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Net loss of wild fish to produce farmed salmon

A total of 2.7 to 3.5 tonnes of wild fish are used to make 1 tonne of farmed salmon

Salmon farming proponents often point out that, since the wild fisheries are collapsing, farming the oceans is necessary to feed a hungry world (1). They claim that their industry can supply food while taking pressure of ocean resources. But it isn't that straightforward. The impact of aquaculture (farming of a seafood species) varies, depending on what species is farmed and what method is used. With regard to taking pressure of ocean resources, a key factor is whether the species being farmed is carnivorous or not.

There are more than 220 different species of seafood currently farmed in the world and about 85 per cent of the total production is made up on non-carnivorous species (2). In British Columbia, however, the majority of aquaculture production consists of salmon, a carnivore. In order to try and mimic their natural diet, carnivorous species are given feed that is high in fishmeal and fish oil. These key ingredients are obtained from wild fish such as sardines, mackerel and anchovies, which are mainly supplied by South American fisheries.

The amount of fish meal and fish oil in dry feed can vary depending on the type of feed and it has also changed over the last few decades. For the 1990's a typical average composition for Atlantic salmon feed is 35% fish meal and 25% fish oil (3).

Feed Conversion Ratios & Ocean Resource Use

From an ocean resource point of view, the total amount of wild fish used to make feed for farmed salmon, compared to the total amount of salmon produced is the ratio of interest, but this ratio is not what the industry tracks. Since feed is one of the most expensive components of a salmon farm operation, the farmer tracks the Feed Conversion Ration (FCR), which is how much dry feed is used to make a given amount of salmon for market. The current FCR on British Columbia salmon farms can vary from 1.3 to 1.7 (ie: 1.3 to 1.7 tonnes of dry feed to make 1 tonne of farmed salmon for market), depending on farm efficiency and type of feed used (4). But what amount of wild fish is needed to make this quantity of dry feed?

It takes about 4.7 tonnes of wild fish to make one tonne of fish meal. At 35% fish meal content, a tonne of dry feed contains 350 kilograms fishmeal. Therefore, 1.65 tonnes of wild fish is needed to make the fish meal used for one tonne of feed. However, it takes 8.3 tonnes of wild fish to make one tonne of fish oil (5). To make the 250 kilograms of fish oil found in one tonne of feed requires 2.08 tonnes of wild fish. At this point one must be careful not to double count the amount of wild fish used, since a given amount of wild fish will supply both fish meal (mainly protein) and fish oil (mainly fat). In the above example, the 2.08 tonnes of wild fish used to make the fish oil in one tonne of feed is more than enough to supply the fish meal component as well (only 1.65 tonnes of wild fish required for that). At 25% fish oil content then, it is the oil that determines how much wild fish is consumed to make the dry feed.

Since a salmon farm in BC currently uses between 1.3 and 1.7 tonnes of dry feed (ie: FCR of 1.3 to 1.7) to make one tonne of farmed salmon, then the total amount of wild fish used to make one tonne salmon is between 2.7 and 3.5 tonnes (ie: the FCR multiplied by 2.08). It should be noted that in practice, BC salmon farms do not often reach the lower FCR of 1.3 which is achievable only when feed is used very efficiently on the farm. Rather than taking pressure off ocean resources then, salmon farming is currently adding greatly to that pressure.

How has conversion efficiency changed?

The high cost of feed means that the salmon farming industry is constantly trying to reduce their FCR. Since 1980, the FCR has been reduced on average from 2 (6) to the current range of 1.3 to 1.7. They have done this by switching to computer controlled feeding systems that minimize feed waste and also by lowering the ratio of fishmeal to fish oil in the feed. More fish oil makes the feed more concentrated in terms of food energy, so less feed needs to be used. But how does this affect the amount of wild fish

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used to make the feed?

When FCR is reduced as a result of wasting less feed, clearly less wild fish is consumed. However, this is not the case when the FCR is lowered as a result of increasing fish oil content of the feed. As we saw above, the making of fish oil requires the rendering of much more wild fish than for fishmeal. Technological improvements have allowed the fish oil content of feed to increase from 12 per cent in 1980 (7) to the current 25 per cent, while at the same time, fish meal content has gone from 40 down to 35 per cent.

Although there has been an improvement since 1980 on the amount of wild fish used to make a tonne of farmed salmon, the improvement is not as great as the change in FCR would suggest. This is due to an increased reliance on fish oil content in the dry feed. The amount of wild fish used to make one tonne of dry feed has actually increased by about 11% since 1980.

Alternatives to Using Fish Oil and Meal in Feed

In a June 2001 news release, the Fishmeal Exporters Organization announced that "the outlook for fish meal was bullish with prices rising reflecting the tight supply situation" (8). While this may be good news if you are a fishmeal investor, it is not so if you're a fish farmer who's feed prices may increase as a result. Nor is it good news for the ocean ecosystem, which has to supply fish for an increasing global appetite for fishmeal.

Leaders within the salmon aquaculture industry are aware they may soon not be able to secure enough fishmeal and oil for their industry to continue to expand (9). The race has been on for some time now to try and find substitutes for these 2 key ingredients. Most of the research has focused on replacing some of the fishmeal component of farmed salmon feed with vegetable protein sources. Two recent studies have shown that feed composed of between 28 to 32% fishmeal, 12 to14% soy protein and 32 to 39% fish oil could be used with success (10,11). Another study showed some success by replacing 69.4% of the fishmeal with soy protein (12). Although promising, these studies still rely on feed with relatively high amounts of fishmeal and no substitution of the fish oil. As we saw above, the fish oil component of feed is the main reason that farmed fish are not a net contributor to seafood production. One of the main obstacles to increasing the amount of fishmeal and oil that can be substituted by vegetable sources is the presence of antinutritional factors in the plant-derived materials (13).

Much more research needs to be done and it is unclear when, or if the day will come when farmed salmon will be vegetarian. In the meantime, the stress on the ocean ecosystem will increase as salmon aquaculture expands globally. The consumption of 6.2 tonnes of wild fish for each tonne of salmon produced not only means less food for humans, but also for the many ocean species that rely on these fish as part of their food chain. Currently, the continued expansion of salmon farming is not sustainable.

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