Food & Water Watch • 1616 P St. NW, Suite 300 • Washington, DC 20036
T +202.683.2500 • F +202.683.2501 • www.foodandwaterwatch.org

November 13, 2011

Comment on the National Organic Standards Board Materials Committee Proposed Discussion Document "Aquaculture Materials Review Update"

In response to the National Organic Standards Board Materials Committee's proposed discussion document "Aquaculture Materials Review Update," please accept these comments on behalf of Food & Water Watch, a national non-profit consumer advocacy organization. Our members and supporters support organic agriculture and are very concerned with the integrity of any organic standards that are developed for seafood. Additionally, Food & Water Watch has worked for many years on fisheries management issues, including the impact of large-scale aquaculture on the environment, fishing communities, and aquatic ecosystems.

Food & Water Watch believes that not all types of aquaculture are suited for the organic label, because not all types of aquaculture will be able to meet bedrock organic principles of minimizing environmental impacts and protecting biodiversity. We believe that the use of wild-caught fish for fishmeal and oil as feed for aquacultured fish is incompatible with the principles of organic production. If only herbivorous fish can meet organic standards, then only herbivorous fish should be allowed to be certified as organic. As we pointed out at the last Board meeting, since the 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 make it worthwhile for the Board to reconsider its recommendations. We also urge the National Organic Program to consider this information before pursuing rulemaking to develop organic standards for aquacultured products. A summary of the new information that has emerged about open net pens and wild fish based feed is attached to this comment.

The appropriate place to start with an organic standard for aquacultured products is with closed, recirculating inland systems raising herbivorous fish. This avoids the problems of open net pens and wild fish based feed, which are incompatible with the principles of organic production.

In addition to urging the Board to reconsider the 2008 recommendations on aquaculture, we do have thoughts on the "trial balloon" process the Materials Committee is conducting on the issue of materials that could eventually be approved for organic aquaculture operations. We are supportive of the comments submitted on this topic by Beyond Pesticides, Center for Food Safety, the National Organic Coalition and the Recirculating Farms Coalition.

First, we have some general thoughts about criteria for evaluating aquaculture materials.

1. The evaluation process for materials to be used in aquaculture production must consider the type of operation – closed systems, in which water is recirculated and does not reach any body of water or open systems, in which the water can flow through the aquaculture operation and then enter the ocean or other body of water. The location of an aquaculture operation in open water means that any material used or waste generated there is very mobile and will quickly move into the surrounding aquatic environment. This is different than farming operations on land, which obviously can impact water quality, but do not immediately and constantly add materials into waterways.

2. Open water systems demand a level of evaluation for materials that specifically addresses the location of the facility and the likelihood that materials used there will end up in the surrounding environment. The impacts of materials added to an aquaculture system must be considered very broadly, to cover not only the animals raised there, but also the resulting water quality in the area where it is located, other marine organisms that could be exposed nearby and changes to the aquatic food web that could be caused by increased nutrients or other discharges from the aquaculture facility. In addition to considering impact of materials on phytoplankton, zooplankton, fish of all trophic levels and larger predators such as sharks that may be drawn to open ocean facilities because of the concentration of food and waste generated there, materials should also be evaluated for impact on the chemistry and ecosystem of the benthic (bottom) layer of the ocean floor.

3. The potential for bioaccumulation of any materials used in aquaculture systems must be considered, not only for the fish raised there, but also up the marine food chain in the area surrounding the facility. This should include the potential for accumulation of materials in the ocean floor beneath the aquaculture facility that serves as habitat for various organisms and the potential for magnification of toxic loads at higher levels of the food chain, as carnivorous fish accumulate the toxic load of the smaller fish and organisms they eat. This evaluation of the potential for bioaccumulation should occur for any materials being approved for aquaculture use, but also for the feed used at the facility, which will end up in the surrounding ecosystem. Because some of the fish from the aquaculture facility should be expected to escape from an open net pen system, and will therefore end up in the food chain of the surrounding water, their contribution to the potential for bioaccumulation of toxic materials should also be considered.

4. The materials evaluation process must consider the purpose of the material. Synthetic materials must not be used to fulfill system functions that should be filled by the underlying ecology of a well-designed system, but should only be permitted as non-routine inputs. It is critical that approved materials not serve as crutch for overcrowded or poorly designed systems.

5. Materials that are intended to change the appearance of fish raised in aquaculture facilities, such as dye fed to farmed salmon to make their flesh appear more pink, should not be approved, no matter if the source is synthetic or natural. The purpose of feeding dye to the fish is to compensate for a disadvantage in appearance that farmed salmon has in

relation to wild salmon, which feed on a diet that naturally gives their flesh more color. Feeding dye to farmed fish to artificially imitate the appearance of wild fish is deceptive to consumers and should not be permitted in any future organic standard, no matter what the source of the dye might be.

6. The materials review process should encompass feed for aquacultured fish. Carnivorous species are more likely to need outside inputs, and will not be able to rely on the underlying ecology of the water in the location of the facility for food. This is why we believe that the best approach to developing organic standards for aquaculture is to start with vegetarian fish that can be grown in closed systems without the high energy demand of carnivorous fish. But if carnivorous fish are to be permitted, the materials review process should cover their feed. The evaluation criteria for feed should include:

- Prohibitions on feed ingredients included in standards for other types of livestock, including no genetically engineered crops used as fish feed.

- The environmental impact of feed production. This is critically important for fishmeal and fish oil. The production of fishmeal and fish oil from wild fish must be evaluated for the impact on wild fish stocks, since the fish used to make fishmeal and oil are often taken from ecologically sensitive species. This consideration of environmental impact is is also important for the development of feeds being proposed as alternatives to fishmeal and fish oil, such as soy. Some research indicates that carnivorous fish fed soy produce more waste than fish fed fishmeal and oil, and thus could potentially be more damaging to the marine environment and seafloor.

- The biodiversity impact of feed production. The production of fishmeal and fish oil from wild fish must be evaluated for the impact on marine ecosystems, since the fish used to make fishmeal and oil are often small species that are critically important links in the marine food chain.

- Potential human health impacts from eating fish with an accumulation of toxic materials from their feed. Fishmeal and oil produced from wild fish are the primary routes of entry for contaminants such as PCBs, dioxin, and methyl mercury into farmed fish. These persistent chemicals can accumulate in the bodies of wild fish and when these fish are converted into meal and oil, the toxins are concentrated in the feed. Studies on cod and salmon show that a large portion of the mercury found in feed accumulates in the edible fillet of farmed fish. It remains unclear if removing contaminants from fishmeal and oil is feasible. Simply requiring that regulatory levels be observed is not offering organic consumers any more protection than the standards used for conventional aquaculture feed.

7. Any new list of materials developed for aquaculture should be separate from other lists and not automatically include materials allowed for other purposes. Materials that are already listed for use for livestock or crops may not necessarily be acceptable for aquaculture uses. Materials should be reviewed individually for aquaculture.

__**Questions about the Development Process for Board Discussion and Public Comment**__

1. Are there international bodies or organizations with a good material review process? If so, who? How could we interact with these entities to address material evaluation issues that we have?

We have not found an international body with a particularly good materials review process for aquaculture. Existing certification programs used in the European Union do not have acceptable materials policies and allow substances like antibiotics to be used that should not be replicated in U.S. organic standards. However, several elements of the IFOAM Aquaculture norms are relevant and should guide the committee's thinking:

> __Animal Nutrition__
> Most of the nutritional needs must be supplied from organic plants and animals appropriate for digestive and metabolic system of the species and that meet their physiological needs.
>
> The system must be designed so that production area comprises entire food with minimal outside inputs.

Taken together, these requirements do not allow for routine use of synthetic or non-organic inputs for feed or other inputs.

> __Prohibitions__
> IFOAM prohibits the following in aquaculture systems:
>
> Prophylactic use of veterinary drugs
> Use of chemical allopathic veterinary drugs and antibiotics
> Synthetic hormones and growth regulators
> Synthetic pesticides and fertilizers

These are prohibitions that should be adopted by the Board. Also experimental veterinary drugs and dyes fed to change fish's flesh color should be prohibited.

> __Location of facility considerations__
> The siting of facilities must include, among other considerations:
>
> Distance to sources of contamination
> Distance to conventional agriculture

Sites near some sources of contamination, particularly nutrient-rich flows, such as those from agricultural runoff or sewage, offer one example of how broad the consideration of materials inputs must be in aquaculture, because of the high mobility of synthetic chemicals in an aquatic environment.

2. How do we ensure that our organic aquaculture material review process is viewed from an aquaculture lens rather than a crop or livestock lens, while not compromising organic farming and environmental principles? In other words, how do we maintain the level of review of materials consistent with crops and livestock uses, while viewing materials in their unique application to aquaculture systems?

The materials review process should incorporate the "Principles for Organic Production and Handling" adopted by the board October 17, 2001. Like organic crop and livestock production, aquaculture operations that are certified organic should rely on the underlying ecology to feed plants and animals, rather than outside inputs. Synthetic materials must not be used to fulfill system functions, but must be used only as non-routine inputs. The materials review process should also take into account the unique aspects of the aquatic environment and aquatic ecosystems in assessing inputs for their impacts on the products of aquaculture, the health of people eating those products, the water quality of the surrounding aquatic environment, and the health of other organisms, from plankton to larger marine animals, in the surrounding environment. This is especially true for open systems where the mobility of an aquatic environment offers unique ability for materials used in aquaculture production, including feed, to enter the surrounding environment immediately and continuously.

3. How can the review of aquaculture materials proceed cautiously while not compromising consumer expectation of the organic label? What do consumers expect from organically produced aquaculture products, and how does that translate into specific requirements concerning materials, e.g., environmental impacts, hormones, organic feed, etc.?

The simplest way to meet consumer expectations for the organic standards is to revisit the recommendations made by the Board in 2008. The use of open net pen production and the allowance of wild fish-based meal and oil do not meet consumer expectations that organic production minimizes environmental impact and promotes biodiversity. Revising the 2008 recommendations on aquaculture is an important first step in ensuring that an organic standard for aquacultured products will not damage the credibility of the organic program for consumers.

Consumers expect that livestock will be fed organic feed and not be fed or treated with hormones or antibiotics. Any standard for organic aquaculture must make sure these materials are not permitted. The Board can best "proceed cautiously" by limiting consideration of organic standards to contained, recirculating inland systems producing plants and herbivorous fish.

Further, the Board can ensure that consumer expectations of organic are met by establishing a strong set of criteria for how materials are evaluated. As the committee considers the criteria for evaluating materials for aquaculture production, we urge them to ensure that antibiotics, hormones, and synthetic anti-microbials, parasiticides and fungicides are prohibited, including:

- Florfenicol (sold as Aquaflor): Antibiotic.
- Formalin (sold as Parasite-S, Formalin-F, Formmacide-B and Paracide-F: Fungicide and parasiticide.
- Sulfadimethoxine and Oremetoprim (sold as Romet 30 and Romet TC): Antibiotic.
- Oxytetracycline Hydrochloride (sold as Oxytetracycline HCL Soluble Powder-343, Terramycin-342, and Tetroxy Aquatic Soluble Powder): Antibiotic.
- Oxytetracycline Dihydrate (sold as Terramycin 2002): Antibiotic.
- Tricaine Methanesulfonate (sold as Finquel and Tricaine-S): Temporary immobilizer.
- Chorionic gonadotropin (sold as chorolun): Injectable hormone used to aid in spawning.
- Chloramine-T: Oxidizing agent being evaluated for use in controlling bacterial infections.
- Diquat: Being evaluated for use in controlling bacterial infections.
- Potassium Permanganate: Used to control parasitic, bacterial and fungal infections.
- Copper Sulfate: Used to control parasitic, bacterial and fungal infections.
- SLICE (emamectin benzoate): Used to control external parasites, particularly sea lice.
- LHRHa: Spawning hormone.
- Common Carp Pituitary: Used to induce maturation in fish.
- 17a Methyltestosterone: Hormone used to produce male populations.
- Ovaplant: Hormone used to induce spawning.
- Catfish Pituitary: Hormone used to induce maturation and spawning.
- Benzoak: Anesthetic or sedative.
- Aqui-S 20E: Anesthetic or sedative.
- Magnesium Sulfate: Solution to treat external nematode and crustacean infections.
- Potassium Chloride: Osmoregulation.
- Povidone Iodine: Egg surface disinfectant and antibacterial.
- Calcium Hypochlorite – Oxidant.
- Aluminum Sulfate – Coagulent.
- Ferric Chloride – Coagulent.
- Chelated Copper – Used to kill unwanted algal growth.

It is important to note that while some of these drugs are only explicitly approved for certain uses or species, some are used as investigational new animal drugs or for other extra-label uses. This should also be prohibited for organic production. Some of these materials are permitted for organic crop production. However, that does not mean they are appropriate for aquaculture production because of the mobility of the aquatic environment and because these materials when added to the water in an aquaculture system will be coming into direct contact with the food.

There are some materials that may be appropriate for aquaculture operations, depending on the use and type of system. Hydrogen peroxide is one example. It is used as a microbicide and can be acceptable for use in controlled setting at allowed levels. However, due to toxicity to the aquatic environment, it is less safe to use in the open ocean than in closed system environments.

Iron is another example. It may be added to aquaculture diets in order to achieve proper nutrient balance or added to closed-containment aquaculture systems in order to promote the growth of beneficial phytoplankton and algae. But iron should not be added as a "fertilizer" to open ocean aquaculture operations or land-based systems that are not entirely contained, due to the possibility of unexpected or uncontrollable eutrophication and algal blooms, which could be disruptive to the aquatic food web.

Other materials designed to stimulate phytoplankton growth may be appropriate for closed systems, but not open systems due to the risk of driving eutrophication in surrounding water that will disrupt the balance of that ecosystem.

Like potassium and other nutrients, calcium is monitored in ponds and closed aquaponic systems to control pH and ensure that plants have the proper nutrients. Some calcium compounds raise toxicity concerns and should not be permitted.

In addition to considering potential toxicity to humans, aquatic animals and aquatic plants, materials should be evaluated for use in open systems for their potential to cause eutrophication. Materials that should not be permitted under this criteria include:

- Ammonium Sulfate
- Ammonium Nitrate
- Sodium Nitrate
- Potassium Nitrate
- Calcium Nitrate
- Triple Superphosphate
- Mono- and di- ammonium phosphate
- Phosphoric Acid
- Potassium Chloride
- Sodium Silicate

Questions Concerning the Material Evaluation Process

1. What criteria are specific to open systems? Closed systems?

Open systems

We do not believe that open water systems can be certified organic. In order for these systems to meet consumer expectations for organic, they must meet high standards of preventing impacts outside the aquaculture system and preventing pollutants from affecting the organic aquaculture system.

In an open system, there is constant flux between the water inside the net pen and the surrounding water. Water-soluble materials have no boundaries, solid materials will fall out of the net pens, and there will be constant movement of algae and small animals in and out of the pens. Frequent escapes of the farmed fish from net pens add to the potential transfer of materials or diseases from the facility to the surrounding environment. Any material added to the system will be an input to the larger ecosystem if extraordinary measures are not taken to confine it.

Since extraordinary measures are needed to contain inputs to an open system, the review of materials should be based on the assumption that the materials will not be contained and will be released into the surrounding environment. Impacts to aquatic plants and larger organisms must be considered. Predators like sharks and other fish are drawn to open net pens by the food and waste found there, addition to escaped fish. The impact of materials on species found on the ocean floor must also be considered.

Because open net pen systems are located in open water, the water in that location is a critical component of the production environment. It is hard to control, even with years of management, unlike farmland. Any consideration of materials on an open system must take into account the likelihood of synthetic chemical pollutants entering the system from open water.

Closed systems

We believe that land-based, contained recirculating aquaculture systems may be able to meet expectations for organic production. But there are still challenges in both preventing unwanted toxic inputs and preventing impacts on the surrounding environment that must be addressed when materials are being evaluated.

Materials destined for use in closed systems must be evaluated for the potential to accumulate in the fish or in the other organism or plants found in the system, because as the water is recirculated, there is less or no loss of the material to the surrounding environment. Therefore, the consequences of recirculating the material throughout the system after it is first used must be considered, and care must be taken not to use more of any material than is needed.

When ponds or tanks are emptied and cleaned, the water should be of a quality that does not have negative impacts on any receiving water in the environment. One criteria for evaluating materials, even in closed systems, is the ecological impact when water is discharged—either purposely or accidentally.

Any waste that is generated by closed systems should be treated carefully, in a manner similar to livestock manure, before it is incorporated into terrestrial crop production.

2. Which evaluation questions in current crops/livestock evaluations are relevant to aquaculture materials?

Category 1. Adverse impacts on humans or the environment?

1. Are there adverse effects on environment from manufacture, use, or disposal?

This evaluation should include the potential impact on the aquatic environment surrounding open facilities, the potential impact of catching wild fish for fishmeal and oil, the potential impact from closed facilities from discharge of water when tanks or ponds are cleaned or emptied, and the potential impact when waste is removed from closed systems.

2. Is there environmental contamination during manufacture, use, misuse, or disposal?

This evaluation should include the potential impact on the aquatic environment surrounding open facilities, the potential impact of catching wild fish for fishmeal and oil, the potential impact from closed facilities from discharge of water when tanks or ponds are cleaned or emptied, and the potential impact when waste is removed from closed systems.

3. Is the substance harmful to the environment and biodiversity?

The evaluation of harm to the environment should include not only the aquatic environment surrounding open facilities, including water quality and the benthic environment beneath the facility, but also the full range of animals and organisms in the area, including the birds, mammals and other animals drawn to these facilities. For closed systems, consideration must include the environment where any occasional discharge will go and the environment where any waste will be disposed of or used as a fertilizer.

4. Does the substance contain List 1, 2, or 3 inerts?

5. Is there potential for detrimental chemical interaction with other materials used?

8. Is there a toxic or other adverse action of the material or its breakdown products?

The degradation pathways and persistence of materials being evaluated must be determined specifically in aquatic systems.

9. Is there undesirable persistence or concentration of the material or breakdown products in the environment?

It is particularly important to consider the persistence of materials in an aquatic environment, for both open systems and closed systems where materials will be recirculated. The potential for bioaccumulation up the food chain is also critically important for both the fish being produced in the aquaculture facility and those in the surrounding environment that may be exposed to the material from an open system.

10. Is there any harmful effect on human health?

The issue of residues present in the fish produced by the facility, or in wild caught fish in the surrounding area, must be considered. This is especially true for the persistent toxins found in the aquatic food chain such as mercury, PCBs and dioxin.

Category 2. Is the Substance Essential for Organic Production?

1. Is the substance formulated or manufactured by a chemical process?

2. Is the substance formulated or manufactured by a process that chemically changes a substance extracted from naturally occurring plant, animal, or mineral sources?

3. Is the substance created by naturally occurring biological processes?

7. Is there a wholly natural substitute product?

9. Is there any alternative substance?

10. Is there another practice that would make the substance unnecessary?

This is a critical question that should be used to evaluate materials intended for use in aquaculture. The purpose for the material is a critical factor that must be evaluated. Materials should not be approved for routine use that can serve as a crutch for poorly designed or overcrowded systems, or to push production to the point that environmental or other impacts are exacerbated.

Category 3. Is the substance compatible with organic production practices?

2. Is the substance consistent with organic farming and handling, and biodiversity?

We would urge the board to consider aquaculture feed as well as impacts on the surrounding environment.

3. Is the substance compatible with a system of sustainable agriculture?

This question should also drive an evaluation of aquaculture feed for carnivorous fish. The use of wild fish-based meal and oil is not sustainable because it is depletes ecologically sensitive species that are a foundation of many marine food chains, and because it is not efficient, resulting in a net loss of protein (in which a pound of wild fish based feed results in less than a pound of aquacultured fish.)

Other materials can be considered in this lens, especially if materials are being proposed for routine use as a way to substitute inputs that should be available from the underlying environment in a well-designed system.

7. Is the substance used in production and does it contain an active synthetic ingredient in the following categories:

a. copper and sulfur compounds
b. toxins derived from bacteria
c. pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins, and minerals?
d. livestock parasiticides and medicines?
e. production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleaners?

3. Which evaluation questions do not apply, or need to be modified?

Category 1. Adverse impacts on humans or the environment?

6. Are there adverse biological and chemical interactions in agro-ecosystem?

This should be defined in the context of an aquaculture system. It could include oxygen depletion, or any biological or chemical change that would lead to a need for intervention, such as fungus or disease control or "balancing" chemistry levels of the water in the facility to maximize production.

7. Are there detrimental physiological effects on soil organisms, crops, or livestock?

Organic aquaculture, like other forms of organic agriculture, must rely on the underlying ecology to feed plants and animals, rather than outside inputs. Synthetic materials must not be used to fulfill system functions, but must be only non-routine inputs. Therefore, we suggest the following modification:

> 7. Are there detrimental physiological and ecological effects on aquaculture crops, animals, or the organisms supporting the aquatic system?

Category 3. Is the substance compatible with organic production practices?

6. Is the primary use to recreate or improve flavors, colors, textures, or nutritive values lost in processing (except when required by law, e.g., vitamin D in milk)?

This is a question worth adding to any list of criteria used to evaluate materials for use in aquaculture. One example of a material that should not be allowed in organic aquaculture under this criteria would be dyes fed to farmed carnivorous fish like salmon, in order to make their flesh appear pink. The purpose of the dyes, no matter if their source is synthetic or from natural sources, is to mask a deficiency in the color of farmed salmon when it is compared to wild salmon. This is deceptive to consumers and should not be allowed in organic production.

4. What new questions need to be asked about aquaculture materials?

Does the material contain bioconcentrating synthetics? There is some precedent for giving special consideration to chemicals that concentrate in the food supply, such as the pesticide residue in processed foods. Similarly, bioaccumulative synthetic chemicals should be considered as synthetic inputs into an aquaculture system when they concentrate above the levels found in the ambient water through the addition of these chemicals from feed made from fishmeal or oil.

5. What information needs to be considered in assessing the essentiality of a material in the context of cultural practices as they apply to water instead of soil ecosystems?

If an aquatic system is managed according to organic principles, it will promote and enhance biodiversity and biological cycles. It will promote and enhance those elements of an aquatic ecosystem that support plant and animal growth, without requiring outside inputs or synthetic materials to fulfill system functions. Synthetic materials, if used, will not be routine.

6. Do different questions need to be asked about carnivorous and herbivorous fish? Carnivorous fish pose additional problems, as has been pointed out by commenters. Because of the bioaccumulation of toxic chemicals, it is difficult to find clean natural foods for carnivorous fish.

Bioaccumulative toxic contaminants in fish used for feed must be considered to be synthetic additives when they are in feed used in aquaculture. The difficulty in finding clean natural foods for carnivorous fish is a compelling reason to exclude carnivorous fish from organic certification and to revisit the 2008 recommendation to focus organic certification on herbivorous fish raised in closed systems.

Thank you for the opportunity to comment on this issue.

Sincerely,

Patty Lovera
Assistant Director
Food & Water Watch

Attachment to Food & Water Watch Comment on Materials Committee Proposed Discussion Document "Aquaculture Materials Review Update"

New Information on Aquaculture Impacts

Food & Water Watch submits the following information, based on recent academic literature as well as reports from several operating open water finfish aquaculture facilities, to encourage the Board to reconsider the aquaculture recommendations made in 2008 (Final Recommendation on Aquaculture on Fish Feed & Related Issues and Final Recommendation on Aquaculture on Net Pens & Related Issues.)

We believe that this information is significant enough to give the Board adequate justification to reconsider its 2008 recommendations. We also urge the National Organic Program to consider this information before it pursues rulemaking to develop organic standards for aquacultured products.

Open Net Pens

It is important to review the troubled history of open net pens internationally, and introduce recent research that provides new reason 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, it is premature 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] One study has suggested that fish farms should be located at least 400 meters (one-quarter mile) from sensitive habitats,[2] and another has observed detectable effects on the seafloor as much as 907 meters away from fish cages.[3]

Recent research shows that this impact may even 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 Oahu 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, research released in June 2011 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 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 to conclusions that such impacts do not exist.

Natural behavior and aggregation of marine wildlife

In addition to ongoing concerns about whether farmed fish in net pens or 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 a 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]

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]

Far from a complete list, these are in fact just a few of the dozens of major escape events that take place every year in the open water aquaculture industry internationally. Few of these reports go fully documented, but of those that do, 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."[22]

Even more worrisome, 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.[23] This is highly significant as it is evidence of a new form of "escape" by marine fish being raised to maturity in net pen enclosures. Experiments have 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.[24]

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[25] — 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.

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.[26]

The Infectious Salmon Anemia (ISA) virus has also spread across the globe – most likely through Atlantic salmon eggs exported from Europe to farms in other regions. This virus was first discovered after an outbreak in Norwegian farms in 1996. In 2007, it devastated the Chilean salmon farming industry.[27] Most recently, the virus has been found in British

Columbia, Canada. Scientists warn that it is not only dangerous to Pacific Canadian salmon farms, but also to wild salmon and herring populations.[28]

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.

The problem of disease in open net pen farms also raises questions about how realistic it can be to expect that farms can avoid all use of chemicals and antibiotics. When disease strikes, fish farmers are forced to take chemical action regardless of whether they would prefer to have an organically-certifiable product. Antibiotics, generally applied by way of medicated baths and medicated food, can enter the environment around cages, where they may alter the composition of marine bacteria.[29] Evidence suggests that these antibiotic-resistant bacteria can, in turn, pass on their antibiotic resistance genes to other bacteria, including human and animal pathogens.[30] An increasing number of studies have documented elevated levels of bacterial antibiotic resistance in, around and because of aquaculture operations. For example, in the United Kingdom before 1990 the bacteria *Aeromonas salmonicida* were sensitive to amoxicillin. After the antibiotic was introduced to fish farms, amoxicillin-resistant strains began to appear.[31] Even if organic standards ban fish exposed to antibiotics and chemicals from being sold under an organic label, they may support an industry that will periodically have to succumb to chemical use.

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

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 study of salmon found that 13 out of 14 organochlorine contaminants are more common in farmed salmon than wild salmon, which the authors attributed largely to the concentrated diet fed to the former.[32] A 2009 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%."[33] 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%."[34]

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 fish-based 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."[35]

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.

<u>Soy as an Alternative Feed</u>

One potential option to minimize the use of wild fish in aquaculture feed and reduce the risk of contamination is to replace part of the fishmeal and oil in commercial fish feed with soy meal. However, this option does not necessarily resolve concerns about compatibility with organic principles. Fish fed soy produce more waste than fish fed fishmeal and oil, and thus could potentially be more damaging to the marine environment and seafloor.[36] And because 94 percent of soy grown in the United States is genetically modified, it will be difficult for aquaculturists to find a source of soy that could be used in organic feed.[37]

<u>Conclusion</u>

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. Since the Board made recommendations on these two issues in 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 these recommendations into question. We urge the Board 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 as well as not allow the use of wild fish or fishmeal as feed.

If these criteria can only be met by closed inland systems raising vegetarian fish such as shrimp or tilapia, then that is an appropriate place for the organic aquaculture industry to start. We propose this idea because such systems can provide experience with organic aquaculture systems while minimizing known problems associated with aquaculture systems outside of this scope. We suggest that any standards for aquaculture must include:

- Regulation and monitoring of control inputs, outputs, and fish health and welfare.
- Feeding 100 percent organic feed, as required for all organic livestock and poultry producers. Wild fishmeal and oil must be prohibited in feed.
- Escapes of farmed fish into inland waterways or the ocean must be prohibited.
- Fish must be reared in closed, recirculating systems that do not release waste or water into waterways.
- Aquaculture wastes can be used on farms as fertilizers provided that run-off is contained and does not reach inland waterways or the ocean. Wastes from organic aquaculture facilities must be composted and otherwise managed in the same way that livestock waste is required to be handled under the organic standards.
- Stocking rates for organic herbivorous fish must avoid overcrowding.
- Antibiotics, genetically engineered inputs, hormones and any other substances that are prohibited under OFPA cannot be used in certified organic aquaculture systems, without exception. This includes antibiotics administered directly to fish or added to feed and water. Extra-label uses of drugs and experimental drugs must also be prohibited.

---

[1] Holmer, Marianne, et al. "Monitoring of Environmental Impacts of Marine Aquaculture" in *Aquaculture in the Ecosystem*. (2008). New York, NY: Springer Science + Business Media B.V. at 47-85; Pérez, Marta, et al. "Physiological responses of the seagrass *Posidonia oceanica* as indicators of fish farm impact." *Marine Pollution Bulletin* 56 (2008) at 869-879; Holmer, Marianne, et al. "Effects of fish farm waste on *Posidonia oceanica* meadows: synthesis and provision of monitoring and management tools." *Marine Pollution Bulletin* 56 (2008) at 1618-1629; Gambi, Cristina, et al. "Biodiversity response to experimental induced hypoxic-anoxic conditions in seagrass sediments." *Biodiversity and Conservation* 18 (2009) at 33-54; Yoza, Brandon A., et al. "Impact of mariculture on microbial diversity in sediments near open ocean farming of *Polydactylus sexfilis*." *Ecological Indicators* 7 (2007) at 108-122; Dempster, Tim and Pablo Sanchez-Jerez. "Aquaculture and Coastal Space Management in Europe: An Ecological Perspective" in *Aquaculture in the Ecosystem*. (2008). New York, NY: Springer Science + Business Media B.V. at 87-116; Giles, H. "Using Bayesian networks to examine consistent trends in fish farm benthic impact studies." *Aquaculture* 274 (2008) at 181-195.

[2] Holmer, Marianne, et al. "Effects of fish farm waste on *Posidonia oceanica* meadows: synthesis and provision of monitoring and management tools." *Marine Pollution Bulletin* 56 (2008) at 1627.

[3] Forchino, Andrea et al. "Evaluating the influence of off-shore cage aquaculture on the benthic ecosystem in Alghero Bay (Sardinia, Italy) using AMBI and M-AMBI." *Ecological Indicators* 11.5 (2011) at 1112-1122.

[4] Apostolaki, Eugenia T., et al. "Metabolic imbalance in coastal vegetated (*Posidonia oceanica*) and unvegetated benthic ecosystems." *Ecosystems* 13 (2010) at 459-471; Sarà, G., et al. "Impacts of marine aquaculture at large spatial scales: Evidences from N and P catchment loading and phytoplankton biomass." *Marine Environmental Research* (2011); Holmer, Marianne, et al. "Effects of fish farm waste on *Posidonia oceanica* meadows: synthesis and provision of monitoring and management tools." *Marine Pollution Bulletin* 56 (2008) at 1623.

[5] Gambi, Cristina, et al. "Biodiversity response to experimental induced hypoxic-anoxic conditions in seagrass sediments." *Biodiversity and Conservation* 18 (2009) at 33-54.

[6] Lin, David T. and Julie H. Bailey-Brock. "Partial recovery of infaunal communities during a fallow period at an open-ocean aquaculture." *Marine Ecology Progress Series* 371 (2008) at 70-71.

[7] Sarà, G., et al. "Impacts of marine aquaculture at large spatial scales: Evidences from N and P catchment loading and phytoplankton biomass." *Marine Environmental Research* 71.5 (2011) at 317-324.

[8] Sarà, G., et al. "Impacts of marine aquaculture at large spatial scales: Evidences from N and P catchment loading and phytoplankton biomass." *Marine Environmental Research* 71.5 (2011) at 317-324.
[9] Dempster, Tim and Pablo Sanchez-Jerez. "Aquaculture and Coastal Space Management in Europe: An Ecological Perspective" in *Aquaculture in the Ecosystem*. (2008). New York, NY: Springer Science + Business Media B.V. at 97.
[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.
[11] Dempster, Tim and Pablo Sanchez-Jerez. "Aquaculture and Coastal Space Management in Europe: An Ecological Perspective" in *Aquaculture in the Ecosystem*. (2008). New York, NY: Springer Science + Business Media B.V. at 99.
[12] Dempster et al., unpublished data appearing in Dempster, Tim and Pablo Sanchez-Jerez. "Aquaculture and Coastal Space Management in Europe: An Ecological Perspective" in *Aquaculture in the Ecosystem*. (2008). New York, NY: Springer Science + Business Media B.V. at 100.
[13] Yates, Chris E. Protected Resources Division of National Marine Fisheries. Public comment re: Draft EA/CDUA HA-3443 for the Expansion of Kona Blue Waters Farms Offshore Aquaculture Facility. 4 February 2008. On file with Food & Water Watch.
[14] Yates, Chris E. Protected Resources Division of National Marine Fisheries. Public comment re: Draft EA/CDUA HA-3443 for the Expansion of Kona Blue Waters Farms Offshore Aquaculture Facility. 4 February 2008. On file with Food & Water Watch.
[15] Yates, Chris E. Protected Resources Division of National Marine Fisheries. Public comment re: Draft EA/CDUA HA-3443 for the Expansion of Kona Blue Waters Farms Offshore Aquaculture Facility. 4 February 2008. On file with Food & Water Watch.
[16] Polhemus, Dan. [March 2008] Division of Aquatic Resources. Public comment to Sam Lemmo, Office of Conservation and Coastal Lands, re: Draft EA/CDUA HA-3443. 3 March 2008.
[17] Polhemus, Dan. [March 2008] Division of Aquatic Resources. Public comment to Sam Lemmo, Office of Conservation and Coastal Lands, re: Draft EA/CDUA HA-3443. 3 March 2008.
[18] Cottee, Stephanie Yue, and Paul Petersan. "Animal welfare and organic aquaculture in open systems." *Journal of Agricultural and Environmental Ethics* 22 (2009) at 437-461.
[19] Witte, Benjamin. "Thousands of salmon and trout escape in southern Chile." *The Patagonia Times*, January 19, 2009.
[20] Lavoie, Judith. "40,000 fish escape farm." *The Times Colonist*, October 24, 2009.
[21] Grindheim, Joar. "Costly salmon escape." *IntraFish Media*, October 15, 2010.
[22] Jensen, Ø., et al. "Escapes of fish from Norwegian sea-cage aquaculture: causes, consequences and methods to prevent escape." *Aquaculture Environmental Interactions* 1 (2009).
[23] Jensen, Ø., et al. "Escapes of fish from Norwegian sea-cage aquaculture: causes, consequences and methods to prevent escape." *Aquaculture Environmental Interactions* 1 (2009).
[24] Jørstad, Knut E. "'Escapes' of eggs from farmed cod spawning in net pens: Recruitment to wild stocks." *Reviews in Fisheries Science* 16 (2008) at 293.
[25] "Fish inbreeding causes concern." *Fish Information Services*, October 30, 2009.
[26] "Global advance of shrimp virus follows evolutionary biology predictions." *Science Daily*, November 2, 2010.
[27] "Chile's ISA outbreak originated in Norway." *Seafood Source*, July 21, 2009; and Murias, Analia. "The ISA virus that hit Chile came from Norway, claims study." *Fish Information Services*, September 17, 2010.
[28] "Lethal European Fish Virus Found in Canada." *AFP*, October 17, 2011.
[29] Chelossi, Elisabetta. "Antibiotic resistance of benthic bacteria in fish- farm and control sediments of the Western Mediterranean." *Aquaculture,* vol. 219, April 2003 at 84.
[30] Heuer, Ole. e. *et al.* "Human Health Consequences of Use of Antimicrobial Agents in Aquaculture," *Clinical Infectious Diseases,* vol. 49, no. 8, 2009 at 1248-49.
[31] Sapkota, Amir et al. "Aquaculture Practices and Potential human health Risks: Current Knowledge and Future Priorities." *Environment International,* vol. 34, 2008 at 1219.
[32] Hites, Ronald A. et al. "Global Assessment of Organic Contaminants in Farmed Salmon." *Science,* vol. 303, January 2004 at 226-229.
[33] Saera-Vila, Alfonso, et al. "Assessment of the health and antioxidant trade-off in gilthead sea bream (*Sparus aurata* L.) fed alternative diets with low levels of contaminants." *Aquaculture* 296 (2009) at 91.

[34] Berntssen, Marc H.G., Kåre Julshamn, and Anne-Katrine Lundebye. "Chemical contaminants in aquafeeds and Atlantic salmon (*Salmo salar*) following the use of traditional- versus alternative feed ingredients." *Chemosphere* 78 (2010) at 637.
[35] Naylor, Rosamond L., et al. "Feeding aquaculture in an era of finite resources." *Proceedings of the National Academy of Sciences* 106:36 (September 8, 2009) at 15104.
[36] Gatlin, Delbert et al. "Expanding the utilization of sustainable plant products in aquafeeds: a review." *Aquaculture Research*, vol. 38. 2007 at 557, 558 and 566.
[37] "Adoption of Genetically Engineered Crops in the U.S.: Soybean Varieties." Data Set, Economic Research Service, United States Department of Agriculture, July 2011.