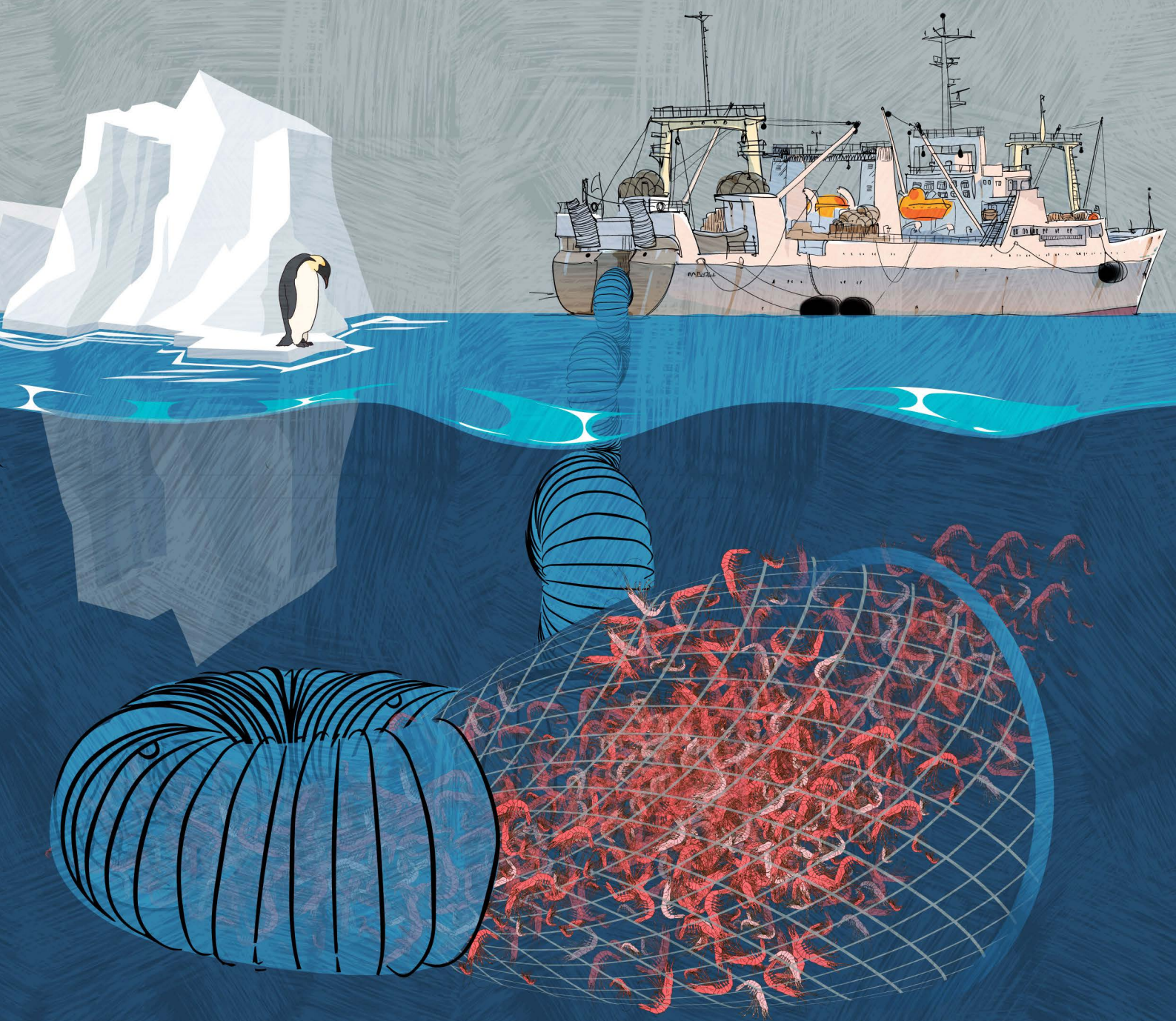


# Krill, Baby, Krill

The corporations profiting from plundering Antarctica



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## List of abbreviations

ARK	Association of Responsible Krill
ASC	Aquaculture Stewardship Council
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CMI	Chonghe Marine Industry
CNFC	China National Fisheries Corporation
DHA	Docosahexaenoic acid
EPA	Eicosapentaenoic acid
FAO	Food and Agricultural Organization
FMFO	Fish meal and fish oil
FOS	Friend of the Sea
IPCC	Intergovernmental Panel for Climate Change
MPAs	Marine Protected Areas
MSC	Marine Stewardship Council

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## Executive summary

Antarctic krill is a cornerstone of the entire Antarctic ecosystem. Much of the marine life in the Southern Ocean is either a direct predator of krill or just one step removed, meaning that many animals - including whales, penguins, seals and squid - are dependent on krill as a crucial food source.<sup>1</sup>

Because of global warming, the Southern Ocean is already experiencing important changes affecting temperature, sea-ice dynamics and currents, and their cumulative impact on the marine ecosystem is predicted to increase considerably during the present century.<sup>2</sup> The latest 2022 Intergovernmental Panel for Climate Change (IPCC) report found that these changes to the west of the Antarctic Peninsula are already altering krill, questioned the viability of supply chains and advised industry players to explore alternatives, such as microalgae.<sup>3</sup>

Numerous studies have demonstrated how targeted krill-fishing activities are exacerbating existing threats towards krill and the predators that feed on them.<sup>4</sup> A key concern is not *how much* krill gets fished but rather *where* that fishing is conducted. Conservationists have been ringing the alarm bell for years about how fishing activities are concentrated in very small areas.<sup>5</sup> This concentrated krill fishing overlaps with foraging areas for key species, such as penguins and seals, who then have to compete with fishing vessels for food.

This is unlikely to change, as fishing activities in the past decade are intensifying.<sup>6</sup> Only five countries (and a total of about 12-14 vessels) are involved in krill fishing in the region, with Norwegian company and market leader Aker BioMarine taking 65% of the catch in 2021.<sup>7</sup> However, catch levels have increased over the past decade, and authorised catch limits in some areas have been reached much quicker in the past few years.<sup>8</sup> These trends are likely to get worse; more players have expressed interest in joining the fishery, and current actors have announced their intention to increase production. Meanwhile, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), responsible for managing the krill fishery, has repeatedly failed to reach a consensus on more protective measures for krill and local ecosystems.<sup>9</sup>

## Exposing murky krill-supply chains

Two main krill-based end products are now dominating the market: krill meal (largely used as feed additives in the aquaculture industry) and krill oil (extracted mostly to produce Omega-3 dietary supplements).

Changing Markets' survey of the 50 largest retailers' online stores shows how widely krill-based health supplements are still available around the world. Globally, of the 50 largest retailers that sell health supplements:

1. 68% (34 retailers) were found to sell krill-oil products;
2. 88% of the 17 North American retailers and 75% of the 8 Asian retailers included sell krill-oil supplements; and
3. Nearly half of the 21 European retail chains included sell krill-oil health supplements.

Krill meal is much harder to trace than krill oil; it is mostly used as one of many ingredients of fish meal in aquaculture, an industry that suffers from an endemic lack of transparency. Yet a detailed investigation of a sample of 16 European retail chains in France, Germany, Spain and the UK revealed that all of them are likely to sell products from salmon that were reared on feed containing krill:

1. Similar to the use of wild-caught fish, none of the retailers have developed sourcing policies that exclude the use of krill feed for their farmed seafood. Salmon products in Aldi Nord, Edeka, Kaufland and Lidl (Germany); Auchan, Carrefour, Intermarché and Leclerc (France); Carrefour, Dia, Lidl and Mercadona (Spain); and Asda, Marks & Spencer, Sainsbury's and Tesco (UK) were found to have links to krill meal. In all cases, the krill meal within these retailer supply chains originates from the biggest market player: the Norwegian company Aker BioMarine.
2. Further upstream in the supply chain, the investigation also found that five of the largest European companies farming salmon (Bakkafrost, Cermaq, Grieg Seafood, Lerøy Seafood and Norway Royal Salmon) use krill meal, which is likely sourced from Aker BioMarine, for at least some of their salmon production.
3. The world's largest salmon company, Mowi, as well as SalMar and Cooke Aquaculture, appear not to be using krill-based feed.
4. Finally, the investigation also found that two (BioMar and Skretting) of the four aquafeed companies that dominate the global aquaculture feed market add krill meal to their feed products and source the krill from Aker BioMarine, while the other two (Mowi and EWOS) do not seem to use krill meal.

## Industry tactics to legitimise krill fishing

Industry players have had to legitimise the existence of krill-based products with research and studies to promote their proclaimed benefits and justify their high price compared to similar marine-based products.<sup>10</sup> To date, however, most of these studies – which the industry often commissions itself – have produced mixed results.<sup>11</sup> Yet the industry is not giving up; it is still desperately trying to create new products and markets to prop up its unprofitable operations. Aker BioMarine, responsible for two-thirds of the global krill catch and 80% of the global production of krill oil<sup>12</sup>, has run a net loss nearly continuously for the last decade and aims to turn this around through increased revenue from new and existing markets, increased fishing efforts, and the development and marketing of new products, such as krill protein for human consumption<sup>13</sup> and pet food.

Meanwhile, the krill industry downplays environmental concerns with heavy greenwashing and marketing techniques (such as self-created ecolabels) that hide its ecological impacts. This is further enabled by the Marine Stewardship Council (MSC), whose certification fails to take into account the effects of climate change and the impact of the fisheries as a whole on predators, and ignores our limited understanding of krill's life cycle and its importance to the Antarctic food web.<sup>14</sup> This certification provides a cover for the industry and further hinders broader and deeper discussion about the sustainability of the fishery.

This report shows that the krill-fishing industry is inherently unsustainable as it threatens one of the world's most fragile ecosystems, which is already under pressure due to a rapidly accelerating climate emergency. It is unjustifiable to continue to allow this industry to plunder Antarctica in order to keep producing these unnecessary products. The Changing Markets Foundation is calling for:

1. an immediate moratorium on krill fishing;
2. retailers, feed producers and fish farms to phase out the use of wild-caught fish for aquaculture, including krill;
3. retailers to immediately stop stocking krill dietary supplements; and
4. consumers to stop using krill supplements and to demand their farmed seafood be krill-free.

# 1. Introduction

Fishing for Antarctic krill is, relative to the exploitation of other marine resources in the Southern Ocean, a recent phenomenon. Hunting for seals and whales dates back to the 19th and early 20th centuries respectively,<sup>15</sup> but it was only in the 1970s that distant-water fishing nations turned to Antarctic krill, after the depletion of many traditional Antarctic fisheries (including whales) and coastal countries' establishment of Economic Exclusive Zones, which further restricted fishing and made it more difficult for fishing nations to keep their industries economically viable.<sup>16</sup> At the time, studies suggested that the exploitation of Antarctic krill could reduce the deficit of animal protein and solve global malnutrition.<sup>17</sup> While there were serious attempts to develop krill meat for human consumption in the 1980s - particularly in the Soviet Union and Japan<sup>18</sup> - factors relating to the difficulty of processing krill, its high-fluoride content and achieving consumer acceptance for an unknown crustacean drastically slowed the development of krill as a food product.<sup>19</sup>

Although technological advancements have enabled the industry to overcome some of these hurdles, krill for direct human consumption never fully took off, which meant that actors involved in the krill industry found themselves in dire need of justifying high fishing costs. This fuelled the need for product innovation and marketing, which, after decades of trial and error, led the industry to focus on using krill for domestic animal feed. Since the turn of the millennium, aquaculture has been a booming sector,<sup>20</sup> and most of the krill catch has been directed towards producing aquafeed.<sup>21</sup> Due to its costs, krill meal has never substituted widely used fishmeal as aquafeed; instead, it has mainly been used as a nutritious feed additive in aquaculture,<sup>22</sup> and is associated with benefits such as making other feeds more palatable<sup>23</sup> and salmonids 'pinker'.<sup>24</sup>

But what really shifted the odds for the krill industry in the past two decades was the emergence of a lucrative health-supplement market on the back of a massive body of research that demonstrated the value of Omega-3 for a variety of disorders.<sup>25</sup> Just like fish oil, most of krill oil's health benefits are attributed to its high eicosapentaenoic (EPA) and docosahexaenoic (DHA) acid content<sup>26</sup> (two Omega-3 fatty acids associated with health benefits, such as better heart and brain health).<sup>27</sup> In the past 20 years, there has been a noticeable increase in both the promotion and research of krill oil for its purported health benefits, including the management and treatment of conditions such as hyperlipidemia, inflammation and arthritis.<sup>28</sup> Because of the need to compete with traditional fish oil while at the same time justifying the high cost of krill oil, Antarctic krill oil is marketed as a premium product '*from the pristine waters of Antarctica*'<sup>29</sup> - ignoring a 200-year history of extreme exploitation - and krill-oil products can be up to 30 times more expensive than fish oil.<sup>30</sup>

The industry's strategy of concentrating its efforts on marketing krill oil as a premium health product is paying off; the krill-oil health-supplement market is foreseen to increase by 13.1% between 2020 and 2027.<sup>31</sup> Significant efforts have been made by industry players - such as the Norwegian biotech company Aker BioMarine - to conquer markets with an emerging middle class, such as China, and to inundate consumers with new krill-based products in addition to health supplements, such as pet food<sup>32</sup> and protein powder.<sup>33</sup>

Although such news should excite investors, the future of Antarctic krill fishing and krill-based products is in question. The 2022 IPCC report<sup>34</sup> warned about the sustainability of krill harvesting and viability of supply chains in the face of climate change. The report states that biodiversity changes, warming and acidification, compounded by fishing (see section 2 of the report), may decrease the availability of krill in the future, and advises producers to turn to alternative sources - such as marine phytoplankton, macroalgae, marine microbes and underutilised marine by-products - instead. The IPCC's assessment adds to mounting evidence that harvesting Antarctic krill could lead to catastrophic environmental consequences (such as biodiversity loss of key species that feed on krill), particularly in the face of climate change.

While numerous NGOs, supported by scientists, have been working for decades to improve the management and limit the impact of Antarctic krill harvesting on local ecosystems, this report aims to explore the main market drivers of Antarctic krill fishing in the first place - krill-oil health supplements and krill-based feed additives in aquaculture (with a special focus on its use in the salmon industry) - and to identify the actors who fuel the krill industry and their tactics to present krill as a sustainable premium product. Looking at both the environmental impacts of Antarctic krill fishing and how krill-based end products are being used, the report aims to address the simple question: On balance, is it all worth it?

## 2. The dangers of Antarctic krill harvesting, particularly in the context of climate change

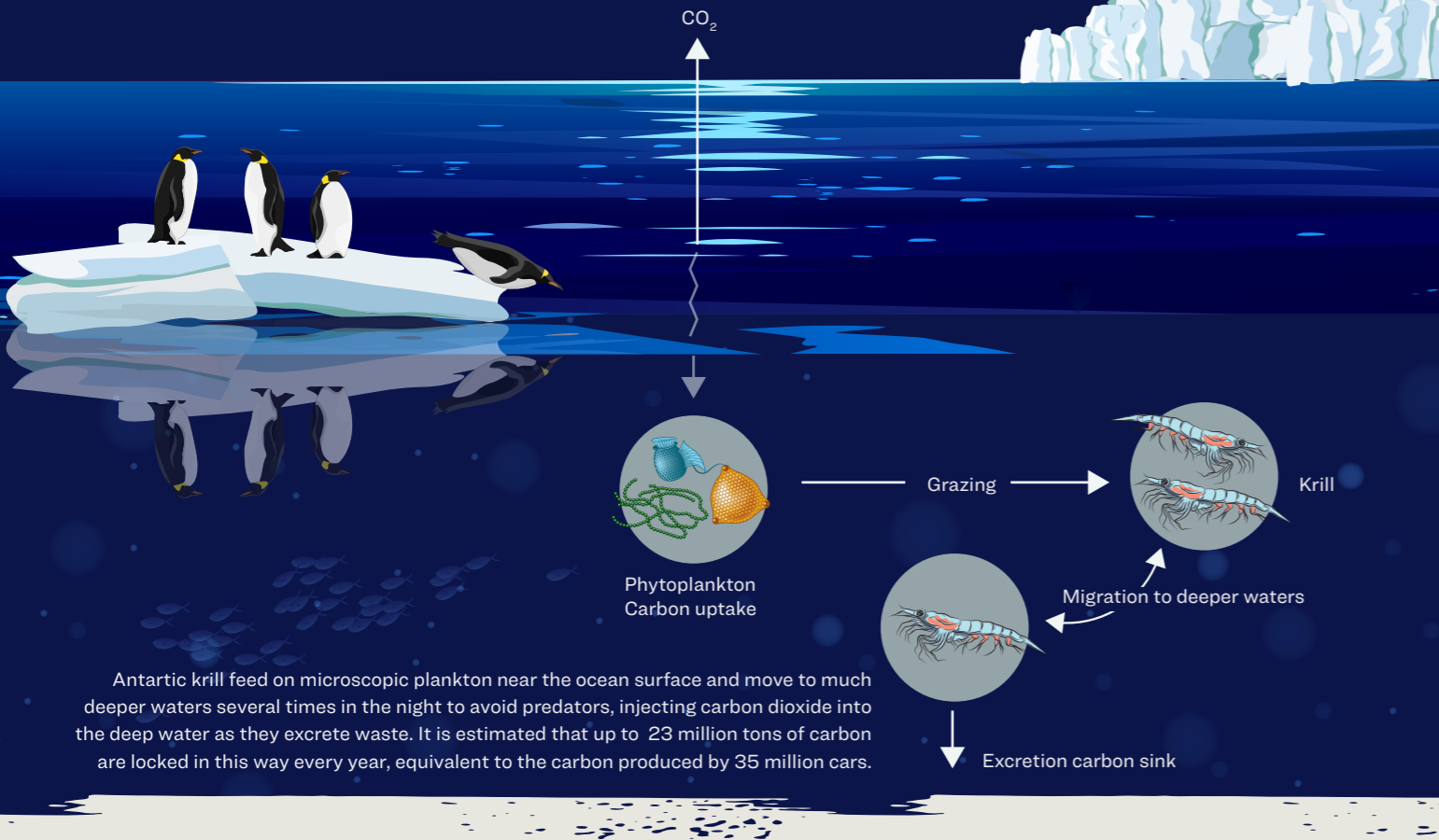
### 2.1. Wonderful krill

Antarctic krill (*Euphausia superba*, hereafter krill) is a paperclip-sized crustacean that is considered one of the most abundant species on Earth, making up an estimated global biomass of around 379 million tonnes.<sup>35</sup> Indeed, scientists believe the total weight of Antarctic krill is greater than the cumulative weight of any other animal species on the planet.<sup>36</sup> Krill group together in swarms so dense that they can be spotted by satellites from space.<sup>37</sup>

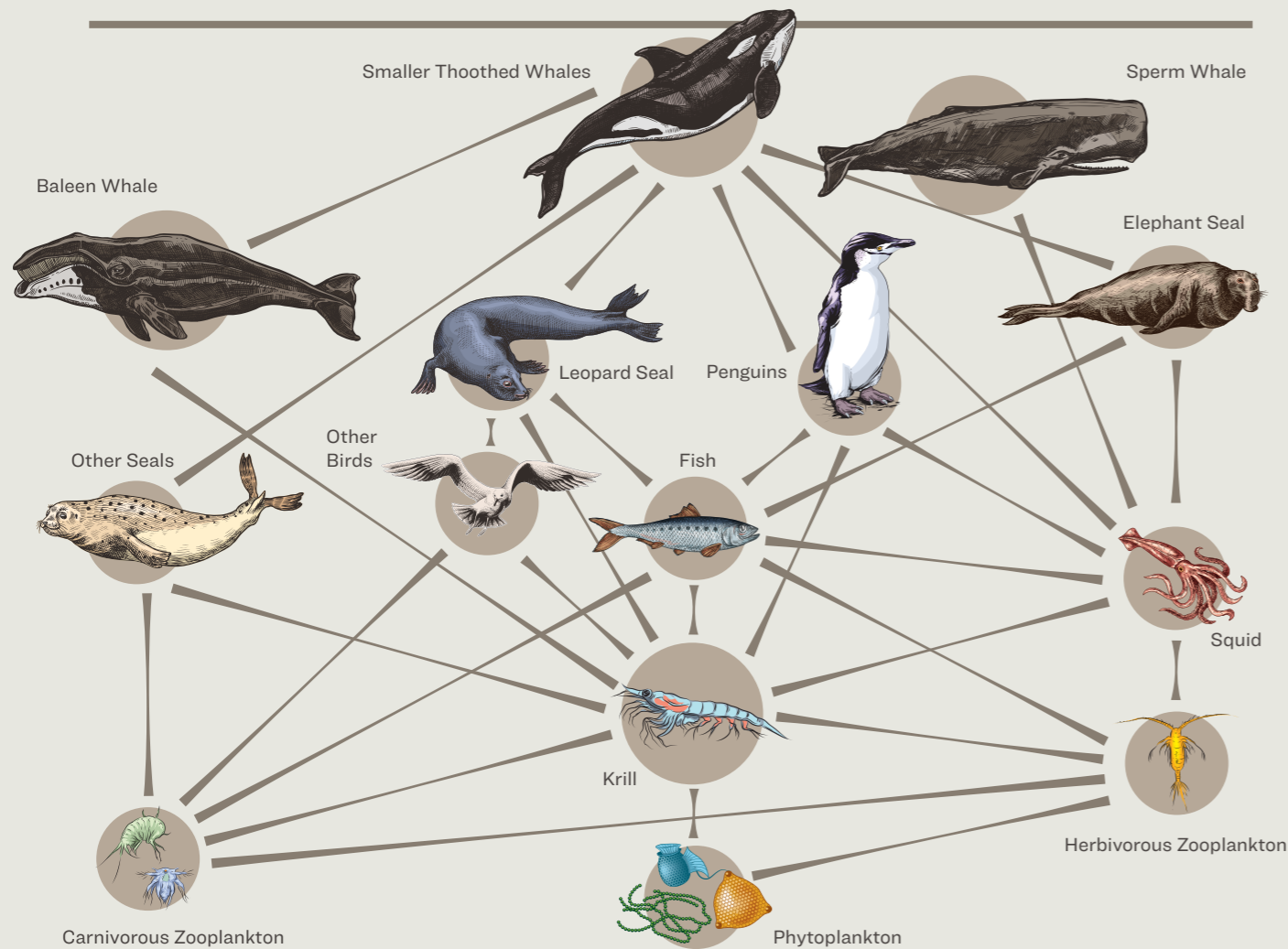
Krill play a vital role in supporting the local ecosystem by forming the base of the food web. Considered a keystone species, they serve as a major dietary item for invertebrates and vertebrate predators (such as whales, seals, seabirds and fish)<sup>38</sup> and provide over 96% of calories for the seabirds and marine mammals in the Antarctic Peninsula.<sup>39</sup> In short, the Antarctic ecosystem as we know it depends on the fate of krill (see Figure 2.1) and the role of Antarctic krill in supporting predators might be more significant than that of any comparable species elsewhere in the world's oceans.<sup>40</sup>

Humans also depend on krill for their survival. Krill swarms act as a major carbon sink<sup>41</sup> by feeding on carbon-capturing algae near the surface of the water, then swimming to the lower depths and dropping their carbon-filled waste at the bottom of the ocean in a giant conveyor-belt fashion. Krill can remove as much as 23 million tonnes of carbon from the Earth's atmosphere each year - equivalent to the emissions from 35 million cars (see Figure 2.1).<sup>42</sup> They swarm in such vast numbers that their combined contribution to the movement of ocean carbon is significant, greatly influencing carbon levels and therefore our capacity to mitigate climate change.<sup>43</sup>

# KRILL ARE CARBON SINKS



## ANTARCTIC KRILL IS A KEYSTONE SPECIES IN THE FOOD WEB OF THE SOUTHERN OCEAN



Over the past 30 years, considerable efforts have been made to understand the biology and ecology of krill, yet they largely remain a mystery; there is much debate and controversy in the scientific community regarding population trends, overwintering, migration and other key aspects of krill biology.<sup>44</sup>

## 2.2. Current threats to krill

### 2.2.1. Negative impact of climate change on krill

The Southern Ocean is among the most sensitive areas to climate change,<sup>45</sup> and is already experiencing important changes in ocean temperature, sea-ice dynamics, stratification and currents.<sup>46</sup> Ocean temperatures along the Antarctic Peninsula have risen by 2.7°C since the 1970s<sup>47</sup> - about five times the global rate of warming.

The cumulative impact of these climate-induced changes on the marine ecosystem is predicted to increase considerably during this century.<sup>48</sup> The scientific community is still in the process of uncovering how these changes, in addition to highly dynamic natural climate variability in the region, may negatively affect krill populations, particularly their distribution and abundance.<sup>49,50</sup>

Water temperature, in correlation with sea-ice coverage, appear to be the driving factor for krill density.<sup>51</sup> The latest 2022 IPCC report found that changes in sea ice and physical environment to the west of the Antarctic Peninsula are already altering krill.<sup>52</sup>

As global heating continues, a 33% decrease in the areal extent of Antarctic winter sea-ice is predicted by the end of this century.<sup>53</sup> The sea-ice retreat would become a dominant driver of krill population decline as it would drastically reduce current krill-spawning grounds in important habitats, such as along the west Antarctic Peninsula, as the winter under-ice population is dominated by larvae and juvenile krill feeding on available ice algae.<sup>54</sup> It has been estimated that Antarctic krill could lose 20-55% of their habitat by the end of the century<sup>55</sup> - and, in some cases, as much as 80% for young krill.<sup>56</sup> The Antarctic's warming water temperature is also likely to reduce krill growth rates, especially in the northern Scotia Sea, where the worst case scenario of global heating could lead to a 40% decline in the mass of individual krill by the end of this century.<sup>57</sup>

Ocean acidification - another consequence of climate change - can also interfere with the metabolism of krill by upsetting their internal pH balance.<sup>58</sup> This steady acidification could affect krill development, from the rates at which eggs hatch to the size and mortality rate of embryos. If greenhouse gas emissions continue to grow at current rates, it is predicted that, by 2100, reductions of 60-70% in hatching rates could be seen in some localised areas (such as the Weddell Sea).<sup>59</sup>

It is difficult to understand exactly how krill populations will respond to these changes in the coming decades, but their cumulative impact will likely be negative.<sup>60</sup> This is because krill are long-lived, and therefore their ability to adapt to rapid climate change is probably limited.<sup>61</sup> And if the krill biomass decline, it will affect the predators that feed on them. Studies suggest that penguins are likely to be the most sensitive to such changes, with potential decline in penguin abundance by up to 30%,<sup>62</sup> while limited availability of krill also undermines the reproductive success of Antarctic female fur seals<sup>63</sup> and pushes crabeater seals to travel further south, switch to other prey or make longer foraging trips.<sup>64</sup> Other studies have found that the negative impact of climate change on the Antarctic krill population could threaten the future recovery of baleen whales.<sup>65,66</sup>

Figure 2.1: Krill are carbon sinks

Figure 2.2: The role of krill in the Antarctic food web



### 2.2.2. Known impacts of Antarctic krill fishing compounding the effects of climate change

The Southwest Atlantic sector of the Southern Ocean (where 70% of the krill population is located) is the main focus of the modern krill fishery, which the CCAMLR manages.<sup>67</sup> At present, the international fishery for Antarctic krill only operates in Food and Agricultural Organization (FAO) Area 48 (i.e. in the south-west Atlantic and north of the Antarctic Peninsula), where the standing population is estimated at around 60 million tonnes.<sup>68</sup>

In 2007, based on standing stock estimates, a precautionary catch limit of 3.47 million tonnes was agreed (Conservation Measure 51-01, further revised to 5.61 million tonnes in 2010<sup>69</sup>).<sup>70</sup> The Commission further decided that, until an allocation of the precautionary catch limit between smaller management units could be decided, the total combined catch in FAO Subareas 48.1 (Antarctic Peninsula and South Shetland Islands), 48.2 (South Orkney Islands), 48.3 (South Georgia) and 48.4 (South Sandwich), where most krill fishing activities are taking place, shall be further limited in any fishing season to an interim catch limit of 620,000 tonnes (the so-called 'trigger level').<sup>71</sup> Conservation Measure 51-07 further spatially subdivides the interim catch limit such that no more than 25% of the catch can be taken from FAO Subarea 48.1 (155,000 tonnes), 45% from 48.2 (279,000 tonnes), 45% from 48.3 (279,000 tonnes) and 15% from 48.4 (93,000 tonnes).<sup>72</sup>

CCAMLR was established in 1980 amid concerns that an expanding krill fishery could have a large impact on the ecosystem of the Southern Ocean, in recognition of the critical role of krill in the Antarctic ecosystem.<sup>73</sup> But while CCAMLR's approach to catch limits is precautionary *in theory*, scientific studies have demonstrated that krill fishing *in practice* is not as sustainable as it may seem, particularly in the face of climate change.

One key concern is not about *how much* krill is being fished but *where* that fishing is taking place. Conservationists have been ringing the alarm bell for years about the dangers of concentrated krill fishing in the current subareas; such concentrated fishing overlaps with foraging areas for key predators, meaning they have to compete with fishing vessels for food. An empirical analysis that reviewed over 30 years of monitoring data found that climate change and concentrated fishing are having - and will continue to have - negative impacts on penguin colonies at two sites adjacent to some of the most important krill fishing areas in Subarea 48.1.<sup>74</sup> Other researchers have found that the combination of high catch rates during years with poor climate conditions has a negative impact on the population of chinstrap and gentoo penguin populations the following year.<sup>75</sup> The ongoing recovery of cetacean populations in the Southern Ocean also has implications for whether the management of the krill fishery is sufficiently precautionary.<sup>76</sup>

In addition to threats to predators, current fishing management is potentially affecting the krill population. This has been overlooked because of a common perception that the catch trigger level represents only a small fraction of the total biomass. A 2020 study found that, because of the restricted distribution of successfully spawning krill and high interannual variability in their biomass, the risk of direct fishery impacts on the krill population itself might be higher than commonly perceived.<sup>77</sup>

Probably the largest blind spot of CCAMLR's management is its failures to consider the impact of climate change on the krill population over time. As described in the previous section, there is mounting concern that the krill population is being - and will increasingly be - impacted by climate-induced changes. With these changes currently ignored by outdated management measures, fishing activities are likely to exacerbate the impact of climate change on the krill population in a dramatic way. A study found that the krill fishery would benefit from management at a local scale to help mitigate the impacts of climate change on this ecosystem. It also found that current krill fishing limits further increase risks of depletion, and that stopping fishing altogether in certain areas could offset the increased risks associated with ocean warming - particularly risks to the penguins that depend on krill for their survival.<sup>78</sup>

## 2.3. Intensification of krill fishing and future trends

### 2.3.1. Countries involved in krill fishing

Only a very small number of countries currently have active fleets operating in the krill fishery. While there were 21 active fishing nations in 1972, currently only five countries are involved in krill fishing within the CCAMLR convention area, with Norway taking 55% of the catch in 2020.<sup>79</sup>

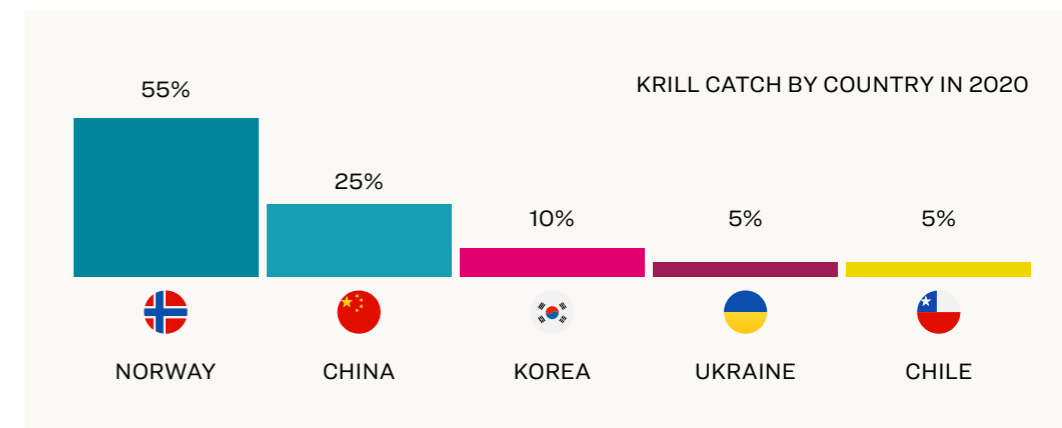


Figure 2.3: Krill catch by country in 2020

The number of fishing vessels engaged in the krill fishery has not changed substantially in the last decade: CCAMLR authorised 12 vessels to fish for krill during the 2021/22 fishing season and 10 vessels a decade earlier.

Country	Vessel	IMO	Length (m)	Fish-hold capacity (m3)	Owner
Chile	<i>Antarctic Endeavour</i>	8717453	73.50	901	Pesca Chile SA
China	<i>Fu Yuan Yu 9818</i>	7817452	102.65	2,847	Fujian Zhengguan Fishery Dev. Co., Ltd
China	<i>Long Fa</i>	8607115	120.70	3,582	China National Fisheries Corporation
China	<i>Long Teng</i>	8607373	120.70	3,582	China National Fisheries Corporation
China	<i>Shen Lan<sup>A</sup></i>	9849332	111.20	5,870	Jiangsu Sunline Deep Sea Fishery Co.
Republic of Korea	<i>Sae In Champion<sup>B</sup></i>	7042538	95.60w	5,324	Jeong-Il Corporation <sup>80</sup>
Republic of Korea	<i>Sae In Leader<sup>C</sup></i>	8505977	93.50	2,845	Jeong-Il Corporation <sup>81</sup>
Republic of Korea	<i>Sejong</i>	8607385	110.22	3,743	Dongwon Industries Co. Ltd.
Norway	<i>Antarctic Endurance</i>	9827891	129.60	6,400	Aker BioMarine Antarctic AS
Norway	<i>Antarctic Sea</i>	9160358	133.88	7,720	Aker BioMarine Antarctic AS
Norway	<i>Saga Saga</i>	7390416	92.00	3,858	Aker BioMarine Antarctic AS
Ukraine	<i>More Sodruzhestva</i>	8724315	103.10	4,294	Marissco Fishing Limited

Table 2.1: Vessels authorised to fish krill in CCAMLR convention area, 2021/22 season<sup>82</sup>

A This vessel may have been transferred to Shanghai Kaichuan Marine International.

B This vessel appears twice in the CCAMLR register, also under the name of Insung Ho.

C This vessel appears twice in the CCAMLR register, also under the name of Kwang Ja Ho.

### 2.3.2. Recent intensification and potential future trends

While the trigger limit of 620,000 tonnes per year in Area 48 has never been reached since its inception, one cannot help but notice an intensification of the fishing effort nonetheless (see Figure 2.4).

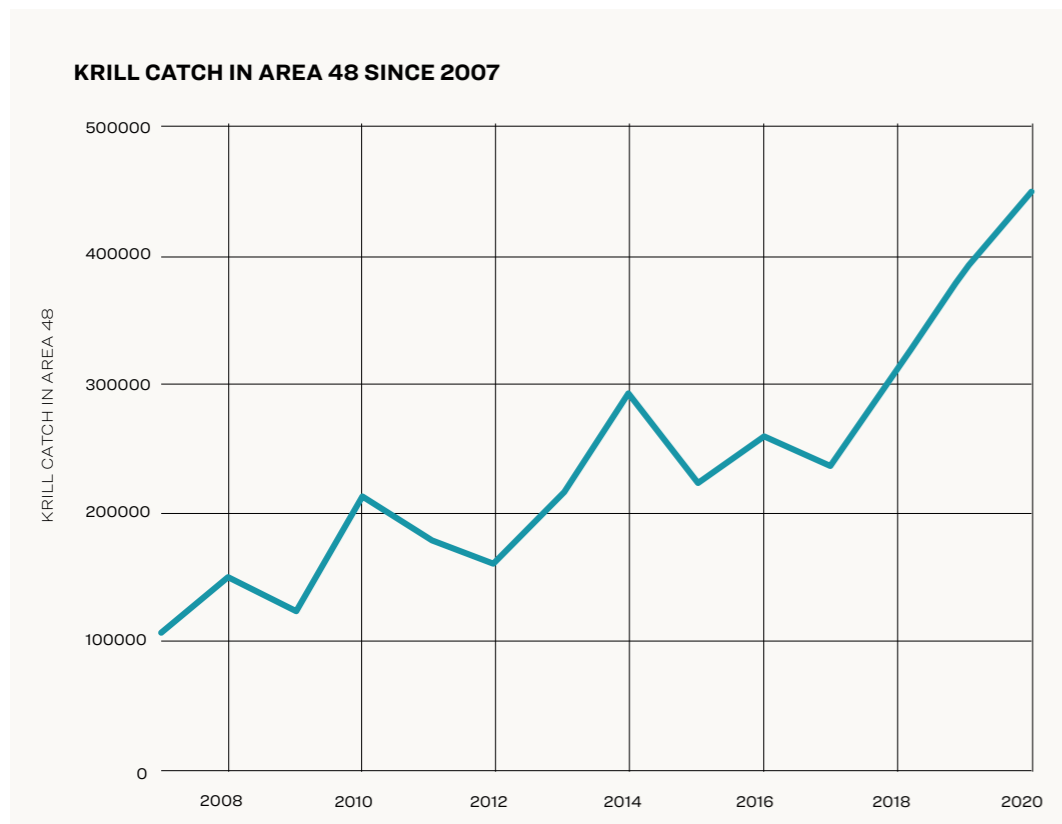


Figure 2.4: Krill catch in Area 48 since 2007

The total catch in Area 48 increased from 104,728 tonnes in 2007 to 450,781 in 2020, which is the highest level ever reached.<sup>83</sup>

The catch limit has also been reached much more quickly in the last few years. The fishery takes place in a free-for-all fashion (also known as 'Olympic style', meaning first come first served); once the maximum catch for the fishery has been reached, it closes. During the 2019/20 season, it took just 69 days to reach 95% of the allowable catch in Area 48-1, almost twice as fast as in the past five years. Between 2010 and 2020, the catch limit in Area 48-1 was reached eight times, resulting in the closure of the fishery significantly earlier than the end of the fishing season.<sup>84</sup>

There are also clear concerns about the increasing concentration of the krill fishery. This is the main shortcoming of the subareas: they work on the assumption that catch will be spread out evenly across the areas, but the reality is that fishing vessels make economic decisions to concentrate where it is most profitable; that is, where krill concentrate.<sup>85</sup> For example, between 2010 and 2018, 74% of the total krill catch within Subarea 48-1 was caught from locations that made up just 8% of the whole subarea, while in Subarea 48-3, 95% of the catch came from just 5% of the subarea.<sup>86</sup> The CCAMLR Working Group on Ecosystem Monitoring and Management warned that 'the increased temporal and spatial concentration of the fishery, particularly within Subarea 48.1, may contribute to localised ecological effects',<sup>87</sup> referring to the competition for food for other animals that feed on krill.

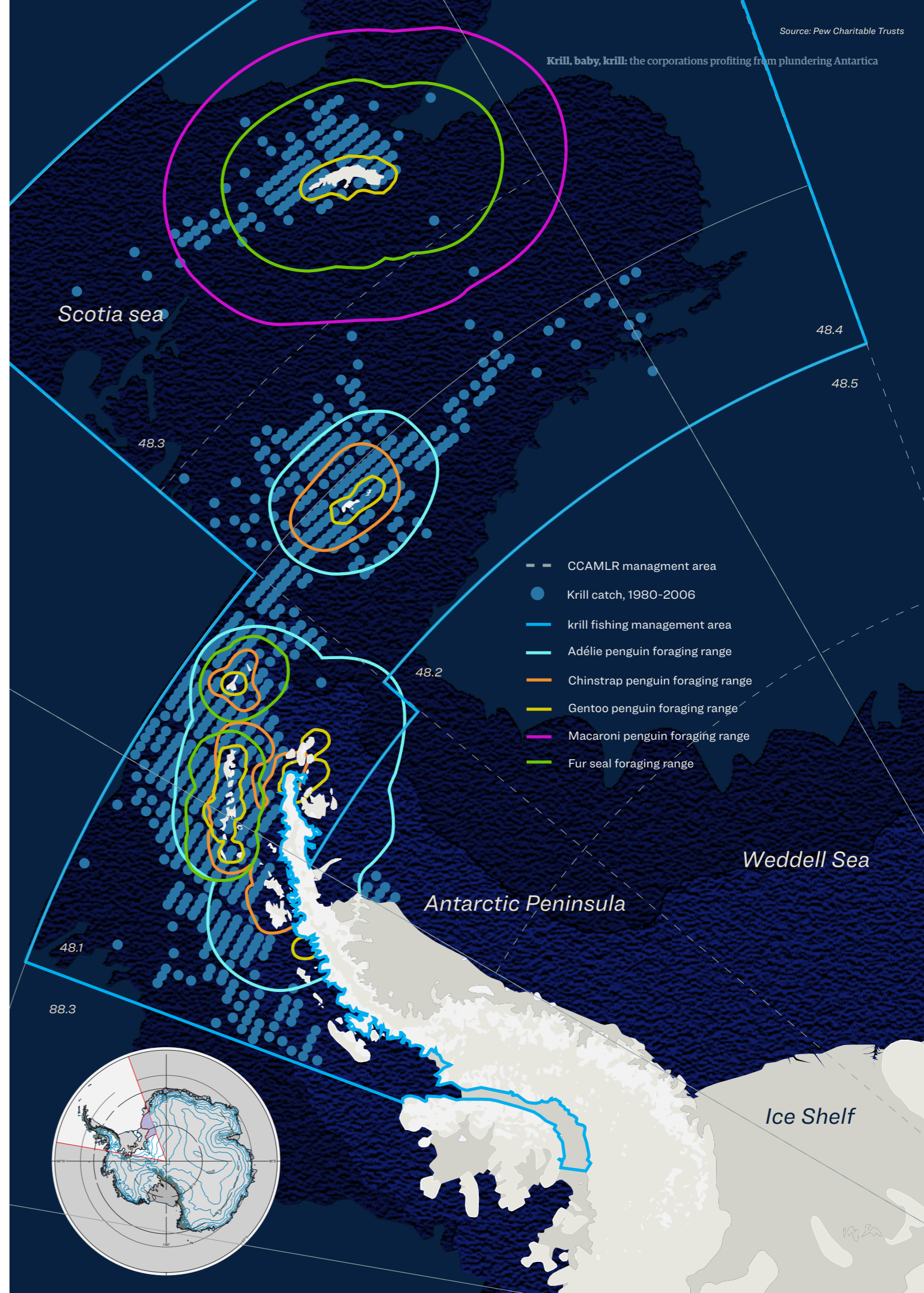


Figure 2.5: Krill fishing and overlaps with key predators' foraging areas

This is likely to get worse; a number of announcements have been made recently about additional capacity being developed (although it is worth noting that not all plans will come to fruition).



**China**

Reports in 2021 indicated a significant increase in catch capacity in China coming online in the next two years, starting with the addition of the newly built *Shen Lan* to the Chinese fleet in 2021.<sup>88</sup> However, other announced vessels have not yet materialised; the vessel to be operated by Chinese fishing firm Pingtan Marine Enterprise may have been cancelled due to a sharp rise in shipbuilding costs,<sup>89</sup> while the status of a 140-metre long krill vessel owned by Shanghai Chonghe Marine Industry (CMI) is not currently known. On the other hand, the *Fu Rong Hai*, is no longer on the CCAMLR list of authorised vessels.<sup>90</sup>



**Norway**

Norwegian company Rimfrost, which has long been involved in krill processing, has commissioned a purpose-built 120-metre-long krill vessel, which is expected to be delivered to the company in the last quarter of 2022.<sup>91</sup> According to Rimfrost, this vessel will be the only one in the world where supplements are produced at sea.<sup>92</sup>



**Russia**

It has been reported that Russia plans to invest 45 billion roubles (USD 604 million) in the fishery, including building five high-tonnage trawlers.<sup>93</sup>

Applying a conservative calculation in which one new vessel from Norway, two from China and three from Russia enter the krill fishery with a fishery effort matching the average catch across all vessels in 2020 (latest available figures), the CCAMLR trigger level of 620,000 tonnes would already be exceeded. Such a scenario would result in more than 630,000 tonnes of krill being caught (see Table 2.2). This does not take into account that new vessels are likely to be larger than the current average, nor that additional new actors might seek to enter the krill fishery.

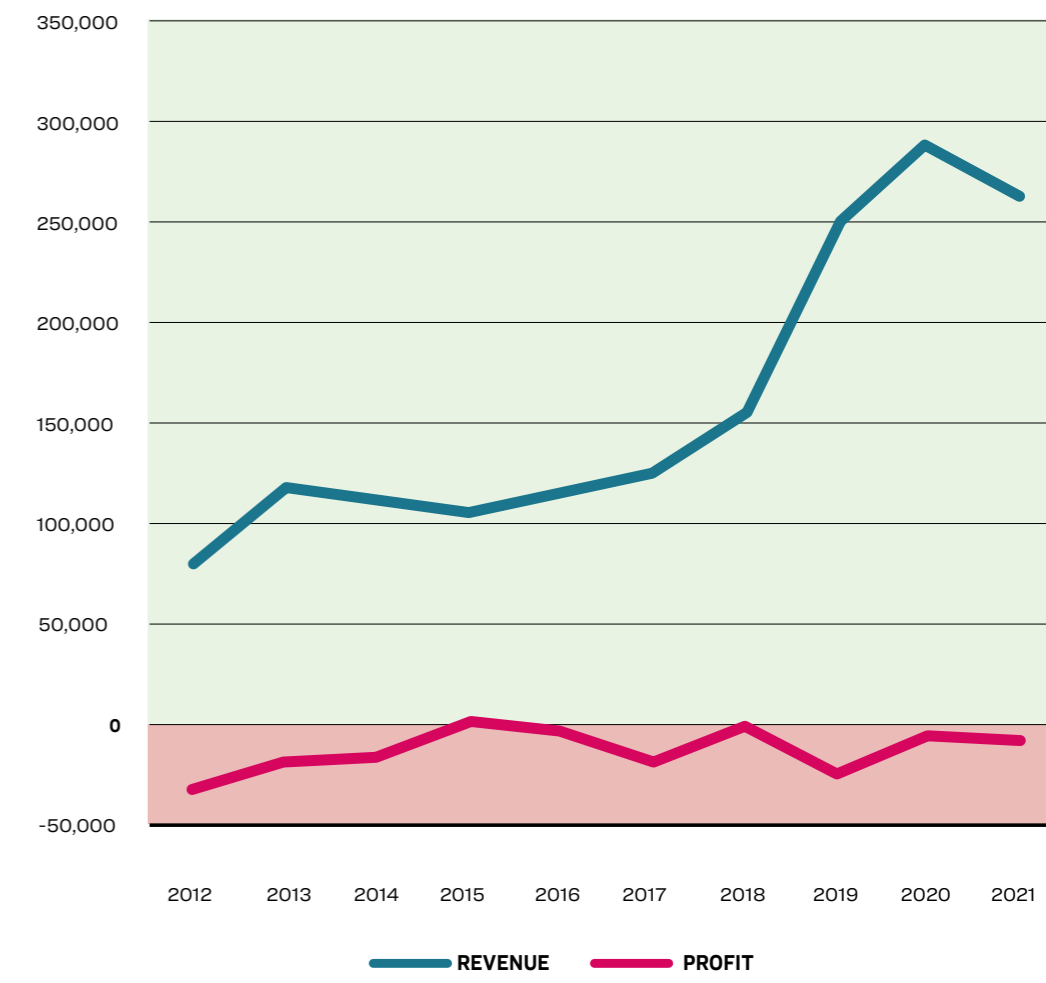
Year	No. of vessels	Average catch by vessel	Total catch
2020	12 <sup>D</sup>	37,120	445,442
<b>Scenario with 6 additional vessels</b>	17	37,120	<b>631,042</b>

**Table 2.2:** Conservative estimate of future krill catch

The current trigger level set by CCAMLR prevents fishing companies from radically increasing their fishing efforts. However, to operate profitably, it is likely that the predicted overcapacity - combined with the planned growth of existing companies involved in the industry - will result in companies pressuring CCAMLR to increase the krill trigger level. If successful, this could attract further industry capacity and new krill-fishing vessels.

D Two Korean vessels were listed twice in the CCAMLR register for that year.

Yet it seems that some major businesses engaged in the krill supply chains do not operate profitably, casting further doubt on the need for this industry, especially when considering its ecological impacts. For example, the Norwegian company Aker BioMarine - the largest player in the krill industry, responsible for 65% of the 2020/21<sup>94</sup> catch - has not managed to make its krill business a profitable proposition, despite having operated for 15 years. Even though the company's revenue has more than tripled in the last decade (with one exception), Aker BioMarine has posted net losses every year, ranging from more than USD 31 million in 2012<sup>95</sup> to USD 8 million in 2021 (see Figure 2.6).<sup>96</sup> Aker BioMarine has publicly stated that its goal is to double its revenue again by 2025, with annual growth rates of up to 18%.<sup>97</sup>



**Figure 2.6:** Aker BioMarine revenue and profit (USD 1,000s)<sup>98</sup>

While Aker BioMarine's harvest-to-revenue ratio has improved over the three years for which full datasets are available,<sup>E</sup> an analysis of the balance sheets found that it would be very difficult, if not impossible, for the company to double its profits (to more than half a billion US dollars) without a strong increase in production.

And this is what the company intends to do. Aker BioMarine's own presentation suggests that it might increase its harvest by up to 60% over recent harvest values.<sup>99</sup> Its strategy to do so is to increase the number of fishing days,

E Revenue and profit from Aker BioMarine annual reports. Harvest data from CCAMLR since, post-2017, Aker BioMarine was the only Norwegian company engaged in krill harvest.



lift the price for its aquafeed and pet feed on the back of higher harvesting, and 'aggressively hunt new markets of scale' for its krill oil.<sup>100</sup> In addition, the company continues to rapidly expand by acquiring existing companies and developing new products, such as protein powder, for the wellness and fitness markets.<sup>101</sup>

Assuming the same levels of yield efficiency, this would result in nearly 400,000 tonnes by Aker BioMarine alone - corresponding to nearly 90% of the total harvest reported by CCAMLR in 2020.<sup>F</sup> When combined with the krill catch by other existing and new companies, this will result in a capacity that exceeds the current trigger level, likely resulting in industry pressure on CCAMLR to raise that limit.

#### BOX 21: China's role in the global krill market

China is the second-largest krill-fishing nation; in 2020, a quarter of the krill harvest CCAMLR reported was caught by vessels registered in China.<sup>102</sup> Currently, four Chinese vessels are authorised to fish for Antarctic krill, but additional vessels might already be being built. Catch from Chinese vessels was reported for the first time in 2010 and has increased eightfold in the last 10 years - much faster than any other nation (in comparison, the Norwegian catch increased 2.2-fold, albeit from a much higher baseline).<sup>103</sup>

Three companies are active in the fishery:

5. **Jiangsu Sunline Deep Sea Fishery**, a subsidiary of CMI Group,<sup>104</sup> believed to be vertically integrated and active along the entire krill value chain;
6. **Fujian Zhengguan Fishery Dev. Co.**, believed to focus on fishing for krill (and other species) rather than processing, although there have been reports the company is seeking approvals to set up a processing operation,<sup>105</sup> and
7. **China National Fisheries Corporation (CNFC)**, a subsidiary of central-government-owned company China National Agricultural Development Group Co. CNFC owns two vessels in the CCAMLR registry and sells products such as krill meal, krill oil, krill paste and krill flavouring for pet food.<sup>106</sup>

Recent developments in the Chinese regulatory framework suggest a clear intention to rapidly grow the Chinese krill industry and market. In 2009, the Ministry of Agriculture launched a Development and Utilisation of Antarctic Krill Biological Resources Project.<sup>107</sup> Shortly after, a handful of companies received licences to engage in the fishery, with a required minimum catch of 500 tonnes each.<sup>108</sup> In the same year, China's State High-Tech Development Plan announced a grant of 17 million Chinese Yuan to develop technologies linked to krill processing and krill product manufacturing.<sup>109</sup> In 2013, krill oil was approved as a new food raw material for human consumption.<sup>110</sup> Aker BioMarine was reportedly the first company to request this approval.<sup>111</sup>

In 2017, the Ministry of Agriculture called to 'accelerate the independent innovation and research and development of complete sets of Antarctic krill fishing equipment and product processing, and comprehensively improve the benefits of Antarctic krill fishery'. However, it followed up with a guidance opinion in 2022, emphasising the need for 'high-quality development' of pelagic fishing in its 14th five-year plan (covering 2020-25).<sup>112</sup> This signalled a clear shift: away from simply expanding fishing and upscaling the krill industry, and towards a more managed development model. The wording suggests that the Chinese authorities deemed the krill-fishing fleet to be expanding beyond necessity and the industry to be developing faster than consumer demand.

<sup>F</sup> Aker seems to report on tonnes of krill meal, while CCAMLR reports the biomass of the catch. The potential increase of 60% measures in the image in the Aker presentation has been added to the Norwegian catch reported by CCAMLR in 2020, when only Aker BioMarine was active with Norwegian flagged vessels.



### 3. Industry tactics to justify krill fishing

As we have seen, humans are not 'natural' krill predators, and the industry had to be innovative to create markets for krill products. This section will reveal industry tactics and efforts to create new markets, present krill as a premium product and dispel growing concerns about the sustainability of the fishery.

#### 3.1. How the industry legitimised the existence of krill products

The most significant development in the krill fishery since the demise of the Soviet Union was Norwegian companies' entry into the fishery in 2009. Norwegian companies are now the dominant force in the industry, and have truly reshaped the market for krill products.<sup>113</sup> Much of the global production of krill meal is used in the aquaculture industry and, while the *production* of krill meal is much higher than that of krill oil, the *value* of krill meal is significantly lower. In the case of Aker BioMarine, more than 60% of the company revenue is generated from krill oil,<sup>114</sup> even though it makes up a much smaller volume than krill meal (see Box 3.1).

#### BOX 3.1: Aker BioMarine's domination of the global krill market

Aker BioMarine has long been the main driver behind the expansion of the krill industry. As the only Norwegian company engaged in the krill fishery for a number of years, it has become synonymous with krill fishing, at least in Europe. The company is a subsidiary of Aker ASA, an industrial investment company with significant interests in the oil and gas industry and the largest shareholder of 11 companies listed on the Oslo stock exchange.<sup>115</sup> In 2021, the total turnover of companies associated with Aker ASA was close to USD 9.7 billion.<sup>116</sup>

Aker BioMarine (Aker), established in 2006,<sup>117</sup> soon developed its Superba krill-oil line for human supplements and its Qrill products for aquaculture, which were later expanded to petfood. In 2014, Aker began converting an existing factory in Houston, Texas, into a krill-oil production plant.<sup>118</sup> In 2018, Aker first listed on the Euronext Growth stock exchange; it later transferred to the Oslo Stock Exchange.<sup>119</sup> Nearly 80% of the stock is controlled by Aker ASA, and many of the other larger shareholders are located in Scandinavia.<sup>120</sup> Today, Aker has more than 400 employees, with revenues exceeding USD 260 million in 2021.<sup>121</sup>

Aker is by far the largest actor in the global krill market. The company says its extraction plant in Houston is responsible for 80% of the global production of krill oil, and its own consumer brands sell more than 13 million units of krill soft-gel tablets per annum in the United States.<sup>122</sup> In addition to supplying oil to krill-supplement manufacturers, Aker also owns the Kori brand, which is for sale in US retailers such as Walmart, Target, Costco and CVS. In 2019, Aker bought Lang Pharma Nutrition, a major private-label manufacturer of supplements for USA retailers.<sup>123</sup> Of the krill meal Aker produces for aquaculture, around 50% is used in salmon feed and around one-third in shrimp feed. Europe has the largest share of its customer base, followed by Oceania.<sup>124</sup>

Krill-based products, as we know them today, have not appeared ‘organically’ as a result of basic human needs. While there were serious attempts to develop krill meat for human consumption<sup>125</sup> in the early days of krill fishing in the 1970s, krill for human consumption never fully took off, which meant that actors involved in the industry had to reinvent what we could use krill for. Between 1976 and 2009, as many as 812 krill-related patents were lodged as the industry researched ways to use krill, covering human consumption, animal feed, aquaculture and pharmaceuticals.<sup>126</sup> Krill-based products, being only a few decades old and unknown to humans, have had to provide justifications for their existence, benefits and high price in their marketing strategies.

Using findings from scientific studies has been crucial to demonstrating the proclaimed benefits of krill-based products and to convince customers of their legitimacy. However, these justifications remain equivocal.

### 3.1.1. Krill oil as a premium health supplement

Krill oil as a health supplement entered the market in 2003,<sup>127</sup> and has benefited from a large body of research that demonstrated the value of Omega-3 for a variety of disorders, from high blood pressure to attention deficit and hyperactivity disorder.<sup>128</sup> Just like fish oil and other marine oils, krill oil contains a mixture of different types of fats or oils, including Omega-3s (EPA and DHA acid content) and phospholipids, and is deemed able to deliver many of the purported benefits of consuming marine oil-based health supplements.

But because krill oil is more expensive to produce than most other sources of Omega-3 oils (largely because of the difficulties of fishing in Antarctic waters and the considerable investment it requires), research has been conducted to determine whether krill oil is equal to or better than other marine oils,<sup>129</sup> so as to support marketing claims that, because krill oil is more effective in delivering Omega-3 acids than fish oil, customers would need to consume a smaller amount of krill oil compared to fish oil to achieve the same level of health benefits.<sup>130</sup> Such findings would, in effect, justify its very high price compared to other marine oils.

To date, however, this research has produced mixed results,<sup>131</sup> with studies on krill oil lacking both the volume and scientific rigour generally found in the body of research on fish oil.<sup>132</sup> For example, in a 2022 company presentation,<sup>133</sup> Aker BioMarine claimed that krill oil is twice as effective in increasing the Omega-3 index as fish oil. However, the 2013 study<sup>134</sup> referenced in the footnote was debunked after it was pointed out that the fish oil used was not equivalent to the fish oil typically commercially marketed, and that the conclusions were therefore ‘not justified and misleading’.<sup>135</sup> A study published two years later, which also compared the benefits of krill oil to those of fish oil, concluded that ‘interpretation is difficult’ and that, although there seems to be a difference in bioavailability of EPA and DHA after intake of krill oil and fish oil, more studies are needed before a firm conclusion can be made.<sup>136</sup> An additional study in 2015 concluded that similar levels of EPA and DHA were achieved with fish-oil and krill-oil products when matched for dose, indicating comparable oral bioavailability irrespective of formulation.<sup>137</sup> The superiority of krill oil over other marine oils therefore remains unproven. A major difference that the krill industry has used for marketing advantage, however, is that krill oil is less likely to produce reflux and a fishy aftertaste compared to fish-oil supplements.<sup>138</sup>

Fish-oil dietary supplements are also associated with an array of environmental and social impacts, as a large share of fish-oil’s production relies on Peruvian anchoveta, a controversial fishery that provides an important source of nutrition for the wildlife in the Humboldt Current, one of the most productive marine ecosystems on Earth.<sup>139</sup> Many vegan alternatives to both krill and fish oils that contain Omega-3 but none of the environmental costs, such as algae oil, are now increasingly available to consumers.

### 3.1.2. Krill as a premium aquafeed ingredient

Much less scientific information is available when it comes to demonstrating the benefits of krill meal for aqua-feed. Krill contains astaxanthin – the substance that turns salmon flesh pink or red. Most farmed salmon use synthetic astaxanthin, meaning farmed fish that were fed krill can be marketed for a premium price as ‘naturally coloured’.<sup>140</sup> Krill is also advertised as a feeding stimulant<sup>141</sup> because it makes the feed more palatable,<sup>142</sup> leading to higher feed intake and faster growth.

It is notable, however, that the main study Aker BioMarine cites in its presentations is hardly independent; of the six authors listed,<sup>143</sup> two were employed by Aker BioMarine and three were from research institute Nofima, which is partly funded by industry.<sup>144</sup> In 2014, Nofima’s research into krill used in salmon feed was funded by both Aker BioMarine and BioMar,<sup>145</sup> two of the companies most heavily involved in the krill-meal aquafeed industry. In the pet food study that Aker BioMarine cites in its publications, all three of the authors were employees of Aker BioMarine and no independent scientists were involved.<sup>146</sup>

In its presentations to investors, Aker does not disclose that these studies were funded and largely carried out by the company itself, nor any conflict of interest. While these arguments have convinced some aquafeed manufacturers and fish farmers, others remain sceptical to these proclaimed benefits (see section 4).

## 3.2. Industry tactics to portray krill fishing as sustainable

Industry players that fish krill, as well as corporate actors further down the supply chain that sell krill-based products, use common tactics to greenwash their products. These tactics – often drawn from the ‘delay, distract, derail’ corporate playbook<sup>147</sup> – hide the truth about the sustainability of krill.

### 3.2.1. Heavy greenwashing in marketing: the narratives

Krill-oil dietary supplements are marketed as a premium eco-friendly product from the ‘pristine waters of Antarctica’.<sup>148</sup> One of the most recurrent so-called ‘facts’ the krill-harvesting industry puts forward to support this claim is that the catch limit is ‘only 1% of the krill biomass, which makes it one of the most precautionary in the world’.<sup>149</sup> While the trigger level of 620,000 tonnes is indeed low compared to the estimated biomass, it distracts from the true impact of krill fishing on key predators, such as penguins, particularly in the face of climate change – it essentially steals food from them. In 2021, several NGO groups – including the Pew Charitable Trusts – called out<sup>150</sup> Aker BioMarine for using a study based on a 2019 survey<sup>151</sup> to demonstrate the health of krill stocks, which failed to reflect the costs of the fisheries on predators and krill density overtime, particularly in the face of climate change.

More generally, the overall krill fishery, managed by CCAMLR, is often coined as ‘the best-managed in the world’ – a narrative relayed by industry players themselves, who praise CCAMLR’s ecosystem-based approach and strict governance system, which requires the consensus of 25 governments to change fishery regulation.<sup>152</sup> While this sounds like a good system of checks and balances, it also means that any management decisions are extremely slow – if not impossible – to adopt, which seriously undermines CCAMLR’s ability to make the best decisions possible for krill, particularly in the context of a rapidly warming climate (see Box 3.2).

**BOX 3.2: CCAMLR - frozen in time**

In 2007, CCAMLR agreed Conservation Measure 51-01, which set a catch limit of 3.47 million tonnes across Area 48 based on scientific data collected during 2000 – over 22 years ago. It also introduced the precautionary trigger level of 620,000 tonnes, until the Commission defined an allocation of this total catch limit between smaller management units, based on the advice from the Scientific Committee.<sup>153</sup> The figure of 620,000 was based on historical catches in Area 48 and represents the sum of the maximum catch taken from each of the subareas over the history of the fishery. In 2009, following extensive discussion in the Scientific Committee, CCAMLR agreed on the additional temporary measure against concentrated fishing (Conservation Measure 51-07), which divided the so-called trigger level of 620,000 tonnes in the four subareas (48-1, 48-2, 48-3 and 48-4).<sup>154</sup> This measure was set to expire in 2021.<sup>155</sup> However, since 2010, countries have not been able to adopt a new measure, and in October 2021, Conservation Measure 51-07 was renewed for another year as CCAMLR was unable to produce an updated management plan.<sup>156</sup> Similarly, a plan for a network of marine protected areas (MPAs), supported by NGOs and scientists,<sup>157</sup> which would have protected key breeding and foraging areas of many predators and mitigated combined effects of concentrated fishing and climate change, was also rejected for a fifth year.<sup>158</sup> This is because CCAMLR's decision-making process is based on consensus; as long as some members oppose changes to the status quo (in this regard, China and Russia), decisions cannot go ahead. This means that, for the foreseeable future, it is difficult to envisage how management measures regarding krill can evolve and adapt to our rapidly changing climate. The ways in which the krill fishery operates is based on a biomass survey from over two decades ago, with current precautionary catch limits and divisions established according to activity at spatial and temporal scales that differ significantly from current fishing hotspots.<sup>159</sup>

**3.2.2. Keeping a hand in the research**

The biomass estimates that the industry waves around are also problematic. They rely on the only two surveys conducted, in 2000 and 2019, which were both single-season surveys in one part of the CCAMLR Area 48.<sup>160</sup> Due to the high variability of the krill biomass, these surveys' single-snapshot estimate of krill biomass are an uncertain and inexact<sup>161</sup> representation of the unexploited biomass.<sup>162</sup> The latest survey was also largely driven and funded by commercial harvesting interests. This tactic is not uncommon for groups like Aker BioMarine, which, through setting up the Antarctic Wildlife Research Fund<sup>163</sup> (in partnership with environmental NGOs), fund some of the research conducted in the region. While further funding for research is desperately needed, the involvement of private actors that have a financial stake in krill fishery is clearly a conflict of interest, and allows the industry to keep a stronghold over the type of research conducted and the methodology employed.<sup>164</sup>

**3.2.3. Voluntary commitments**

The industry is well aware of CCAMLR's shortcomings; in 2018, the Association of Responsible Krill (ARK), an industry alliance representing 90% of the krill-harvesting sector, announced voluntary restricted zones to protect predators.<sup>165</sup> Although this could offer a level of protection and therefore be a step in the right direction, such industry measures do not cover all key sensitive areas – and, because they are voluntary, they are neither monitored nor enforced. Their impact is therefore limited, and could potentially distract and derail plans for setting up more stringent MPAs, which some industry members reportedly vehemently oppose and describe as 'square pegs in round holes'.<sup>166</sup> Their effectiveness and ability to limit fishing is also undermined by recent industry moves to increase krill-fishing capacity.

**3.2.4. Hiding behind third-party certification schemes**

The krill-harvesting sector also tends to hide behind various certifications, such as the MSC and Friend of the Sea (FOS). Consumers, increasingly conscious about the sustainability of the products they buy, rely on labels and certifications as a quick and easy way to identify more sustainable products without having to become supply-chain experts.<sup>167</sup> However, stakeholders – including Changing Markets<sup>168</sup> – have raised the flag about certification schemes like MSC and FOS, which were found to be certifying numerous fisheries as sustainable even when they were overfished, had high levels of bycatch and,<sup>169</sup> in some cases, were even at odds with national legislation. The MSC's certification of Antarctic krill dates back to 2010, has since been renewed twice and has been the subject of a lot of controversy. The Pew Charitable Trusts pointed out three key issues which were not taken into account in the MSC's decision: the potential effects of climate change, the impact of all the concentrated fisheries targeting krill in the Antarctic, and the limited understanding of krill's life cycle and its importance to the local food web.<sup>170</sup>

Our report and previous campaigning around krill has shown that it is really difficult to question the sustainability of products that carry the MSC label, which – despite its significant shortcomings – is still perceived as the gold standard by many stakeholders in fisheries food retail. Retailers have repeatedly used MSC certification as a defence against any NGO campaigns or scientists' concerns around sustainability of a particular fishery.<sup>171</sup> Furthermore, numerous retailers, aquafeed and salmon-farming companies have policies or aspirations to increase the use of MSC- or Marin Trust-certified marine ingredients in their farmed-seafood supply chains. This shows that getting MSC to certify krill was a crucial industry tactic that is used as the main defence against critiques of krill fishing.

**Figure 3.1:** MSC label on krill supplements



**3.2.5. Making up certifications**

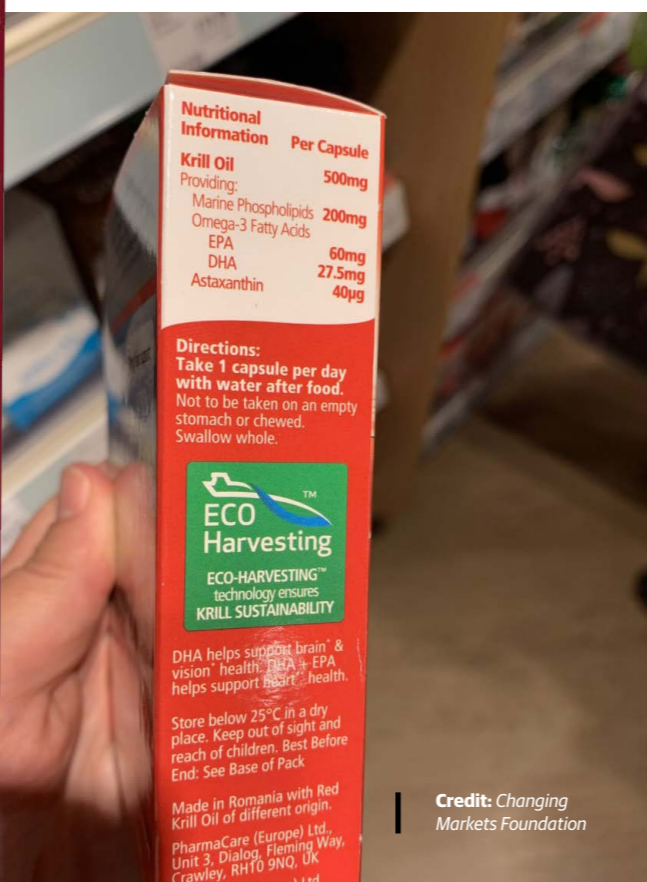
Krill-fishing companies' certifications are often displayed on products as a key selling point for well-meaning consumers. Such labels are often confusing and can be a key greenwashing tactic – especially when labels created by the brands themselves are added to the packaging. On the Aker BioMarine krill products investigated for this report, the company prominently displays the so-called 'Eco-Harvesting' label. This small green label 'certifies' that the krill was caught using the Aker BioMarine 'eco-harvesting method', which is a fishing method developed and patented by Aker BioMarine that allows fish to be caught continuously without needing to retrieve the nets. The promotional video<sup>172</sup> on the website informs the viewer that this method prevents bycatch. However, according to Reuters, Aker BioMarine entangled four humpback whales, including three juveniles, during its 2021/22 fishing season.<sup>173</sup> On other products, the logo of the Antarctic Wildlife Research Fund (established to conduct the research, including into krill volumes in the region) was displayed, apparently as a sustainability label. This is concerning, as it appears to be an endorsement of a research organisation for this product.



Credit: Changing Markets Foundation

**Figure 3.2:** AWR logo on Swisse products. Swisse is listed as a supporter of AWR, alongside BioMar, Aker BioMarine and others.

**Figure 3.3:** 'Eco-harvesting' label on Aker BioMarine product



Credit: Changing Markets Foundation

### BOX 3.3: European supermarkets lack policies to eliminate fish (and krill) from aquaculture feed

In November 2021, Changing Markets released a report that assessed the policies European retailers have adopted to reduce and eliminate the use of wild-caught fish in the feed of farmed fish, such as salmon (among other subjects). Retailers were contacted because they play an important role in global fish-supply chains; 77% of Europeans buy fish from either grocery stores, supermarkets or hypermarkets.

The global aquaculture industry has experienced rapid growth over the past decades, from supplying a mere 4% of fish 70 years ago to accounting for over half of the fish eaten in 2018.<sup>174</sup> The use of wild-caught fish in aquaculture feed is a particularly controversial practice, since 90% of fish used in fish meal is suitable for direct human consumption.<sup>175</sup> Today, more than one-third of global fish stocks are overfished – up from 10% in 1974<sup>176</sup> – and marine populations reduced by around half between 1970 and 2012.<sup>177</sup>

In the retailer research carried out by Changing Markets across six European countries and exposed in the report *Floundering Around*,<sup>178</sup> none of the 33 companies surveyed provided strong responses in any of the three areas they were assessed in: feed, welfare/mortalities and transparency/labelling. When it comes to aquaculture feed, Marks & Spencer, Tesco and Waitrose had the most progressive approaches on feed and fish welfare, while Auchan had a target date for transitioning 50% of the farmed seafood it sells to feed containing less or no fish meal and fish oil (FMFO). Intermarché even saw krill as a sustainable feed alternative,<sup>179</sup> while Co-op Switzerland informed Changing Markets that it was seriously considering dropping the use of FMFO as an ingredient in fish feed.

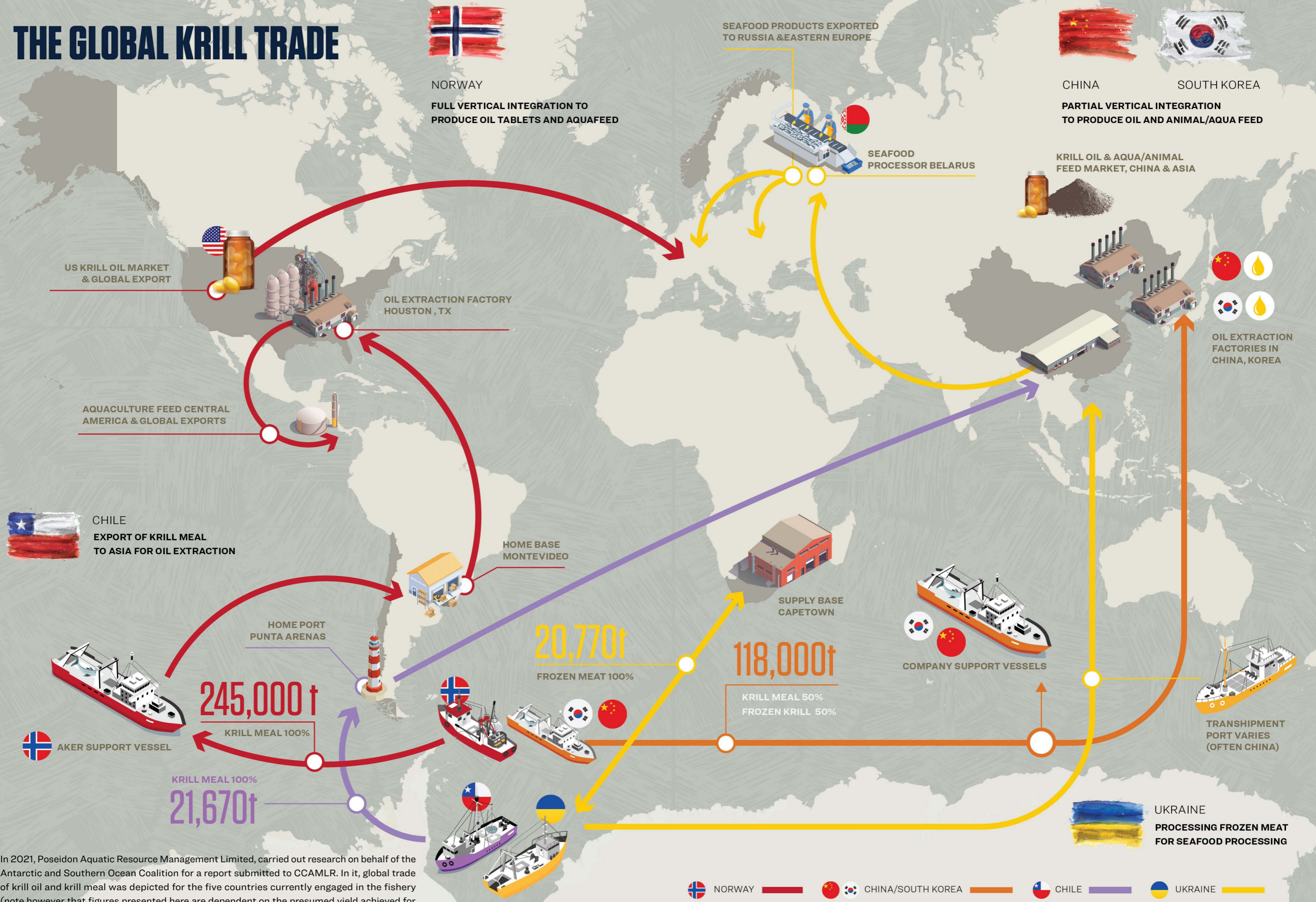
The report concluded that the European retail sector still has a long way to go to eliminate the use of wild-caught fish in feed, as not a single supermarket had a policy to phase out the use of wild-caught fish – which includes krill – from feed.



Credit: Shutterstock



# THE GLOBAL KRILL TRADE



**NORWAY**  
**FULL VERTICAL INTEGRATION TO PRODUCE OIL TABLETS AND AQUAFEED**

SEAFOOD PRODUCTS EXPORTED TO RUSSIA & EASTERN EUROPE

**CHINA**      **SOUTH KOREA**  
**PARTIAL VERTICAL INTEGRATION TO PRODUCE OIL AND ANIMAL/AQUA FEED**

US KRILL OIL MARKET & GLOBAL EXPORT

OIL EXTRACTION FACTORY HOUSTON, TX

SEAFOOD PROCESSOR BELARUS

KRILL OIL & AQUA/ANIMAL FEED MARKET, CHINA & ASIA

AQUACULTURE FEED CENTRAL AMERICA & GLOBAL EXPORTS

OIL EXTRACTION FACTORIES IN CHINA, KOREA

**CHILE**  
**EXPORT OF KRILL MEAL TO ASIA FOR OIL EXTRACTION**

HOME BASE MONTEVIDEO

SUPPLY BASE CAPETOWN

COMPANY SUPPORT VESSELS

TRANSHIPMENT PORT VARIES (OFTEN CHINA)

**245,000 t**  
 KRILL MEAL 100%

**20,770 t**  
 FROZEN MEAT 100%

**118,000 t**  
 KRILL MEAL 50%  
 FROZEN KRILL 50%

KRILL MEAL 100%  
**21,670 t**

**UKRAINE**  
**PROCESSING FROZEN MEAT FOR SEAFOOD PROCESSING**

In 2021, Poseidon Aquatic Resource Management Limited, carried out research on behalf of the Antarctic and Southern Ocean Coalition for a report submitted to CCAMLR. In it, global trade of krill oil and krill meal was depicted for the five countries currently engaged in the fishery (note however that figures presented here are dependent on the presumed yield achieved for krill oil and krill meal).

**Figure 3.4:** The global krill trade<sup>80</sup>

Source: Poseidon Aquatic Resource Management Limited

## 4. Global krill supply chains

Reliable information on the value of krill products and markets is relatively scarce. While a number of market consultancies have attempted to estimate the global value of the krill industry, figures vary significantly. Estimates for krill oil range from USD 141 million<sup>181</sup> to USD 740 million,<sup>182</sup> but most settle at around USD 300 million. The market value for krill meal is significantly smaller, and has been estimated at around USD 160 million.<sup>183</sup>

This chapter further investigates the key supply chains for krill oil and krill meal, highlighting specific end users and retailers and their roles and responsibilities within global krill supply chains. For krill oil, the focus is on the world's largest retailers, since the use of supplements is ubiquitous globally. For krill meal, the focus is on Europe, where it is widely used in salmon feed; Europe is responsible for more than 60% of global production and nearly 50% of consumption of Atlantic salmon (by far the most widely farmed salmon species).<sup>184</sup>

### 4.1. Retailers still selling krill oil

Krill oil is the most valuable product that the krill-fishing industry manufactures and is mostly used to produce dietary health supplement (albeit some extracted krill oil is also used for aquafeed). To investigate the global prevalence of the sale of krill-oil health supplements, Changing Markets surveyed the online stores of the largest retailers globally. To be included in the assessments, retailers had to have online stores for any of their subsidiaries, and had to be selling other supplements (such as vitamins). Using this methodology, the 50 largest retailers on the Deloitte ranking of retailers were included. These mostly consisted of supermarkets and discount-, convenience- and drug-store chains, as well as some online retailers.

Our survey shows that 68% (34 stores) of these companies sold krill-oil supplements. Notably, these products were found in 88% of the 17 North American retailers and 75% of the 8 Asian retailers. In Europe, 21 retailers were included in the survey, 48% of which were found to be selling krill health supplements. Both of the Australian retailers and one of the two South American retail chains on the list were also found to be selling krill.



Retail chain	Retail revenue 2019 (USD millions) <sup>185</sup>	HQ	Krill products found?
 Walmart Inc	523,964	USA 	YES
 Amazon	158,439	USA 	YES
 Costco	152,703	USA 	YES
 Schwarz Group	126,124	GERMANY 	YES
 Kroger	121,539	USA 	YES
 Walgreens Boots Alliance, Inc.	115,994	USA 	YES
 Aldi	106,326	GERMANY 	NO
 CVS	86,608	USA 	YES
 Tesco	81,347	UK 	YES
 Target	77,130	USA 	YES
 Ahold Delhaize	74,160	NETHERLANDS 	YES
 JD.com	73,909	CHINA 	YES
 Aeon	72,711	JAPAN 	NO
 Albertsons	62,455	USA 	YES
 Carrefour	83,039 <sup>186</sup>	FRANCE 	YES
 Edeka	61,221	GERMANY 	NO
 Seven & I Holdings	58,552	JAPAN 	YES
 REWE	55,772	GERMANY 	NO
 Auchan	51,264	FRANCE 	YES
 E.Leclerc	43,426	FRANCE 	YES
 Woolworths Limited	41,778	AUSTRALIA 	YES
 Casino Guichard-Perrachon SA	38,775	FRANCE 	YES
 Publix	38,463	USA 	YES
 Sainsbury's	36,303	UK 	NO
 Loblaw Companies Limited	35,493	CANADA 	NO

Retail chain	Retail revenue 2019 (USD millions) <sup>185</sup>	HQ	Krill products found?
 Intermarché (Les Mousquetaires)	35,435	FRANCE 	NO
 HEB	28,200	USA 	YES
 Dollar General	27,754	USA 	YES
 Mercadona	26,146	SPAIN 	NO
 Coles	25,063	AUSTRALIA 	YES
 Migros	24,968	SWITZERLAND 	NO
 Dollar Tree	23,611	USA 	NO
 Co-op Group	23,339	SWITZERLAND 	NO
 Système U, Centrale Nationale	22,922	FRANCE 	NO
 Morrisons	22,400	UK 	NO
 A.S. Watson Group	21,597	HONG KONG 	NO
 Jerónimo Martins, SGPS, SA	20,860	PORTUGAL 	NO
 Reliance Retail Limited	20,371	INDIA 	YES
 Meijer	20,200	USA 	YES
 Kohls	18,885	USA 	YES
 Rite Aid Corporation	15,616	USA 	YES
 Femsa	15,141	MEXICO 	NO
 Lotte	15,109	SOUTH KOREA 	YES
 El Corte Inglés, SA	14,614	SPAIN 	YES
 BJ's Wholesale Club Holdings, Inc.	13,191	USA 	YES
 John Lewis Partnership plc	12,967	UK 	YES
 Marks and Spencer Group plc	12,935	UK 	YES
 Cencosud SA	12,895	CHILE 	YES
 Vipshop Holdings Limited	12,744	CHINA 	YES
 Alibaba	12,381	CHINA 	YES

Table 4.1: Results of retailer survey for krill-based supplements

Considering the ecological concerns associated with krill harvesting, and the lack of convincing data showing the benefits and necessity of krill-based health supplements compared to more sustainable alternatives, the extent to which these products have been found on supermarket shelves is disappointing. Furthermore, it is of concern that industry tactics have been successful; the sale of krill-oil supplements seems to be expanding, with some companies, such as Holland & Barrett, even renege on previous promises to stop selling these products (see Box 4.1).

### BOX 4.1: Broken promises to stop selling krill oil

In 2018, pressured by environmental groups, a small number of retailers – especially in the UK – agreed to not stock krill supplements. However, the majority of these no longer have such policies in place. Even more concerning, at least one supplement retailer has broken its promise to ban krill supplements from its stores.

In March 2018, after a campaign by Greenpeace, Holland & Barrett – which claims to be Europe’s largest health and wellness retailer, with over 1,600 stores in 18 countries<sup>187</sup> – decided to remove all krill products from its shelves. The company’s CEO stated: ‘Protecting the oceans is important to us ... We have therefore decided today to remove all krill-based products from sale over the next few weeks.’<sup>188</sup>

This promise did not last long; as of July 2022, Holland & Barrett is back to selling Bioglan-branded krill capsules. The company justifies this by saying:

*So, back in 2018 when Greenpeace alerted us to the potentially unsustainable fishing practices of our suppliers, we made the decision to remove it from our shelves. But we have good news! Krill oil is back at Holland & Barrett and 100% sustainable. We promise to only work with suppliers and fisheries who are registered with ARK. ARK members have all voluntarily committed to stop fishing in extensive areas around the Antarctic Peninsula to prevent damage to the delicate eco-system.*<sup>189</sup>

ARK is not an independent organisation; it is an industry group, whose members include most of the major krill harvesters, with the goal to commercialise – and often increase – the harvest of krill to make their industry profitable (see section 3.2.3).

## 4.2. Tracing krill meal in European salmon products

Much of the krill meal utilised in aquaculture is used in the rearing of farmed salmon; for instance, around 50% of Aker BioMarine’s aquaculture-feed customers are linked to the farmed-salmon industry, while shrimp makes up another one-third.<sup>190</sup>

With the EU and Norway capturing nearly 50% of the global farmed Atlantic salmon market (see Figure 4.1), our investigation focused on the European supply chain.

The major European grocery retailers are the most important sales channel for farmed salmon; within the EU, 80% of farmed salmon is sold through supermarkets.<sup>192</sup> Many supermarkets sell own-branded salmon products (private labels) in addition to branded products by salmon-farming companies and processing or packaging companies.

This investigation – for the first time – follows krill meal from ‘net to plate’, with a focus on the European supply chain. To do so, Changing Markets used desktop research as well as investigative techniques and field research in major supermarkets in the main salmon-consuming countries – France, Germany, Spain and the UK – in an attempt to identify salmon that may have been fed on krill. Four supermarkets

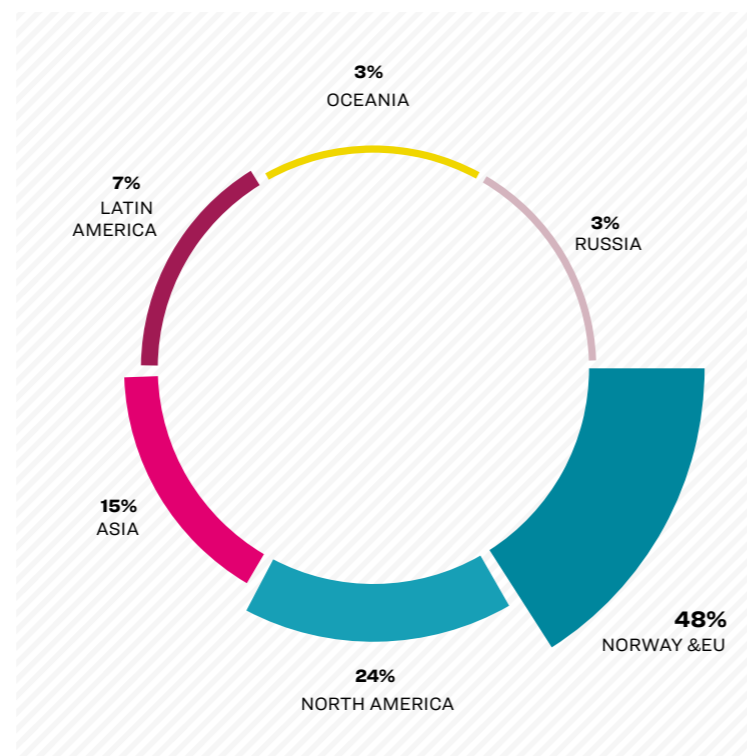


Figure 4.1: Main markets for farmed Atlantic salmon<sup>191</sup>

in each of these four countries were identified: the two highest-scoring companies in Changing Markets’ previous report, *Floundering Around* (see Box 3.3) which assessed retailer policy with regards to sourcing farmed fish,<sup>193</sup> and the two retailers with the largest market shares. Where these two selection criteria resulted in an overlap of retailers, the supermarkets with the next-largest market shares were chosen.

Despite the lack of labelling, Changing Markets was able to link krill from the Antarctic to several European retailers and specific products. The results show the widespread use of krill in salmon products throughout Europe. The lack of transparency makes it impossible for consumers to avoid contributing to krill depletion in Antarctica.

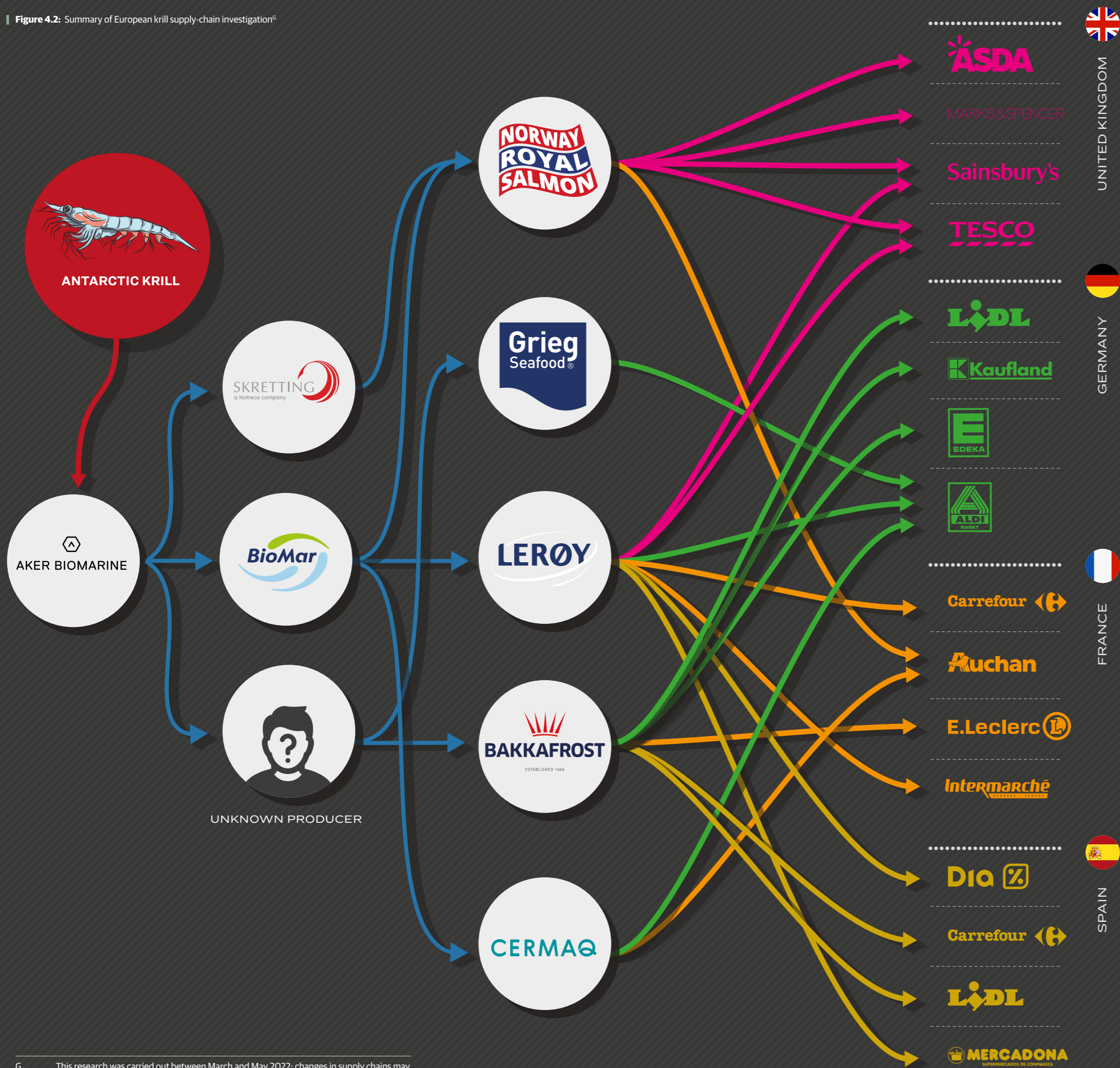
**In summary, this investigation found evidence of various degrees of strength that all 16 of the European retailers investigated are connected to supply chains that use krill-based diets for farmed salmon products. In all cases, the supply chains originate with Aker BioMarine, as the key supplier of Antarctic krill. Moreover, none of the retailers have adopted a policy to exclude krill feed from their own brands, even though they would have the power to do so.**

In contrast, very few retailers have banned krill-oil products from their sales of health supplements, including own brands and branded products. One of these retail chains is Lidl UK (owned by the German Schwarz Group), which has a Sustainable Fish and Seafood Policy that states: ‘Krill forms the basis of the Antarctic food web, with many Antarctic species relying on its sufficient availability. For this reason, Lidl GB does not stock products that contain Krill or Krill oil.’<sup>194</sup> Yet Lidl does apply this policy to aquaculture feed and salmon products, and krill oil-based health supplements and krill-fed salmon were found in other stores owned by the Schwarz Group in Europe; for instance, Kaufland stores in Germany.<sup>195</sup>

The European salmon-supply chain is characterised by a particular lack of transparency, since feed ingredients do not have to be listed on retail packaging. This makes it impossible for consumers to avoid krill products and make ethical purchasing decisions. This lack of transparency is consistent with previous research, which found that the aquaculture industry as a whole rarely offers information on its production practices and routinely deflects attempts to draw attention to its supply chains, focusing instead on low-carbon credentials and talking up its potential to relieve pressure on fish stocks in the wild.<sup>196</sup>

Due to the lack of supply-chain transparency, our investigation relied on investigative techniques and information printed on packaging. For instance, in the EU, animal products are required to carry labels with codes that identify the company that last handled the products. In the case of salmon, this is usually (but not always) a packaging, processing or smoking company. In addition, some retailers include QR codes or certification codes on packaging, which provide various degrees of information regarding the origin of the product. In most cases, however, these codes do not provide information about the specific farms the salmon originated from, and they never provide information on the origin of the feed (which is also not required legally). Finally, in some cases, products also include codes from initiatives such as GGN, operated by GLOBALG.A.P. (a brand of smart-farm assurance solutions developed by FoodPLUS GmbH) or the Aquaculture Stewardship Council (ASC), which can also reveal additional supply-chain information. The ASC feed standard does not exclude the use of krill.<sup>197</sup> However, in the vast majority of cases, the information provided is insufficient for consumers to find out where their product originates from in detail. Most importantly, none of the markings and codes allow consumers to deduce whether krill is used in the production of the farmed -salmon product they have purchased, and we had to rely on other methods.

Figure 4.2: Summary of European krill supply-chain investigation<sup>6</sup>



**UNITED KINGDOM**

In the UK, the own brands of **Marks & Spencer** and **Asda** have been linked to the UK's largest distributor and processor, **Young's Seafood**,<sup>198</sup> which reportedly supplies around 40% of all fish consumed in the UK.<sup>199</sup> Our investigations show that one of the suppliers of salmon to Young's Seafood is **Norway Royal Salmon**, which sources its feed mostly from **Skretting** but also from **BioMar**.<sup>200</sup> Both of these aquafeed companies obtain krill for their feed from **Aker BioMarine** (**EWOS** also supplies feed, but does not use krill). However, the main direct customer of **Norway Royal Salmon** is believed to be **Morrisons**, which uses the salmon in its own brands.<sup>201</sup> Young's salmon is also sold by **Tesco**<sup>202</sup> and **Sainsbury's**,<sup>203</sup> and our investigation found that salmon provided by **Norway Royal Salmon** is also likely to end up in these stores.<sup>204</sup> **Tesco** and **Waitrose** are also believed to be supplied by **Lerøy Seafood**.<sup>205</sup>

**GERMANY**

In Germany, **Bakkafrost** (a major user of krill feed) has been linked to the **Ocean Sea** own brands of **Lidl**, and salmon products branded as **Frosta** – which were also linked to **Bakkafrost** – were identified at both **Lidl** and **Kaufland**.<sup>206</sup> At **Edeka** stores, products could be linked to the branded **Costa** range, which also uses salmon provided by **Bakkafrost**.<sup>207</sup> In **Aldi Nord** stores in Germany, the GGN number of the packages of the **Gourmet Finest Cuisine** own brands led to a number of suppliers that, in turn, have salmon farmers linked to krill in their supply chain. This includes **Odin Seafoods** in Denmark (krill feed-based suppliers include **Grieg Seafood**, **Cermaq** and **Lerøy**), as well as **BG Productions** (**Grieg Seafood**, **Cermaq** and **Lerøy**), **Milarex** (**Grieg** and **Lerøy**) and **Contimax** (**Lerøy**) in Poland.<sup>208</sup> Since multiple salmon supplies are connected to these processors and traders, it is not possible to ascertain with certainty which of them are being used in **Aldi** products.

**FRANCE**

In France, our investigations show that **Lerøy Seafoods** is a supplier of **Carrefour** retail outlets for the company's own brands.<sup>209</sup> In addition, some of the own-branded products of both **Carrefour** and **Auchan** are provided by French processor **MerAlliance**. This company has numerous Norwegian and Scottish salmon suppliers, including **Cermaq**, **Lerøy** and **Norway Royal Salmon**, all believed to be users of krill feed.<sup>210</sup> Products found in **Leclerc** supermarkets have also been linked to **MerAlliance**, and own brands of the **Pêche Océan** label have been supplied by **Bakkafrost**.<sup>211</sup> Products at **Intermarché** have also been linked to krill supply chains. For instance, a frozen tart<sup>212</sup> of the **Marie** brand, which is ultimately owned by French **LDC** group<sup>213</sup> (a processed-food products company that is among the largest in Europe),<sup>214</sup> was found in the retailer's online store. One of the salmon suppliers of salmon to **Marie** is **Lerøy**.<sup>215</sup>

**SPAIN**

In Spain, an own brand of supermarket chain **Dia** (**Distribuidora Internacional de Alimentación**) is supplied with salmon that originates from **Mowi** or **Lerøy**,<sup>216</sup> and the latter is known to use krill in its feed. **Carrefour** in Spain stocks products processed by **Ahumados Gimar**, which sources some of its raw materials from **Bakkafrost**.<sup>217</sup> **Lidl** in Spain sources products directly from **Bakkafrost** for some of the retailer's own brands, according to information found on the packages.<sup>218</sup> Products of the own-brand **Hacendado** in Spanish **Mercadona** supermarkets have been found with the logo of **Lerøy Seafood**, possibly the largest krill user among major salmon-farming companies.<sup>219</sup> Note, however, that it is possible that **Lerøy** also supplies processors with salmon products they do not produce themselves, and the use of krill in these products is unknown.

<sup>6</sup> This research was carried out between March and May 2022; changes in supply chains may have occurred since then.

**BOX 4.2: Lerøy Seafood Group**

Supply chains involving salmon farmer Lerøy Seafood Group are of particular interest for two reasons: the company's fish-feed formulation includes a high percentage of krill, and it is the world's second-largest salmon farmer. Yet Lerøy is engaged in not only farming approximately 200,000 tonnes of salmon a year but also catching wild fish.<sup>220</sup> Lerøy is vertically integrated and has its own processing facilities, fish farms and fishing vessels. In addition to production and packaging plants in Norway, where Lerøy is headquartered, it has offices in Denmark, Finland, France, Italy, the Netherlands, Portugal, Spain, Sweden and Turkey, as well as China, Japan and the USA.<sup>221</sup> The company's revenue was around NOK 20 billion (approximately 2 billion dollars) in 2020.<sup>222</sup>

In one of its most recent publications (2022), Lerøy reports that 8% of its fishmeal is made up of Antarctic krill.<sup>223</sup> Older publications show a lower percentage of krill, suggesting the company's use of krill is increasing.<sup>224,225</sup> While the reasons for this increase are not entirely known, it is notable that the company has a policy to increase the share of MSC-certified marine raw materials year by year.<sup>226</sup>

Lerøy sources the majority of its krill-based feed from major aquaculture feed company BioMar,<sup>227</sup> with additional feed supplied by EWOS, which is not believed to be using krill in its feed formulation.<sup>228</sup> BioMar's krill is supplied by Aker BioMarine and is MSC-certified.<sup>229</sup> Our investigation indicates that Lerøy then sells farmed-salmon products to various supermarkets across Europe, often for the private labels these supermarkets own. Some of the European supermarkets linked to salmon supplied by Lerøy include Carrefour in France, Tesco and Waitrose in the UK, and Lidl supermarkets in various European countries.<sup>230</sup> In fact, we were told that Lerøy Seafood sells farmed-salmon products to the 'majority of big supermarkets in the UK and Europe'.<sup>231</sup> Many supermarkets renegotiate their contracts with<sup>232</sup> Lerøy Seafood every six months and, like other farmed-salmon suppliers, Lerøy may use or gain customers during these negotiations. Supermarkets have the ability and power to include feed ingredients in the negotiations,<sup>233</sup> but our research shows that none of the major supermarkets included in our investigations have public policies to exclude krill (see next section).

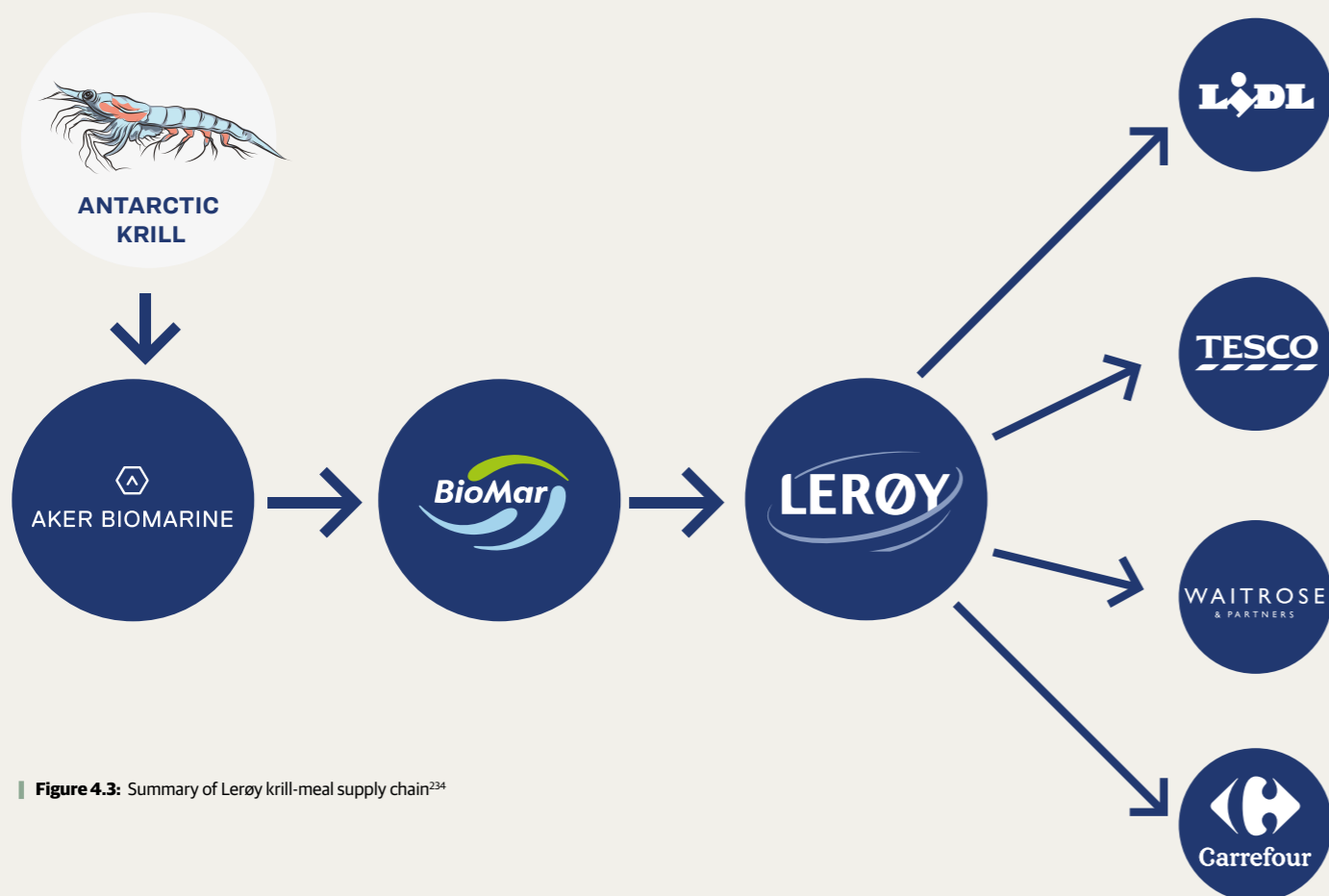


Figure 4.3: Summary of Lerøy krill-meal supply chain<sup>234</sup>

**4.2.1. European retailers**

All 16 retailers investigated have been linked to krill feed in their salmon-supply chains or products for sale on their shelves. None of them have adopted policies that exclude the use of krill in the feed used to produce their own-branded salmon products, making it impossible for consumers to be certain that their purchasing decisions do not support the krill-fishing industry.

Retailer	Country	Policy to exclude krill feed in own brands or branded salmon products?	Links to supply chains using krill in salmon feed?
<b>Kaufland</b>	Germany	No policy found	Yes
<b>Lidl</b>	Germany	No policy found	Yes
<b>Edeka</b>	Germany	No policy found	Yes
<b>Aldi (Nord)</b>	Germany	No policy found	Yes
<b>Mercadona</b>	Spain	No policy found	Yes
<b>Dia</b>	Spain	No policy found	Yes
<b>Carrefour</b>	Spain	No policy found	Yes
<b>Lidl</b>	Spain	No policy found	Yes
<b>Auchan</b>	France	No policy found	Yes
<b>Carrefour</b>	France	No policy found	Yes
<b>E. Leclerc</b>	France	No policy found	Yes
<b>Intermarché</b>	France	No policy found	Yes
<b>Tesco</b>	UK	No policy found	Yes
<b>Marks &amp; Spencer</b>	UK	No policy found	Yes
<b>Sainsburys</b>	UK	No policy found	Yes
<b>Asda</b>	UK	No policy found	Yes

Table 4.2: Summary of krill supply-chain links and policies of major retailers

**4.2.2. Salmon-farming companies**

The investigation focused on the largest salmon-farming companies that have their headquarters in Europe. Together, the companies included make up about half of the world's farmed-salmon production.<sup>235,236</sup>

Our research found that five of the eight companies investigated source salmon feed that contains krill meal from Aker BioMarine. Importantly, none of these salmon farmers have a public policy excluding krill from their feed-supply chains, which means none of the three companies currently not sourcing krill-based feed have made public promises not to do so in the future.

There is also a risk that salmon companies' commitments to increase their use of certified-feed ingredients will drive them towards increased uses of krill, since Aker BioMarine - the main supplier - is MSC-certified. Six out of eight companies have a policy to move towards certified marine ingredients. This drive for certified ingredients could have negative consequences for increasing the demand for krill meal. Some fish-feed manufacturers have also been on record stating that they only buy certified ingredients for their feed formulations, broadly arguing that they consider them more sustainable.<sup>237</sup>

Salmon-farming company <sup>238</sup>	Krill-based feed?	Details	Feed suppliers /krill-meal suppliers	Policy to increase or use certified-feed ingredients?
<b>Lerøy Seafood</b>	Yes	Lerøy is the second-largest salmon company and a major user of krill. The company says: 'we also use a great deal of krill meal', <sup>239</sup> most – if not all – of which is supplied by Aker BioMarine. Lerøy sells products to the majority of big supermarkets in the UK and Europe. <sup>240</sup>	BioMar/Aker BioMarine <sup>241</sup>	Yes <i>'Lerøy also aims to increase the share of MSC certified marine raw materials, year by year'</i> <sup>242</sup>
<b>Cermaq</b>	Yes	Cermaq, the third-largest salmon-farming company globally, uses significant amounts of Antarctic krill in its feed, and BioMar is Cermaq's principal feed supplier. <sup>243</sup>	BioMar/Aker BioMarine <sup>244</sup>	Yes <i>'Fishmeal and fish oil shall be sourced from certified fisheries'</i> <sup>245</sup>
<b>Bakkafrost</b>	Yes	Bakkafrost lists krill as one of its marine ingredients and, with Norway being listed as the country of origin as well as MSC certification, <sup>246</sup> the supplier is likely Aker BioMarine.	Unknown/Aker BioMarine	Yes <i>'We aim to source all marine feed ingredients (i.e. fishmeal and fish oil), used in the production of feed for Bakkafrost, from fish species which are certified as sustainable'</i> <sup>247</sup>
<b>Grieg Seafood</b>	Yes	Grieg Seafood lists krill as one of its feed ingredients, <sup>248</sup> and this likely originates from Aker BioMarine, since it is listed as being supplied from a Norwegian MSC-certified company. The feed supplier remains unknown.	Unknown/Aker BioMarine	Yes <i>'100% of the marine ingredients we source from forage fisheries are certified according to third party certification schemes'</i> <sup>249</sup>
<b>Norway Royal Salmon</b>	Yes	Listed company Norway Royal Salmon mainly sells whole fish throughout Europe. The main feed supplier to Norway Royal Salmon is Skretting; BioMar and EWOS also supply smaller amounts. <sup>250</sup>	Skretting, BioMar <sup>251</sup> / Aker BioMarine	No statement found
<b>Mowi</b>	No	As mentioned, Mowi does not use krill in its feed, and is not convinced of the feed's benefits compared to its cost.	None	Yes <i>'Marine raw materials processed from whole fish shall be sourced from suppliers who adhere to responsible fishery management practices. This entails sourcing fishmeal and oil from fisheries that are certified'</i> <sup>252</sup>
<b>SalMar</b>	No	SalMar is not believed to be using krill in its feed. <sup>253</sup>	None	Yes <i>'We require our feed suppliers to ensure that the ingredients they use are certified'</i> <sup>254</sup>
<b>Cooke Aquaculture</b>	No	Currently, Cooke Aquaculture is not believed to be using krill in its feed. <sup>255</sup>	None	No statement on certification found in sustainability policy <sup>256</sup>

**Table 4.3:** Summary of krill supply-chain links and policies of major salmon farmers

### 4.2.3. Salmon-feed producers

The first supply-chain stage for the krill meal that fishing companies produce is salmon-feed manufacturers. A handful of companies controls the aquafeed market for salmon, including Mowi (the world's largest integrated salmon-farming and -feed company), Skretting (ultimately controlled by Dutch trading company SHV), EWOS (owned by US-based global food corporation Cargill) and BioMar (owned by Dutch industrial conglomerate Schouw).<sup>257</sup> Our investigation shows that both Skretting and BioMar use krill in the feed they formulate and, in both cases, the krill is believed to be provided by Aker BioMarine. Mowi, the world's largest salmon company, has indicated that it has not seen sufficient cost benefits from krill to include it in its feed products.<sup>258</sup>

Salmon-feed company	Krill-based feed?	Policy and details	Supplier
<b>BioMar</b>	Yes	Of the big four global feed companies, BioMar seems to have embraced krill as a feed ingredient the most. For instance, krill is used for instance in the Quick brand. <sup>259,260,261</sup>	Aker BioMarine
<b>Skretting</b>	Yes	Skretting only uses krill in some of its feed products, <sup>262</sup> and the krill is supplied by Aker BioMarine. <sup>263</sup>	Aker BioMarine
<b>Mowi</b>	No	Mowi has an Emerging Feed Raw Materials Policy, which states that, by '2030, Mowi aims to achieve an inclusion of 10–15% ingredients from emerging feed raw materials'. <sup>264</sup> Mowi Feed provides 95% of the feed consumption to its sister businesses in Mowi Farming and also sells into Norway, Scotland, Ireland and the Faroe Islands. <sup>265</sup> Research by Changing Markets also indicates that Mowi does not use krill in its feed – but, more importantly, that the company is not convinced of the cost vs benefit of using krill as a feed material. <sup>266</sup> This is an important finding, considering that Mowi is by far the largest salmon-farming company globally, with more than twice the harvest of the second-largest company. Despite the widespread use of krill, this is a clear sign that significant parts of the industry do not see an advantage in the use of krill.	None
<b>EWOS</b>	No	Changing Markets' investigation suggests that EWOS currently does not use krill in its European operations in Scotland and Norway. <sup>267</sup> Although the company reported in 2015 that there was some krill in its marine-feed ingredients, <sup>268</sup> no more recent figures could be found.	None

**Table 4.4:** Summary of krill links and policies of major salmon-feed producers

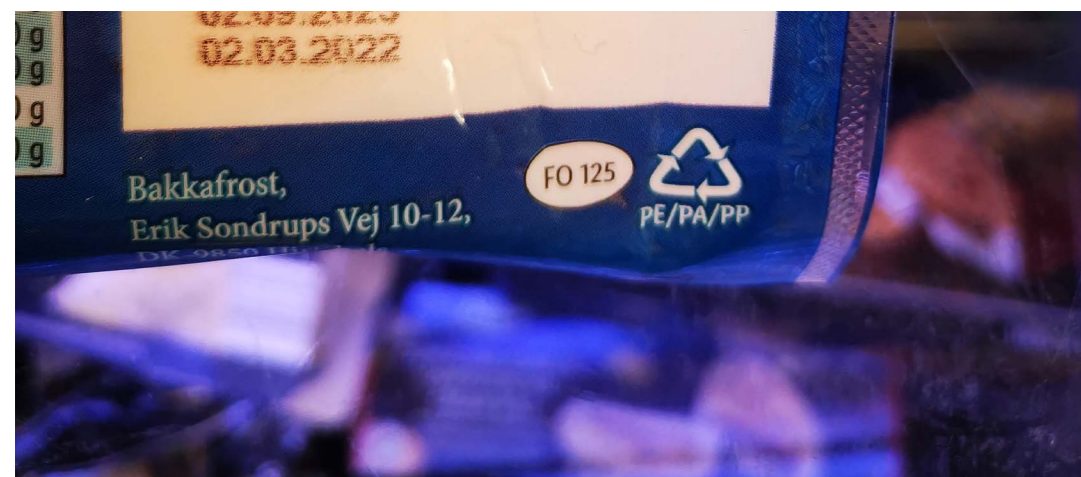


**Figure 4.4:** Own-brand Asda salmon, supplied by Young's Seafood

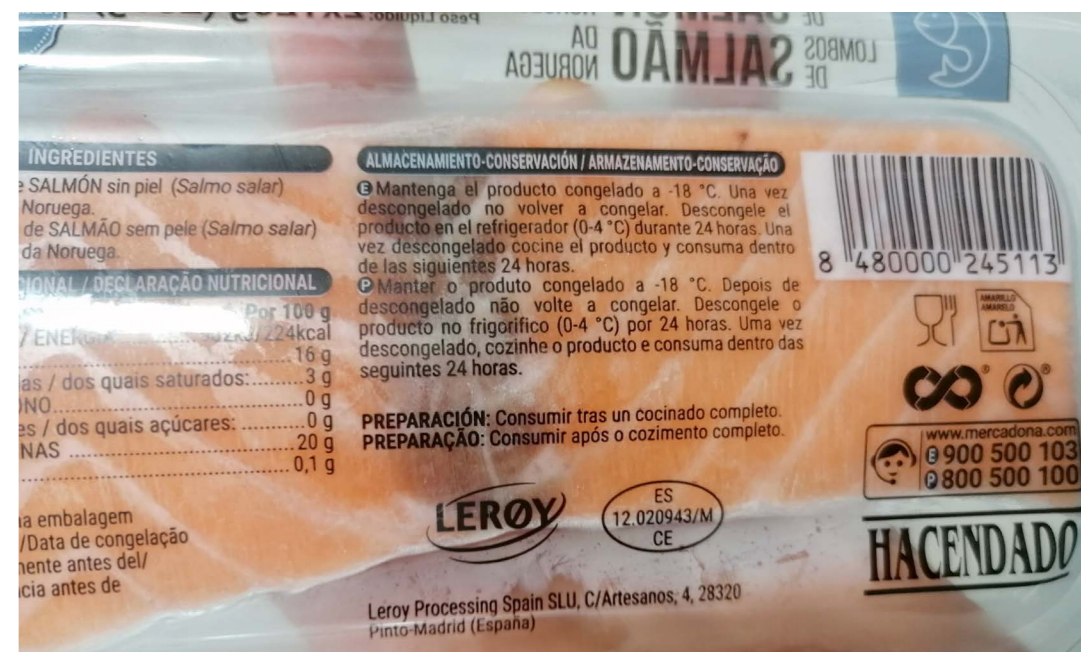
**Figure 4.7:** Leclerc's Pêche Océan product, supplied by Bakkafrost



**Figure 4.8:** Carrefour-branded smoked salmon, supplied by MerAlliance



**Figure 4.5:** Text and number identifying Bakkafrost as the supplier of Lidl Germany's own-brand Ocean Sea salmon



**Figure 4.6:** Mark identifying Polish Company BG Production, which sources from farms that use krill, on an Aldi Ocean Sea own-brand product



In summary, this investigation shows that the use of krill in health supplements and salmon products is widespread. In particular, many of the world's largest retailers sell krill-oil supplements, and some have even reversed their promise to stop stocking them.

For krill meal, this investigation - for the first time - clearly illustrates the global supply chain, and how krill meal manufactured by Aker BioMarine is supplied to at least two of the four main salmon-feed producers. The feed is then purchased by the majority of the largest salmon-farming companies in Europe, which, in turn, provide consumer-grade products to supermarkets across the continent. Our investigation also links the widespread use of krill in aquafeed to the lack of labelling of feed ingredients, as well as to the absence of policies to specifically exclude krill by nearly all supply-chain actors, particularly supermarkets. This deprives consumers of their right and ability to make ethical purchasing decisions and makes it impossible to avoid supporting an industry that manufactures products with significant biodiversity impacts and few - if any - benefits. In addition, there is a risk that feed companies use their commitment to source certified feed as a smokescreen to increase their use of krill, instead of completely phasing out the use of aquafeed containing food-grade marine ingredients.





## 5. Conclusion and recommendations

This report shows that the krill-fishing industry is inherently unsustainable as it threatens one of the world's most fragile ecosystems, exacerbating mounting pressure due to rapidly accelerating global heating. The industry is not only ignoring but also hiding these threats, and has employed several tactics to present krill-derived products as sustainable - from pushing inexact narratives about the impact of krill harvesting in its marketing to relying on problematic certification to justify the plunder.

But the krill-harvesting industry is not the only piece of the puzzle. The retailers, fish farms and aquafeed manufacturers, which we found are routinely selling krill-based products, are also complicit in this damaging gambling with the Antarctic ecosystem. Krill-oil health supplements are sold by as many as 68% of the world's 50 largest health-product retailers, while krill-fed farmed-salmon products are routinely sold by 16 leading supermarkets across Europe, none of which have adopted policies that exclude the use of krill in the feed used to produce their salmon products.

The wide availability of krill-based products is mind-boggling. Although a significant amount of research has been dedicated to the proclaimed superiority of krill-based products, often funded by the industry itself (so as to justify its high price compared to other marine-based products), the purported superiority and associated cost/benefits remain questionable. Nevertheless, the industry is not giving up; it continues to create new products and markets to prop up its unprofitable operations. Aker BioMarine, which has run a net loss nearly continuously for the last decade, aims to turn this around through increased revenue from new and existing markets, increased fishing efforts and the development and marketing of new products, such as krill protein for human consumption<sup>269</sup> and pet food.

## 5.1. Recommendations

In light of these findings, Changing Markets is calling for an immediate moratorium on krill fishing.

In addition:

- **Aquafeed and aquaculture companies** should stop using Antarctic krill and switch to more sustainable alternatives, ensuring these alternatives do not give rise to other social and ecological problems. This recommendation is in line with the latest 2022 IPCC report. While some companies are taking action to reduce reliance on forage fish in their aquafeed, the use of fishmeal and fish oil (including krill) must be phased out entirely, across the entire industry, for transformational change to take place by 2025.
- **Certification schemes** should not certify Antarctic krill, as doing so gives the false impression that krill fishing can be sustainable.
- **Retailers** should stop sales of krill-based health supplements and adopt policies to phase out krill from the farmed-seafood products on their shelves. They should have due-diligence measures in place and conduct regular audits to ensure implementation of these policies. We are also calling on retailers to commit to phasing out the use of wild-caught fish in feed more generally. Retailers should also provide full transparency about farmed-seafood supply chains - the identity of suppliers, processors, aquafeed companies, and fishmeal and fish oil producers - and whether the suppliers use Antarctic krill-feed additives.
- **Consumers** should stop using krill-based dietary supplements and demand that their farmed seafood be krill-free.



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