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Whaling and Whale Management in the Southern Ocean, and German Participation and Interests Therein

Introduction

Whaling activities, which date back to the eleventh century, focused for a long time on slow-swimming species in the North Atlantic which could be hunted from small rowboats with hand-held harpoons. Most stocks of slow-swimming whales (bowhead, *Balaena mysticetus*, right, *Eubalaena glacialis* and *E. australis*) were commercially exhausted by the mid 1850s. To what extent sperm whale became depleted by whaling remains debatable (see Lance et al., 1988 for discussion). Whaling in traditional whaling countries such as the US and the United Kingdom (UK) was in demise. Changes in demand are usually assigned a major role in explaining the collapse of the American whaling industry (Lance et al., 1988). Fewer and fewer whaling ships went out to sea each year. Baleen prices, however, remained high until the early 1900s (when spring steel was invented). Whalebone (baleen) became the leading product of the whaling industry and led to the exploitation of bowhead whales in the American and Russian Arctic from 1848 onwards (Bockstoce, 1995).

Rorquals whose oil was used to lubricate heavy machinery and to fuel lamps in the home (Lance et al., 1988) were in plentiful supply but were difficult to hunt in the traditional western manner, from rowboats. They moved too fast and had the disadvantage of sinking after they had been killed. Their catch only became possible after Svend Foyn's developments had revolutionized whaling from the late 1860s onwards.

This is a scientist's view on how whaling in the Southern Ocean developed and came to a halt in 1986 for an unknown period of time. It describes the pitfalls, shortcomings and successes whaling management went through in the sixty years of its existence and summarizes the contribution Germany made to modern whaling.

Whaling Attempts Prior to the Commencement of Commercial Whaling

Modern whaling, i.e. the systematic pursuit of rorquals, commenced in the Western hemisphere with Svend Foyn's development of a bow-mounted explosive grenade harpoon gun in 1863–72 (patented in 1870 and 1872). It is still a matter of dispute (Tønnessen and Johnsen, 1982) whether Foyn's invention was based on an 1850 German patent in England of a small harpoon gun, developed by Rechten for use in rowboat whaling and later further advanced by Cordes in

Bremen (Winterhoff, 1974). It is undisputed, however, that Foyn built his developments on experiments by other Norwegians such as Walsøe, Dahl and Esmark (Johnsen, 1947). Foyn developed his initial patents into an entire technological concept encompassing both the harpoon gun and the vessel design (Basberg, 2006). The Japanese, in contrast, had already hunted rorquals successfully since about 1675 by netting humpback, fin, right, gray, Bryde's and other whales in coastal waters (Omura, 1986). Foyn also resolved the problem of producing high-quality oil from the whale's blubber and meat by 1878. He made use of the whole whale carcass (Tønnessen and Johnsen, 1982).

The use of sail gave way to steam about the same time. Both innovations radically changed the whaling industry. The pursuit of the fast-swimming rorquals was now possible. A third innovation, the compressor, solved another problem with regard to rorquals, which did not float when dead. The compressor pumped air into the carcass immediately after death, allowing whalers to secure the whale before it sank. The transition to the mechanized age could not have come at a more opportune time for the industry (Clapham and Baker, 2002). The door was wide open for the whaling industry to spread over larger parts of the world's oceans (Tønnessen and Johnsen, 1982). This development, however, did not come about until the end of the nineteenth century.

The influence of the two dominant whaling nations of the nineteenth century, the Americans and the British, who hunted primarily right and sperm whales, declined dramatically after the 1860s while Norway's influence in the whaling industry began to expand rapidly. Most developments with respect to whaling worldwide from the late 1890s/early 1900s onwards were based on Norwegian initiative and technology, as well as capital, or both. The Southern Ocean slowly started to become the focus of Norwegian whaling interests from the early 1890s onwards, although the focus was initially still on right whales and not on rorquals (Basberg, 2005).

The German whaling captain Eduard Dallmannn, working on behalf of the Deutsche-Polar-Schifffahrts-Gesellschaft, was the first to sail in search of right whales in the Southern Ocean in 1873/74. His barque Grönland was equipped with an auxiliary steam engine but did not carry a harpoon gun. Dallmann did not encounter right whales. However, he was able to explore the uncharted waters west of the Antarctic Peninsula down to Gerlache Strait. Several places still bear German names, such as Dallmann Bay or Bismarck Strait (Petermann, 1875). He hunted seals instead of right whales. The success of his voyage was very limited. He killed 505 Antarctic fur seals and 297 other seals, hardly enough to cover even part of the cost of his expedition (Krause und Rack, 2006).

The next serious attempts to search the Southern Ocean for whales were by Norwegian and Scottish whalers in the first half of the 1890s, after plans to conduct whaling in the Southern Ocean had been discussed in Australia and Scotland from the 1870s onwards (Gray, 1891, based on earlier remarks by Ross, 1847; Basberg, 2005). Even during the mid 1890s and twenty-five years after Svend Foyn had introduced the harpoon gun, the new whaling technology was not utilized in the Southern Ocean. Steam whalers used by the expanding whaling industry in the Northern hemisphere were too small and were considered too risky to send on a long cross-ocean voyage to the Southern Ocean. Supplying them with coal was another problem. Pioneer whalers such as Dallmann and later the Norwegians and Scots used sealers, perfect for operations in remote places such as the Southern Ocean but not suitable for hunting rorquals (Basberg, 2005). However, it was the demand for (and at that time the continually rising price of) whalebone (right whale baleen) more than the demand for whale oil which prompted the venture to the Southern Ocean (Hart, 2001).

The Norwegians sent three expeditions: The first two were the Jason expeditions to the Antarctic Peninsula–Scotia Sea region in 1892/93 and 1893/94 with C.A. Larsen as their master.

The main initiator of these expeditions was Chr. Christensen. One of the companies involved was *A/S Oceana* (Hart, 2001; Basberg, 2005). One of this firm's main shareholders was the German Carl Lindenberg. The extent to which Lindenberg was involved in the two JASON expeditions, however, remains debatable (Barthelmess, 1989; Barthelmess and Reupke, 1991). The substantial involvement of German capital even led the contemporary German press to label the journey a "German expedition".

Countless schools of blue whales (*Balaenoptera musculus*), and hundreds of fin (*B. physalus*) and humpback whales (*Megaptera novaeangliae*) swam close to the ship. The JASON, however, was only fitted for catching right whales. No right whales were encountered. Larsen was able to secure a load of 6335 seal skins, two bottlenose whales and 1800 tons of blubber. Financially, the trip was a disaster (Hart, 2001).

The second JASON expedition, supplemented by two further vessels, the HERTHA and the CASTOR, visited South Georgia in 1894. The first right whale was shot with seven harpoons in Royal Bay, but subsequently lost. A similar incident occurred the next day when CASTOR harpooned another right whale. The vessels returned to Norway with a cargo of 13,227 seal skins and 1,100 tons of blubber – again a financial loss (Hart, 2001). Friedrichsen, a German cartographer, drew up a new map of the Southern Ocean based on Larsen's discoveries in the Weddell Sea during the two trips (Hart, 2001).

Larsen tried to persuade Lindenberg to provide him with capital to start whaling on South Georgia or the South Shetland Islands. He also described in detail the kind of combined whaling and sealing expedition he envisioned, and added that sheep farming could be conducted on South Georgia to add to the profit. Lindenberg rejected Larsen's plans because the results of the two JASON expeditions had been too poor to support such an enterprise (Hart, 2001). No further action was undertaken by Norwegians because Larsen and Chr. Christensen, who had sponsored the first JASON expedition in 1892/93, became engaged in whaling in Finnmarken (northern Norway). Larsen, however, still tried to promote his ideas of how whaling could be conducted in the Southern Ocean (Hart, 2001; Basberg, 2005).

The third expedition, with H. J. Bull as its master took Svend Foyn's old vessel KAP NOR, renamed ANTARCTICA, to the Ross Sea in 1893/94. Bull had pioneered whaling with Samuel Foyn, a distant relative of Svend Foyn, off the Russian Pacific coast in 1890 (Kalland, 1992). They shot (and landed) a right whale near Campbell Island in June 1894, the first whale shot by Norwegians on the margins of the Southern Ocean. Despite some success in terms of their seal catch, the ANTARCTICA expedition returned with a large financial deficit. Bull's efforts to interest other Norwegians in sealing and whaling in the Southern Ocean failed, just as Larsen's efforts had previously (Hart, 2001).

At the same time, when JASON made her first voyage, Scottish whalers sent four vessels, the BALAENA, DIANA, ACTIVE and POLAR STAR, to the Antarctic Peninsula–Scotia Sea region. Barques rigged with auxiliary steam engines, like the Norwegian and German vessels they were unable to pursue fast-swimming rorquals. Right whales were not encountered. They harpooned a fin whale in Erebus and Terror Gulf at the tip of the Antarctic Peninsula but the whale was lost. Given the absence of right whales and the problems of catching rorquals, the Scots agreed that they had to change their catching practises and use the Foyn method in order to be able to pursuit rorquals in the future. They filled their holds with 16,000 seal skins and lots of blubber, but the expedition was again a financial loss. Plans developed after the expedition to return to South Georgia to build a modern whaling station, however, were rejected. One of the participants of the respective planning meeting in Edinburgh was a Mr. Salvesen who started whaling at Leith on South Georgia a few years after Larsen had commenced whaling at Grytviken on South Georgia (Tønnessen and Johnsen, 1982).

Whaling gets underway in the Southern Ocean

C.A. Larsen became the master of the Antarctic, Otto Nordenskjöld's vessel for the Swedish Antarctic Expedition of 1901–03. The aims of this voyage were primarily scientific, but the vessel was also equipped to catch whales and seals in order to generate some income. Seals were hunted, but no whale was caught (Basberg, 2005). There were several reasons why the expedition became important for the development of whaling in the Southern Ocean:

– An abundance of rorquals was spotted in waters of South Georgia and farther south,
– the expedition was based on South Georgia from 22 April to 15 June 1902, discovered a small cove in Cumberland East Bay and named it Grytviken ("pot bay") after the old sealers' try pots they found ashore,
– their vessel Antarctic was beset by the ice in the north-western Weddell Sea in 1902 and lost. The crew was rescued and brought to Buenos Aires in 1903. During his stay in Argentina, Larsen was able to generate interest in whaling with local businessmen – primarily natives of Norway, Germany and Sweden. They founded a company, the Compañia Argentina de Pesca, with a capital of 200,000 gold pesos (Walton, 1982; Hart, 2001) with the aim of conducting shore-based whaling on South Georgia.

After a short stay in Norway, where he tried unsuccessfully to raise additional Norwegian capital for his enterprise, Larsen returned to South Georgia later in 1904. Grytviken was occupied on 16 November. Work commenced on 27 November 1904 when the first humpback whale was landed (Hart, 2001). The total catch of the first season at Grytviken from December 1904 to April 1905 was eight blue, eleven fin, sixty-seven humpback and five southern right whales (Hart, 2001). The whaling year was considered to have been a success.

From the beginning of Antarctic whaling, both shore stations and floating factories were in use (Basberg, 1993). Chr. Christensen, Larsen's former employer, sent the first floating factory Admiralen first to the Falkland Islands and then to the South Shetland Islands in the season 1905/06, one season after Grytviken had started its whaling operation. While Grytviken, and later other stations on South Georgia, became the centre of shore-based whaling, the fishery in the South Shetland Islands centred on bay-based operations with floating factories moored in sheltered bays as their basis. The two forms of whaling were very similar until the stern ramp was introduced in 1925. Floating factories produced more oil at that time than the shore stations (Basberg, 1993). Before full utilization of the whale carcass was introduced by the British government in 1909, there were a number of floating factories specializing in processing the skrotts (the remainder of the whale's carcass), which were either abandoned or purchased from shore stations (Headland, 1984). At that time, there were more disadvantages to bay-based whaling than to shore-based operations: less space, both for production and storage, and a less reliable fresh water supply (Basberg, 1993).

The whaling industry was hindered by little or no control or regulations in the beginning, and grew rapidly. Increasingly large catches meant large profits. More shore stations were established on South Georgia, and whaling in the South Shetland Islands expanded. The situation changed in 1909 after the UK was able to settle a dispute over the political status of South Georgia and claimed sovereignty of South Georgia, the South Sandwich Islands, the South Orkney Islands, the South Shetland Islands and the Antarctic Peninsula (called Graham Land at that time). A magistrate was appointed by the UK government and the process of "full utilization" of the whales was introduced at shore stations. The number of leases permitting the establishment of shore stations was limited, and operation of shore stations was limited to twenty-one years. The number of catcher boats employed and the length of the season was also limited (Basberg, 1993, 2005; Hart, 2006).

Furthermore, the award of whaling licenses was restricted in general, possibly to keep other

countries out of whaling. This may have been the reason why an unknown German whaling company was not granted a lease to conduct whaling in the Falkland Island Dependencies in 1911, like many other companies in that season (Barthelmess, 1989; Hart, 2006).

The Expansion of the Whaling Industry

South Georgia and the South Shetland Islands provided more than ninety percent of the almost 6,100 whales caught in the Southern Ocean in the season 1909/10, with Norway taking more than sixty percent of the catch (Basberg, 2005). Sealing of elephant seals became an integral part of shore-based whaling on South Georgia with 6,000 seals caught in one year (Dickinson, 1989; Hart, 2001; Robinson and Hart, 2003). Whaling was extended to the South Orkney Islands from 1911/12 onwards. Eight whaling licenses were issued for the South Sandwich Islands in 1911 and 1912 but only one company went in late 1911. Its two vessels were surrounded by ice before the destination was reached, and it gave up (Hart, 2006). The South Orkney Islands provided far fewer whales than South Georgia and the South Shetland Islands, and whaling on these grounds sometimes came to a halt for one or several seasons when whaling was not profitable enough (Tønnessen and Johnsen, 1982).

The rapid expansion of whaling would not have been possible without the findings of the German chemist Wilhelm Normann. On 27 February 1901 he concluded his study of how liquid fat could be hardened successfully. His invention, referred to as the 'Process for Converting Unsaturated Fatty Acids or their Glycerides into Saturated Compounds', was patented in Germany on 14 August 1902, and in the UK on 21 January 1903. The hardening of fatty acids came to be carried out industrially within a few years under the direction of Normann himself at the Leprince and Siveke Company at Herford in Germany, where he had made his discoveries, and at the soap-makers Joseph Crosfield & Sons Ltd. in the UK. The groundwork for the mass production of margarine had been laid. Patents of inventions by other Germans such as Ludwig Rissmüller revolutionized the processing of whale carcasses in Canadian waters, but did not find their way to the Southern Ocean (Goddard, 1993, 2005). Between 1905 and 1940, Germany held 28 of the 274 patents related to whaling, and was the most important patent holder after Norway.

A crisis in the world fat supply in 1906 led to competition between soap-makers and margarine producers for the best-quality raw materials, and provided an incentive for the more widespread use of whale oil (Scholl, 1991). However, there was still controversy about whether whale oil should be used for the production of margarine. Even margarine producers announced as late as 1913 that whale oil was not to be used for the production of margarine. It was not until 1914 that the German government circulated a memorandum allowing the use of whale oil for the production of margarine. Whale oil became a key component of margarine in the 1920s and constituted thirty to thirty-five percent of the raw materials for margarine production in the early 1930s in Germany (Scholl, 1991; Barthelmess, 2005). The mass production of margarine became one of the long-term strongholds of the whaling industry until the early 1960s.

The German whaling company Walfang-Gesellschaft m.b.H. Sturmvogel was founded in Bremen on 8 July 1912 with a capital of 920,000 Reichsmark, about one year after the unsuccessful attempt of an unknown German company to obtain a lease to start whaling in the Falkland Island Dependencies. Concomitantly, a branch of the company was set up at Lüderitz Bay (German South-West Africa, now Namibia). Although the whaling station was located well north of the Southern Ocean, its main aim was to exploit humpback whales of what was now termed "Stock B" (Anon., 2009b), which were either on their northward/southward migration to and from the breeding grounds off West Africa (substock B1) or off Angola and Southwest

Africa (substock B2) to their feeding grounds in the Southern Ocean. Two new catcher boats, Sturmvogel and Seeadler, were ordered from Norway. At the same time, a processing plant was constructed by Norwegian specialists near Lüderitz Bay. Considerable problems came about in the construction of evaporators, which had to produce the necessary fresh water for rendering the blubber down. The first whale was shot on 4 August 1913 (Barthelmess, 1986).

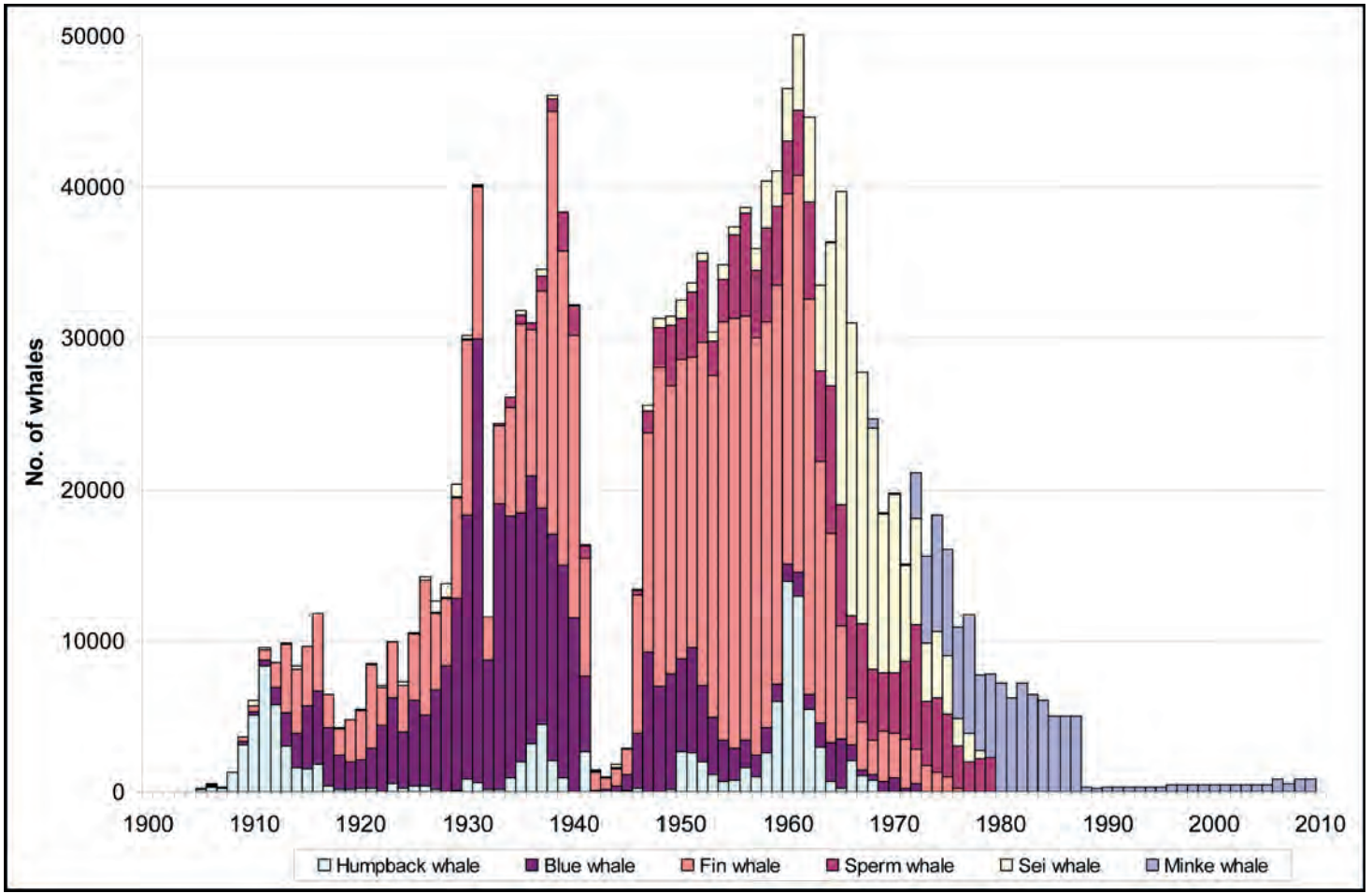
The shortage of fresh water became a continuous problem at the station and the amount of oil produced per whale was low. Two thousand barrels were produced (six barrels correspond to 1,016 tonnes) in the first season. The number of whales taken, however, remained unknown. The second season started in March 1914. Activities ceased on 19 September 1914, when British troops took possession of Lüderitz Bay. Four thousand barrels of whale oil and two thousand bags of Guano had been produced by that time (Barthelmess, 1986).

World War I and the Decade Thereafter

Whale oil provided one of the basic ingredients for the production of glycerine and the manufacture of dynamite in the UK. It was essential for the tanning and curing of leather for military boots, and an ingredient of torpedo lubricant in Germany (Barthelmess, 2005). Whaling was thus too important to be discontinued during World War I, at least by the main whaling nations – Norway and the United Kingdom. The importance of whale oil for strategic purposes was illustrated by the fact that the UK declared whale oil contraband in 1915 (Scholl, 1991). The supply of whale oil was also important for countering the shortage of fat, which seriously affected the civilian populations in war-stricken countries. Meanwhile, the number of the more coastal humpback whales had begun to diminish rapidly. They were replaced by blue whales, the species which was soon to become the most important to the industry (cf. diagram concerning the catches of whales in the Southern Ocean from 1904 to 2009).

The period between the end of World War I and 1925 saw enormous technological development in the whaling industry, as well as heavy capitalization of the industry. The number of whale-related patents increased substantially (Basberg, 1985). New hull forms of the catcher boats and improved harpoon guns led to much greater hunting success and an increase in the number of whales landed. Other developments such as the hauling-up slipway from 1925 onwards, new types of cookers (Hartmann cookers in the 1920s and Kvaerner cookers in the 1930s), freshwater evaporators, the introduction of separators and centrifuges, and much-improved refinement techniques all contributed to a much higher output per whale caught at reduced energy consumption and need for space (Kock, 1995). Shore stations provided twenty percent more oil per carcass then floating factories. Productivity in shore-based and pelagic whaling increased at different rates. At the same time, the need for whale oil on the world market increased dramatically due to the demand for margarine and soap. By 1929/30, floating factories surpassed shore stations in their efficiency (Basberg, 1997). This was reflected in an almost six-fold increase in the catch of whales between 1919/20 and 1929/30 (Basberg, 2005).

Concomitant to the rapid technological advances, the British government put additional pressure on the whaling companies every year not to increase the number of catcher boats, and encouraged the companies to invest in the improvement of the processing plants. Furthermore, the restrictive policy of the British authorities to issue new whaling licenses encouraged the whaling industry to look for new grounds. The whaling pioneer C.A. Larsen, for example, commenced whaling with the mother ship James Clark Ross and five catcher boats in the Ross Sea in 1923 (Barr and Watt, 2005; Hart, 2006).



Catches of whales in the Southern Ocean from 1904 to 2009.

The mid 1920s to World War II and the crises of the 1930s

After a peak season in 1925/26, shore-based whaling started to decline and South Georgia lost its importance as a prime whaling ground. Its share in whale catches was only five to ten percent from the mid 1930s onwards (Basberg, 2005).

An important transformation took place in the industry in 1925 when pelagic whaling was introduced. The Norwegian Petter Sørlle obtained a patent for a stern ramp which he had designed in cooperation with two other Norwegians, Christensen and Melsom (Johnsen, 1947), and which came into use in 1925 when the floating factory Lancing received the first stern slipway of a mother ship. Floating factories were now able to operate independently of land, and accordingly widened their range substantially. Old factory ships were now converted. The first purpose-built factory vessels with a stern ramp were the Norwegian Kosmos and Vikingen in 1928. Despite the turbulent and uncertain economical climate of the late 1920s, with an overall declining trend in prices, the production of whale oil increased.

The whaling industry experienced the same type of crisis besetting many other food industries in the late 1920s and early '30s: The price of whale oil rose to an initial peak of nearly £90 per tonne in 1919/20 with a subsequent rapid decline to less than £15 in the early 1930s (Basberg, 1985). Concomitant with the declining whale oil prices, the market was heavily capitalized: Norway alone had twenty-seven floating factories running in the Southern Ocean. Three and one-half million barrels of whale oil were produced in the 1930/31 season. It was the heydays of the British-Norwegian hegemony in whaling when the two nations together took ninety-five percent of the catch (Tønnessen and Johnsen, 1982; Kalland, 1992; Basberg, 2005).

Forty-one floating factories and six land stations with 232 catcher boats caught 29,410 blue whales, more than 10,000 fin whales and several hundred humpback and sei whales (*B. borealis*). The world output in whale oil exceeded 600,000 tonnes in 1931 (Scholl, 1988). The vast increase in production (combined with the Wall Street crash in 1929) led to a further precipitous decline in the price of whale oil. Large quantities of the peak catch of 570,000 tonnes in 1930/31 remained unsold (Gambell, 1990). The oversupply on the whale oil market had widespread ramifications: Many vessels, for example the entire Norwegian whaling fleet, were laid up for the 1931/32 season because of the marketing crisis facing the whaling industry. Whale oil production declined to 150,000 tonnes (Basberg, 1985; Scholl, 1988). The whaling industry's attempts to reduce the number of whales taken in the years following 1931/32 were at best only partially effective, since these efforts were based more on economic concerns than on the awareness that the stocks of humpback and blue whales had already been severely depleted (Heazle, 2006).

The whaling companies began to come to voluntary agreements amongst themselves to prevent overproduction of whale oil and the consequent further drop in prices as well as ruinous competition between the companies. The oil yield was calculated in blue whale units (BWUs) from a formula based on the oil yield whereby 1 blue whale was equivalent to 2 fin whales or 2.5 humpback whales or 6 sei whales (Gambell, 1990). The concept of the BWUs later formed the first management measure of the International Whaling Commission in the late 1940s (see below). Catch quotas were introduced in 1932 for the first time. They did not only limit the number of whales to be taken, but also demanded a minimum yield of 110 barrels per blue whale unit for floating factories and ninety for shore stations (Tønnessen and Johnsen, 1982).

In the meantime, new whaling nations emerged. Japan, whose activities had previously been confined to East Asian waters (Mageli, 2006), sent its first floating factory Tōnan Maru (the ex-Norwegian Antarctic) to the Southern Ocean in 1934. In contrast to other whaling nations, a substantial proportion of the Japanese production was whale meat for human consumption. Whale meat was consumed on the Japanese market, while the whale oil production was mostly

exported to obtain foreign currency (Mageli, 2006). Due to the emerging whaling nations which increased their whale oil production within a few years from 0 to 12.4 % (Germany) and 0.5 to 16.5 % (Japan), Norway's share of the world whale oil production decreased by 50% from the mid 1920s to the end of the 1930s (Mageli, 2006).

In the wake of the disastrous situation of the early 1930s, Norway, the UK and a few smaller whaling nations signed four agreements under the League of Nations in 1931, 1937, 1938 and 1939 to limit the production of whale oil. These included:

- the specification of dates within which whaling could be carried out (8 December to 7 March),
- a ban on the catch of right whales,
- the introduction of minimum landing sizes for blue (70 ft), fin (55 ft), humpback and sperm whales (35 ft),
- a ban on the catch of humpback whales in 1938,
- the stipulation that the entire whale carcass had to be utilized,
- a ban on the catch of females accompanied by calves, and
- the establishment of a whale sanctuary in the Pacific sector of the Southern Ocean (Whaling Area I) from 70° to 160° W (Tønnessen and Johnsen, 1982; Birnie, 1985; Gambell, 1990).

Germany signed and ratified the agreements from 1937 onwards, while Japan ratified whaling agreements from 1938 onwards.

Germany had always been one the largest consumers of whale oil in the world. German margarine contained ten percent hardened whale oil in 1924, sixteen percent in 1928 and over thirty-five percent in 1932. The situation was similar in the UK. The overall tendency was to increase the proportion of whale oil at the expense of higher-value vegetable oil which was then available for higher-value use (Barthelmess, 2005).

Germany established the "New Plan" so as to become less dependent on fat imports and thus to save the foreign currency needed for the expansion of the war industry. It became obvious within two years, however, that the plan would fail. Germany concluded bilateral clearing contracts with other countries to allow the import of important goods without direct payment of scarce foreign currency. Norwegian whale oil was one of them. When the whale oil price doubled on the world market within one year, the only way to try and improve the German fat supply appeared to be the establishment of a whaling fleet (Scholl, 1988; Barthelmess, 2005).

Blue whale stocks dwindled substantially in the 1930s. Fin whales took their place as the most-sought-after species (fig. 1). Sperm whales became another target of the whaling industry (fig. 1). They had to be strictly separated from baleen whales for processing. Sperm whale oil is inedible and must not be confused with baleen whale oil. It was used only as a lubricant in various industries (Kock and Scheidat, 2007).

Germany sent its first whaling fleet down to the Southern Ocean in 1936/37. The fleet consisted of the floating factory Jan Wellem (the converted Hapag-Lloyd freighter Württemberg) and the six catcher boats Treff I–VI. Some twelve percent of the crews were Norwegians. The fleet returned with 10,497 tonnes of whale oil (Reupke, 1986). However, the Jan Wellem fleet produced only seventy-two percent of the oil produced on average by Norwegian fleets.

Concurrently with the onset of commercial whaling, an institute of cetacean research was founded in Hamburg, with Dr. Nicolaus Peters being appointed its director. Most of the research conducted by the institute was similar to whale research carried out by other whaling nations such as the UK and Norway (Barthelmess, forthcoming). The only one of its publications to gain an international reputation was Peters's handbook *Der neue deutsche Walfang* (*The New German Whaling;* Peters, 1938) ,which later became a model for similar publications in other whaling countries such as Japan, the Netherlands and Russia (Barthelmess, 2005). The book initially closed with a serious warning against the overfishing of the whale

stocks. This remark, however, did not survive publication of the book (Barthelmess, forthcoming).

German whaling increased to six fleets in the subsequent season, 1937/38, with the Jan Wellem, the newly built Walter Rau, and the Unitas with eight catcher boats each, plus the ex-Norwegian Südmeer with six catcher boats. In addition, two chartered Norwegian fleets, C.A. Larsen and Skytteren, worked for Germany (Lüdecke, 2003). Whale oil production of the four fleets during that season amounted to about 60,000 tonnes with the two modern fleets producing almost double the amount of oil than the two older floating factories (Reupke, 1986). Despite an increase of catches in that season, it became obvious that the fight against the fat gap in Germany was lost. Butter, margarine and tallow were rationed from 1937 onwards (Scholl, 1991).

Despite the increased production of whale oil, Germany still had to import 152,000 tonnes (compared to 253,000 tonnes in 1935; Reupke, 1986). This was incentive enough to increase the number of German whaling fleets even further in the last season before World War II: a fifth whaling fleet (Wikinger) was purchased. Forty-one catcher boats provided whales to the floating factories (Reupke, 1986). As in 1937/38, two chartered Norwegian fleets worked on behalf of Germany. Whale oil production by the seven fleets amounted to about 83,000 tonnes (Reupke, 1986).

Like Germany, Japan had built up a large whaling fleet beginning in 1934. Six whaling factories with forty-one catcher boats were sent to the Southern Ocean in the last pre-war season (Kalland, 1992). With Norway and the UK, Germany and Japan were the leading whaling nations before World War II.

International law and geopolitical circumstances were the main reasons for sending the Schwabenland down to the Antarctic on 17 December 1938. Her research programme entailed aerial photogrammetry and exploration with the purpose of establishing claims, should the Antarctic and its surrounding oceans be distributed among nations in the future. A detailed account of this expedition is provided in Ritscher (1942), Lüdecke, (2003), Barthelmess (forthcoming), and Lüdecke and Summerhayes (forthcoming). A limited scientific programme only loosely connected to whaling was conducted: its results have been summarized by Stadel (1958). The outbreak of World War II stopped a second expedition, which was intended to cover part of the Pacific sector of the Southern Ocean in the austral summer of 1939/40. The planning of further expeditions, however, continued, with the next one envisaged for 1940/41, before the war stopped all further activities (Lüdecke, 2003).

Whale oil production declined from 556,720 tonnes produced by thirty-one fleets in 1937/38 to 470,130 tonnes produced by thirty-four fleets in 1938/39 (Reupke, 1986). The decline in catches was seen as a first possible indication of an overall dissipation of whale stocks.

The whole German whaling fleet became part of the navy at the outbreak of World War II. Whaling came almost to a standstill during this time (fig. 1). One or two land stations on South Georgia and a limited number of floating factories continued whaling in the Southern Ocean for the Allies during World War II. Three of them and eleven catcher boats were seized by the German raider Pinguin on 14 January 1941 and sent back to Bordeaux (France) with 23,526 tonnes of whale oil as prizes (Reupke, 1986).

Most floating factories worked as tankers and their loss was heavy. There was clearly a demand for whale oil in many of the war-ridden countries at the end of the war. A large number of newly built floating factories augmented the few floating factories that had survived the war (Basberg, 2005). Whaling commenced again on a large scale in the first post-war season 1945/46.

German Post-War Activities in Whaling

Germany and Japan had lost World War II. Three German floating factories survived the war. They became war booty of the Allies. The Walter Rau went to Norway and became the Kosmos IV. The Unitas first became the Empire Victory as part of the British whaling fleet and was later sold as the Abraham Larsen to South Africa. The Wikinger became the Soviet Slava.

The UK and Norway strongly opposed a return to whaling by Germany. Legislation by the Allies prohibited Germany from continuing whaling after the war. Japan, in contrast, was allowed whaling again to help overcome its food crisis. The Japanese whaling industry recovered remarkably quickly. Forty-seven per cent of the total animal protein consumption in 1947 came from whale meat and was still as high as twenty-three percent in 1964 (Kalland, 1992). The first two floating factories were sent to the Southern Ocean in 1946/47. By 1960/61 Japan was sending seven whaling fleets to the Southern Ocean. Production reached its peak in the season thereafter, when more than 300,000 tonnes of whale meat and oil were produced (Kalland, 1992). Japan became a member of the IWC in 1951.

It was in 1949/50 that the Greek Aristotle S. Onassis advised Howaldt shipyard in Kiel (Germany) to convert a World War II T2 tanker into a floating factory. He asked one of the German pre-war whaling companies, the Erste Deutsche Walfang-Gesellschaft (EDWG), a branch of Henkel Co., to supervise the conversion of the tanker into the floating factory Olympic Challenger and twelve corvettes into catcher boats. With the exception of the expedition leader and the twelve gunners, the entire crew was German. The EDWG managed the fleet. However, the vessels did not run the German flag but those of Panama and Honduras. Crews were hired according to the regulations of the flag states (Reupke, 1986). Many of the working regulations binding in Germany were unknown in Central American countries.

Panama was not a member of the IWC at the time. The Onassis fleet did not abide by any of the regulations of the IWC. Their gunners targeted protected species, females accompanied by calves and undersized whales. Catch data reported to the IWC were falsified to disguise the illegal take (Barthelmess, 1996; Barthelmess et al., 1997). The activities of the Onassis fleet were in many respects comparable to the illegal activities of the Russian whaling fleet from 1946–72, which did not become known to the world until 1994 (Yablokov, 1994; Anon., 1995). Further evidence that Soviet whaling data (catch data as well as length of whales caught) was falsified even after the introduction of the International Observer Scheme in 1972 – and was still being falsified as late as 1979/80 – only became available in 2009 (Mikhalev et al., 2009). The USSR had been an original signatory of the 1946 convention.

The Olympic Challenger fleet conducted five voyages to the Southern Ocean and produced about 115,000 tonnes of whale oil (Reupke, 1986). Onassis's illegal whaling activities were disclosed to the Norwegian government by German whalers who opposed the working conditions on board the Olympic Challenger and the illegal whaling practices. Their reports allowed an initial correction of the Olympic Challenger's falsified catch data. Norway and a number of other important whaling nations took the opportunity to force Onassis to discontinue whaling. He sold his fleet to Japan, where it continued working in the Southern Ocean until 1970/71. About forty to fifty of his German crew were hired by the Dutch floating factory Willem Barendsz II, where they worked until 1965 when whaling was discontinued in the Netherlands. A final validation of the catch data of the Olympic Challenger fleet was submitted to the IWC in 1996 by Germany and was subsequently published in its journal (Barthelmess et al., 1997).

The Regulation of Whaling and the Demise of the Great Whales

Right and bowhead whales came under protection as early as 1937, and Pacific gray whales in 1946. The war had left Norway and the UK the dominant whaling nations. The USSR and the Netherlands began whaling soon after the war. Both nations played an important role in the International Whaling Commission (IWC). The Soviet Union falsified its catch data in order not to disclose that protected species and undersized whales were taken by their whaling fleets in large numbers from 1946 to 1972 (Yablokov, 1994; Mikhalev et al., 2009). This circumstance did not become known until 1994. The Dutch scientists at the Scientific Committee consistently challenged the view of all other members based on their own scientific studies, pretending that there was "insufficient evidence" to prove the decline of the stocks. A reduction of the catch was therefore not needed (Bruijn, 2002).

Following two whaling conferences in London in 1944 and 1945, the "International Convention on the Regulation of Whaling" (ICRW), signed in Washington in 1946, went into effect in 1948. The convention sought "to establish a system of international regulation for the whale fishery to ensure proper and effective conservation and development of whale stocks and thus make possible the orderly development of the whaling industry on the basis of the principles of a Whaling Agreement and protocols signed in 1937, 1938 and 1945 to provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry" (preamble to the convention). The species to be included in the convention were: right (including bowhead), pygmy right, humpback, blue, fin, sei, Bryde's (*B. edeni*), minke, sperm and northern and southern bottlenose whales (Recommendation IV of the International Whaling Conference in 1946). Decisions became binding within ninety days. The schedule of the ICRW also foresaw the issue of national licenses for scientific whaling. Scientific whaling, carried out until the early 1980s, meant that a few individual specimens of a protected species could be taken.

The ICRW, which initially brought together fifteen nations, consists of two parts: the convention itself, which describes the objectives and basic rules, and the schedule, which provides detailed information on how whaling operations should be conducted in keeping with the convention. The schedule is flexible since it must allow for changes in commission policy in relation to the setting of quotas, the opening and closing of sanctuaries, the catching season, and the protection of species and stocks considered endangered. The main purpose of the IWC's annual meetings is to review the existing schedule and make changes were necessary in accordance with the wishes of the three-quarter majority of (voting) members (Gambell, 1990). These reviews and the resulting amendments and changes, as well as how these changes are to be added to the schedule, are laid down in Articles V/2 and 3 of the convention (IWC, 1946). They contain contradictions and ambiguities in phrases such as "the conservation of whale stocks" on the one hand, and "their optimal utilization" and "the orderly development of the whaling industry" on the other hand, or the provisions for governments not to be bound by the Whaling Commission's decisions if they lodged an objection to that decision within ninety days (Gambell, 1990).

This set the scene for the IWC's failure to conserve whale stocks in the first forty years of its existence (Heazle, 2006). It soon became obvious that the warnings of scientists were never beyond dispute as long as a country could gain something from challenging them, the Netherlands being a typical example (Bruijn, 2002). It is possible that the convention would never have been adopted unless this loophole had been included (Gambell, 1990).

The contracting parties agreed to establish the International Whaling Commission in order to implement these ideals. In a number of ways, the authors of the 1946 convention were quite forward-looking in their language and the concepts they embraced. The current ideals of "wise

use" and "sustainable development" are to be found in the text (Gambell, 1997). The inaugural session of the commission in 1949, however, already demonstrated that reality was a different matter, and there were disagreements over the convention's enforcement from the beginning. The whale oil price increased from £ 40 to £ 110 in 1948 (Tønnessen and Johnsen, 1982).

The first means of control put in place shortly after the IWC commenced work were the "blue whale units" (BWUs). The BWUs were instituted when the penultimate expansion of the whaling industry began. BWUs had been developed by the whaling nations as early as 1932. Sperm whales were not part of the BWU system and their catches remained unrestricted until 1971. The only species-specific quota was established for humpback whales in 1949 (Clapham and Baker, 2002), when it was recognized that humpback whales had significantly declined.

The convention specifically prohibited the Commission from setting individual catch quotas by nation or whaling operation (Gambell, 1990). As a result, BWUs were not species- or stock-specific, and whales were taken irrespective of whether they were largely depleted or not. The 16,000 BWUs, set as a total allowable catch (TAC) from the late 1940s onwards, was lower than the average pre- World War II level of 24,000 BWUs. Quotas set in BWUs permitted the whalers to make their own decisions about which whales to take, and made no allowance for the conservation status of a particular species or population (Gambell, 1997). Norway and the UK tried to limit the number of fleets going for the 16,000 BWUs. Their efforts were even more urgent when it became evident after the poor catches in the 1945/46 season that the whale stocks had not recovered to any significant extent (Heazle, 2006).

The Scientific Committee was established by the commission in 1950 (joined with the Technical Committee until 1951). The Scientific Committee reflects Articles IV and V, 2 of the convention, which refer to scientific research and the publication of their results and statistics, and to the commission stipulation that their conclusions be based on scientific findings (Gambell, 1997). The Scientific Committee meets during the two weeks before the commission. However, for the first twelve or thirteen years of its existence, the Scientific Committee did not play the important role it should have played, but remained mostly in the sidelines of the commission's policy-making (Heazle, 2006), despite the fact that it made a number of important recommendations with respect to changes in management, such as setting catch quotas by species and not by BWUs (1954) or the severe reduction in BWUs (1955). Had the commission been prepared to accept the advice provided by the majority of scientists on the depleted state of many humpback, blue and fin whale stocks, it seems likely that a more conservative approach to managing whales would have been taken (Heazle, 2006).

However, with the fat shortage in post-war Europe and Southeast Asia, substantial additional pressure was put on whale stocks in the Southern Ocean. With no individual quotas set on the various fleets, it became vital for each fleet to catch as many large whales as possible within the shortest possible time – before the total quota was taken. This became known as "Olympic Whaling" (Gambell, 1997). The pressure of competition led to a vicious circle of more and more capital being required to catch a steadily dwindling number of whales faster than anyone else. During the heyday of post-war whaling, it was possible for profit margins to be maintained, but when the prices began to drop after the 1951/52 season, profitability became increasingly elusive in the face of increasing capital investment (Heazle, 2006). Thus, the BWU system worked against rather than in favour of the conservation of whale stocks (Kalland, 1992, 2009).

The number of whaling factories and catcher boats increased rapidly. Each of the following causes contributed in one way or the other to the demise of the whale stocks:

– the choice of the BWU as a management tool,
– setting catch quotas consistently higher than recommended by the Scientific Committee in order to ensure the stable production of whale oil,

– competition and disagreement between the whaling nations and companies,
– no limitation on new countries or new companies entering the whaling industry,
– over-capitalization,
– the focus on short-term economical interest instead of long-term sustainable yield,
– insufficient information concerning stock size, vital rates and ecological relationships, and
– the common property nature of whales.

First suggested by Norway in 1955, national quotas only came to be introduced from 1962 onwards (Kalland, 2009).

Japan's whale oil and meat production continued to increase due to the purchase of foreign fleets and quotas. By 1960, Japan had surpassed Norway as the leading whaling nation (Kalland, 1992). Japan became engaged in shore-based whaling at South Georgia in its final two years (1963–65) (Dickinson, 1993), since shore-based whaling was not under the control of the BWU system.

Blue whales and humpback whales were largely depleted by the beginning of the 1950s. Most blue whales taken at that time were pygmy blue whales (*B. musculus intermedia*). It was in the mid 1950s that many scientists saw the rapid dwindling of the remaining whale stocks and called for a severe reduction of the BWU limit. This opinion was opposed by most whaling nations on the grounds that there was too little scientific evidence to support a severe reduction in catch quotas. The rapid decline of fin whales by the early 1960s, however, substantiated the notion of many scientists that most Antarctic whale stocks were severely depleted and the commercial viability of pelagic whaling was at stake (Heazle, 2006). Humpback whales came under full protection in 1963, and blue whales in 1966.

In 1965 the whaling nations agreed for the first time on the scarcity of large whale species in the Southern Ocean. It was obvious that catch quotas were far in excess of what was sustainable. Whaling had become no longer viable. As a consequence, important whaling nations such as Norway, the UK, Australia and the Netherlands suspended whaling between 1963 and 1967, leaving only Japan and the Soviet Union in the arena. The demise of the great whales was also obvious from the decline in average individual weight from 66 tonnes in 1932 to 56 tonnes in 1939, 46 tonnes in 1950, 36 tonnes in 1960, 23 tonnes in 1970, and 20 tonnes in 1978 (Allen, 1980).

What followed was the rapid decline of what had been a flourishing industry ten years before. Commercial whaling became more and more restricted from the second half of the 1960s onwards, with two of the whaling industry's three preferred species – blue and humpback whales – being protected, and the third species – fin whales – becoming increasingly scarce (Heazle, 2006). Whaling focussed on the next smaller species: sei whales. Sei whales suffered the same fate as fin whales barely ten years later, in the early 1970s. Only the smallest of the great whales, the minke whale (*Balaenoptera bonaerensis*), not more than eight metres in length, remained relatively little affected by exploitation because they were not taken in large numbers before the beginning of the 1970s.

Thanks to the ever-increasing efforts, the annual catch was limited to 15,000 BWUs for a number of years in the first half of the 1950s. However, the catch per catcher day declined from 0.9 in 1953 to 0.5 in 1962 (IWC, 1961). The mismanagement of quotas and the collapse of many whale stocks could have been avoided if the commissioners had taken the advice the scientists had offered earlier on (Heazle, 2006).

The Scientific Committee gained more influence when the Ad Hoc Scientific Committee was formed in 1959 and a report by Laws (UK) was endorsed, concluding that the "combined evidence leaves no room for doubt of a decline of the fin whale stocks in the Antarctic" (IWC, 1960). The Committee of Three (Chapman, Allen, Holt), later four (Gulland), appointed in 1960

recommended to the IWC that blue and humpback whales be protected, catch quotas be introduced for individual species, and the concept of BWUs be abandoned (Chapman et al., 1964). The influence of this group of three laid the foundation for continuing scientific assessments of the stocks until the "zero catch limit" came into force in 1986 (Gambell, 1990). BWUs were continuously reduced, from 16,000 to 4,500 in 1965/66 to 2,300 in 1971/72, but not abandoned entirely until 1972, when they were finally replaced by a species-specific catch quota system. An international observation system, carried out on board whaling fleets, was introduced the same year (Gambell, 1977, 1999).

At the same time, the "krill surplus hypothesis" was created, postulating that minke whales and other predators benefitted from the demise of the large whales and increased in number (see, for example, Sladen, 1964; Laws, 1977; Ohsumi, 1979; Mori and Butterworth, 2006 for discussion). There is still no agreement as to whether, and to what extent, the krill "surplus" has been available to krill-feeding species other than large whales, or whether, and to what extent, minke whales increased in abundance concomitant to the demise of the large whales (see further discussion during the 61st Meeting of the Scientific Committee of the IWC in May/June 2009, Ecosystem Modelling Working Group, Anon., 2009b).

Under the influence of the environmental groups which started to emerge in the Western world in the late 1960s with Greenpeace as their spearhead, people worldwide started to view whales differently. The perception of whales and whaling changed. The notion in the Western world that whale-hunting was a positive activity on account of its commercial benefits gradually changed to a recognition of the need to protect whales as well as the desire for a more environmentally friendly image (Heazle, 2006). The legend of the "gentle giant" was born and fuelled the anti-whaling campaigns of many environmentalists' groups. By protecting whales, governments in the Western world enjoyed increasing political support. Whalers became regarded as a threat to the marine environment. The IWC was branded as a lobby of the whaling industry. Yet even this commission began to realize that it was ultimately better to manage whales as a renewable resource.

The New Management Procedure and the End of Commercial Whaling

A resolution made at the UN Conference on the Human Environment in Stockholm in 1972 for a ten-year moratorium on commercial whaling worldwide found no majority within the IWC. The Scientific Committee expressed serious reservations with regard a blanket moratorium in response to the Stockholm Conference. The Scientific Committee had invested a great deal of effort in the principle that whale species should be managed individually. For this reason, many scientists felt that the moratorium was without justification as all endangered stocks were already under IWC protection (Heazle, 2006).

Instead, the IWC established a "New Management Procedure" (NMP) in 1974. The NMP was based on an individualized species production model. It separated whale stocks into three categories:

- initial management stocks: stocks which were over 72% of their original stock size; catch levels are always set below maximum sustainable yield (MSY) to ensure that the stock was not reduced below 60% of the MSY level,
- sustained management stocks: stocks between 54 and 72% of the original stock size; catch limits again set below MSY, the degree below depending on how far below the MSY level the stock is, and
- protected stocks: those below 54% of the original stock size; no catches allowed in such stocks (IWC, 1977; Gambell, 1977, 1999; Allen, 1980).

The aim of the categories was to rebuild depleted stocks to such a level that the MSY could be taken.

The NMP was a conservative approach. It appeared that the Scientific Committee was at last able to perform its function. However, the NMP – unlike its successor, the Revised Management Procedure (see below) – did not take errors into account in its formulation. One of the greatest problems in the decision-making process under the NMP was the workload placed upon the Scientific Committee. At the 1978 meeting of the IWC, for example, recommendations on twenty-four whale stocks had to be made (Allen, 1980). One prerequisite for the successful implementation of the NMP was detailed knowledge of the state of exploited whale populations. There was disagreement in the Scientific Committee as to what risk the NMP system involved. Scientific results were often equivocal enough to be interpreted in one way or the other, depending on the interest. In spite of these caveats, the application of the NMP led to the protection of most fin whale stocks and a number of sei whale and sperm whale stocks in the second half of the 1970s (Gambell, 1977). The number of whaling fleets decreased rapidly. Japan only operated one whaling fleet from 1977 to the institution of the "zero catch limit" on whales in 1986.

The research activities which the IWC was able to promote and fund as well as the enhanced awareness of the need to regulate whaling in a sustainable manner led to a strengthening of the IWC in the mid 1970s. A permanent secretariat was established in Cambridge (UK) in 1976. It established the "First International Decade of Cetacean Research" (Gambell, 1990, 1997). An important step towards better protection of whales was the introduction of the "Indian Ocean Sanctuary" in 1979 which extended to 55° S, and the ban on pelagic whaling for all whales except the minke whale in 1981 was another important step in this process.

The IWC is open to all independent nations whether they have a history of whaling or not. The number of IWC members increased from fifteen in 1972 to thirty-nine in 1982. Germany became a member in 1982 and, with countries such as the USA, UK, Australia, New Zealand and France, forms the group of "like-minded" countries. The increase in IWC membership went hand in hand with a paradigm shift: the problem of insufficient knowledge of the status of whale stocks as a basis for implementing catch limitations – prevalent above all in the 1950s and early 1960s – now became a precautionary principle. Positive evidence was now required that stocks were not endangered before the catch limit could be set (Heazle, 2006).

The political pressure to protect whales more efficiently increased particularly in the West. In 1981, all pelagic sperm whaling was stopped and the use of mother-ship operations was restricted to minke whaling. The IWC had a seventy-five-percent majority to adopt a "zero catch quota" (suspension of commercial whaling) on 23 July 1982 – as an amendment to the ICRW Schedule, paragraph 10(e) – which went into effect for the 1986 coastal and the 1986/87 pelagic whaling seasons (Gambell, 1999). Interestingly, the lack of scientific evidence and scientific uncertainty – arguments strongly opposed by whaling nations in the 1950s – became the most important arguments in favour of the moratorium (Heazle, 2006). Commercial whaling came to a halt in Brazil, Chile, Peru, Republic of Korea, Japan and USSR. Portugal and Spain were the last Western European nations to give up whaling (the former, a non-member, in 1984 with few whales taken until 1987; the latter in 1985) (Sampera and Aguilar, 1992; Brito, 2008). The "zero catch quota" is not a "moratorium" as defined by IWC terminology. However, the term is now commonly used (Sand, 2007) in that sense.

Japan, Peru, Norway and the Soviet Union initially lodged an objection to the moratorium. Japan withdrew its objection in 1987 under the US threat to curb Japanese fishing quotas in US territorial waters under the terms of the Packwood- Magnusson Amendment (Heazle, 2006). Norway and the Soviet Union upheld their objection and are thus not bound by the moratorium. Iceland and the Republic of Korea also opposed the moratorium but neither lodged an objection within the required ninety-day period in accordance with the ICRW.

The Work of the Scientific Committee 1985–95

The Scientific Committee was primarily preoccupied with two important issues:
– the "comprehensive assessment" of whale stocks, and
– the development of the Revised Management Procedure (RMP).

Under the new system, the moratorium could only be modified after the Scientific Committee had completed its "comprehensive assessment of whale stocks". The comprehensive assessment had to be undertaken by 1990 at the latest (Kock, 2007). The Scientific Committee, however, adopted a broader definition of the term "comprehensive assessment" as an "in-depth evaluation of the status of stocks in the light of management objectives and procedures" (Gambell, 1990). The Scientific Committee believed that this broader approach would enable it to carry out the commission's terms of reference. The work of the Scientific Committee encompassed three major elements:
1) a review and revision of stock identity, assessment methods and data quality and availability,
2) the collection of new information, and
3) the examination of alternative management regimes (IWC, 1987).

The Scientific Committee may have underestimated the difficulty and dimension of this task in 1987. More than twenty years later, the only assessment which is near completion is that of humpback whales (IWC, 2009a). Other work is still in progress in 2010.

The development of the RMP got underway in 1987. The RMP was also a product of the political response to the growing calls for greater environmental sensitivity – i.e. not just another management approach. Unlike the NMP and many fishery management models, the RMP does not use models based on catch per unit effort or biological parameters such as natural mortality or recruitment rates (Heazle, 2006). The RMP is a single-stock approach. The development of the RMP was largely determined by the precautionary principle: at its core is the "catch limit algorithm" which calculates the long-term sustainable yield based on recent abundance estimates from sighting surveys and a time series of historic catch data (Kock, 1995). It has a tuning level (size which a stock should reach under harvesting) of seventy-two percent of the initial stock size and could be applied to all baleen whale stocks which are above a protection level of fifty-four (IWC, 1995). The principle behind the RMP and the Strike Limit Algorithm (SLA; developed later) under the Aboriginal Subsistence Whaling Management Procedure (AWMP) is one of simulation testing under a plausible set of scenarios. This testing takes into account biological and environmental uncertainty. Both the RMP and the AWMP incorporate regular implementation reviews (at five-year intervals) during which new information on cetacean biology and environment is evaluated (e.g. IWC, 2009c). The RMP was hailed as a conservative and safe approach to harvesting a marine resource in a sustainable manner. The IWC adopted the RMP in 1994 (IWC, 1995). It has yet to be implemented, pending the negotiation of a Revised Management Scheme (RMS; under discussion since 1996) which would, among other things, institute a framework for inspection and observation to ensure compliance with the RMP.

To better protect whale stocks and enhance their recovery, the IWC adopted a second large sanctuary after the Indian Ocean Sanctuary: the entire Southern Ocean became a whale sanctuary in 1994, initially for a period of ten years, against the votes of Japan and a number of "pro-whaling" nations. Japan argued that the establishment of the Southern Ocean Whale Sanctuary was in contravention of the ICRW and is therefore illegal. Several prominent legal experts have agreed. Japan has asked the IWC to submit its case to a relevant legal body for analysis, which the IWC has refused to do.

In 2004 the Southern Ocean Sanctuary was extended for another ten years (IWC, 2004),

although scientific whaling continued there. It was the time when people were confident that the IWC had abandoned its old policies and shortcomings and was rapidly evolving into an organisation primarily concerned with the protection of whales (Kock, 2007).

Special Permit Whale Catches

Just as the IWC's Scientific Committee began developing the RMP, Japan issued a license for an annual take of 875 whales in the context of a "Japanese Whale Research Program under Special Permit in the Antarctic" (JARPA) in 1987 (Sand, 2007). At the start of the programme, this amount was reduced to 300 minke whales (with a ten percent allowance) to be taken in whaling areas IIIE, IV, V, and VIW. The USA, Australia, New Zealand, a number of European countries, the Seychelles, and other countres, and a number of NGOs disputed the Japanese claim to research.

The granting of special permits under ICRW, Article VIII is at the discretion of the competent national authorities. Paragraph 30 of the ICRW Schedule provides for submission of all national special permits to the IWC's Scientific Committee for assessment. However, the ICRW Guidelines stipulate no sanctions in case of non-compliance. One of the main objectives of the JARPA Programme was to estimate biological parameters, notably the natural mortality of minke whales. At virtually every annual meeting since 1987, the Scientific Committee noted (although its advice is non-binding) that neither the research programmes submitted by Japan in support of its special permits nor the programme results subsequently submitted met the requirements of Article VIII and the Guidelines (e.g. IWC, 2004a). The Japanese government dismissed the criticism of the committee each time as unfounded (Sand, 2007). The scientific catch was increased to 400 in 1995/96 (with a ten percent allowance). In the eighteen years that the programme ran, 6778 minke whales were taken (Sand, 2007).

The results of the JARPA Programme were reviewed in detail by an international group of experts after the programme had ended in 2005. The expert group concluded that one of its major objectives, "the natural mortality rate had … not been determined". The Scientific Committee of the IWC nevertheless concurred with conclusions of the 1997 JARPA Workshop (IWC, 1998b) that "the results of the JARPA Programme, while not required for management under the RMP, have the potential to improve management of minke whales in the Southern Hemisphere".

The take of whales was further extended after the close of JARPA. The Japanese government announced the annual catch (with a ten percent allowance) of 850 minke whales in 2005, when the JARPA II Programme was launched. The intended take of 50 humpback whales and 50 fin whales was of particular concern as the comprehensive assessment for humpback still awaited completion, while a comprehensive assessment of fin whales had hardly begun. Three fin whales each were taken in 2006 and 2007 and one in 2008. The take of humpback whales, however, was postponed.

The number of whales taken by Japanese scientific whaling over the past twenty-two years (1988-2009) amounted to over 12,000. By comparison, during the forty years *before* (1948–7), the total number of whales reported to have been taken under Article VIII by *all* countries worldwide (including Japan) was about 2,100 (Sand, 2007). There is a clear indication that in the minds of those who drafted Article VIII, the number of whales a country could take for science annually was less than ten (Sand, 2007).

Towards the Development of a Revised Management Scheme (RMS)

The development of the RMP by the Scientific Committee and its adoption by the commission in 1994 formed the first step towards the protection and rational exploitation of whales. However, the RMP was to be embedded into a larger, comprehensive "Revised Management Scheme" (RMS), incorporating, among other things, monitoring and policing procedures such as inspection and observation. The adoption of the RMS was considered by many members of the IWC as a prerequisite to re-launching commercial whaling. It was in 1997 that Ireland proposed ending all high seas whaling and allow quotas of whales to be taken in the exclusive economic zones of countries interested in taking whales (IWC, 1998a). Japanese small type coastal whaling for minke whales is one example.

Frictions between "pro-whaling" and "anti-whaling" fractions in the IWC had been growing since the early 1980s, and the two factions became more and more polarized in the 1990s, when the annual meetings of the commission became battlefields over what were often procedural matters. In 1999, Japan introduced a revision to its earlier draft of an observation and inspection scheme in order to finalize the text of the RMS quickly and thus allow a resumption of whaling. At the same time, Japan failed to receive the necessary majority at the 2000 CITES Meeting (Convention on International Trade in Endangered Species) (COP 11) to de-list certain whale species and populations, removing their statutory protection so that commercial whaling could be resumed. In terms of international law, Japan's current scientific whaling programmes in the Antarctic and the Northwest Pacific qualify as infractions of CITES (Sand, 2007).

The Scientific Committee of the IWC developed technical specifications for the "Requirements and Guidelines for Implementation" in 2004 (SC-IWC 2004). The commission was meanwhile in an almost deadlocked position, with very little progress being made towards the completion of the RMS. Compromise packages for an RMS such as the proposal by the chairman of the commission in 2004 failed to receive the necessary three-quarters majority. Japan did not participate in certain working groups of the commission such as the Conservation Committee established in Berlin in 2003. Furthermore, Japan tried to strike certain matters from the commission's agenda such as whale-watching, whale sanctuaries and matters of animal welfare. In 2008, Japan threatened to leave the IWC and found an international organisation of its own for regulating the harvest of whales.

The Role of Germany in the IWC

Germany became a member of the IWC in 1982 when the IWC decided on a zero catch quota for whaling (later called the "moratorium") and, along with such countries as the UK, Austria, New Zealand, the USA and France formed the group of "like-minded" countries which objected to reopening commercial whaling as long as the IWC was unable to agree on a sustainable method of harvesting of whales. Their basic principles included:

- commercial whaling could not be reopened before the completion of the "Comprehensive Assessment" of all whales stocks which the Scientific Committee had embarked upon in 1990. The Comprehensive Assessment has only been nearly completed for humpback whales, but is still pending for species such as fin whales,
- the Scientific Committee had developed a concept for exploitation which would minimize the risk of whale stocks being overexploited. This development was completed in early 1993 and adopted by the commission in 1994, and
- the commission needed to develop a system of surveillance and inspection which allowed tight control of all legal whaling activities.

Germany further developed its profile in the IWC from the early 2000 onwards. The 55th Annual Meeting was held in Berlin in June 2003. A new technical working group of the commission, the Conservation Committee, was established at that meeting. Germany conducted two cetacean sighting surveys from board the ice-breaking research vessel Polarstern in the Weddell Sea – Antarctic Peninsula region in November 2006 – January 2007, and in the eastern Weddell Sea in December 2008 – January 2009. It was possible to work an extended period of time in dense pack-ice and collect information on the distribution of minke whales therein (Scheidat et al., 2007; Kock et al., 2009). This information is highly sought after by the Scientific Committee of the IWC as a basis for adjusting its abundance estimates of minke whales in and in front of the pack ice. More detailed and in-depth analyses of these two data sets were presented at the meeting of the Scientific Committee in Agadir (Morocco) in June 2010. A further survey with the RV Polarstern is envisaged for 2010/11.

The first two surveys underlined Germany's notion that important investigations on cetaceans do not need to involve their death. They furthermore demonstrated how little we still know about whales and their association with the ice. To what extent minke whales, for example, use the pack-ice as a habitat, and what proportion of the population overwinters in the pack ice are questions currently being addressed by German research to respond to needs expressed by the Scientific Committee of the IWC. The climate change and the effects of warming in certain areas of the Southern Ocean such as the Antarctic Peninsula and their effects on cetaceans and their prey in those areas constitutes another focus of research in the future.

Is There a Future for the IWC?

A dichotomy appears to have emerged in the development of the IWC's most prominent bodies, the Scientific Committee and the Commission, in the last five to eight years. The Scientific Committee is making considerable progress in those tasks assigned to them by the Commission, such as developing management procedures for various species taken in Aboriginal Subsistence Whaling (ASW). The management procedure for the ASW is in various stages of completion in early 2010 from "considerable progress in its development of a strike limit algorithms (SLA)" as in the case of West Greenland fin and minke whales (*B. acutorostrata*) to "Implementation Reviews" either completed, as in the case of the North Pacific bowhead whales, or about to start, as in the case of the Eastern North Pacific gray whales (*Eschrichtius robustus*). Other important instruments further developed by the Scientific Committee were the RMP, its detailed description and amendments as well as its preparation for implementation with regard to the Western North Pacific Bryde's whales, and implementation reviews for North Atlantic fin and minke whales (IWC 2009a).

In contrast, the Commission appears to have remained in the deadlock position it has been in for a number of years, with little or no progress being made in resolving issues such as "small type coastal whaling" or whale sanctuaries. One of the consequences of this stand-still is that the IWC as a whole is now at stake.

At inter-sessional meetings of the commission from 2008 to 2010, the chairman has undertaken new attempts to work out and agree on a compromise acceptable to all parties and thus safeguard the existence of the IWC over the next few years (IWC 2009b). A group (the "support group") has been established to develop suggestions to resolve the issue of four key items of conflict:

– small type coastal whaling,
– whaling under special scientific permit,
– whale sanctuaries, and
– whale-watching as alternative to whaling.

Results of discussions carried out by the group will be confidential until the 62nd Annual Meeting of the commission in Agadir (Morocco) in June 2010.

Conclusions

Whaling in the Southern Ocean started in December 1904. The two nations catching most of the whales until the mid 1950s were Norway and the UK. Germany played a leading role in the development of whale-processing technology, but participated in whaling only from 1936 to 1939. The International Convention for the Regulation of Whaling (ICRW) went into force in 1948. The late implementation of the ICRW almost forty-five years after whaling had started, and the inadequacy of its first two management systems (Blue Whale Units, New Management Procedure) from 1949 to 1986 led to the demise of all great whale stocks in the Southern Ocean except the minke whale. The history of whaling thus followed the typical pattern of human exploitation of a natural resource: detection, overexploitation and demise.

Germany became a member of the IWC in 1982 and of the "like-minded" group of countries in the IWC. Germany strongly supported the adoption of whale sanctuaries and the development of a third management scheme, the Revised Management Procedure (RMP), which was hailed as one of the few examples of a management strategy which would allow the safe long-term harvesting of whales if commercial whaling were re-introduced. The RMP was later to be embedded into the Revised Management Scheme which would encompass, among other things, an inspection system. Germany intensified its whale research from the early 2000s onwards by including regular whale-sighting surveys in the pack ice of the Southern Ocean. Given the pending development of the RMS, the Japanese threat to leave the IWC, and the hardened front between pro-whalers and anti-whalers, the existence of the IWC is currently at stake.

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Walfang und Walbestandsmanagement im Südpolarmeer unter besonderer Berücksichtigung der Mitwirkung und Interessen Deutschlands

Zusammenfassung

Die Suche und die Jagd nach Walen im Südpolarmeer nahmen in den 70er und 90er Jahren des 19. Jahrhunderts ihren Anfang. Die kommerzielle Ausbeutung der Wale des Südpolarmeeres begann im Dezember 1904, als die erste Walfangstation der Antarktis in Grytviken auf der Insel Südgeorgien ihren Betrieb aufnahm. Der Walfang mit Verarbeitungsschiffen (sog. Mutterschiffen), bei denen die Fangboote ihre Beute ablieferten, wurde in der nachfolgenden Saison 1905/06 aufgenommen.

Der Walfang nahm schnell zu, Norwegen und Großbritannien waren die Hauptfangnationen. Als 1925 die Heckaufschleppe eingeführt wurde und die Wale auf den Decks der Mutterschiffe geflenst werden konnten, wurde der Walfang von geschützten Fjorden und Buchten unabhängig und auf die hohe See verlagert. Die Internationale Walfangkonvention mit ihrem Ausführungsorgan, der Internationalen Walfangkommission (IWC), trat 1948 in Kraft. Bis 1986 versuchte die IWC mit zwei Managementverfahren, den »Blauwaleinheiten« und der »New Management Procedure«, jedoch nur geringem Erfolg, den Walfang zu regulieren und den Spagat zu versuchen, auf der einen Seite eine vernünftige Entwicklung des Walfanges zu fördern und auf der anderen Seite die Walbestände ausreichend zu schützen. Der Walfang kam 1986 mit dem Inkrafttreten des Walfangmoratoriums zum Erliegen, als alle Walbestände bis auf die der Zwergwale stark dezimiert waren. Das Moratorium sollte erst aufgehoben werden, wenn ein neues, umfassendes Managementregime verabschiedet worden sein würde.

Auf dem Weg dorthin nahm die IWC als drittes Managementverfahren 1994 die von ihrem Wissenschaftsausschuss entwickelte »Revised Management Procedure« (RMP) an. Die RMP, ein Arten-/Bestandsmodell, ist aber nur Teil eines umfassenderen Managementverfahrens, des »Revised Management Scheme« (RMS), und wurde bisher nicht angewendet. Das Prinzip der RMP und des später entwickelten »Strike Limit Algorithm« (SLA) unter dem Eingeborenenwalfang (AWMP) besteht darin, dass man mit Hilfe von Simulationen unter einem plausiblen Satz von Szenarien testet, wie Walbestände unter bestimmten Annahmen auf eine Entnahme reagieren. Unsicherheiten in Bezug auf die Bestimmung biologischer und von Umweltparametern gehen in diese Tests mit ein. Generell lässt sich sagen: Je größer die Unsicherheiten der Eingangsparameter sind, desto niedriger ist die errechnete Fangquote. RMP wie AWMP schließen regelmäßige (alle fünf Jahre abgegebene) sogenannte »Implementation Reviews« ein, in die neue Erkenntnisse, die in der Zwischenzeit gewonnen wurden, einfließen. Während der Wissenschaftsausschuss gute Fortschritte in seiner Arbeit der letzten beiden Jahrzehnte verzeichnen konnte, führte die zunehmende Polarisierung zwischen Walfangbefürwortern und

Walfanggegnern beide Parteien in eine Art Sackgasse, die Beschlüsse fast unmöglich machte. Walfangbefürworter, wie Japan, drohten die IWC zu verlassen, sodass die Gefahr besteht, dass die IWC auseinanderbricht.

Deutschland trug in vielerlei Hinsicht zum Walfang im Südpolarmeer bei. Die wichtigste Entwicklung war die Erfindung der Fetthärtung durch Wilhelm Normann im Jahr 1901, die es ermöglichte, durch Härteprozesse aus flüssigem Fett Margarine herzustellen. Deutschland stand bei der Zahl von Patenten im Walfang und hinsichtlich der Verarbeitung von Walprodukten nach Norwegen an zweiter Stelle.

Vor dem Ersten Weltkrieg wurde durch Deutschland Walfang in seiner Kolonie Deutsch-Südwestafrika betrieben, und zwischen 1936 und 1939 beteiligte sich Deutschland an der Ausbeutung von Walen im Südpolarmeer. Im Gegensatz zu Japan wurde es Deutschlands nach dem Zweiten Weltkrieg jedoch nicht erlaubt, den Walfang wieder aufzunehmen. Deutsche stellten allerdings 90% der Besatzung der Olympic Challenger-Walfangflotte des griechischen Reeders Aristoteles Onassis, die unter den Flaggen Panamas und Honduras' in der ersten Hälfte der 1950er Jahre auf Walfang ging. Nachdem Onassis gezwungen worden war, seine Walfangflotte 1956 zu verkaufen, arbeitete ein Teil der Deutschen in der niederländischen Willem Barendsz-Walfangflotte weiter, bis die Niederländer 1965 den Walfang einstellten.

Deutschland wurde 1982 Mitglied der IWC und bildet mit einer Anzahl von Staaten die Gruppe der »like-minded«, der den Walschutz befürwortenden Nationen. Deutschland war Gastgeber der 55. Jahrestagung der IWC in Berlin im Jahre 2003. Walforschung in Deutschland konzentriert sich auf den Nordostatlantik, die Nord- und Ostsee sowie das Südpolarmeer.

Pêche à la baleine et gestion des populations de baleines dans l'océan Antarctique, en tenant compte de la participation et des intérêts de l'Allemagne

Résumé

La recherche de baleines et leur chasse dans l'océan Antarctique prirent leur essor dans les années 70 et 90 du XIX^{e} siècle. L'exploitation commerciale de la baleine de l'océan Antarctique démarra en décembre 1904, lorsque la première station de chasse à la baleine de l'Antarctique fut mise en service sur l'île de la Géorgie du Sud, à Grytviken. La chasse à la baleine avec des navires de traitement (dits navires-usines), sur lesquels les baleinières livraient leur butin, fut lancée au cours de la saison suivante en 1905/1906.

La chasse à la baleine connut un essor rapide, la Norvège et la Grande-Bretagne possédant les principales stations. Lorsque, en 1925, grâce à l'introduction d'un plan incliné à l'arrière des navires, les baleines purent alors être dépecées sur le pont des baleiniers, la pêche à la baleine devint indépendante de l'abri fourni par les fjords et les baies, et put être transférée en haute mer. La Convention internationale pour la régulation de la chasse à la baleine et aux grands cétacés entra en fonction en 1948 avec son organe exécutif, la Commission baleinière internationale (CBI). Jusqu'en 1986, la CBI tenta de réglementer la chasse à la baleine, toutefois avec peu de succès, grâce à deux procédures de gestion, le « *Blauwaleinheiten* » (unités de baleines bleues) et le « *New Management Procedure* ». Elle tenta également de réussir le grand écart consistant d'un côté à encourager un développement raisonnable de la chasse à la baleine, et de l'autre, à protéger suffisamment les populations de cétacés. En 1986, lorsque le moratoire sur la chasse à la baleine prit effet, celle-ci périclita, tous les effectifs de baleines, à l'exception de la baleine de Mink, étant fortement décimés. Le moratoire devait être supprimé uniquement lorsqu'un nouveau régime global de gestion serait voté.

En chemin, la CBI adopta en 1994 comme troisième procédure de gestion celle que sa commission scientifique avait développée, la « *Revised Management Procedure* » (RMP). La RMP, un modèle portant sur les espèces/les effectifs, n'est qu'une partie d'une procédure plus importante, et n'a pas été appliquée jusqu'à présent. Le principe du RMP et du « *Strike Limit Algorithm* » (SLA), développé ultérieurement parmi la capture de baleines des aborigènes (AWMP), consiste à l'aide de simulations dans une série de scénarios plausibles, à tester comment réagissent les effectifs de baleines – dans des hypothèses particulières – à une capture. Des incertitudes quant au choix de paramètres biologiques et environnementaux sont comprises dans ces tests. En général, on peut affirmer que, plus grandes sont les incertitudes des paramètres source, plus bas sont les quotas de capture calculés. La RMP, tout comme le AWMP, comportent des « *Implementation Reviews* » régulières (délivrées tous les 5 ans), dans lesquelles on tient compte des nouvelles connaissances qui ont été établies entre-temps. Tandis que la commission scientifique a pu faire preuve de progrès satisfaisants dans son travail des deux dernières décennies, la polarisation croissante entre les partisans et les adversaires de la pêche à la baleine des deux parties mena à une sorte d'impasse, qui rendit les décisions pratiquement impossibles. Les partisans de la pêche à la baleine, comme le Japon, menacèrent de quitter la CBI, si bien que le danger que la CBI se démantèle est réel.

L'Allemagne contribua sous de nombreux aspects à la chasse à la baleine dans l'océan Antarctique. La plus importante innovation fut l'invention en 1901 de l'hydrogénation des graisses par Wilhelm Normann, qui permettait de fabriquer de la margarine en procédant au durcissement de la graisse liquide. L'Allemagne se tenait au deuxième rang après la Norvège quant au nombre de brevets dans la pêche à la baleine et au traitement de produits baleiniers.

Avant la Première Guerre mondiale, la pêche à la baleine fut pratiquée par l'Allemagne dans sa colonie du Sud-Ouest africain allemand, et entre 1936 et 1939, l'Allemagne participa à l'exploitation des baleines dans l'océan Antarctique. Contrairement au Japon, il ne fut néanmoins pas permis à l'Allemagne, après la Seconde Guerre mondiale, de reprendre la pêche à la baleine. Toutefois, les Allemands formaient 90% de l'équipage de la flottille de l'Olympic Challenger de l'armateur grec Aristote Onassis qui, sous les pavillons de Panama et du Honduras, partait pour la chasse à la baleine durant la première moitié des années 1950. Après qu'Onassis fut forcé de vendre sa flotte de baleiniers en 1956, une partie des Allemands continuèrent à travailler dans la flotte néerlandaise de baleiniers Willem Barendsz, jusqu'à ce que les Néerlandais cessent leurs activités dans ce domaine en 1965.

L'Allemagne devint en 1982 membre de la CBI et forme avec un groupe d'États la fraction des « *like-minded* », les nations encourageant la protection des cétacés. L'Allemagne fut l'hôte du 55e congrès annuel de la CBI à Berlin en 2003. En Allemagne, la recherche sur les baleines se concentre sur le nord-est de l'Atlantique, les mers du Nord et de la Baltique ainsi que sur l'océan Antarctique.