INTENSIVE MARINE FISH AQUACULTURE

Introduction
WWF’s mission is to conserve nature and ecological processes, whilst ensuring the sustainable use of renewable resources. WWF therefore recognises the potential value to society arising from aquaculture in terms of providing food security, revenue and an alternative food source to that derived from wild-caught fish. The farming of marine and aquatic organisms can however cause detrimental effects on the environment and be socially and economically unsustainable in the short-term and in the long-term.

WWF has two overriding concerns related to the expansion of the aquaculture industry: the intrusion of fish farms into vulnerable marine and coastal areas, with potentially detrimental environmental effects, and the overall unsustainability and potentially ecological effects of an industry that is dependant on wild-caught fish used as fish feed in a conversion ratio sometimes as high as 4:1.

The environmental effects of intensive fish farming can be:
- Pollution into marine systems can cause serious impacts through the release of nutrients, pathogens, chemicals and pharmaceuticals.
- Increased fishing pressure on species exploited to produce fish-feed;
- The introduction of exotic fish and shellfish species that escape and compete with, infect, or prey on, native species;
- Dense farm populations provide an incubator effect on diseases which can then infect wild stocks;
- Catching of juveniles and adults for on-growing in farms and for breeding in nurseries;
- Intermixing or escape wild fish with local races of the same species;
- The unintended capture, illegal culling or disturbance of habitats of fish, mammals, birds or other animals can exert pressure on species that play no role in aquaculture.

Aquaculture is the farming of aquatic organisms, and intensive marine fish farming is hereby defined as any freshwater or marine culture system depending exclusively on manufactured inputs and energy to raise fish. Marine fish farming is conducted either in land-based artificial tanks and ponds in coastal areas, or floating net cage enclosures at sea, usually in sheltered locations. During the last two decades there has been a rapid expansion of commercial and intensive fish farming. Increase in production has especially come from the on-growing of marine fin-fish species such as salmon, trout, tuna, sea bass, sea bream, and more recently, marine white fish species such as cod. The farming of shrimps and shellfish differs greatly from marine fin-fish farming and is not covered in this position statement.

WWF’s vision for the industry is: “a sustainable aquaculture industry, where no part of the production line threatens the natural environment or local communities”.

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The environmental impacts of marine fish farming can be difficult to quantify, and our scientific knowledge and understanding of the oceans ecosystem are still inadequate. The FAO Code of Conduct for Responsible Fisheries is now fully endorsed by nearly all relevant international fora. The Code, in accordance with the Precautionary Approach, establishes that the burden of proof is on the industry side. Responsibility therefore rests with industry to provide the scientific evidence that their practices will not be harmful.

The following 11 criteria comprise best-practice methodology that WWF expects the fish farming industry to follow:

1. Not operate in areas where the activity is likely to cause serious or irreversible effect on vulnerable species or habitats and avoid operating in marine protected areas.
2. If aquatic species is caught for further growing in farms or nurseries, the catch must be in accordance with sufficient fisheries management avoiding species that are threatened, or comes from fish stocks that are not healthy and well managed.
3. Fish used for fish oil and fishmeal, often small marine pelagic species, should only come from healthy, well-managed and sustainable stocks. The industry should make any effort to find more sustainable alternatives, preferably fish offal and fish waste, plants or fish from independently certified fisheries.
4. Extraction of water must not have a harmful effect on humans or natural wildlife that depend on the same water source.
5. Genetically modified fish should not be developed for aquaculture and fish feed should be guaranteed free of genetically modified plants or animals.
6. Harmful quantities of waste nutrients must not be discharged to freshwater or marine ecosystems, and best available technology should be employed to ensure resource efficient farming systems and adequate wastewater treatment.
7. Toxic chemicals, pathogens, pharma-ceuticals or other substances not be discharged in harmful concentrations.
8. There should be no transmission of diseases and parasites to wild species.
9. Exotic species and races should be farmed in closed systems where the potential for escapes can be largely eliminated.
10. Cease the illegal capture or culling of fish, mammals, birds and other animals that have interactions with farming systems.
11. The development and spread of the aquaculture industry must be controlled and sensitive so as to avoid physical damage to coastal ecosystems and structures and negative impacts on coastal communities.

Environmental effects in coastal areas

Oceans cover two-thirds of the earth's surface, and more than half the world's population lives within 60 km of a coast. Many coastal communities are completely dependent on marine resources. At the same time increasing numbers of marine ecosystems are endangered. Coastal zones are exposed to a massive pressure from numerous interests, and many nations face a rising level of conflicts in their coastal zones.

Marine aquaculture developments in coastal areas have caused conflicts with many stakeholders, as a result of their effects on local environments. Fishermen raise concern about fish farming and interactions with spawning grounds for lobster and local fish stocks, and anglers are concerned about fish farms placed in the migratory routes of wild salmon. Such effects on local marine biodiversity can in turn cause problems for local communities.

Impacts from fish farming include the escape and interbreeding or competition of culture species with wild species or races; conflicts and damage to coastal resources through destruction of habitats for both terrestrial and aquatic wildlife when fish-farm facilities and accompanying infrastructure are built and operated; and wastewater disposal into marine systems can cause serious impacts through the the release of nutrients, pathogens, chemicals and pharmaceuticals.

Before new aquaculture development takes place, identification of potential negative effects on local biodiversity and ecosystems should be addressed, for then to ensure sufficient protection of areas where the operation is likely to cause serious or irreversible effects on vulnerable species or habitats.
WWF calls for an international code of conduct for responsible aquaculture, preventing aquaculture operations in marine protected areas and in areas where such operation is likely to cause detrimental effects on the local communities and the environment.

**Sustainable fish-feed**

Marine fisheries in the world are under heavy pressure with many close to collapse. The FAO estimates that about 75% of fisheries are over-fished, exploited to their maximum biological limits or recovering. Most fisheries are under urgent need of management. The remaining biomass of our planet's large predatory fishes is only about 10% of pre-industrial levels. Carnivorous species such as eels, tuna, salmon, seabass, sea bream and cod are grown on fish feed containing large proportions of fishmeal and fish oil derived from wild caught fish. Aquaculture therefore contributes to an increased pressure on fish stocks rather than relieving pressure. Hence, we have little knowledge on the possible ecological effects of removing such large quantities of biomass from the oceans, knowing such species are prey for other fish, mammals and birds.

The largest sources of fish-meal are the anchovy and sardine fisheries primarily in the Pacific Ocean off South America. Heavy over-fishing of South American pilchard has caused a serious decline in the stock from 6.5 million tonnes (Mt) in 1985 to less than 0.5 Mt in 1999. In the North East Atlantic, Blue whiting is widely used in the fish-feed industry. In 2001 North East Atlantic coastal states caught 1.7 Mt, double the recommended quota from ICES.

WWF calls for the aquaculture industry to find more sustainable feed resources such as fish waste from fishing industry, and to examine the possible use of other resources such plant-based protein.

WWF calls for the producers of fish feed to ask for documentation that any fishmeal and fish oil used, only originate from healthy and sustainable fish stocks preferably certified to Marine Stewardship Council (MSC) standards.

**Wild caught fish used for farming**

Fish farming based on species caught alive, and then transferred to cages for fattening has experienced an explosive growth the last decade. Blue-fin tuna is especially popular, and the marked demand is still growing, creating a pressure on natural stocks. Blue-fin tuna has a long life span and late sexual maturing, so the species is vulnerable to over fishing. In the Mediterranean, a significant share of tuna captured and transferred to cages is undersized or just within the legal minimum landing size. The East Atlantic blue fin tuna stock is currently heavily overexploited, a situation partly caused by the massive increase in the catch for aquaculture.

WWF urges governments to include the catch of fish for on-growing in fish-farms within the total catch statistics and to ensure total catch quotas recommended by authorities, such as ICES and ICCAT, are not exceeded. Fish smaller than the minimum landing size should not be caught for aquaculture.

**Genetically Modified Organisms**

WWF objects to the introduction of genetically modified organisms (GMO) into the natural environment. The introduction of new species into ecosystems, or exotic genetic material into wild species can trigger changes in the adaptability and relationships of organisms. This alters the natural balance and affects established ecosystem processes, which are essential to maintain environmental integrity. Natural systems are losing biodiversity, and hence genetic material, at a higher rate than ever before. The release or escape of GMOs into the general environment further threatens the declining biodiversity and natural resource. WWF therefore opposes the use of GM fish as a type of exotic species in any type of aquaculture, and also the use of GM animals or plants as feed resources. Chain of custody documentation is needed to ensure GM material is not used.

WWF calls for a total ban on use of GM fish in aquaculture and urge the industry to avoid feed resources containing GM substances.

**Pollution**

Discharges of nutrients from fish-farms have led to serious local habitat damage. Discharges from various farms in the same coastal areas can lead to local eutrophication problems, which in turn can be a likely cause of toxic algae blooms. Concentrations of organic matter from fish-farms can be greatly raised in the water downstream from facilities, resulting in an increase in the aerobic bacteria populations that use oxygen to break down organic matter. Levels of available oxygen in the water can decrease, causing anaerobic conditions leading to the production of ammonia, ammonium, methane and hydrogen sulphide, which are toxic to many aquatic species. These impacts, predominantly on the benthos, may be long-lived at sites in relatively quiescent waters, persisting for many years after the culture activity has ceased. At more dynamic sites impacts may be relatively shorter-lived. WWF considers this discharge of energy rich wastes from intensive aquaculture as a serious threat to marine life.
negative impact on the local marine environment and a poor use of valuable dwindling resources.

WWF calls for the improvement in food conversion rates and good feeding practices together with technical solutions for collection of suspended wastes and wastewater treatment.

Diseases
Dense aggregations of farmed fish are ideal breeding grounds for diseases and parasites. Additionally, stress on fish resulting from high density and intensive cultivation is often sufficient to allow pathogens to take hold and form disease reservoirs. Wild fish may move in and out of floating cage systems, escaped fish may enter natural habitats and wastewater may carry pathogens capable of infecting other culture stocks or the surrounding environment. Transmission of diseases and parasites from farmed organisms to natural communities can be a major threat to local species and endemic races of the culture species. In areas of Northern Europe, sea-lice numbers are now significantly higher as a result of the millions of cultured fish in the sea.

WWF calls for good health management on all fish farms, focusing on minimising any risk of possible transfers to wild fish or potential ecological effects such as resistance-development.

Chemicals and medication
A wide range of chemicals is currently used in the aquaculture industry, mainly medical treatment and anti-fouling agents. Open cage farming allows seawater and discharged chemicals to flow through and out of farm systems. The release of chemicals such as copper and pharmaceuticals such as antibiotics can therefore end up directly in the water column. Some of these treatments are toxic to various molluscs and crustaceans, and little is known about their broader ecological implications. In some areas, such as South East Asia and South America frequent use of medications has led to increased resistance of the target pathogen to treatment.

WWF calls for fish farmers to use treatments and technical solutions to avoid discharge of chemicals and pharmaceuticals in to the marine ecosystems. Such solutions can be: enclosed marine cage systems, offshore cages, vaccinations, less density of fish in the cage, use of cleaner-fish instead of therapeutic chemicals and the development of biological and natural methods of treatment.

Escapes
Aquaculture is one of the main routes of introduction of marine organisms or races of organisms that do not naturally live in an area. Ecological impacts include the effects of the interaction of the introduced species on the local fauna and flora, transmission of hitherto unknown diseases and alteration of habitats.

The escape of cultured animals from farms is a severe form of biological pollution of the environment, and constitutes a constant threat of parasite and disease transfer to wild species. Escaped, farmed species can interbreed with wild relatives. The maintenance of genetic variation, both within and between populations, is essential for their long-term survival and to maintain the evolutionary potential of the wild stock. It is important to protect populations in their natural habitat because they have in them gene complexes capable of continually responding to evolutionary forces. Aquaculture itself depends on genetic diversity to sustain productivity, prevent inbreeding and to conserve the potential for new products and increased yields. The objective is to avoid decline in the long-term sustainability of wild populations that could come from interbreeding with farmed fish.

WWF calls for strict technical requirements to prevent the high numbers of farmed species escaping into the wild. These include better farm security, staff training, individual tagging, catch netting, improved tank and dam quality and suitable farm locations avoiding extreme weather conditions or water borne debris.

Predator conflicts
Prevention of predation on cultured stocks by native animals can be a day-to-day problem for many aquaculture operators. The farms can be attractive to mammals, birds, molluscs, crustaceans and fish wildlife because they provide high concentrations of prey animals and waste food. Mammals and birds cause damage on open net-cages or mussel cultivation grounds, while bottom browsing fish, starfish and crabs preys on bivalves and sometimes cultured flatfish.

WWF calls for a stop of the illegal culling of mammals, birds and other predator species attracted to an aquaculture site. Fish farms should not be located in areas with dense populations of species known to cause conflicts and preventative techniques such as secure fencing for land-based facilities, non-lethal predator netting at cage sites, more secure feed storage and reduced wastage should be promoted.
**WWF and the aquaculture industry**

Aquaculture potentially has an important role to play as a source of much needed high quality food and as a livelihood especially in coastal communities and possibly in communities suffering from the demise of the fishing industry. Fish farming can approach sustainability, but it has a long way to go.

As an industry, aquaculture is dependent on a clean and healthy marine environment, though short-term business strategies have occurred in several places and led to serious habitat degradation. Farmed fish are mainly marketed using a clean and healthy image so there is a consumer expectation that aquaculture is environmentally sound and healthy. Consumer, retailer, legislation and neighbourhood demands are growing and the aquaculture industry must accept its impact and act with respect for both environment and local communities.

WWF should be seen as both a challenge and an opportunity for the fish farming industry. We acknowledge that the industry needs to be profitable, but it must get its house in order and grasp the business opportunities afforded by a more sustainable approach.

The philosophy, the culture, the driving force of aquaculture management needs to change and WWF aims to assist the aquaculture industry to move to more environmentally sustainable management that will bring more sensitive techniques, safer production and more secure long-term profits. We need also to act against companies that are continuing to cause the degradation of the environment and that are harmful to communities or livelihoods. This can be achieved by influencing finance, legislation, authorities, company management or staff, markets or the public. There is also potential in linking the issuing of production licences with past environmental performance.

Sustainable management must be incorporated into the business ethic and culture. Many other sectors are doing so from forestry to telecommunications. Such a strategy for example incorporates resource management, stakeholder involvement, globalisation, staff inspiration and strategic partnerships. It is not merely about conducting an Environmental Impact Assessment prior to a development or producing a glossy environmental report. Action is needed from the sourcing of feeds, through farm operations, to the markets.

Sustainable companies need to profit from being so. They need to be recognised and supported possibly resulting in access to markets (and countries), increased market share and the development of new products, in preference to unsustainable companies. WWF can play a part in encouraging this such as is being done by work with the Marine Stewardship Council.

**Conclusions**

Intensive fish farming can cause detrimental effects on marine ecosystems and fish farms should not operate in areas where the activity is likely to cause serious or irreversible effect on vulnerable species or habitats. However, WWF sees fish farming as having the potential to be beneficial in terms of food security and sustainable livelihoods. The environmental cost of these benefits though needs to be minimised.

Before a new aquaculture development, or expanding of the existing industry takes place, vulnerable species and habitats should be identified and sufficiently protected.

Environmental Impact Assessments (EIA) should always be in place for large-scale projects, or for regions where several smaller projects are operating in close proximity and represent significant combined effect.

A code of conduct for responsible aquaculture should be developed, and individual farms should set up operational guidelines and development plans that will control cumulative impacts and secure that any possible mitigation measures are taken.
Background documents for this position:


Fishing Madness, 101 reasons why the CFP needs radical reform, point 95 - 100 WWF Fishing Subsidies Campaign [http://passport.panda.org/stopoverfishing/html/fromadmin/docs/newsroom/FishingMadness.pdf]


