fished
Third Party Fished
3rd Party Farmed
Direct Farmed



Revenue disclosed by source?

No

Farmed and fished quantities and values

Not available

Fish species and geography

Poor disclosure on geographic source of main species sold

Revenue breakdown by species and geography

Not available

Estimations

As there was little transparency we had to use default assumptions to estimate the breakdown of sources

Policy on sustainability?

No

Fishing

Not applicable

Farming

Not applicable

Third-party procurement

Not available

Facilities

Not available

Comment

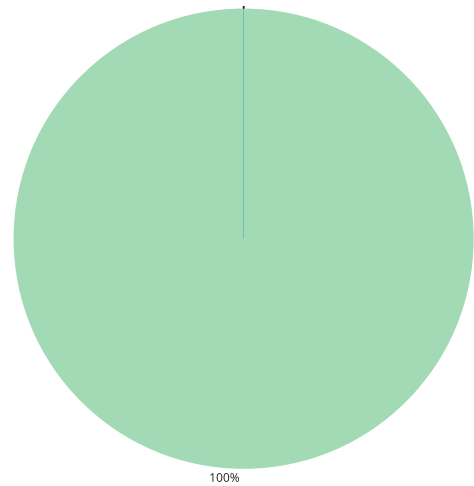
We could not find relevant sourcing policy in English on the company's website relating to production or sourcing standards

Schouw & Co

Seafood revenues:

\$1.3 billion

Direct Fished
Third Party Fished
3rd Party Farmed
Direct Farmed



Revenue disclosed by source?

No

Farmed and fished quantities and values

Not applicable

Fish species and geography

Not applicable

Revenue breakdown by species and geography

Tonnage of species sourced for feed production disclosed but no geographic breakdown

Estimations

The company's fish feed segment is the only seafood-related business.

Policy on sustainability?

Yes

Fishing

Not applicable

Farming

Not applicable

Third-party procurement

Policy in place

Facilities

Not available

Comment

The company has detailed policy covering major sourcing and production issues

Appendix 6:

Case Study: Sustainable fishing: Menhaden and the Omega Protein Corporation

Omega Protein Corporation is a major integrated wild-catch fishing company operating primarily on the United States East Coast and in the Gulf of Mexico, and which is listed on the New York Stock Exchange. It is a strongly performing wild-catch company, returning 120% over the last five years, and was one of only two companies from the list of the top 19 fishing companies to source entirely from stocks with a healthy biomass – in this case, the menhaden fisheries off the US East Coast and in the Gulf of Mexico. The sustainable management of these fisheries underpins Omega's production of fishmeal and fish oil production and provides room for future expansion.

Regulation & Production

Omega does not disclose the actual menhaden catch amount from each region, while the actual landings are obscured by privacy laws.³⁷ We therefore estimate Omega's catch from the fisheries based on quotas and their historical catches. Omega owns approximately 77% of the Atlantic quota, and this region accounts for roughly 34% of its fish catches.³⁸ The quota for Gulf menhaden is 829,737 tonnes, but this is unlikely to be realised. Omega's catches in the Gulf of Mexico are highly variable, but even recent catches at the high end of the range, of nearly 400,000 tonnes, are considerably below the quota.

We selected menhaden as a case study partly to highlight that there are opportunities, not just risks, relating to fisheries management, and partly because of the strength of the links between the fisheries and the listed company – although it does not provide a full breakdown of the split between Gulf and Atlantic menhaden. Omega is the largest user of these menhaden fisheries, which form the majority of its raw materials. The animal nutrition division that uses the fish accounted for 67% of total revenues in 2016. The long-term health of the business therefore depends on consistent and growing supplies of menhaden.

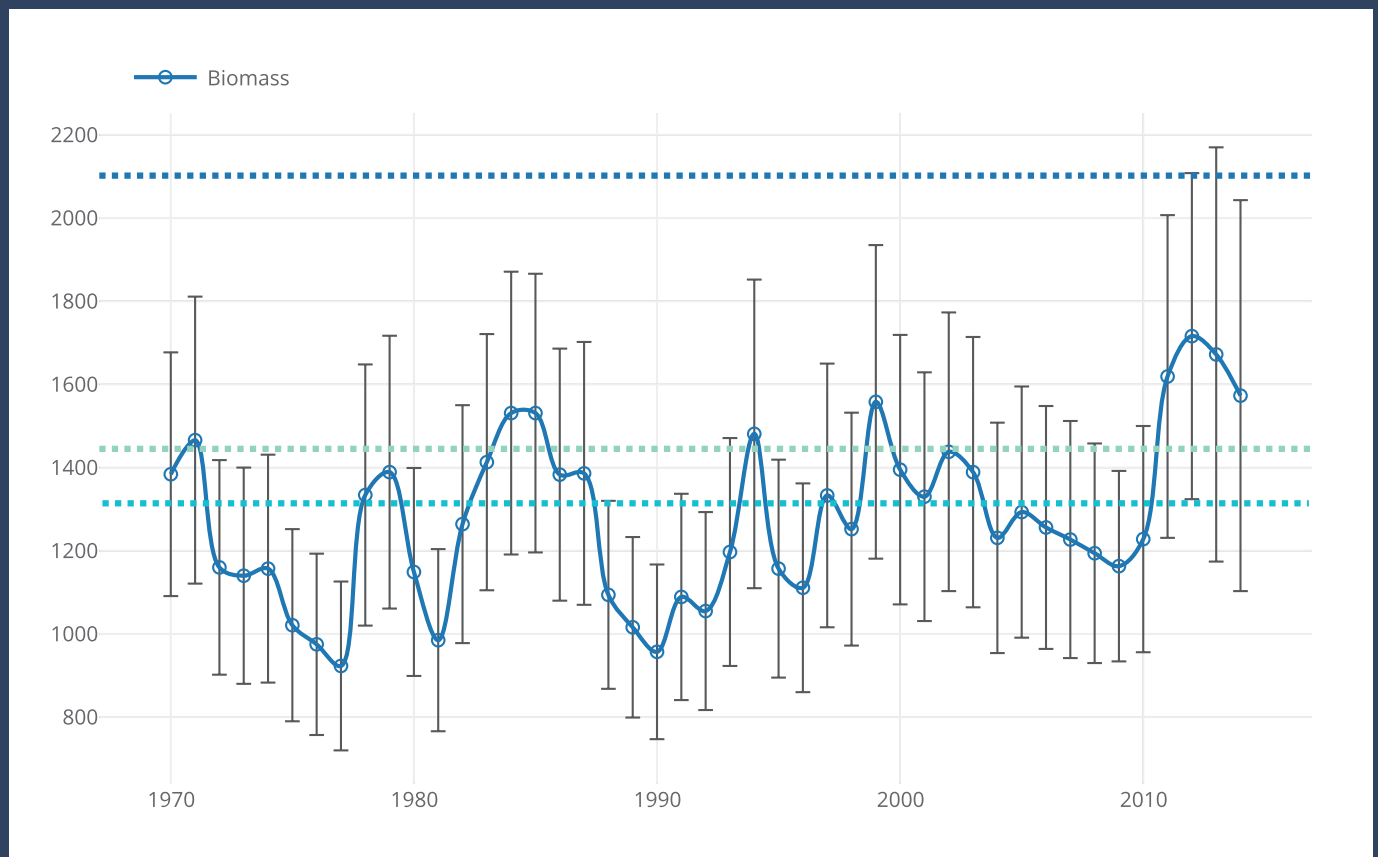
Menhaden have a short life cycle, of one to three years, and high fecundity. Biomass and mortality levels for the fisheries therefore provide a reasonable indicator for future catch quotas set by the relevant bodies and, consequently, Omega's ability to fish for the species.

Biomass

We used catch per unit effort (CPUE) and biomass data from the Gulf and Atlantic menhaden stock assessments, and landings data from the US National Marine Fisheries Service to model biomass and maximum sustainable yields.^{38,39,40} The results agree with other published stock assessments.

Both stocks show a positive trend in increasing biomass from low points during the 1970s, with substantial biomass increases for both fisheries between 2009 and 2012. This has resulted in current biomass exceeding the level required for maximum sustainable yield for both fisheries. These stocks will likely continue to perform well and deliver high catches at low cost at near or above maximum potential profitability.

Figure 5: Gulf Biomass relative to Biomass (Maximum Sustainable Yield)



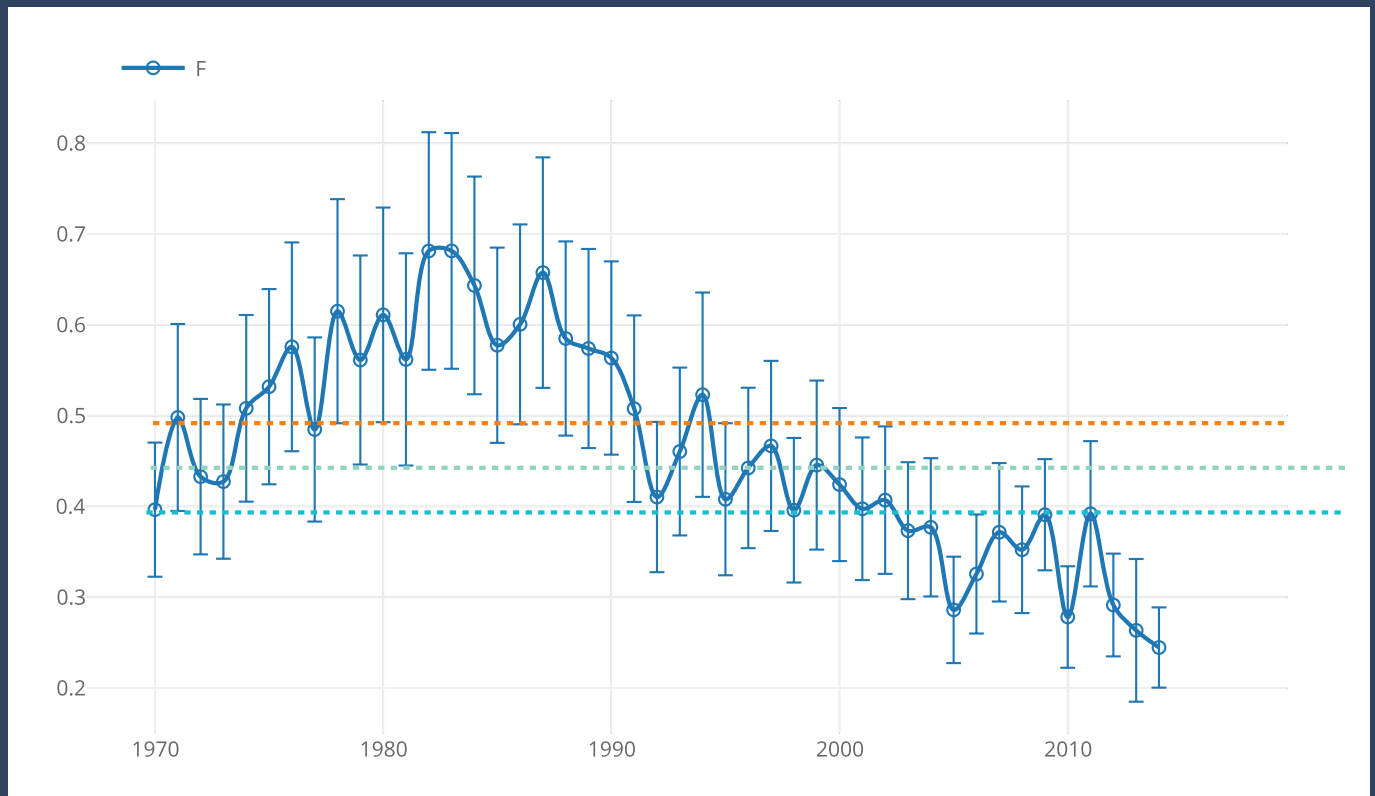
Source: SEDAR⁴⁰, NFMS⁴¹

Catch rates and potential

Similarly, current catch levels are below the maximum sustainable yield and maximum economic yield, demonstrating a sustainable level of exploitation. The proper management of these fisheries has led to high biomass levels, which provide benefits to the actors of this fishery, including Omega Protein. While Omega could catch more fish in the Gulf region, the

company appears to be maintaining stocks to make it relatively easy to catch menhaden, keeping fishing costs low. That the company does not fully realise its allowed catches shows that biomass and regulation to support the fishery does not currently provide a constraint to the company's growth.

Figure 6: Gulf Fishing Mortality Rate and Maximum Rate of Fishing Mortality



Source: SEDAR⁴⁰, NFMS⁴¹

Other sustainability considerations

It should be noted that fish stock availability is not the only criteria that determines the sustainability of fishing company investments. As we undertook the research, we noted other sustainability factors that investors would typically consider, including improper discharge of wastewater at a subsidiary's plant at Abbeville, Louisiana, regulatory intervention, and a class action lawsuit. A further issue is

the potential negative effect that the fishing of this keystone species might have on the wider ecosystem. This highlights the importance for investors of forming an integrated view of seafood sustainability, governance, market positioning, and financial structure to develop an opinion on prospects and appropriate valuation for seafood companies.

Appendix 7: Proposed strategies, sustainability policies and standards

Proposed strategies, policies and standards for companies with direct fishing activities

Fishing companies:

- Ensure that responsibilities flow from the board and throughout the chain of command, with relevant key performance indicators at each level
- Disclose production volumes and areas
- Ban IUU fishing from all vessels
- Phase out all fishing of CITES and IUCN listed species
- Do not use destructive fishing methods
- Do not allocate capital to increase vessel capacity targeting sensitive stocks
- Allocate capital to convert fleets to more sustainable fishing practices; to R&D of equipment that makes capture methods more species specific; and to technology that allows safe release of non-target species
- Ensure investment in fleet expansion or upgrades includes measures to mitigate environmental damage, destruction of habitat and catch of non-target species
- Implement targets to reduce catch of non-target species
- Participate in Fisheries Improvement Programmes to help stocks recover and increase future economic value
- Adopt sustainability certification schemes, such as the Marine Stewardship Council (MSC) and standards relevant to their sourcing
- Introduce targets and timelines for adoption of sustainable sourcing standards, certified by trusted third parties
- Collaborate in processes that enable good fishery management, including property rights systems
- Put in place robust traceability systems

Proposed strategies, policies and standards for companies with direct aquaculture

Aquaculture companies:

- Share best practices with industry and across geographies to ensure improving and consistent environmental management
- Disclose production volumes and areas
- Adopt relevant sustainability standards such as those developed by the Global Aquaculture Alliance, Best Aquaculture Practices, or Aquaculture Stewardship Council (ASC)
- Have verification of standards and certification by third parties
- Undertake research into efficient fish oil and fishmeal feed stocks, identifying substitutes where possible
- Keep use of fishmeal and fish oil to a minimum and only use suppliers with appropriate accreditation
- Adhere to the IUCN's policy on alien species
- Halt operations involving harvesting of juveniles from the wild where these are from an endangered species or where the harvesting process is damaging
- Invest in R&D to support the above activities
- Minimise use of antibiotics, ensuring that use is not routine

For companies with open system aquaculture:

- Ensure there are systems in place to prevent contamination of the surrounding ecosystem
- Prohibit conversion to aquaculture farms of ecologically sensitive sites, such as mangroves
- Minimise and treat waste to eliminate negative impacts on surrounding areas
- Ensure appropriate stocking densities and implement robust measures to prevent escapes

Proposed strategies, policies and standards for fish wholesaling, processing or fish-meal manufacture

Companies involved in sourcing and / or processing:

- Source only from suppliers developing sustainability practices and adopting robust traceability systems, preferring sources with certification, such as ASC or MSC
- Ensure that no CITES or IUCN fish are bought or traded
- Ensure that no IUU fish are bought or traded
- Ensure that no undersize or juvenile fish are bought or traded
- Disclose the amount of underlying seafood production and sourcing areas
- Ensure that waste is minimised and that all parts of a fish that have a market are used
- Work with suppliers to develop transparent and traceable sourcing systems

Companies involved in fishmeal and fish oil manufacture:

- Ensure that trimmings from other fish production process are used as a priority input before whole fish
- Ensure that fish that have little or no market for human consumption are used as a priority input before whole food-grade fish

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