



W H I T E S H A R K T R U S T

The White Shark Trust is a non-profit organization dedicated to conducting research, conservation and education projects on the endangered Great White Shark.

SALMON FARMING IN GANSBAAI

An Ecological Disaster



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Introduction

Salmon farming is a relatively new industry that has emerged in the last 30-40 years. It arose in response to a growing demand for luxury fish that could no longer be satisfied by a decreasing fishery. In countries such as Scotland, the industry has grown to become a vital resource of employment for fragile rural economics and produced about 130,000 tons of salmon in 2000 (*Rae, 2002*). Today, nearly one third of the fish and shellfish products commercially available worldwide come from aquaculture (*FAO The State of World Fisheries and Aquaculture, 1998, Fisheries Department, Food and Agriculture Organization, Rome, 128pp.*).

Aquaculture, and particularly salmon farming, has been a hot topic in many countries on numerous occasions, and usually it is not in a positive light. Though aquaculture is a highly lucrative industry, which provides people with employment and potential for improvements of living conditions, it is a relatively new industry that still has a large amount of flaws and short-comings that have yet to be resolved. Thus, the salmon industry poses a severe risk to the environment and has in many areas had a severe impact on local flora and fauna (*Crawford et al., 2001*)

In August 2002, a license for a salmon farm pilot project was issued by Marine and Coastal Management (MCM) to the Norwegian Aquaculture giant Salmon Salar. The pilot farm was to be set up in the small fishing village, Gansbaai, about 190 km south east of Cape Town. Gansbaai is home to the extremely lucrative shark cage diving industry, as well as being renowned for the excellent whale watching possibilities.

When enquiries about the license issuing and a request to review the Environmental Impact Assessment (EIA) were made with MCM, it became apparent that none had been made for this project. In light of this, this paper was written in order to highlight some of the major environmental problems associated with salmon farming and the potential impact that such an installation could have on the local wildlife (much of which is already endangered), but also to the local community and economy. All aspects, environmental as well as anthropogenic are outlined below.

Environmental issues associated with salmon farming

1. Aquaculture

1.1. Biological pollution

Salmon is an alien fish to South African waters. Biological pollutants result from the introduction of non-indigenous or alien species into an ecosystem where they were previously absent. Their introduction can have potentially severe consequences for the local wildlife by competing with and/or consuming native species, and adding alien pathogens and parasites to the environment (Noakes *et al.*, 2000). This pollution is often referred to as '*smart pollution*': alien species may reproduce and spread, whereas chemical pollution cannot proliferate and dissipates over time. Many examples of alien species introduction exist (e.g. zebra mussel). Large numbers of salmon escape from the ocean nets for several reasons:

- 1.1.1. Damage to their holding pens due to storms or predators, improper upkeep of nets, accidents during transportation, etc.
- 1.1.2. Farmed fish may be lost through '*leakage*' (frequent small-scale escapes which go unnoticed) and '*escape events*' leading to massive numbers of escaped salmon into the ecosystem.

Escapes are unavoidable in open-water pens. Existing estimates of escaped salmon must be regarded as conservative as most legislation does not require farmers to report the escape of farmed salmon. Moreover, during the past decade, aquaculturists have introduced genes from other fish species into new breeds of farmed fish to increase temperature tolerance, growth, feed efficiency and disease resistance. Therefore these transgenic fish have a better chance of surviving in our waters.

1.2. Location

The fish pens will be situated about 1.5 kilometres south of the Kleinbaai slipway, between Danger Point and Dyer Island by 30-35 meters depth.

- 1.2.1. Proximity to Dyer Island and Geyser Rock: Permanent home to breeding colonies of Cape Fur Seals and many sea birds;
- 1.2.2. Centered along the migration route and breeding area of Southern Right Whales;
- 1.2.3. Proximity to the highest density area of Great White Sharks worldwide;
- 1.2.4. Lack of protection for the fish pens against natural element: strong and long-lasting north-westerly winter storm are usually succeeded by high south-westerly seas, which will affect, and possibly destroy the fish pens leading to an increase in Salmon escapees;
- 1.2.5. The fish pens have been permanently anchored to the sea floor, which will prevent following (i.e. rotation of the fish pens around a dedicated farm area to allow the sediments underneath to recover from build-up of farm waste deposits).

1.3. Fish species

Farming carnivorous species of fish has a direct impact on the fisheries. Farmed fish require a protein-rich and high-energy diet, which is provided by commercial fisheries of wild fish, such as anchovies, sardine and mackerel, species, which in many places represent important sources of protein for poor people. Much of the protein in fish feed is coming from fishmeal and the fat from fish oil. In February 2003, the World Wildlife Foundation (WWF) made the following statement: 'Without reform, this fast growing industry could be consuming all the world's fish oil and half of its fish meal by 2010, up from 70% fish oil and 34% fish meal now.' The farming of predatory fish is only increasing the already existing commercial fishing pressure (Naylor *et al.*, 2001). To produce one kilogram of farmed salmon, 2-5 kilograms of wild caught fish is required (Tacon,

1996), resulting in a net loss of protein in the marine ecosystem as a whole and decreasing the amount of fish potentially available for human consumption.

2. Pollution:

Fish faeces, diverse drugs and nutrients from uneaten food are released directly into the water with dire consequences for the local ecosystem. These pollutants are assimilated by local wildlife, the seabed and drift in the current, potentially affecting a much larger area. The areas surrounding the salmon cages suffer badly and assessment of the environmental impact of salmon farms clearly showed changes in levels of organic enrichment, cover of the algae *Beggiatoa*, sediment colour, and change in the abundance of flora and fauna (Crawford *et al.* 2001).

The crowded conditions within the fish pens allows for pathogenic organisms occurring at low levels in the wild to grow to epidemic proportions. This threat is countered by salmon farmers using antibiotics, vaccines and other chemicals mixed in the fish feed or released directly into the pens. The impact extent and degree of these agents on the local marine life and human health are at present mostly unknown. Diseases and parasites not only kill thousands of farmed salmon every year, but may also be transferred to wild fish populations.

2.1. Antibiotic

Antibiotics are widely used in fish farming and enter the surrounding water both directly through uneaten fish feed and indirectly through faeces. These may then accumulate in the sediments beneath the fish pens and persist for several months. The key concerns with the use of antibiotics are the development of resistance to antibiotics and the presence and accumulation of antibiotics in farmed fish, as well as in wild fish and shellfish harvested from areas surrounding the fish farm. Furthermore, similar antibiotics are used in fish farms and for the treatment of human diseases and infections, causing the effectiveness of antibiotics to potentially decrease. General antibiotic resistance of pathogens may increase, leading to increased health risk to people who eat a high fish protein diet. At some locations between 50-100% of the bacteria beneath pens has become antibiotic resistant (Torvik *et al.*, 1988).

2.2. Pharmaceuticals

Growth hormones for example are used in fish farms to save time in producing large fish. These hormones remain in the flesh of commercially available salmon on the market, with direct effects on humans. Another example is the use of artificial colorants (e.g. *canthaxanthin* or *astaxanthin*), which is included in the fish feed of farmed salmon to alter the colour of the flesh, since farmed salmon normally is of a pale and unappealing colour to consumers.

2.3. Pesticides

Nowadays, pesticides (e.g. organo-phosphorous insecticides and neuro-toxic drugs like *Ivermectin* to treat sea lice) are not usually applied directly into the fishnets in open water, but the fish are rather 'bathed' out of the nets. However, no information is currently available for the intended procedure at the planned Kleinbaai pilot farm.

2.4. Biological waste

Uneaten and drifting fish feed: A estimated 5-20% of feed used at salmon farms enters the surrounding environment uneaten. Feed also enters the environment as faeces from salmon. The unconsumed fish feed and the high concentrations of animal waste products (e.g. ammonium) in the form of faeces, which often include chemicals and other agents, can lead to:

- 2.4.1. Toxic algal blooms (*Lynngbya* and *Pfiesteria*);
- 2.4.2. Eutrophication of the sea floor;
- 2.4.3. Lowering oxygen levels.

These impacts lead to a massive decrease in biodiversity underneath and in proximity to the salmon nets, as well as a considerable loss of habitat (Crawford *et al.*, 2001). They also represent a major threat to the endangered Abalone, both wild and farmed.

2.5. Parasites

The sea louse, *Lepeophtheirus salmonis*, is a major health problem for both farmed and wild salmonids. Sea lice occur naturally in wild population, but usually only in small numbers. However, these ectoparasites are thriving in the salmon farms (Bjørn & Finstad, 2002). Thus salmon farms can act as a massive breeding ground that spreads to the wild populations of various species of fish. The two major parasites that are a problem in salmon farming are:

2.5.1. External parasite: e.g. Sea lice *Lepeophtheirus salmonis*

2.5.2. Internal parasite: e.g. *Parvicapsula minibircornis*

2.6. Salmon diseases

Bacterial, viral and fungal diseases can infect farmed salmon. Monoculture is a hotbed for disease due to the high density of animals. High salmon densities, high parasite burdens, and related stress levels in nets can make farmed salmon even more susceptible to outbreaks of the following natural diseases:

2.6.1. Infectious Salmon Anaemia (ISA);

2.6.2. Infectious Hematopoietic Necrosis (IHN);

2.6.3. Viral Haemorrhagic Septicemia (VHS);

2.6.4. Furunculosis;

2.6.5. Bacterial Kidney disease (BKD);

2.6.6. Enteric Redmouth disease (ERM);

2.6.7. Coldwater disease caused by a bacterium;

2.6.8. Vibriosis;

2.6.9. Infectious Pancreatic Necrosis (IPN);

2.6.10. Salmon Swimbladder Sarcoma virus (SSSV).

2.7. Human diseases

The parasites and other pathogens from the aquaculture complex may also spread to other species (e.g. crayfish, abalone, periwinkle, mussels, e.t.c.). Some of the diseases that can be provoked can also be harmful to humans, e.g.:

2.7.1. ASP (Amnesiac Shellfish Poisoning)

2.7.2. DSP (Diarrhetic Shellfish Poisoning)

2.7.3. ISA (Infectious Salmon Anaemia)

3. Implications for local established fisheries

It is possible that the salmon farms may also have an impact on the local fishery in that it will reduce the amount of fish that can be caught.

3.1. Local line fishery

3.1.1. No fishing within a certain distance from the Salmon pens would reduce potential fishing area;

3.1.2. Potential disappearance / competition of local fish species due to direct competition from Salmon escapees, leading to reduced numbers of fish available to the fishery.

3.2. Overfishing

Refer to paragraph 1.3. It is, however, unlikely that the locally caught fish will be used to feed the farmed fish.

3.3. Perlemoen aquaculture

The I&J Abalone farm at Danger Point is pumping water from the ocean. This water may contain, depending on the current direction and strength, chemicals, pathogens, and /or parasites from the salmon farm directly affecting or destroying their own production.

3.4. Shellfish

The commercial crayfish and perlemoen fisheries may be directly affected by the by-products of the salmon farm. Eutrophication of the sea floor and associated shellfish diseases may destroy local stocks and / or markets.

3.5. Disease

Refer to paragraph 2.6. and 2.7. If disease becomes a major problem at the salmon farm, the epidemic may spread to the wild populations, which will diminish the populations, thus leaving fewer fish for the local fishermen.

4. Endangering local endangered and protected wildlife

Marine life, such as sharks, whales, seals, dolphins and birds, are killed, wounded and harassed by ocean fish pens: entanglements in salmon nets, anti-predatory nets and fish feed nets, as well as by salmon farmers using guns and acoustic deterrent devices to protect their fish. The marine ecosystem along the Overberg coastline is unique through its diversity and complexity, and is a major tourism attraction.

4.1. Sharks

Sharks have very good senses, and there is little doubt that the white sharks in Haibaai, Geelbekgat, Dyer Island and Holbaai will become aware of the presence of hundreds of salmon very quickly. Cages may therefore act as fish aggregation devices. The bay from Danger Point to Quoin Point, including Dyer Island, is 'home' to probably the largest population of transient great white sharks (*Carcharodon carcharias*) worldwide. Research in the area has shown that over a thousand different White Sharks have visited the area from 1998 through 2004, and some of them visit the area on a regular basis (Scholl, unpublished data). White sharks have been protected in South Africa since 1991 and listed as vulnerable on the IUCN Red List and on Appendix II of the CITES convention. In Australia, over a five year period, nine white shark captures by the tuna farming industry have been confirmed: in six of these cases the shark was killed, while in three cases the shark was already dead (A. De Maddalena, personal communication). Another potential impact is ecological: salmon pens may affect the sharks by disturbing their normal behaviour. Sharks may spend a lot of time around the pens instead of hunting their usual preys, and they may be attracted to the area when they normally would not. Furthermore there is the danger of the sharks becoming trapped or entangled in the nets. In addition, it may lead to illegal persecution of the endangered great white shark.

Examples from the Port Lincoln Times in South Australia:

- In June 2001, several white sharks were spotted swimming around tuna farms ('Farm shark warning' by Stan Gorton, on Thursday, 28 June 2001, 'Sharks attract researchers' by Stan Gorton on Tuesday, 3 July 2001 and 'Shark sightings draw tourists' by Grant Sherlock, Thursday, 9 August 2001);
- In October 2002, tuna farmers kill a white shark swimming in the pens ('Local Officers kill shark - farmers praised' by Stan Gorton on Tuesday, 12 November 2002);

- During 2003, four white sharks were found trapped in tuna cages, of which one was shot and another died of stress related causes, while the two other sharks were released. ('Shark quietly slips away...' by Stan Gorton on Thursday, 26 June 2003, 'Shark released from tuna farm' by Stan Gorton on Thursday, 4 September 2003 and 'Shark examined' by Stan Gorton on Tuesday, 4 February 2003);
- In April 2003, 13'000 Yellow Tail Kingfish escaped from a farm in Arno Bay, South Australia, after a shark attacked the cages and damaged the nets (Hunt, Inquiry into the kingfish great escape, The Advertiser, 9 April 2003);

Without a doubt, great white sharks will be attracted to the salmon pens once operational. These sharks may then break or damage the nets, get entangled, or killed by fish farmers.

4.2. Marine mammals

Evidence suggests that the pollution from ocean cage fish farms can cause harm to cetacean (whales, dolphins and porpoises) populations, and as a result, cetaceans, inhabiting areas in close proximity to sea cage fish farms, have higher incidences of skin disease, and higher levels of toxic burden. The research also suggests (<http://www.raincoastresearch.org/home.htm>) that the mortality rate of firstborn calves is significantly higher. This is of even greater concern in this area due to the fact that the southern right whales give birth here.

The following cetaceans occur in the concerned area:

- 4.2.1. Cape fur seal *Arctocephalus pusillus pusillus* (Protected in South Africa - Sea Birds and Seals Protection Act of 1973 affords complete protection but allows the government to grant permits to kill fur seals at specific colonies - CITES Appendix II) - Geysers Rock is home to a permanent 40-60'000 Cape fur seal colony;
- 4.2.2. Southern right whale *Eubalaena australis* (CITES Appendix I) – Walker Bay and the proposed salmon farming region is the resting and reproduction area for these whales from May / June through November / December every year;
- 4.2.3. Bottlenose dolphins *Tursiops truncatus* (CITES Appendix II);
- 4.2.4. Common dolphins *Delphinus delphis* (CITES Appendix II);
- 4.2.5. Indo-Pacific humpbacked dolphins *Sousa chinensis* (CITES Appendix I);
- 4.2.6. Dusky dolphins *Lagenorhynchus obscurus* (CITES Appendix II);
- 4.2.7. Humpback whale *Megaptera novaeangliae* (CITES Appendix I);
- 4.2.8. Bryde's whale *Balaenoptera edeni* (CITES Appendix I).

4.3. Sea Birds

Dyer Island is a Cape Nature Conservation island for about 36 species of sea birds, among which several are endangered and protected bird species: African or jackass penguins (*Spheniscus demersus*), Cape (*Phalacrocorax capensis*) and whitebreasted cormorants (*Phalacrocorax carbo*), Cape gannets (*Morus capensis*), white chinned petrels (*Procellaria aequinoctialis*), Arctic (*Sterna paradisaea*) and Antarctic (*Sterna vittata*) terns, kelp gulls (*Larus dominicanus*), etc.

4.4. Persecution of wild predators

Salmon farms represent an ideal target for marine mammals, sharks and sea birds in search of an easy meal. Several measures have been developed by fish farmers to prevent predators from preying upon farmed salmon, damaging nets and releasing salmon: e.g. anti-predator nets surrounding fish farms. Both fish pen nets and anti-predator nets can entangle and drown wild animals. Farmers may also use acoustic devices emitting high-powered sounds underwater that deter seals. These devices have led to the withdrawal of resident populations of dolphins and whales in certain areas as these sounds may be painful to these animals.

When these techniques fail to deter predators like cetaceans, sharks or birds, fish farmers may take matters into their own hands and eliminate them using:

4.4.1. Firearms

4.4.2. Poison

4.4.3. Underwater sound production:

4.4.3.1. Firecrackers

4.4.3.2. Acoustic Deterrent Devices (ADDs)

4.4.3.3. Acoustic Harassment Devices (AHDs). AHD's have been shown to actually exclude animals from their habitat (Johnston, 2002), so it is possible that the effects of such a device installed on the farm would have dire consequences for the Geyser Rock Cape Fur Seal colony

4.4.3.4. Playing killer whale (*Orcinus orca*) vocalizations

However, there is also the problem with illegal, or unauthorized, persecution of the wild animals by the salmon farm installation personnel. There are no official numbers for how many animals are entangled and killed accidentally in the salmon farm as these incidents are not required to be reported. However, a study done in British Columbia, Canada, showed that over a 4 year period 431 harbour seals, 38 sea otters, 29 sea lions, one harbour porpoise (*Phocoen phocoen*), 16 herons, and one osprey (*Pandion haliaetus*) were killed (Würsig and Gailey, 2002). There have also been reports of bottlenose and common dolphins getting entangled in salmon farm nets (Gibbs and Kemper, 2000), as well as grey and Bryde's whales (Würsig and Gailey, 2002) although these last two are extremely rare.

Conclusion

There is no doubt that there is going to be damage done to the nets and the farmed animals by the amount of predators that occur naturally in these water. This will lead to conflict between the local wildlife and aquaculturists. Sooner or later active persecution will commence, with or without permission, and this will take a serious toll on the local wildlife on which many people in Gansbaai depend. In 2004 the combined shark cage diving industry and the whale watching boats generated R 987,000,000 (\$ 168,573,867) in South Africa, and R 42,000,000 (\$ 7,173,356) for the Overstrand area alone (Spencer, personal communication). It seems slightly illogical to jeopardize such a vast local income in order to satisfy a foreign company!

Fish farming is a very lucrative business that has brought much needed work and money to many poor areas of the world. Unfortunately it is also currently extremely damaging to the environment and encourages the over-fishing that is seen all over the world. The area of Gansbaai, where the farm is located is already thriving and doing well due to the shark cage diving industry and the annual visits of the whales. It is a distinct possibility that these operations could be damaged by the installation of a salmon farm. Furthermore, the southern coast of continental Africa is well known for its great species diversity, which includes the Southern Right Whales, Jackass Penguins, and the largest known aggregation area for great white sharks. It seems a waste to jeopardize the local economy, but also the highly unique and diverse wildlife of the area over a project that is unnecessary, and also lacks the actual legal backing for its establishment: Environmental Impact Assessment.

One important criteria in favour of this new fish farming industry is obviously job creation, especially important in South Africa. The main question should be which industry creates more jobs, fishing or tourism? Tourism has been identified as one of the key driving forces for economic growth in South Africa, employing around half a million people and representing 7.1% of the GDP (R72.5 billion) in 2002 (2003 *Annual Tourism Report, South African Tourism Strategic Research Unit, April 2004*). The whole South African fishing industry is estimated to have generated less than one percent of the GDP in 2000 (R1.7 billion) and employs only around 130'000 people including primary and secondary sectors as well as aquaculture (<http://www.fao.org>). A Satour survey conducted in 2000, indicated that international tourists were attracted to come to South Africa for the wildlife (33%) and scenery (27%).

Main concerns

- **Location of the fish farm;**
- **Choice of farmed fish;**
- **Direct and indirect adverse impact upon listed threatened species, listed protected species and listed migratory species (e.g. great white sharks, cape fur seals, southern right whales, etc);**
- **Chemical, medical and biological pollution;**
- **Salmon is a carnivorous species that require fish feed from other fisheries that are unsustainable;**
- **Risk for the local line fishery – The main industry in Gansbaai is fishing;**
- **Risk for the local tourism industry - Great white shark cage diving, shore- and boat-based whale watching companies, and associated tourism businesses (accommodation and restaurants);**
- **No business plan or EIA (Environmental Impact Assessment) documents available from the Overstrand Municipality, Dyer Island Fisheries or from Marine and Coastal Management;**

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