October 10, 2012

To: U.S. Department of Agriculture National Organic Program

From: Food & Water Watch

Since the National Organic Standards Board approved final recommendations on aquaculture in November 2008 (Final Recommendation on Aquaculture on Fish Feed & Related Issues and Final Recommendation on Aquaculture on Net Pens & Related Issues), new information has emerged on these two topics that we believe is worthy of the NOP's consideration. We submit the following information, based on recent academic literature as well as reports from several of the open water finfish aquaculture facilities operating throughout the world.

Open Net Pens

It is important to review the troubled history of open net pens internationally, and introduce recent research that explores new reasons for concern with this production method. We believe this corroborates previous evidence already in the literature on the many detrimental impacts of open water net farming on the marine environment. While so much new material is emerging, much of it articulating further reservations about the environmental sustainability of open water farming practices, it is premature and inappropriate to consider approving an "organic" standard for net pen finfish aquaculture production.

Environmental impact

It is already apparent from a multitude of studies that a variety of localized impacts on seabeds occur in the vicinity of many open water fish farms, including sedimentation, nutrient build-up and adverse effects on the diversity and distribution of benthic marine life – even in regions that experience strong currents.[1] As such, one study has suggested that fish farms should be located at least 400 meters (one-quarter mile) from sensitive habitats[2]; another has observed detectable impact on seafloor as much as 800 meters from a farm.[3]

However, the most recent research shows that this impact may be wider-reaching than originally anticipated. Recent studies, for example have observed shifts in the trophic production of marine communities surrounding fish farms, presumably due to the nutrient buildup that occurs as fish waste and uneaten feed drift from open nets. In several cases, this was observed to shift benthic communities from autotrophic (in which organisms are able to synthesize their own food from sunlight or inorganic compounds) to heterotrophic production systems (in which organisms obtain their food from carbon and organic compounds in the environment).[4] The

long-term implications of this shift may mean changes to regional food webs where fish farms are located.[5]

Implementing a requirement for fallow periods after open water aquaculture production will not necessarily remediate the damage to local ecosystems. A 2008 study evaluated the effect of a six-month fallow period on the Hawaiian ecosystem, following production of carnivorous Pacific threadfin raised off the coast of O`ahu from 2001 through 2006. The study found that "species diversity at the end of the 6 mo [sic] fallow period remained significantly lower below the fish farm at the affected site relative to a distant reference site," indicating that marine "communities have not been fully restored to pre-culture or reference conditions," despite the fallow period. [6]

Perhaps most significant, an article to be published in an upcoming 2011 issue of *Marine Environmental Research* indicates that the presence of aquaculture facilities has a measurable impact on the waters in a wide-mouthed gulf more than ten miles across in northern Sicily. In the study, which is the first of its kind in terms of the scale of impacts considered, overall increased levels of chlorophyll-a concentrations are detected throughout the entire gulf, and observe that this is "mostly as the result of the chronic release of nutrient waste produced by local aquaculture."[7] (Chlorophyll-a concentrations are correlated with the derivatives of nutrients such as nitrogen and phosphorous, both of which are typically excreted at high concentrations from fish farms.) This indicates that the impacts of aquaculture operations in the gulf are observable "at a spatial scale never considered before."[8]

The implications of this study are far-reaching. Previous studies (such as those mentioned above) have tended to find impacts from fish farming only in the immediate vicinity of an open water aquaculture facility. In fact, this may be solely due to the fact that previous researchers and scientists had not identified adequate ways to measure broader impacts to the marine ecosystem.

Section 205.255 (k) of the final recommendation states that the location of open water net-pens should be situated in such a way that currents, water depth, and "other factors act to adequately disperse metabolic products in order to minimize any negative impacts on the environment." However, as this research indicates, dispersion and dilution are not likely to be sufficient to remediate the environmental impact and pollution caused by net pen aquaculture. Impacts may be spread far beyond the immediate vicinity of a net pen; the fact that previous research has not been able to detect these impacts (or devise adequate methods for doing so) should not lead the NOSB to conclude that such impacts do not exist.

Significant and long-term impacts to the marine ecosystem from open net pen production are unacceptable for organic production. They also are unnecessary because aquaculture wastes can be managed appropriately in closed systems. Closed systems should be the only type of aquaculture even considered under the organic standards.

Natural behavior and aggregation of marine wildlife

In addition to ongoing concerns about whether farmed fish in cages can adequately express natural behavior, academic literature also continues to confirm that the natural behavior of *wild* fish is seriously altered by the presence of open water cages. This finding is fundamentally at odds with Section 205.201 (a)(7)(xi)(a) of the final recommendation, which states that any net pen must be located in such a way that "minimizes impact to the migratory and reproductive patterns of local wild fish populations, other local species like predators and birds and any other flora or fauna."

Wild fish tend to aggregate in large numbers in the vicinity of fish farms, with one study observing as many as 30 unique species around fish farms, and estimating aggregation biomass around certain Mediterranean net pens at up to 40 tons per site (in addition to whatever quantity of fish may be confined within a net pen).[9] In some cases aggregation has been estimated to be twenty times greater in the immediate vicinity outside of a net pen, as compared with sites 200 meters away from a farm.[10] It serves to reason that aggregation by wild fish may further pollute the local environment and benthic habitat by concentrating fish wastes and excretion within a specific area.

The reported physiological effects to wild marine creatures that congregate around cages may include "modified diet, physiological condition, tissue fat content and fatty acid composition, reproductive condition, parasite load, exposure to predation and susceptibility to fishing pressure."[11] Meanwhile, an unpublished study by Dempster et al. has found significant morphological changes in farm-associated wild fish, visible to the naked eye, including an apparently arched spine, abnormal pelvic and caudal fins, and distinct liver size, compared with wild fish of the same species in areas distant from farms.[12]

Open net pens not only attract other fish, but also a variety of other marine creatures, including dolphins. At one open water fish farm facility in Hawaii, six or seven dolphins have been reported to visit daily in search of food.[13] Their numbers are increasing over time.[14] The dolphins began appearing when the cages were first installed and a fish escape occurred.[15] According to the Division of Aquatic Resources, the animals have begun to exhibit "unnatural behaviors."[16] Conditioning of dolphins is a major concern. It can be detrimental to dolphin survival due to altered feeding and social behaviors and the increased potential for entanglement in nets, pens and other gear, or ingestion of foreign objects from the operations. The Division of Aquatic Resources has warned the Hawaiian company in 2008 that dolphin conditioning could "be occurring, or soon occur, at levels that constitute 'take' as defined under the Marine Mammal Protection Act."[17]

A basic tenet of organic farming is that farms should be in harmony with the local environment, maintain natural biodiversity and not cause significant unnatural

behaviors by local wildlife; the same should hold true of any organic fish farm.[18] And as we have previously stated, there is no entitlement to an organic standard. Open net pens cause disturbances to local wildlife, and products from these systems should not be able to bear the organic standard.

Escapes and Disease

Growing fish in open-water facilities is inherently risky. While suppliers of net pens and underwater cages may tout the structures' strength and ability to withstand strong ocean currents, in practice, there have been hundreds of thousands of fish escapes from net pens and open-water fish farms each year.

Recent international experience can demonstrate the range and scale of these escapes:

- From late December 2008 through early January 2009, a series of massive escapes occurred in Chile, totaling more than 700,000 salmon and trout from various farms, and prompting the leader of the Chilean Senate's Environmental Committee to proclaim the incidents an "environmental disaster."[19]
- In October 2009, a Canadian newspaper reported that 40,000 fully-grown Atlantic salmon had escaped from a net pen facility in British Columbia when a machine removing dead fish from the bottom of the pen broke a hole in the net. The company reportedly recovered less than 3 percent of the escaped fish at the time the article was written, though efforts to recover the fish were ongoing.[20]
- In October 2010, 70,000 harvest-ready salmon escaped from a farm in Norway, resulting in a loss to the company of at least $600,000. Only months earlier, fish at the same location had suffered from an outbreak of pancreatic disease resulting in high levels of mortality.[21]
- Recently, one open ocean fish farm facility producing cobia in the Bahamas reported escapes of an estimated 90 percent of its fish after successive entries by sharks into the cage.[22]

Far from a complete list, these are just a few of the dozens of major escape events that take place every year in the open water aquaculture industry. Few of these reports are fully documented, but of those that are, the numbers are staggering. In Norway, for example, it is mandatory to report all escape events, and "3.93 million Atlantic salmon (*Salmo salar*), 0.98 million rainbow trout (*Oncorhynchus mykiss*) and 1.05 million Atlantic cod (*Gadus morhua*) were reported to have escaped over the 9 years from 2001-2009."[23]

Food & Water Watch analyzed production and escapes data from four major aquaculture regions where comprehensive reporting on aquaculture escapes is mandatory and publicly released: British Columbia, Norway, Scotland and Australia (Figure 1.) The data show that escapes, on average, have tended to increase,

although fewer catastrophic escapes have occurred in the studied countries as of late.

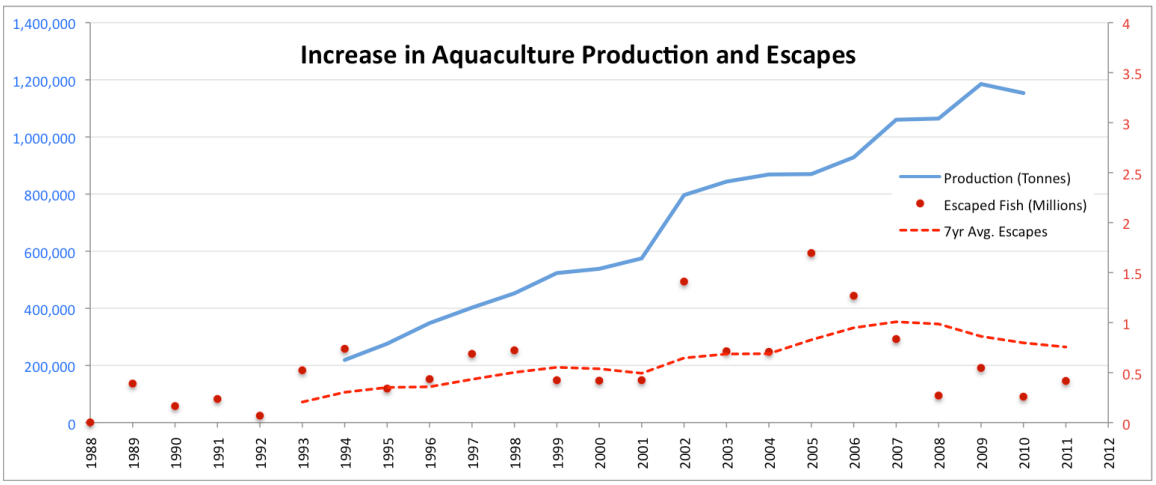

Figure 1: Comparison of aggregate production and aggregate escapes from aquaculture facilities in British Columbia (1987-2009), Norway (1993-2010), Scotland (2002-2011) and Australia (2001-2011). The escapes trendline is a seven-year average (each point represents the average of that year plus the preceding six years) to control for the impact of extreme weather events triggering massive escapes.

The reported data on escapes underestimates the number of fish that actually do escape from aquaculture facilities, although to what degree is unclear. British Columbia's Environment Assessment Office clarified that the available escapes data is only a minimum number of escapes, as fish farmers typically only report large escapes. They concluded that chronic "leakage" of fish from net pens is not reported and, if assessed, could double the number of total escapes.[24] A study of Chile's farmed salmon industry suggested that one to two percent of farmed fish could escape.[25]

More recent studies out of Norway have suggested that only 12 to 29 percent of the actual number of escaped farmed salmon are reported.[26] This would mean that, between 2001 and 2009, instead of 3.93 million Atlantic salmon escaping, somewhere between 13.55 and 32.75 million salmon would have escaped. Size variability in catches of escaped farmed fish in Norway also support the idea that these fish continually escape in small but constant numbers at all stages of production, including smolt and pre-smolt cultivation.[27]

The adverse effects of aquaculture production of newly farmed species in open waters are sometimes discovered only *after* an industry is underway. For example, spawning activities by fully-grown farmed cod in net pen cages were recently documented for the first time.[28] This is highly significant as it is evidence of a new form of "escape" by marine oceanodromous fish being raised to maturity in net pen enclosures. Experiments have furthermore found evidence that the released eggs of cage-spawning farmed cod can successfully develop in wild environments. Of such

eggs, one study found that as much as 20 percent of a local cod population in Norway was of farmed larval origin after a spawning event was detected – even from a relatively small farm maintaining a total farmed biomass of only three metric tons.[29]

Escaped fish are a risk to the marine environment. Several recent studies have demonstrated that confined (farmed) fish over time eventually will lose genetic diversity due to inbreeding[30] — meaning that if these farmed fish escape into the wild and breed (or breed via spawning from within nets as recently observed), wild fish might lose natural traits that help them survive in the wild. A review of 23 peer-reviewed studies concluded that hatchery-raised fish can harm wild fish through competition for food and habitat, harming the genetic diversity of wild populations and causing wild population declines.[31] NOAA acknowledges a large number of genetic, ecological, health, and behavioral risks from hatchery fish used to restock diminished wild populations.[32]

Meanwhile, diseases in fish farms can spread rapidly among fish grown in close captivity, and as mentioned above, this may result in spreading infection to wild populations. A study on the global impact of white spot syndrome virus to shrimp farms found that as the virus spread across the globe in the 1990s, it became increasingly severe and has spread even to wild marine populations in Europe.[33] Similarly, the devastating ISA virus that hit Chile's salmon farms in 2007 likely originated in an outbreak in Norwegian farms in 1996 — which suggests that the virus probably persisted in the wild environment for more than a decade before beginning to affect Chile's industry.[34]

Sea lice, a parasite that feeds on marine fish, is also a common pathogen that spreads between aquaculture facilities and wild populations. In Canada, net pens for salmon are often situated on migration routes of wild salmon, and outbreaks of sea lice in these pens correlate to decreased survival rates for wild salmon.[35]

Food & Water Watch analysis of disease outbreaks data from Norway (Figure 2) shows that the number of disease events has typically increased each year. In 2002, the number of disease outbreaks spiked by 456 percent to over 200 total outbreaks, and every year since there have been over 200 disease outbreaks in Norwegian aquaculture facilities.

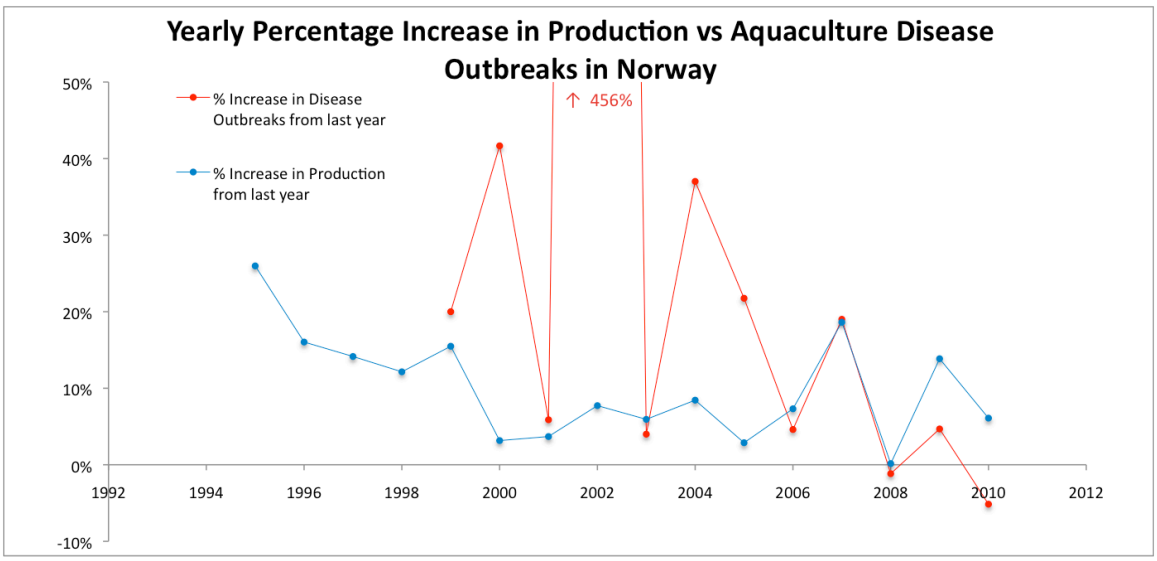

Figure 2: Comparison of yearly percentage increase in Norway's aquaculture production to yearly percentage increase of disease outbreaks.

A recent study to determine the causes of the long-term decline of the Fraser River sockeye salmon indicated that a combination of increased competition with pink salmon and contact with aquaculture facilities best predicted the observed population decline.[36] The low returns of sockeye have put "enormous pressure on aboriginal and commercial fishing communities that depend on these fish for food, social, and ceremonial purposes, as well as their livelihoods."[37]

Disease transfer to wild fish is a serious cause for concern, and necessarily prompts the question of whether the sustainability of any aquaculture system that allows for such occurrences can accurately be considered organic. Open net pen aquaculture clearly has too many risks associated with the industry to be considered for the "organic" label.

Wild-Caught Fish as Feed

The risk of contamination, adverse impacts on wild fish populations, and damage to marine food chains make the use of wild-caught fish in fishmeal or oil as feed for farm-raised fish incompatible with the principles of organic production.

Contaminants

Academic research continues to demonstrate that the use of alternative feeds in increasing proportions as a replacement to fishmeal and fish oil both significantly and progressively reduces the contaminant load of most persistent organic pollutions (POPs) such as mercury, polychlorinated biphenyls (PCBs), dioxin-like PCBs, and organochlorine pesticides in farmed fish. One recent study of gilthead sea bream estimated that the "total replacement of FO [fish oil] by vegetable oils reduced the total charge of POPs in fish feeds by 45–85%."[38] A 2010 study of

Atlantic salmon, meanwhile, found that "the use of alternative feed ingredients reduced the fillet load of POPs by 51–82% and the level of arsenic and mercury by 80–96%."[39]

It is extremely important that fish to be certified "organic" are fed 100% organic feeds. As wild fish cannot earn the "organic" label due in part to their unknown levels of exposure to marine contaminants, there remains a fundamental inconsistency if "organic" farmed fish can be fed potentially contaminant-laden wild feed.

Marine food chains and low-trophic level fish

Forage fisheries, for which the majority of the product is reduced into fishmeal or fish oil, play an extremely important role in the ecosystem, and these species' position near the bottom of the food chain makes them an important food source for a wide range of marine creatures, ranging from larger fish species and seabirds to marine mammals. It remains true that "most forage fisheries are either fully exploited to overexploited or are in the process of recovering from overexploitation," and that "overexploitation of forage fisheries can lead to local stress on…higher trophic species, particularly during El Niño events."[40]

Section 205.252 (k) of the final recommendation on aquaculture and fish feed intends to require that any fishmeal or oil used in feed come from sustainably managed fisheries by mandating that the products may not be sourced from fisheries defined as "over-exploited," "depleted," "overfished," etc. However, the holistic health of any reduction fishery cannot be meaningfully assessed simply on the basis of whether the stock status is at an acceptable level; it is important to take into consideration the need to sustain the vital ecological role of the target species as forage – a need that is increasingly urgent due to the rapid development of aquaculture worldwide. Reliance by USDA organic standards on such ecologically sensitive forage fisheries for purposes of reduction to fishmeal and fish oil, even in the short term, is wholly inappropriate.

Other feed ingredients and alternative feeds

Other commonly used feed ingredients would also fail to meet the organic standard.

Broadly, compound animal feeds like those used in aquaculture present food safety risks.[41] Fish feed often contains rendered animal proteins and fats, including meat and bone meal, poultry by-product meal, feather meal, blood meal, and poultry fat.[42] Tacon and Metian (2008) suggest that food safety risks from aquaculture feeds may include: *salmonellae*, mycotoxins, veterinary drug residues, persistent organic pollutants, other agricultural chemicals and solvent residues, metals and mineral salts, and transmissible spongiform encephalopathies.[43] There is a risk these contaminants will be passed along the food chain to consumers.

Alternative sources of protein, such as soybean meal, also present problems for an organic label. According to the 2007 Census of Agriculture, the number of soy farms in the United States, at 279,110, was second only to the number of corn farms.[44] In the 2008 Organic Survey, only 1,336 soybean farms were reported as certified organic.[45] By 2009, 93 to 94 percent of the soybeans produced in the United States were genetically modified according to Monsanto patents.[46] The standards for certified organic food do not allow the use of genetically engineered crops.

We reiterate that it is vital that fish that would be certified organic are fed only 100 percent organic feeds. Rendered animal products and agriculture products like soy that are currently used in aquaculture feeds cannot not be used to raise "organic" fish.

Conclusion

The significant and long-term impacts of open net pens on the surrounding environment and ecosystems are incompatible with the principles that organic production should minimize environmental harm and promote biodiversity. Open net pen finfish aquaculture clearly has too many risks associated with the industry to be considered for the "organic" label. And any reliance on ecologically sensitive forage fisheries for fishmeal and fish oil as a source of feed for farmed fish, even in the short term, is wholly inappropriate for an organic product.

Since 2008, more information about the impact of open net pens on surrounding ecosystems and the use of wild fish as feed has come to light, calling the 2008 recommendations into question. We urge the NOSB to re-evaluate their recommendations on aquacultured products.

A more appropriate standard would require:

- Closed, recirculating systems that do not release waste or water into the environment.

- No use of wild fish or fishmeal as feed.

If these criteria can only be met by systems raising vegetarian fish such as shrimp or tilapia and carefully controlling for organically-raised inputs, that is an appropriate place for the organic aquaculture industry to start. Building on this foundation could allow the industry to create a system of organic fish that can be used to generate truly organic fish-based feed or fishmeal that could be used as a feed source for organic carnivorous fish, as long as those fish are raised in closed, recirculating systems.

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[10] Dempster, T., et al. "Species-specific patterns of aggregation of wild fish around fish farms." *Estuarine, Coastal and Shelf Science* 86 (2010) at 271.

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