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Foreign and Commonwealth Office  
London SW1A 2AH

Telephone 01- 233 3776

Miss M Davies  
Department of Trade  
1 Victoria Street  
LONDON  
SW1H 0ET

Your reference

Our reference

Date 14 April 1983

*Doc. 411/1*

OCEAN RESEARCH TECHNOLOGY INTERNATIONAL (ORTI)

1. In paragraph 2 of your letter of 31 March to Charles de Chassiron, you invited comments on ORTI's proposal to set up a British/Brazilian krill fishing industry based in Brazil using the Falklands as a supply base and for some processing of the 'catch', plus trans-shipment back to the mainland and possibly using the outward bound ships to carry supplies from Brazil to the Falkland Islands.

2. We have no indications as to how Brazil will respond to ORTI's proposal. We have no objections to the initiative but as you know Brazil regards the Falkland Islands as disputed territory and the area is one of political sensitivity for them. But individual enterprises will wish to be guided by their commercial judgement.

3. As regards the part to be played by the Falkland Islands in the proposed 'new industry' again, we have no objections but we know that facilities are limited. The Falkland Islands Government are best placed to comment on the proposal and I am sending copies of the correspondence to the Development Officer, John Reid, and suggest that ORTI get in touch with him at Government House, Port Stanley, Falkland Islands.

*Your min*  
*29/4/83*

C B Dowds (Miss)  
Falkland Islands Department

cc: J Reid Esq  
Government House, PORT STANLEY



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DEPARTMENT OF TRADE

Overseas Trade Division 5/23

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Your reference:

Our reference:

Mr Charles de Chassiron  
British Embassy  
Brasilia

31 March 1983

*Dear Charles*

OCEAN RESEARCH TECHNOLOGY INTERNATIONAL

1 Following your letter of 17 February I wrote to the company and received a phone call from Mr Michael Butler who confirmed that his company was still interested but matters had been in abeyance because of the Falklands dispute. Mr Butler has since written and I enclose a copy of his letter and report.

2 I am copying this correspondence to Mr Longstaff QDA and Mr Goodworth FID, FCO, in case they have any comments to make on Mr Butler's letter.

*Yours  
Majone*

Miss M Davies

*cc Rio  
Sao Paulo*





OCEAN RESOURCE  
TECHNOLOGY INTERNATIONAL

27 Ranelagh Gardens  
Stamford Brook Avenue  
London W6  
Tel: 01-748 8747

25 March 1983

Miss M. Davies  
Department of Trade  
Overseas Trade Division 5/2b  
Room 105  
1 Victoria Street  
LONDON  
SW1H 0ET

Dear Miss Davies

Thank you for your letter dated 4 March 1983, reference: KRILL, and further to our telephone conversation, please find a copy of the information which we sent via Mr. Rogerio Viana Saboia Santos, who is co-ordinator in the International Department Ministry of Industry and Commerce. We have also enclosed a photo-copy of his departmental reply for your perusal.

We are still intensely interested in the possibility of setting up a Krill fishing industry to be located in the South of Brazil and to this end we set out to inform the Brazilian government of the current international interest in the resources of the South Atlantic.

Due to the Falklands Invasion, we had some reservation about the viability of the basic scheme; but circumstances now appear to be most favourable for a British-Brazilian participation in the setting up of a 'new industry' based in Brazil using the Falklands as a supply base for the fishing fleet and some processing of the 'catch', plus trans-shipment back to the mainland. The possibility also exists for the using of fishing vessels outward bound from Brazil to carry supplies for the Falkland Islands:

It is our opinion, that British-Brazilian co-operation in the South Atlantic have benefits of both commercial and political stature, and to this end we are now exploring the British governmental attitude towards such a scheme.

Any help your department can offer us, will be most helpful in overcoming some of the complexities of such a scheme.

If you require any further information please do not hesitate to contact us, as we shall be only too happy to oblige in this matter.

We look forward to hearing from you in the near future.

Yours sincerely

ORTI

A handwritten signature in dark ink, appearing to read 'M. Butler', written over a horizontal line.

Michael J. Butler  
Technical Director



Encs.

MIC/CAI/C/Nº 01/82

Brasília, January 6<sup>th</sup>, 1982

Mr. MICHAEL J. BUTLER  
Director,  
ORTI - Ocean Resource Technology International  
27 Ranelagh Gardens  
Stamford Brook Ave,  
London W6

Dear Mr. Butler,

I have received with thanks your letter of November 26 together with the information included on the "Krill Project".

Concerning this issue I would like to inform you that a copy of your letter was sent to the adequate departments of the Ministries of Agriculture, Navy and Foreign Affairs, as well as to SUDEPE, which will provide us with additional comments, in due time.

Sincerely Yours,



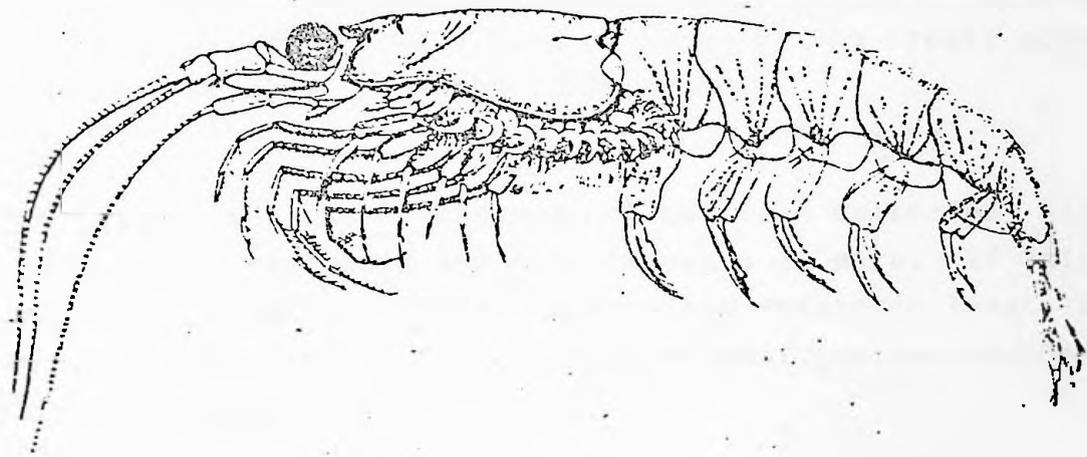
ROGERIO SABOIA

Coordinator

International Department  
Ministry of Industry and Commerce

OOJ/vt.





## K R I L L

Krill are found in both international waters and within 200 miles of the Antarctic mainland and islands. There is no agreement whether the territorial claims of seven of the treaty powers have 200-mile Exclusive Economic Zones or not.

The text of the "Krill Convention" has been delicately written to satisfy both claimants and non-claimants at once. If this shaky compromise breaks, it might destroy the Antarctic Treaty itself, which has kept the continent internationalised and weapons-free for two decades.

In spite of their internal splits, the treaty powers present a united front against outsiders. They have effectively squashed an FAO initiative to help develop the fishery. Some Third World nations think krill should be part of the "common heritage of mankind", and production taxed as part of the New International Economic Order. But the group of 77 seems so far uninterested - perhaps because the Antarctic club includes Argentina.

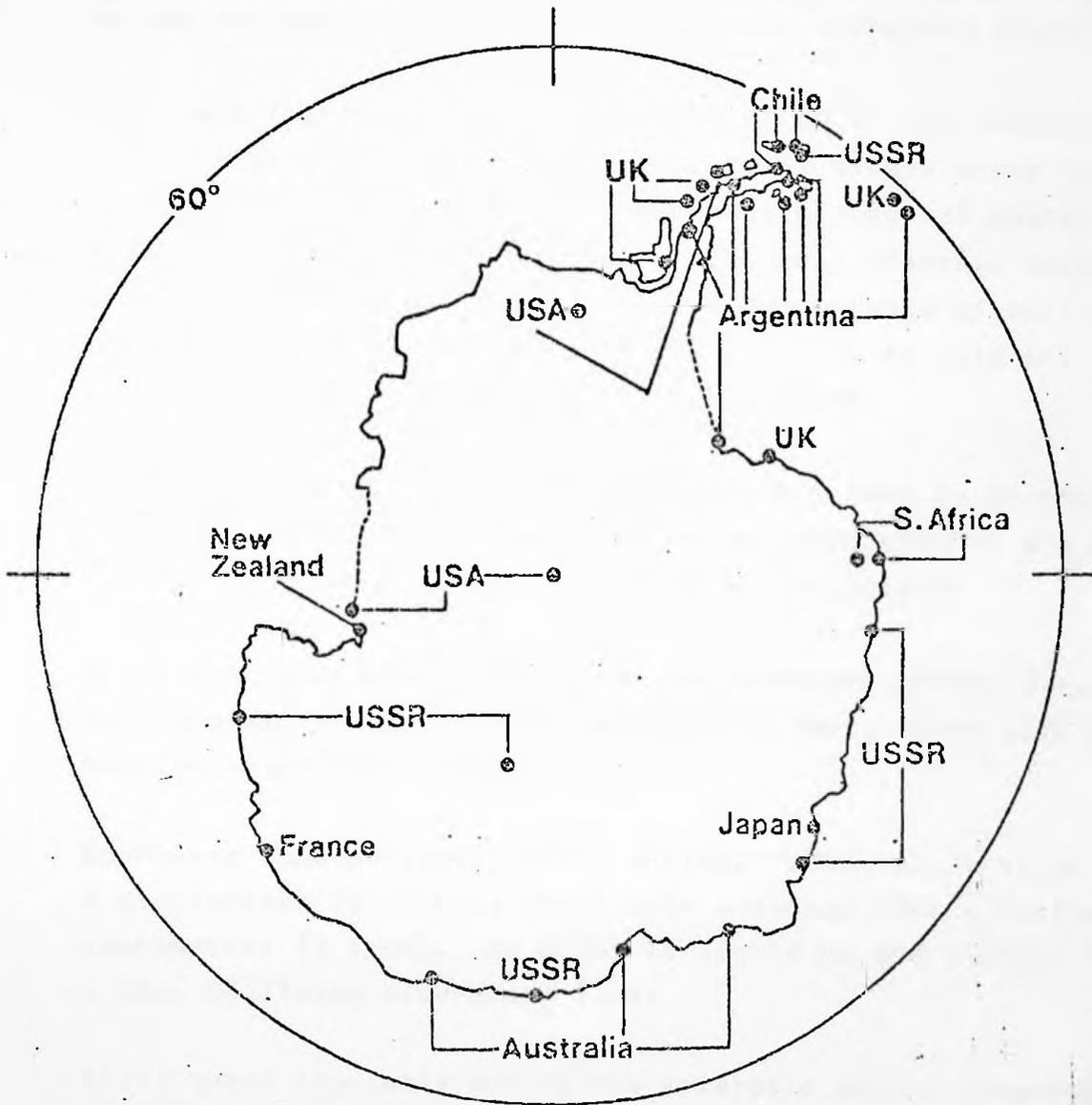


Figure 5 Until the growth of the krill fishery, interest in Antarctica was almost exclusively scientific. Ten of the 12 treaty powers had scientific stations south of the 60th parallel during winter 1978.

### What is krill?

Krill is a Norwegian whaling term meaning "whale food". It refers to many species of planktonic crustaceans, but most particularly to the dominant species: the shrimp-like *Euphausia superba*.

Krill are found both north and south of 60°S (the northern boundary of the Antarctic Treaty area). But krill always occur south of the Antarctic Convergence, an important biological boundary which lies between 47° and 63°S. One of the most dramatic ocean features in the world, the convergence is a sudden change of surface temperature, sometimes as much as 4°C (7°F), as cold Antarctic waters sink below warmer waters moving south.

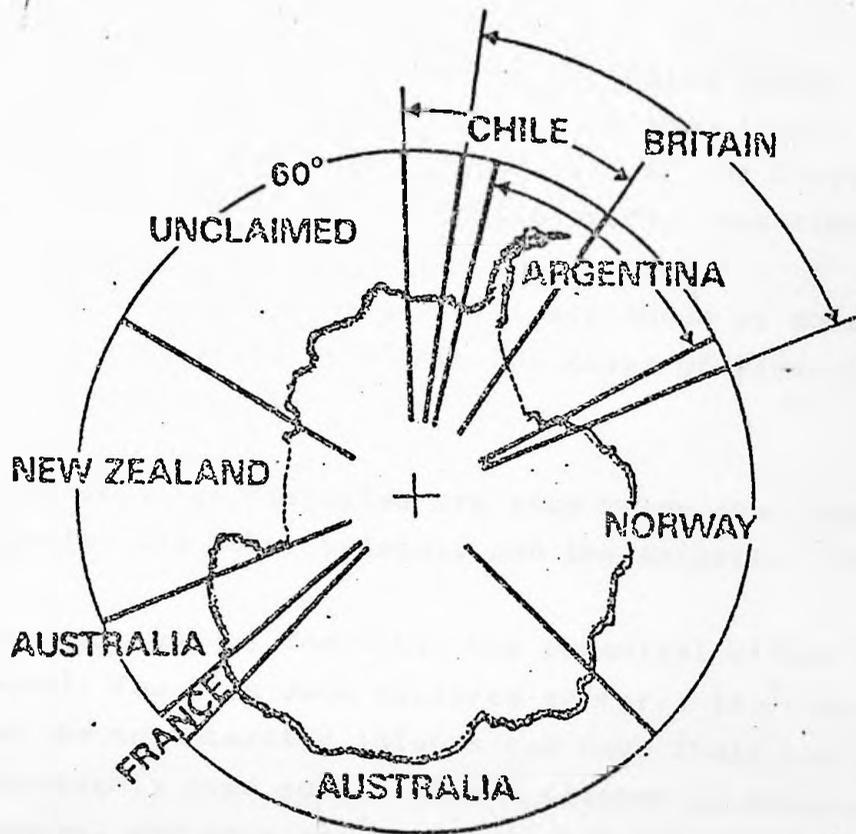
Krill have a circumpolar distribution, but seem to be most abundant in the South Atlantic Ocean. We do not know whether the Antarctic contains one or several distinct krill populations.

Krill are herbivores, feeding on the abundant phytoplankton or floating microscopic plants (mainly diatoms), which grow in the nutrient-rich cold waters.

*Euphausia superba* looks like a shrimp. When mature it is about 5 centimeters (2 inches) long, with antennae adding another 2½ centimeters (1 inch). At night it lights up and a shoal becomes a mass of living blue-green fire.

Krill swarm regularly during the Antarctic summer (December to May), which makes them easy to catch. Shoals vary from a meter (three feet) to 800 meters (half a mile) across. During January-April shoals contain about 12 kg per cubic meter of krill (35 lb of krill per cubic yard). The West Germans have reported catch rates of 40 tons per hour.

Figure 8 Territorial claims in Antarctica: all but 17% of the continent has been claimed. Australia, France, New Zealand, Norway and the UK have mutually agreed claims, while Argentina and Chile have claims conflicting with each other's and with the UK's. The USA, USSR and some other nations do not accept the validity of these claims.



The Antarctic Treaty area extends to 60°S (solid line). Krill are found south of the Antarctic Convergence (dashed line). The proposed convention will deal with the fishery south of the Convergence, which has been precisely defined in the draft Convention (dotted line)

The main known concentrations of krill are shown as dots; the biggest densities seem to be within 200 miles of land disputed between Argentina and the UK.

The main Antarctic fin fisheries are also below the Convergence: around Kerguelen and other islands, and the Antarctic Peninsula.

The map (see sep. sheet) indicates the potential effect of 200 mile zones (shaded): few have been declared so far. It is generally agreed that the subantarctic islands can have their own zones, although sovereignty over some of these islands is disputed between two states, and some are uninhabitable and might not be entitled to 200 mile zones. However, there is no agreement on 200 mile zones off the Antarctic mainland, since there is no agreement on Antarctic territorial claims.

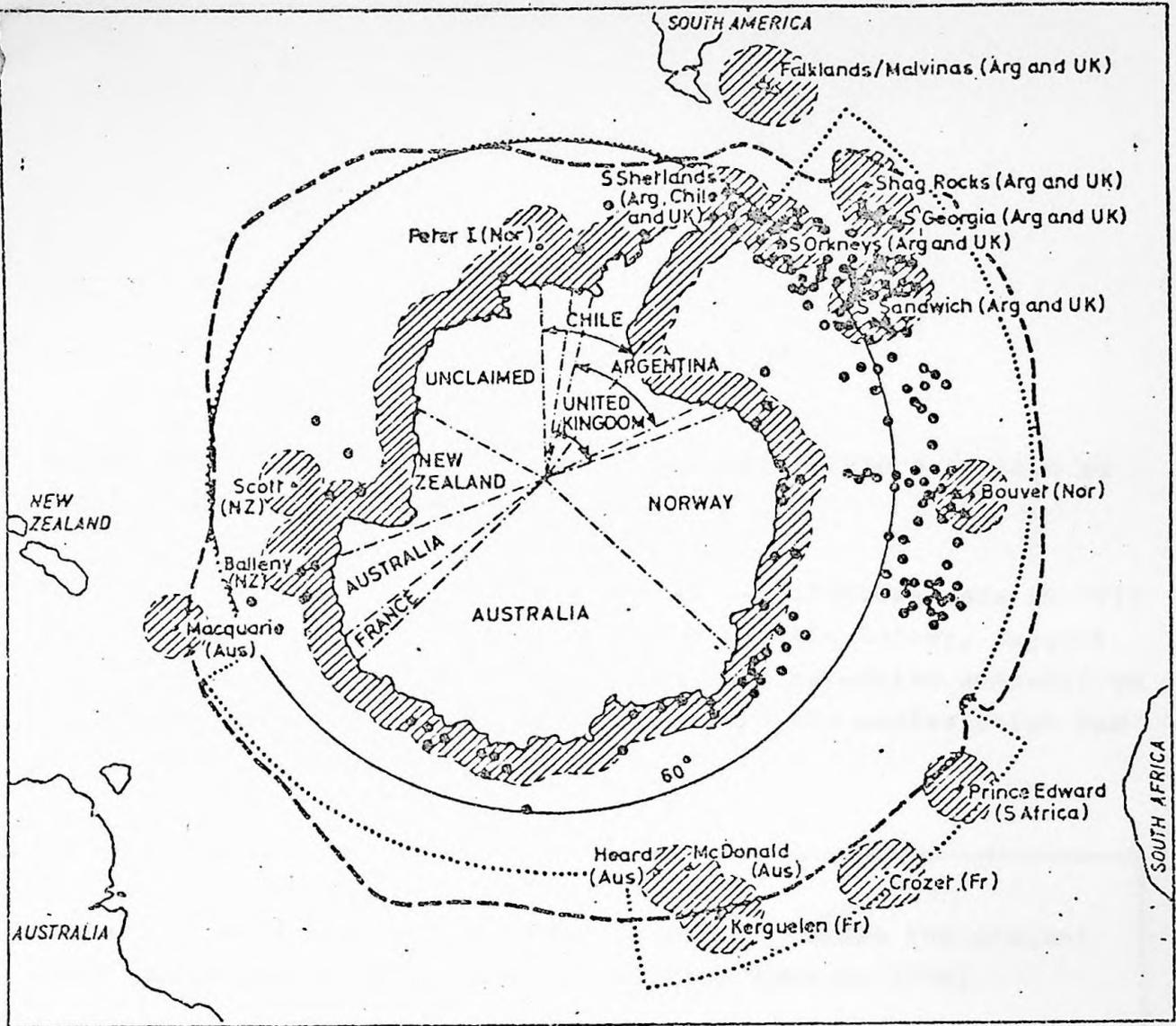


Figure 9 Antarctica, krill and EEZs: It is agreed that the subantarctic islands (owned by France, Norway, Australia, New Zealand and either Argentina or the UK) can have their own 200-mile EEZs, although not all are yet declared. But there is no agreement on territorial claims on the Antarctic mainland, or on whether these claims have an EEZ (shown here shaded). The Antarctic Treaty area extends to 60°S (solid line). Krill are found south of the Antarctic Convergence (dashed line), and the proposed "Krill Convention" will deal with the fishery within a similar area (dotted line). The main known concentrations of krill are shown as dots. The biggest known density of krill seems to be within the EEZs of land disputed between Argentina and the UK.

How much can we catch?

In the past, estimates of annual sustainable yield have been as high as 160-1,000 million tons.

More recent estimates are lower. Thus, calculations made in 1977 by R.M. Laws, director of the British Antarctic Survey, suggest that 110-150 million tons of krill could be harvested annually on a sustainable basis, if man simply replaced the whales which had previously fed on krill.

A yield in this range would still more than double the present total world marine catch (over 73 million tons in 1976).

In the past two years, some scientists have further reduced these estimates. In 1978, Soviet scientists estimated that a total of 15 million tons could be harvested (10 million tons in the Atlantic sector, and 2 and 3 million tons in the Indian and Pacific Ocean sectors respectively). Nevertheless, some Soviet experts are of the opinion that a total annual catch of at least 50 million tons is possible.

fish, lobsters, crabs, squid

Other living resources of the Southern Ocean are also attracting interest: crabs and lobsters (found on continental shelves of subantarctic archipelagoes); fish (near the slopes of Antarctic islands and continent); and squid.

Of the fish, the Nototheniids (white-blooded fish - they have no haemoglobin or other blood pigment) are probably the most significant. Patagonian hake and blue whiting are also caught.

Everson (1977) has estimated the maximum sustainable yield of fish to be approximately 50,000 tons around S. Georgia and 77,000 tons around Kerguelen. There are other fishing grounds, e.g. near S. Shetland Islands and S. Orkney Islands which could support significant fisheries.

The Russians and Japanese were recently reported to have harvested about 340,000 tons of Antarctic cod (*Notothenia rossii*) from the Antarctic and the South Atlantic over a six month period.

In the past 10 years, fish stocks in two areas have been the target of intensive fishing by the USSR: South Georgia in 1969 and 1970, Iles Kerguelen between 1971 and 1974. The chief objective of this fishery has been the nototheniiforms (white-blooded fish).

Soviet fishing in the Antarctic during the 1970s

<u>Year</u>	<u>Catch</u>	<u>Notes</u>
1969	90,000	Probably mainly South Georgia
1970	417,000	Probably mainly South Georgia
1971	228,000	Probably mainly Iles Kerguelen
1972	106,200	Probably mainly Iles Kerguelen
1973	10,100	-
1974	91,000	Probably mainly Iles Kerguelen
1975	18,449	Probably all Iles Kerguelen
1976	51,898	South Georgia and Iles Kerguelen

Which nations are interested?

Although the USSR and Japan were the major krill-fishing nations during the early years, the number of nations now sending vessels to the Southern Ocean has increased considerably. The following groups may be distinguished:

Major fishing nations: Japan, Poland, USSR

Nations involved in experimental fishing: Bulgaria, Chile, East Germany, Taiwan, West Germany

Nations planning programmes: Argentina, Australia, Cuba, France, South Korea, Spain

Nations involved in product work: Brazil, Denmark, Norway, USA

Nations with limited current interest: Canada, New Zealand, South Africa, UK, Uruguay

Nations which have a reasonable probability of being involved in the medium term: China, India, Peru

Most of the above states have some connection with the Antarctic Treaty.

Argentina, Australia, Chile, France, New Zealand, Norway, and the UK are claimant states and original members of the Antarctic Treaty

The USSR and Japan are non-claimants, and original members of the treaty

Poland became a full treaty power in 1977, it had acceded in 1961

West Germany has applied for full treaty membership

Denmark acceded to the treaty (not full membership) in 1965, and East Germany in 1974

South Korea has applied for acceding treaty membership

Brazil, Uruguay and Peru have mentioned the possibility of territorial claims in the past, but are not at present connected with the treaty

Belgium and the US are the only full treaty powers not to have demonstrated much interest in krill fishing

More and more nations are trying to get a foothold in the Southern Ocean fishery. Their motives vary.

Some have an immediate need for krill as food

|| Others believe a major fishery may soon develop and want to establish the right to participate (quotas are often based on previous catches)

|| Some nations without existing distant-water fishery capabilities are interested in joint ventures with other countries to exploit krill

Others again see a share in krill as bolstering their territorial claims to the Antarctic mainland and continental shelf

Recent years have seen a steady increase in the world fish catch, leading to increasing pressure on conventional fishery resources.

The establishment of 200 mile Exclusive Economic Zones (EEZs) by coastal states has forced many nations to look further afield as they are excluded from nearer grounds. (This may account for the interest of Poland, Korea, Taiwan, East Germany, West Germany and Spain).

|| Certain technical difficulties in krill fishing have recently been overcome. Adequate fishing methods were identified in 1976 (leading to higher catch rates), and work on product development has progressed significantly since 1977.

## Fishing Methods

Because of the long distances and lack of harbour facilities in the Southern Hemisphere, Antarctic fleets need to be self-supporting. To date most countries involved in experimental fishing have used large trawlers adapted for research purposes. Brazil has a geographic advantage over many other interested countries.

There are two main approaches to large-scale operations:

The first is the orthodox, large, distant-water, shelter-deck stern trawler, equipped to process the catch on board. It uses local harbours, or carrier vessels and supply ships. However, the intermittent catches of large quantities of krill leads to handling and storage problems, and damage to the catch.

The second approach is to use motherships (of about 10,000 tons) to process the catch of trawlers. In 1978-79 Japan planned a fleet of 10 medium-sized trawlers to service one mothership.

Some observers remain sceptical of the mothership system, because severe weather conditions could result in the catcher boats failing to deliver before decomposition of the catch occurs (4-5 hours). These hazards could be lessened if some degree of preprocessing of the catch (e.g. boiling) took place on board the smaller ship.

Large midwater trawlers used elsewhere can be quite easily adapted to harvesting krill - particularly if they have been used in polar regions before.

No system is yet completely ruled out on technical grounds. At the one extreme are fleets of small fishing vessels of 25-30 meters length overall supplying shore bases or floating factories. At the other extreme are independent super-trawlers, or very large trawlers served by supply vessels and refrigerated transports.

Part of the recent improvement in catch rate is attributable to the increasing reliance on acoustic (sonar) rather than visual detection of krill swarms.

The Soviets are now experimenting with methods of light and electrical field attraction (to overcome the problem of uncertain and sporadic krill distribution which results in damage to the catch). It is thought that krill could be concentrated by light or by sound; or by creating eddies in the water, in the vicinity of which krill are thought to concentrate.

Midwater trawls have been found the most successful type of net for catching commercial quantities of krill. However, Soviets find deep-sea trawls the best adapted to catching krill, and achieve rates of 100-120 tons per day.

The USSR also intends to use sucking and filtering devices for harvesting.

## P R O D U C T S

### Whole Krill

Whole boiled frozen krill were first marketed in Japan in 1976, at a wholesale price of ¥500-800 per ton. (This compared with a wholesale value at the same time of large shrimps in New York of ¥7,000).

The Norwegians are trying to produce whole cooked krill, to boil in oil and serve in Asian-style restaurants.

In 1978, Nippon Suisan Co (Nissui) marketed 100 tons of frozen raw krill in Japan, with good consumer response. Designed to be defrosted and eaten raw, the 200 gram (7 ounce) packages were sold retail for 1,000-1,200 yen (¥5-6). Industrial wholesale packages of 12 kilograms (26 pound) cost 8,400-9,600 yen (¥40-50) - i.e. 700-800 yen per kilogram, or ¥1.50 per pound.

A market for this product might amount to some tens of thousands of tons per year, mainly in Japan, the Philippines and other Indo-Pacific countries where small whole shrimp are traditional.

The total world production of shrimps will have to rise about 300,000 tons above the 1974 level of 1.3 million tons if it is to meet expected demand projected at constant prices for 1985. Krill may be able to meet some of this demand, either in whole form or as tail meats.

### Whole tail meats

The most promising outlet for human consumption may be as a source of crustacean meat. It is likely that the highest-value products obtainable will be based on shell-free intact tail meats.

There are two techniques for krill peeling:

Frozen attrition has been tried in Japan and Poland; this involves centrifugation. It produces individual frozen meats of attractive appearance and small size. This is fast but expensive.

Roller peeling is simpler, but the end-product tends to be dry and fibrous.

Tail meats can be marketed as such, or further processed to increase their size. In 1977, the Chileans prepared intact tail meats by roller peeling, and then moulded them into frozen blocks which were sawn into portions and breaded.

These breaded krill sticks or "krill fingers" were test marketed for six months at an arbitrary price of 16.85 pesos (US\$0.90) per pack of 10. Eighty-four per cent of those tested found them "very good"; 16% found them acceptable.

#### Mince

The production of mince from krill involves the adaption of a recently developed technology for removing flesh from the bones and skin of a variety of minced animals.

Substantial quantities of krill mince frozen in blocks were produced in 1976-77 by the Polish and West German expeditions.

Recently, the Norwegians have reversed the usual process by first cooking, then pressing and separating the edible and inedible parts. However, raw mince may have a higher product potential.

#### Paste

USSR, Japan, West Germany, Poland and Chile have all produced a coagulated paste product from krill via mince.

## NEW DEVELOPMENTS

In Japan, a heat-pasteurised fishcake or "Kamaboko" was successfully developed from krill in 1977, and found comparable in nutritive value and taste to fishcakes traditionally produced from Alaskan pollock.

7) The Chileans have recently reported a breakthrough in processing, which utilises 90% of the raw krill's live weight. (When krill is used in sausages, a yield of 43% of the whole krill has been reported: yields from peeled tail meats are 17-22%). The new Chilean technique yields a red product similar to salami which is hard to cut and has a distinct krill taste. It is said to be marketable at one third the price of similar products.

A product resembling ham in structure is now being obtained in the USSR by certain alterations in the process of preparing "Ocean" paste - "krill ham".

### Concentrates and extracts

fish protein concentrates (FPC) type B, prepared in Norway from capelin and mackerel, has been found acceptable in a number of developing countries with a tradition of eating fish or dried fish.

About 5,000 tons of FPC (type B) have been used since 1970, some through food aid programmes, some through commercial channels. FPC is used as an addition to traditional dishes or as a soup powder.

Because of its high extractable protein content, krill is highly suitable for the production of dried protein concentrates. It is also thought that the light colour and shrimp-like flavour would probably render it more generally acceptable than dark, strongly-flavoured products from fatty pelagic fish.

Japan's Tokai fisheries Laboratory has reported the development of a technique to manufacture protein concentrate from krill. The product is called krill-MARINOLIF, due to its similarity to an FPC product marketed under this name made from Alaskan pollock, blue whiting, mackerel and sardine. It can be used alone or added to meat or fish. Consumer tests have been positive.

The Soviets amongst others are working on the production of a high-quality protein made from pure meat, not tasting or smelling of krill. This would be the equivalent of Fish Protein Concentrate Type A.

#### Fishmeal

Krill meal for cattle and poultry feeds has been produced on a commercial scale by the Soviets, the Japanese, West Germans, Poles and Chileans, generally using existing technology and plants with little modification. There are no fundamental technical problems but the small size of krill can be a problem. Cooking times are longer than for fish; fat separation is poor; yields are low; and drying may cause loss of quality. Further, there are reports of high levels of abortion in Polish cattle on krill meal diets.

The size of the fish meal market (4.1 million tons in 1976) offers krill great potential. Efforts to produce krill products for human consumption are likely to leave a large quantity of unwanted raw material available for reduction to meal.

The astaxanthin (pigment) content of krill may give it added value in fish farming, particularly the raising of salmon, where it results in the desirable pink flesh.

#### Chitin and other products

Chitin and its derivative chitosan, which can be obtained from krill shells, has many uses.

Krill wastes have apparently been used in Chile in the manufacture of pharmaceutical products, bird food and cosmetics.

## WHICH COUNTRIES ARE CATCHING KRILL?

The following notes on national activities in the Antarctic krill fishery are often based only on press reports, and are therefore not so well substantiated as the rest of the facts in this document. Because some countries do not make information about their fishing activities readily available, even limited reports on some nations are missing. However, this summary is believed to be the most comprehensive account of current activity.

### Argentina

According to a March 1978 report, Argentina plans to allocate \$50 million to Antarctic fishing projects. The Instituto Antartico Argentino cooperates in krill studies with the Facultad de Farmacia y Bioquímica of the University of Buenos Aires.

Other reports indicate government interest in obtaining foreign assistance in the development of the krill fishery, and in constructing krill processing plants at the southern port of Ushuaia in Tierra del Fuego.

There is talk of joint venture fishery arrangements with West Germany and Japan, north of 40°S. (Argentine observers joined the 1977-78 West German expedition).

There are also reports that Korea and Spain are interested in arrangements to fish south of 46°S latitude in Argentine-claimed waters for fish such as hake and squid; this might include the EEZ's of the Falkland Isles (Islas Malvinas) and the Antarctic peninsula, both of which are claimed by Britain as well as Argentina.

### Australia

In early 1978, Australia was reported to be planning to build a \$20 million vessel for Antarctic fishing.

An Australian government decision to introduce a 200-mile EEZ off mainland Australia, and probably also off the Australian-claimed sector of Antarctica, was postponed at the beginning of 1979 "until at least April 1979".

### Canada

Following an inter-governmental agreement, a Canadian scientist joined the 1977-78 West German krill expedition to the Antarctic, to assist in the development of krill processing technology.

In Canada itself, research is being conducted on three species of Euphausia (krill), the biomass of which in the St. Lawrence Bay alone is thought to amount to 75,000 tons. As the food value, identity and concentration of the investigated species are similar to Antarctic krill, Canadian researchers consider that fishing in Canadian waters is more profitable than going to Antarctica.

### Chile

Chile's krill programme started in 1974, with a catch of 60 tons. Currently, Chile's National Development Corporation (CORFO) and the Chilean Institute of Fisheries Development (IFOP) are carrying out krill research.

Once marketing problems are solved, it has been reported that \$400 million could be invested over the next decade in a capture fleet and processing facility to utilise 3 million tons of krill per year.

In all, about 25 products based on meat and paste have been developed for human consumption, in addition to flour, animal concentrates and colouring agents.

Chile is reportedly constructing a krill fishing vessel with a carrying capacity of 1,200 tons, capable of catching 100 tons of krill per day. It will be able to operate for 240 days per year.

Chile is understood to be contemplating a joint venture with Spain to exploit krill, and another with West Germany to fish hake. Cooperation with France and Korea is also possible.

A press report suggests that the People's Republic of China and Chile are planning to increase trade and extend cooperation to such endeavours as a joint scientific expedition to the Antarctic.

The country is in the process of writing a Krill Development Act, which will govern joint venture arrangements and is said to include large-scale tax exemptions in order to promote krill fishery development.

In late 1978 the Chileans reported a breakthrough in processing technology. In December 1978, the effectiveness of a technique developed by Chilean personnel was successfully verified in cooperation with a Danish company, Key Engineering, which supplied machinery and technicians to the Chilean experimenters.

This led to an agreement between Danish businessmen and the Chilean centre for the Investigation of Nutritional products (INVIPA) to invest \$4 million in a pilot processing plant to be set up in 1979 in Japan, to process 6,700 tons monthly. If successful, a \$15 million processing plant will be established in Chile.

#### Cuba

Cuba is interested in Antarctic fisheries, and has planned a programme. It has pressed strongly in FAO for the Third World to have an equal right to the benefits of exploitation of Antarctic fisheries.

#### Denmark

The recent agreement reported between Danish businessmen and Chile is reported under the heading Chile. The Danish Matcon Company is reported to be experimenting with peeling krill.

East Germany (German Democratic Republic)

In 1976-77 season, an East German trawler was sighted in the Antarctic.

France

The Institut Scientifique de Pêches Maritimes in Nantes plans to conduct research in krill harvesting and processing.

A press report states that the French international food company Creusot Loire Entreprises, with financial backing from the Societe Bertin, has proposed forming a joint venture with Chile, composed of 45% French capital and 55% Chilean. This would involve the construction of a krill processing plant in Puerto Williams to produce human food, meal and cosmetics. Vessels could fly the Chilean flag and employ Chilean crews; the French would provide the technology.

Japan

Japanese efforts have been undertaken by the University of Tokyo's Ocean Research Institute, as well as the semi-governmental Marine Fisheries Resources Research Centre and the Fisheries Agency of Japan (largely via its Tokai Regional Fisheries Research Laboratory). Not until the 1976-77 season did Japanese fishing companies become directly involved in the fishing.

Fishing operations started in the 1972-73 season, with 50 metric tons of krill. The 1977-78 harvest of 21,000 tons was double that of previous seasons; this was the first year of commercial scale operations.

In the 1978-79 season, nine large privately-owned trawlers caught over 20,000 tons of krill. A fleet of 10 government subsidised medium-sized trawlers chartered by MFRRC is expected to catch over 17,000 tons, making an anticipated total haul of over 41,000 tons of krill.

Several refrigerated transport ships carried the processed catch to Japan.

There is some evidence that Japanese vessels are now spending the winter season in the Antarctic and the summer season in northern waters fishing catch allocations in the US and Soviet EEZs.

Japan originally used krill in liquid protein, meal and paste. In 1976 krill was marketed directly, particularly as whole cooked krill.

Krill caught in the 1977-78 season was sold, apparently successfully, as fresh, frozen whole krill; as peeled, boiled, frozen krill; and as whole dried krill. Boiled krill did not sell well.

Producers estimate that of the 1978-79 catch, 60% was processed into feeds for animals and cultivated fish; the remainder was marketed as processed foods. While outlook for meal products seems good, food products will apparently require more innovation and promotion.

The private Japanese fishing firms involved in krill are Nippon Suisan, Nichiro Gyogyo, Kyokuyo Gyogyo, Taiyo Gyogyo, Hakodate Gyogyo, and Hoko Suisan. V

#### New Zealand

New Zealand has reported the production of a dried krill product: soup powder

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#### Norway

Early work by two Norwegian companies (Landteknikk and Taro Food) led to the development in 1975 of a krill paste processing technique later utilised by the Soviets. Following work was reportedly delayed because krill obtained from the Carman 1975-76 expedition was of unacceptable quality.

A Norwegian scientific expedition in 1976-77 brought back krill samples for analysis.

In 1978 the Shellfish of Scandinavia Company in Norway sold krill feed as animal and fish food, using raw material bought from Polish trawlers. The same company also sells a freeze-dried krill product used mainly in soups. It is trying to produce whole cooked krill to boil in oil and serve in Asian-style restaurants.

Norwegian plans have recently been reported for a five-year pilot project to produce krill paste, for use in sandwiches and to be added to other traditional foods.

#### Poland

In 1975-76 Poland sent the research vessel Professor Siedlecki and the trawler Tazar to Antarctica for the first time.

In 1976-77, a research vessel and four chartered factory stern-trawlers caught 7,000 tons of krill, which was brought back as blocks of frozen minced krill.

#### South Africa

In spring 1978, a South African vessel conducted aerial/acoustic surveys to test the effectiveness of these methods of krill location.

South Africa's substantial existing high seas fishing expertise may ultimately be applicable to krill fishing, but a number of existing problems must first be solved. The Fishing Industry Research Institute in Cape Town developed in 1978 three spray-dry krill products suitable for human consumption. The possibility of using krill as an animal foodstuff is also being investigated.

## South Korea

A late 1977 report indicated that the South Korean government had decided to provide full support for Antarctic krill fishing by subsidising operations of South Korean private fishing industry.

A krill survey expedition was reportedly sent for the 1978-79 season. The Nambuk Fisheries Company supplied the ship (Nanbug-ho) and trained crew in partnership with the government's Office of Fishing, which provided 29.5 million and some fisheries experts. This expedition was designed to evaluate the feasibility of developing a krill fishery.

Other reports state that a 3,000 ton trawler of the Korean Wonyang Fisheries Company, chartered by the Office of Fisheries, left for krill fishing in the Antarctic in November 1978.

Korea is reported to be interested in Chilean offshore fisheries.

In early 1978, the South Korean government notified Antarctic Treaty parties of its wish to accede to the treaty; it did not apply for full membership. There is Soviet opposition to South Korean involvement in negotiations on the new convention.

## Spain

In 1977 it was reported that Spain was prepared to investigate an Antarctic fisheries programme, due to the problems faced by its distant water fishing fleet in the face of EEZ declarations. The programme was to be jointly financed by shipowners and the government.

## Taiwan (Formosa)

The first exploratory expedition of the Taiwan Fisheries Research Institute operated out of South Africa in 1976. The vessel Hai-kung caught 130 tons of krill.

In 1977-78 the Hai Kung returned from a 45-day experimental trip with 700 tons of krill, which was reduced to flour.

Taiwan has reportedly shown interest in joint fishery ventures with Chile in SE Pacific and Antarctic.

#### United Kingdom

Two krill surveys were conducted in 1977-78 Antarctic season by the government research vessel John Biscoe. They were rather unsuccessful in locating krill.

In the 1920s and 1930s, British research from Discovery (Captain Scott's ship) laid the basis of present knowledge of Antarctic marine biology.

Britain's interest in the krill fishery is slight, which is perhaps surprising considering this background, the UK tradition of distant water fishing, and the recent exclusion from Icelandic, Scandinavian and Soviet EEZs. However, under the government's Nature Environment Research Council, the UK has continued investigations into Southern Ocean ecology.

#### Uruguay

In 1976-77, Uruguay served as a base for the West German krill expedition. Uruguay is thought to maintain a territorial claim to parts of Antarctica, and has shown some interest in the past in joining the treaty.

#### USA

Various commercial concerns and universities are investigating uses of krill, but the US is not fishing in the Antarctic, and is not expected to do so for some time.

Union Carbide of the US has reportedly introduced coho salmon near the town of Ancud on Chiloe Island, Chile. If they become established, this could be an indirect way of cropping krill.

An environmental impact statement was prepared in early 1978 on a "Possible Regime for the Conservation of Antarctic Living Marine Resources", which had been drawn up by the State Department.

A Bill "to establish a conservation programme for the living marine resources of the Arctic and Southern Oceans" (HR10905) was introduced to Congress in February 1978, and referred to the House Committee on Merchant Marine and Fisheries.

Among other things, the bill would provide the federal National Oceanic and Atmospheric Administration with \$20 million to build a polar resource assessment vessel, and \$5 million annually until 1982 to maintain and repair the ship.

#### USSR

Soviet experiments in krill harvesting and processing began in 1961. However, until recently the USSR has not reported on the magnitude of its Antarctic operations, or said whether fish or krill is the main objective.

Fishing peaks of 40,000 metric tons occurred in 1972 and 1975, with a steep drop in 1976 to 500 tons, rising again in 1977 to 100,000 tons, according to FAO statistics.

It is believed that 120,000 tons of fish (*Notothenia rossii*: marketed by "Okean", was not particularly successful and sales are reported to have been discontinued. A wide range of products incorporating the paste has been introduced. An agreement has recently been signed in Norway to expand work in this area.

Research into new uses of krill continues.

West Germany (Federal Republic of Germany)

The first West German exploratory krill fishing expedition was an \$8 million government-supported programme in 1975-76, using the research vessel Walther Herwig and the trawler Weser. Thirty tons of krill were caught in one trawl.

In 1977-78 the government reportedly invested \$5 million in another Antarctic fishery expedition, but problems were encountered in locating krill.

West German activities have been financed by the Ministry of Research and Technology and the Ministry of Food, and carried out by the Federal Fisheries Research Institute and the Oceanographic Institute of the University of Kiel.

West German fish processors and dealers are reported to have criticised the 1979 programme of \$16 million. They would prefer to see money spent on more proven European fisheries, and are uncertain of public acceptance of krill. But the government says that research will go on.

In January 1978 Federal Germany applied for full membership of the Antarctic Treaty, and stated it will set up a research station in Antarctica.

Product development has concentrated on krill powder, liquid protein paste, "wurst" (sausage) products, meal and mince.

West Germany has a joint venture agreement with Argentina and has reportedly shown interest in joint venture agreements with Chile.

BRAZIL

Brazil is reported to have a dormant territorial claim in the Antarctic. It has acceded to the treaty, but has not sought full membership.

We consider it both economically and politically important that Brazil take positive steps to enter any international negotiations taking place, in order to establish their right in any future exploitation and development of this important resource.

## SCAR

The Scientific (originally Special) Committee on Antarctic Research (SCAR) was set up in 1958 by the International Council for Scientific Unions (ICSU). Its geographical mandate is wider than that of the Antarctic Treaty, encompassing the area south of the Antarctic Convergence, a natural ecological boundary lying between 45° and 60° South, where water flowing south meets colder water from the ice shelf. The Committee was designed as a vehicle to coordinate and exchange information about scientific activity in Antarctica.

The initial members of SCAR were the twelve Treaty powers, but the national membership requirements are different from those for the Antarctic Treaty; strictly speaking SCAR is only open to countries "actively engaged in Antarctic research", whereas the original Antarctic Treaty signatories remain consultative parties in perpetuity. In 1978 Poland and the Federal Republic of Germany were accepted as new members of SCAR. Although national activities in Antarctica and the sub-Antarctic are financed by the governments concerned the National Committee for SCAR "its normally a separate body, appointed, when possible, by the national academy adhering to ICSU" by ICSU, to each international scientific union (eg International Union of Biological Sciences) federated to ICSU, and to the World Meteorological Organisation, a specialised agency of the UN.

SCAR has its headquarters at the Scott Polar Research Institute, Cambridge, UK. There is an executive committee of three, and full meetings of national delegates are held every two years. The Committee conducts most of its business via working groups, which suggest priorities for research in their special disciplines and organise symposia to discuss progress. SCAR also provides the basic channel for disseminating information about Antarctic scientific programmes; each member nation submits an annual report on its activities to SCAR.