COVER STORY

Big spenders gamble on krill

Picture: Dimitri Sclabos

A close-up look at the 10mm. *Euphausia superba*, the Antarctic krill.

Catches of Antarctic krill are predicted to double in 2010, but which of the main players will turn this most challenging of prizes into profits?

Ewen Cook

2010 could be the year that the Antarctic krill catching and processing industry finds the winning formula.

It is working to cash in on the remarkable nutritional qualities of this small, shrimp-like, crustacean that have led to much speculation over its revolutionary potential for the aquafeed and nutraceutical industries.

There are estimated stocks of up to 500 million tonnes of *Euphausia superba*, but catchers are restricted to a very small slice of the total to ensure the conservation of both the krill and the species that feed on it.

But this quota is a tantalising prize that the non-subsidised commercial fishing world has so far failed to truly claim since exploratory fishing began in the early 1960s.

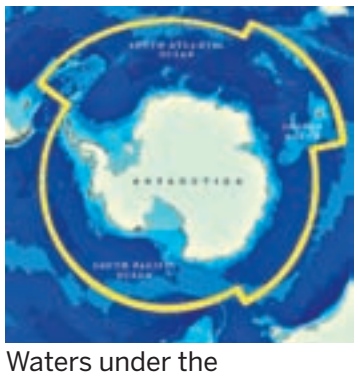
For the past decade, the annual catch has stalled at around 100,000-120,000 tonnes – a far cry from the heyday of the early 1980s when heavily subsidised Soviet ships returned with annual catches of over half-a-million tonnes.

The market for meal, oils and other protein extracts from krill remains very much a work in progress.

The reasons for recent disappointing catch returns are well documented. Immense costs, logistical challenges, processing complexities and environmental concerns make successful krill harvesting notoriously difficult. And, in the absence of the state subsidies of yesteryear, the krill industry has failed to capitalise.

Denzil Miller, executive secretary of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the 25-state organisation responsible for managing all aspects of the fishery, tells *FNI*: "If you'd spoken to me 15 years ago I would have said this fishery would probably have been at the level of a million tonnes a year by now. But it's progressing far more cautiously than expected.

"The volatility of both the financial markets and the cost of fuel mean that, as much as the technology, the use of the vessels and the catch levels can improve and are improving, this industry is driven by sheer cost. Despite the market potential, because it's remote, the financial insecurities are simply enormous."



Waters under the jurisdiction of CCAMLR, the managing organisation of the Antarctic Ocean.

Only eight vessels from six countries targeted krill in the 2007/08 season and they caught a total of 125,000 tonnes – the highest catch since since 1991/92. However, 2009 was another disappointing season when just 100,000 tonnes was harvested.

Giant trawlers from Norway, Japan, Korea, Poland and Russia are all expected to fish again in 2010, with China and Ukraine being potential participators.

Slow progress is certainly not due to any lack of incentive. The total value of the Antarctic krill fishery – comprising krill meal, whole round frozen krill, krill meats, krill oils and nutraceutical products – for the 2009 season is estimated at around $35 million.

Given that the total allowable catch (TAC) for this prime resource – the world's largest single invertebrate biomass – is over six million tonnes, it is easy to see what all the effort is about: krill remains an untapped goldmine.

Yet, according to the Antarctic and Southern Ocean Coalition (ASOC), proposed krill fishing notifications in CCAMLR waters are down for 2009/2010. The total amount notified for 2008/09 was 363,000 tonnes, down from 879,000 the previous year.

Denzil Miller says: "Over the

500 million The estimated total biomass, in tonnes, of Antarctic krill

6.5 million The approximate TAC set by CCAMLR for Area 48 & Area 58

112-metre Korean vessel *Dongsan Ho* is owned by Dongwon Industries and is licensed to fish krill until 2013.

Juvel, one of the newcomers to the Antarctic krill fishery, is operated by Ervik Marine Services of Norway.

past couple of years the notifications in the krill fishery were extremely over-optimistic – around 20 vessels notified last year. Countries were attempting to put a marker down, but many got burned by the financial meltdown and vessels dropped out.

"What we've got now is a much more reasonable indication of what the interest is and, with a little bit more economic stability, I suspect we won't see as many dropouts in the forthcoming season."

2010 is set to be the most dramatic on krill for years as hundreds of millions of dollars of new investment is made ready to enter the race. Experts are predicting a doubling of this year's 100,000 tonne catch.

The arrival on the grounds of the Norwegian firm Krill Seaproduct's refitted 133 metre *Thorshøvdi* (pictured on *FNI's* front cover) will see the start of an attempt to crack onboard processing for the high-end protein extract and oil markets.

Also, a controversial Marine Stewardship Council certification bid by Norway's Aker Biomarine will reach its conclusion.

'The minute one of these products comes up and says it's going to de-age everybody by ten years, you can imagine it's going to be open season'

– Denzil Miller, CCAMLR executive secretary

Dimitri Sclabos, general manager of Tharos Ltd, a Chile-based consultancy and brokerage firm specialising in high-end fishery projects, tells *FNI*: "Krill has shown itself to be a very tricky resource.

"It's really not easy to predict the winners for next year. However, we believe that there will be one or two vessels showing a much better catch performance and there will be one or two new vessels fishing in the area. So, we expect that the catch will be 70-100% more than last year."

The golden rule with krill, however, is that nothing is certain. Hallvard Muri, CEO of Aker Biomarine, tells *FNI*: "This is a very challenging area to operate vessels. Whoever wants to be successful will need a long-term perspective. It's not a question of just putting a vessel in the water and making money. You need the necessary financial stability, competence and technology.

"How far will the industry succeed in the next few years? I am not a betting man, so it is difficult to say!"

Balancing act

THE krill season runs from December to August, peaking in April to July. The grounds comprise FAO statistical area 48 (plus, to a lesser extent, areas 58 and 88) in south-Atlantic waters.

CCAMLR is still grappling with how best to ecologically manage a fishery which is coming under increasing market and NGO pressure. All parties have yet to agree on how to best allocate catch limits in order to protect krill predators such as penguins, seals and whales.

Says Denzil Miller: "Within the measures that we have available, we have a trigger limit of 620,000 tonnes for Area 48 – which is more or less the historical highest catch we've ever had – in the south-west Atlantic. If that is approached, we, CCAMLR, need to ensure the catch doesn't become local-

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ised in one area.

"How do we pre-allocate the location of the catches in anticipation of approaching that trigger level? Well, that's a problem we've been considering for a couple of years now and we haven't fully resolved it.

"The issue of how we're going to apportion the catches is a very crucial one. The debate is heating up more than it did last year and it will heat up again."

The XXVIII CCAMLR annual meeting recently took place to set catch limits for 2010 that were being announced during the final session on November 6. Despite the poor performance in 2009, Denzil Miller believes the industry could be pushing 250,000 tonnes in the next three-five years.

"We know what is being used in terms of human consumption and for aquafeed/meal but, in terms of what the pharma demands are going to be, we just don't know. The minute one of these products comes up and says it's going to de-age everybody by ten years, you can imagine it's going to be open season. This is what the Commission is worried about.

"The potential of this fishery is huge. There's so much discussion going on, but all of these economics are very fluid and very opaque. The industry is keeping its cards very close to its chest. This doesn't concern me so much, but it makes it more difficult to get a predictive handle on what's going on."

Aker Biomarine krill oil supplement Superba Krill has sold well in America, but demand in Europe has been slow

Antarctic krill is the world's largest single invertebrate biomass.

High-end ambitions

THE principal end products from krill harvesting in the 1980s and 1990s were feed-grade dried meal, whole raw frozen and food-grade peeled krill meats. Use of krill as a feed ingredient for the aquaculture industry was the main industry driver.

Turning into the 21st century, the krill industry has seized on rapidly rising demand for pharma-grade krill oil and protein derivatives which are rich in phospholipids and highly attractive to the nutraceuticals market.

Norway's Orkla Group, via cod liver oil producer Axellus (formerly Peter Møller AS), this year filed a lawsuit to stop Aker BioMarine marketing its Superba Krill dietary supplement after disputing the company's claims over krill's nutritive value. The Oslo city court dismissed Orkla's case in October, leading Aker Biomarine to claim a "total victory."

Kjell Inge Røkke, board chairman of Aker BioMarine, said afterwards: "I am not surprised that the cod liver oil producer views Superba Krill as a threat. Compared with cod liver oil, Superba Krill is a naturally better omega-3 product that features 100% traceability and documented health benefits."

Aker Biomarine and Canadian company Neptune Technologies are the current market leaders in developing pharma-grade krill oil. The Norwegian firm claims there is growing demand for its krill oil supplements and krill feed, and it has seen major growth in the US market. Its Superba Krill is being branded in retailers such as WalMart, Costco, Sam's Club, Rite Aid, CVS and WalGreens.

Aker Biomarine shipped 15 tonnes of Superba Krill to the US in the second quarter of 2009, calling the shipment "a key milestone." It applied for Marine Stewardship Council (MSC) certification for its Antarctic krill fishing operations in Area 48 – the only krill fishing operation to do so.

Yet, beneath the surface, the extreme demands and problems associated with krill harvesting are very much in evidence. Aker Biomarine owns two of the four licences granted to Norway by CCAMLR and it planned a state-of-the-art new ship costing $170 million (reported in *FNI* January 2007)

Details of the ship were announced, but then the company scrapped the idea and went ahead with rebuilding *Atlantic Navigator* for krill operations at less than half the cost. Yet, even this state-of-the-art factory remained in dock instead of sailing for the Southern Ocean. The company relied on its other ship *Saga Sea* to keep its krill fishing operations going.

Aker Biomarine posted a net loss of NOK65 million ($11.5 million) for the third quarter of 2009, following a loss of NOK91 million ($16.1 million) in the same quarter of 2008. It recently announced it was to borrow up to $15.5 million from Aker, its parent company.

Hallvard Muri tells *FNI*: "*Atlantic Navigator* did not sail this year. At the stage the decision was made, it was the right decision. It relates to how developed the market is right now. We can take it out only once we see that we can balance demand with supply."

However, he reports that Aker Biomarine – which fell short of its predicted catch of 55,000 tonnes for the 2008/09 season – has now reached a good balance between supply and sales of krill meal, which represents the majority of its production. Much more market development is needed even though demand is growing for krill as a functional ingredient in the aquaculture market.

"We would have liked to have been selling more than we have been able to produce this year. But that's the nature of the beast – some things you cannot control. There is a definite need to educate the market more."

Seasonal problems have also proven to be a primary factor in a frustrating 2009, with terrible weather and historically low krill densities around South Georgia mostly to blame.

Says Hallvard Muri: "It's fair to say it's been a challenging season for all the operators. In the first three months, January-March, catches were significantly below what they've been in previous years.

"Ice was an issue, but the difficult weather was more important. There were very harsh conditions in the first part of the year and, although April-July was decent and our harvest level for this period was above last year, it was not enough to catch up on what we did last year entirely."

According to Dimitri Sclabos, this year's low biomass is the result of Antarctic krill's haphazard biological cycles – another piece of the puzzle yet to be fully understood.

He tells *FNI*: "We have kept log books for 22 years, and there are ups and downs and dramatic changes for the same month of the year from one year to another. You can see dramatic changes in catch levels.

"However, we have identified cycles ranging from six-eight years. We have seen it in 1988, in 1994, in 2001/2 and now in 2009. So, in additi on to some technical difficulties with some of the operators, there has simply been a lower biological biomass this year."

Currently, Aker Biomarine and two other Norwegian firms account for around 40% of the krill catch. They are Krill Seaproducts and Ervik Marine Services, which operates Juvel.

The three firms are the technological leaders in the field and all eyes will be watching in 2010 to see if they can balance their books. There is little doubt the pressure is greatest on Krill Seaproducts, whose state-of-the-art, 133-metre, converted cargo ship *Thorshøvdi* completed her trials near Alesund in Norway during November.

Even Remoy, CEO, said as *FNI* went to press: "Overall the vessel is around 95% finished technically, but the testing phase is extensive and will take up to two months. Everything is progressing well and we are confident the factory will give us 100% utilisation of the raw material."

Krill Seaproducts plans to focus on the protein extract sector and produce krill meat pellets, krill flavour concentrate, krill shell powder and natural krill oil. This is a different market niche to Aker Biomarine.

"We hope we will have the first good production in late January and the first delivery in late February. For the first year we will focus more on quality and optimising the factory. We aim to catch between 50,000-100,000 tonnes of raw material."

The company will run herring or another raw material through the ship's factory to iron out any problems before entering Antarctic waters. "We are doing extremely extensive testing. But, of course, you will always need

'Whoever wants to be successful will need a long-term perspective. It's not a question of just putting a vessel in the water and making money'

- Hallvard Muri, Aker Biomarine CEO

Hallvard Muri, Aker Biomarine CEO.

The ship that never was: Aker BioMarine's planned $170 million krill ship. Aker pulled the plug on this hugely expensive venture.

fine tuning. There will inevitably be surprises when you arrive and start putting the new raw material through the factory.

"But that's why are bringing expert supervisors from the suppliers with us, along with scientists and protein specialists. We will be well manned for the first trip to try to tune and configure the factory as quickly as possible."

Winners and losers

Whether Krill Seaproducts and the other firms targetting high-end krill markets will find their fortunes improving in 2010 is viewed with doubt by some commentators. Dimitri Sclabos, whose consultancy Tharos has assisted Japanese, Ukrainian, Russian, Norwegian, Korean and American krill operations over the last 20 years, says success is particularly unlikely to happen in the first year of an operation.

"We have been involved in three start-ups from scratch and none of them worked perfectly for the first two years. You need to do a lot of fine-tuning. Krill Seaproducts has invested over $100 million in very high-tech technology and very good equipment, but this has only been tested on other products, other resources.

"Krill has its own complexities. You cannot just copy what is done on mackerel or haddock or sardine or herring and just go to the Antarctic and copy it there. That has proved to be a mistake in the past."

Tharos, which claims it has created a unique process to extract krill oil without using chemicals (see box on page 4), believes it is not imperative to be be a technological leader to make krill harvesting pay.

"The three Norwegian firms have, between them, a good chance of leading this new high-tech end of the krill industry. But we must remember that this is all based on technology that is not 100% proven and that, so far, has not been wholly successful.

"The Japanese and Koreans are working on whole frozen krill and krill meal, and it is my prediction is that they will perform better and better. They might not end up in the market with as technologically advanced a product and process, but they can operate in a cheaper way and do not require so much investment.

"They are not seen as technological leaders like the Norwegians. But they are making money."

Success in the Antarctic krill fishery is reliant on many factors, some of which are beyond the control of the operators, but that has seldom stopped the fishing industry before!

620,000 The precautionary "trigger" limit in tonnes set by CCAMLR for Area 48

100-120,000 The average yearly catch in tonnes since 2000

Norwegian firm Krill Seaproduct's new vessel *Thorshøvdi* at the Fiskerstrand Verft yard, Norway.

Solving the problem of speedily pumping up krill from the depths to the factory deck is central to being able to process the catch into high value products. Irish pelagic fish pumping specialist Fluid Controls has the answer.

Russian factory ship tows for a month with:

State of the art krill pump

Cormac Burke

A RUSSIAN krill factory ship is towing a 2.5 metre long and 1400 kg. pump attached to her trawl for carrying out continuous fishing in the Southern Ocean. She has no need to haul in the trawl for a month or more.

Fishing in these waters requires a pump which can be submerged for the duration of a fishing trip for maximum fishing efficiency.

Irish firm Fluid Controls of Killybegs, manufacturer of SeaQuest fish pumps for pelagic species, has developed the SeaQuest Krill Pump for use by a Russian krill factory ship.

This ship has been operating with the pump since 2008 and it has proven to be such a success that a bigger capacity than its present 270 tonnes a day is now being sought by the ship's owner.

The latest in subsea technology has been employed by Fluid Controls in the design of the krill pump along with its expertise in pelagic fish pumping.

This pump is attached to the end of the trawl and is shot away – taking up to two hours – with the gear. Constant operation means that no hauling is required for the rest of the tow.

Krill entering the trawl travel straight into the pump and are sent, via connected 30 metre hosing sections, to the vessel's onboard factory.

Black rubber hosing typically used for pelagic pumping was not considered durable enough for such long periods underwater, so a stronger type with a helix form of structure in its walls was chosen.

The pump enables krill to be in the factory and ready for processing within minutes of being caught. This ensures fishmeal of the highest grade possible as well as pure grade uncontaminated fish oil.

> **'The pump enables krill to be in the factory within minutes of being caught'**

If marks of krill are heavier during daytime fishing, the flow of krill can be diverted from the main factory line to holding tanks which act as a reserve to keep the factory processing overnight when fewer krill are available on the grounds.

Towing a pump weighing 1400 kg., measuring 2.5 metres in length and having a one metre cage height may at first seem to cause substantial additional drag.

However, the huge trawls needed to catch krill are made in very small mesh sizes which cause an extraordinary level of drag. So, the additional drag caused by the pump is almost a minor consideration.

The SeaQuest Krill Pump installed on board a factory ship which is part of the Murmask Trawl Fleet can be fished as deep as 600 metres, which requires many 30 metre hose sections to be coupled together.

Krill are, however, rarely found at this depth and are more likely to be caught at the surface by day or down to 250 metres during the night.

Brian Leslie, a director of Fluid Controls, tells *FNI* that the concept of a pump to fish round-the-clock to continually pump the catch directly to the ship's onboard factory is one that several krill vessel owners had discussed. However, no engineering company had set about investing time and money into researching its feasibility.

He says: "The SeaQuest Krill Pump was totally an in-house design. It took much work and involved many trials to iron out the teething problems. But, with our background in the pump sector – plus the inclusion of some subsea technology – we came up with a robust and reliable pumping system."

Proof of its reliability has resulted in a request for the pump's capacity of 270 tonne a day to be increased to 500 tonnes, a modification which Brian Leslie says is achievable.

Fluid Controls is looking at ways to attempt to offer increased capacity without having to enlarge the size of the pump itself.

Final adjustments to the Sea Quest Krill Pump on the deck of a Russian factory ship. The 1400 kg. and 2.5 metre long pump is towed along with the trawl.

Sections of hose stored on deck are wound onto the drum under the gantry.

270
Daily pumping capacity in tonnes

Brian Leslie, a director of Fluid Controls, aboard a Russian krill factory ship equipped with the prototype Sea Quest Krill Pump. The 30 metre sections of hose reels on the quayside can be connected together to flow krill from the pump when the ship is fishing down to a maximum 600 metres.

A Russian krill catcher docked at Killybegs, Ireland, to take on a Sea Quest Krill Pump from Fluid Controls which is based at the port. The company specialises in pumps for pelagic fish catchers.

The dock station of a Sea Quest Krill Pump manufactured by Fluid Controls of Killybegs, Ireland.

Cameras watch the catch

THE SeaQuest Krill Pump pump has a sealed subsea motor drive and a number of other clever innovations.

An underwater multi-scan camera system – an adaptation of a net sonar system – allows krill travelling along the net and into the pump to be monitored at all times.

Then, in the event of a bulk of krill entering the net and being crushed under their own weight at the pump's mouth, pressure spring-loaded doors allow excess amounts of krill to escape.

This ensures that crushed and poor quality krill is not allowed to enter the pump and move into the processing factory.

In addition, with conservation in mind, the pump's entrance is protected with a rigid grid of bars which will force unwanted catches, such as seals, out of the net and away from the pump.

Even seabirds diving on krill have an escape to the surface via an upper opening at the pump's entrance.

Body of a Sea Quest Krill Pump under construction in Ireland.

Brian Leslie of Fluid Controls tells *FNI* he is proud that his company's system is leading the way in this fishery.

"There have been other ideas and types of pumps tried, but we seem to have won the race to keep some of the world's top fishing factory vessels working around-the-clock.

"This is no mean feat and, with further enquiries for krill pumps coming from Russia and Norway, we will continue to develop this system to hopefully be able to offer a range of solutions to suit different types of vessels."