Performance Metrics for Net Pen Production of Organic Fish:
A Discussion Paper

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Introduction

The potential development of organic standards by USDA for certification of carnivorous (i.e. predatory) finfish grown in open, net pen systems has been extremely contentious because of the apparent inconsistency between the principles of organic agriculture and the demonstrated environmental risks of open net pen farming systems, as well as ecological concerns about heavy use of fisheries products in aquaculture feeds. We hosted a small workshop of organic experts to explore whether performance-based metrics could be developed to bridge the gap between the ecological protections inherent in organic agriculture principles and net pen production of fish. The standards that emerged from this process neither favor the industry explicitly nor fall entirely on the side of precaution. They represent the intersection of purity and pragmatism, in attempt to deliver the business benefits of organic production with the sustainability goals that must be at the heart of our entire food production system. While we did not entirely meet our goal, we hope the NOSB considers these standards in the spirit in which they were conceived – as an experiment in creative thinking designed to be a win-win for business, consumers, and the environment. We look forward to discussing their relative strengths and weaknesses with you, the other members of the panel and our environmental and industry colleagues in attendance in November.

Principles of Organic Farming

The growth of industrial agriculture and its reliance on monocultures of plants, synthetic fertilizers, and chemical pesticides to boost yield fueled the emergence of organic farming as an alternative food production system. As originally envisioned and practiced, organic farming was founded on the principles of ecology, where recycling of wastes and natural defenses against disease were favored. Sir Albert Howard's influential "An Agricultural Testament", published in 1940, summed up the concept of organic farming as an imitation of nature:

> "Mother earth never attempts to farm without live stock; she always raises mixed crops; great pains are taken to preserve the soil and to prevent erosion; the mixed vegetables and animal wastes are converted into humus; there is no waste; the processes of growth and the processes of decay balance one another; the greatest care is taken to store the rainfall; both plants and animals are left to protect themselves against disease."

With the publication of Rachel Carson's evocative "Silent Spring" and the rapid rise in the organic industry in the U.S. over the last two decades, the passage of the Organic Food Production Act of 1990 empowered the United States Department of Agriculture to codify organic farming principles and practices. These principles (NOSB 2001) are

largely consistent with the farming ethic articulated by Howard years earlier. Organic agriculture is identified as an ecological management system that promotes and enhances biodiversity, biological cycles and soil biological activity. The goal of this type of farming is a harmonious relationship between land, plants and livestock through the provision of good quality organic feed, maintenance of appropriate stocking rates, and the promotion of animal health and welfare while minimizing stress. In contrast to traditional agriculture, organic farming avoids the routine use of chemical allopathic veterinary drugs, including antibiotics. It minimizes off-farm inputs through recycling of materials of plant and animal origin and utilizes only breeds or varieties that are well-adapted to the region. As genetic engineering is a synthetic process to control nature at the molecular level, its use is not deemed to be compatible with organic agriculture.

Sustainability Challenges of Open Net Pen Production

As the NOSB and its Aquaculture Working Group (AWG) have worked to apply these basic principles to the organic farming of fish, a number of conceptual challenges have arisen for some methods of production. Most notably, the potential certification of species that are heavily dependent on wild fish inputs as feed and farmed in open net pen systems is viewed by many as fundamentally inconsistent with the ideals of organic production as laid out by Howard and the USDA. This is largely because of a host of environmental impacts that are now well-documented in the peer-reviewed scientific literature. These impacts fall into five major categories:

- Use of Marine Resources for Feed
- Risk of Escaped Fish to Wild Stocks and Ecosystems
- Risk of Pollution and Habitat Effects
- Impact on Predator Populations
- Risk of Disease and Parasite Transfer

Organic farming requires the use of organic feed, but catching wild fish is generally viewed as incompatible with organic principles. Wild fish, including those caught to produce fish meal and fish oil for feed, can not be managed in any way that is reasonably consistent with the concept of farming, whether organic or conventional. Wild fish are at liberty their entire lives and only come under human control at the time they are caught by fishermen. The concept of farm tenure is not applicable for wild fish and their health and welfare is entirely out of human control. While the OFPA was amended in 2003 by Senator Stevens to allow wild fish to be certified organic, this legal assertion is fundamentally at odds with existing organic principles. .

Production of carnivorous farmed fish has risen sharply in the last several decades (Naylor *et al.* 1998; Naylor *et al.* 2000). Naylor and Burke (2005) concluded that if the farming of carnivorous fish continues to grow at its current rate, the demand for fish oil is expected to outstrip supply within a decade, while a similar result is expected for fish meal by 2050. The growth of carnivorous fish farming is thus expected to put additional pressure on wild forage fish stocks, a concept that is at odds with a harmonious relationship between the farm and the broader ecosystem and the goal of organic production to promote biodiversity and ecosystem function. Furthermore, a number of

leading scientists have warned about the inherent unsustainability of "farming up the food web", because of the relatively inefficient use of marine resources, all of which are already used by humans (commercially) or other organisms (e.g. Pauly *et al.* 2002; Pauly *et al.* 2005). Although some would conclude that many forage fisheries are presently sustainable, present fisheries science models do not adequately incorporate the importance of small pelagic fish in the wider ecosystem (Tacon 2005). The ecosystem sustainability of forage fisheries must be addressed before the farming of species heavily dependent on these forage fish inputs can be compatible with organic principles.

Open net pen systems have a scientifically-documented track record of ecological impact or risk of ecological impact, which presently puts this production system at odds with organic farming principles. Although the bulk of this evidence comes from the salmon farming industry, the general principles apply broadly to other marine species at similar trophic levels (e.g. cod, halibut, sablefish, tuna, etc) that are becoming commercially viable through the use open net pens. Concerns may also apply to net pen production of freshwater low trophic level species such as tilapia, although the impact of these production systems is not well studied or understood. Because net pens are open systems (where water flows freely through the farm to the surrounding ecosystem), their use regularly results in the escape of farmed fish, the release of nutrients and applied theurapeutants, and the amplification and transfer of disease or parasites on the farm site.

Escaped farmed salmon have been shown to pose risks to wild stocks and ecosystems through interbreeding, competition for food and spawning sites, and the introduction of exotic species (Youngson and Verspoor 1998; Volpe and Anholt 1999; Fleming et al. 2000; Volpe et al. 2000; Jacobsen et al. 2001; Einum and Fleming 1997; Volpe et al. 2001; McGinnity et al. 2003; Hindar et al. 2006). Nitrogen and phosphorus effluents and fecal matter from a single open net pen are roughly equivalent to the nutrient inputs of a city of 20,000 - 65,000 people (Hardy 2000). Dissolved nutrients (from excess feed as well as fish excretion) flow freely beyond the farm tenure (Cripps and Kelly 1996) while particulate matter settles to the bottom where it can substantially alter both the chemistry and biodiversity of the farm's benthic habitats (Hargrave et al. 1997; Pohle and Findlay 2001; Sutherland et al. 2001).

The elevated density of farmed fish in net pens (relative to wild populations) can readily incubate diseases and parasites first contracted from nearby wild fish. Most notably, salmon farms have been shown to act as an important source of sea lice (Hastein and Lindstad 1991; Berland 1993; Tully et al. 1993; Tully and Whelan 1993; Birkeland 1996; Costelloe et al. 1996; Grimnes and Jakobsen 1996; Birkeland and Jakobsen 1997; Bjorn and Finstad 1997; Jacobsen and Gaard 1997; Tingley et al. 1997; MacKenzie et al. 1998; Gargan 2000; Bjorn et al. 2001; Heuch and Mo 2001; Bjorn and Finstad 2002; Butler 2002; Morton et al. 2004; McKibben and Hay 2004; Penston et al. 2004; Krkosek et al. 2005; Morton et al. 2005) that can dramatically reduce the survival of juvenile wild salmon in the vicinity of farms (Krkosek et al. 2006). Finally, current farming practices designed to reduce the impact of seal and sea lion predators on farmed fish (i.e. deploying predator nets and the use of underwater acoustic deterrent devices) can have dramatic unintended consequences including the entanglement and drowning of large numbers of

these air-breathing mammals and alterations in natural behavior (Morton and Symonds 2002; Wursig and Gailey 2002; CBC News 2007).

All of these scientifically-documented impacts are counter to the principles of organic production. Escaped fish and disease/parasite transfer reduce the biodiversity of surrounding ecosystems. Although disease/parasite transfer can be somewhat controlled by the use of synthetic chemicals such as antibiotics and parasiticides (e.g. Slice, Ivermectin), the use of these chemicals is itself counter to organic principles. To date, management practices for open net pens do not result in the recycling of nutrient effluents within the farm tenure and, if poorly managed, these effluents can dramatically reduce the biodiversity of the farm's benthic habitats. Although there is no provision within the OFPA for the killing of farm predators, deaths of marine predators such as seals and sea lions are clearly counter to consumer expectations that organic products should be "good for me and good for the environment".

Methods and Materials

While these challenges suggest that current net pen systems are not compatible with organic principles, performance-based metrics may be a viable tool to greatly reduce environmental risks and establish production systems that are consistent with the principles of organic production. While USDA's organic certification system is presently more production than performance-based, the latter approach may be an option for open net pen systems where environmental risks are an inherent and unavoidable aspect of current technology.

The goal of such performance standards is to establish criteria for organic production which are consistent with organic ideals. Some of these criteria may not be achievable presently for many net pen systems, which were not, of course, designed with organic production in mind. In fact, the lack of history of organic aquaculture suggests that some aquaculture systems may have to evolve in new and innovative ways before they can be considered organic. Thus, the draft performance standards we propose may not be achievable by any current net pen system. An alternative to simply "saying no" to organic net pens because of current problematic production practices, establishment of strict performance goals may foster the development of new and innovative ecologically-based production systems.

We hosted a 2-day workshop in July 2007 in New York City to explore this issue in detail. We brought together a group of about twenty stakeholders who were willing to engage constructively in the organic/net pen debate. While many participants had strongly entrenched perspectives in this debate, the only prerequisite for their participation was a willingness to not be obstructionist. In advance of the workshop, we developed straw proposals for organic production in net pens and the use of wild feed. As a group, we modified and adjusted these based on communal feedback and discussion. While not a consensus – based process, we strove to incorporate as much feedback as possible in the draft performance metrics presented here. It is important to note that there was not complete agreement on these proposed performance standards and participants

did not "sign onto" or otherwise endorse them. The responsibility for their usefulness or futility of this approach is entirely our own.

Below, the standards are presented in their entirety. A detailed discussion follows that identifies how the standards either match the organic ideal or alternatively, where their utility is limited.

Performance Based Standards for Organic Net Pen Aquaculture

1) Risk of Escaped Fish to Wild Stocks

As in the current AWG proposal, escape prevention systems must be designed and implemented to eliminate the escape of farmed fish. Only native fish of local genotype shall be cultured. Non-native species or native species with significant genetic divergence compared to wild stock (i.e. due to selective breeding or other processes), may not be certified as organic if produced in net pens.

Definitions:

- Native Species: Species endemic to the local area of culture.

- Local Genotype: Fish spawned from a group of broodstock, with no broodstock fish beyond the F1 generation[1] and local, wild fish added to the broodstock every year.

2) Risk of Pollution and Habitat Impacts

Multiple species of aquatic plants and animals - all native species of local genotype - shall be raised in an integrated aquaculture system so that at least 50% of dissolved nutrients and organic material shall be recycled within the farm tenure. Farm level effluents and the potential influence of other farms (both conventional and organic) must be shown not to exceed the natural assimilative capacity of the surrounding ecosystem. In all cases, benthic habitats under net pens must be shown to not have significant measurable changes in chemistry and biodiversity.

Transition Period: Following publication of the final standards, an eight year transition period shall be allowed, starting with a 10% baseline recycling requirement, and biannual increases of 10% to achieve the 50% benchmark.

3) Impact on Predator Populations

As in the current AWG proposal, a comprehensive integrated predator management plan, which employs non-lethal deterrents as a first course of action, shall be developed and implemented as part of the organic farm plan. Underwater acoustic deterrent devices of any kind shall not be used.

No intentional killing of marine mammals or other predators of farmed fish shall occur unless human safety is immediately threatened. Farms that experience more than a rare[2]

[1] This recommendation is consistent with the January 2007 Marine Aquaculture Task Force report, recommendation 9, page 56.

marine mammal death due to entanglement or other accidental cause shall lose organic certification.

4) Risk of Disease and Parasite Transfer

Fish in net pens must not exhibit clinical signs of disease and must not be treated with synthetic animal drugs except those listed under 205.603 "Synthetic substances permitted for use in organic livestock production to be deemed organic". However, fish which do show clinical signs of disease must be treated as necessary for their welfare. Whether or not diseased fish are treated, they may not be sold as organic.

5) Use of Marine Resources for Feed

One hundred percent of agricultural products used in feed, including fisheries inputs,[3] shall be organic. Feed may include slaughter byproducts from organically grown poultry, but not from mammals.

Transition period to 100%: Following publication of the final standards, there will be an eight year transition period during which time the ratio of wild fish inputs to farmed fish outputs, or fish conversion efficiency (FCE), shall decline yearly from a maximum of no more than one:one to zero:one.[4] During this time period fish meal and fish oil shall be sourced preferentially from:

Byproducts from sustainable food grade fisheries OR, barring that,
Sustainably managed forage fish fisheries.

Sustainability shall be defined as a target species whose biomass is at or above that needed to achieve maximum sustainable yield (B_{msy}) under a fishery management plan that includes ecosystem-based management measures OR is eco-certified by a third party certifier compliant with FAO's "Guidelines for the Ecolabelling of Fish and Fishery Products from Marine Capture Fisheries" (FAO 2005).

Policy Statement: Until the transition period expires, USDA shall amend its 2005 guidance concerning the status of fish meal from wild fish as a "natural" product to make clear that this guidance a) extends to fish oil, and b) is issued in the absence of US organic standards for wild caught fish

Transition Period

To ensure a track record of compliance to the performance based metrics, a 3-year period of compliance to all standards, along with the usual 3 year prohibition on application of prohibited substances, is required before an aquaculture net pen system can be eligible for organic certification.

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[2] Rare is defined as one predator mortality event per certification period (i.e. 5 years) and no killing of any cetaceans at any time.

[3] Senator Stevens' 2003 amendment to the Organic Foods Production Act stating that wild fish are eligible for organic certification means that wild fish are legally an agricultural product.

[4] FCE shall be calculated as recommended in the January 2007 report of the Marine Aquaculture Task Force, *Sustainable Marine Aquaculture: Fulfilling the Promise; Managing the Risks*. See pages 92-93. www.whoi.edu/sites/marineaquataskforce

Discussion

A Higher Standard for Organic Aquaculture

The standards presented above and discussed below represent a very high performance bar for open net pen systems – one that will likely be difficult for most producers to meet. This high bar is necessary for several reasons. First, net pen systems have a well-documented track record of environmental impacts. Production based standards (e.g. best management practices) have generally not been successful at reducing these risks. Strict performance standards will limit entry into the organic market to the few truly innovative producers can achieve success on the five metrics proposed. Secondly, open net pens are usually located in public waters, a resource that is held in public trust for all users. This is in contrast to terrestrial farms which are generally located on private lands: violation of organic and/or ecological principles on those lands has less direct impact on public resources compared to open marine waters. For this reason, organic net pens must be held to a higher standard than organic terrestrial farms.

Risk of Escaped Fish to Wild Stocks

As currently practiced, farming in open net pen systems poses inherent environmental risks that are generally inconsistent with organic production. Salmon farming's track record of leakage (continuous low level escapes) as well as catastrophic escape events due to weather and human error demonstrates that open net pens will never be escape-proof. However, our requirement to raise only native species of local genotype substantially reduces the threat to marine ecosystems of those fish that will inevitably escape. While the risk is clearly not eliminated, it would put organic production on par with many fish stocking programs designed to enhance fish populations that are under threat from historical overfishing, habitat destruction or other causes. It would be disingenuous to not acknowledge that the use of hatchery practices is coming under increasing scrutiny as more is learned about fish population genetics and unintentional selection within hatcheries (e.g. Araki et al. 2007). However, only use of more closed systems, where fish are raised in fully-enclosed tanks or, for example, ponds on land, would further reduce this threat.

We acknowledge that this standard would likely eliminate a large fraction of present day open net pen production from being certified as organic. In particular, farmed Atlantic salmon would not be likely to meet this standard. It is either non-native in the Pacific Ocean (e.g. in British Columbia and Chile), or is native, with current farmed stocks having substantial genetic divergence from the few remaining wild populations (e.g. eastern Canada and Europe). Conversely, production of native fish under careful broodstock management (e.g. yellowtail in Hawaii or cod in the Shetlands) may be viable organic candidates for this standard. This standard would encourage the farming of native species – a net benefit over the status quo of expanding the farming of non-natives.

Risk of Pollution and Habitat Effects

As with escapes, open net pen production poses substantial risk of pollution and habitat impacts. However, by embracing the concept of recycling that is central to organic production principles, our standard can substantially reduce this risk. The current draft

organic standards mandate integrated production systems for net pens, but without any minimum requirement for the amount of nutrients and particulates to be recycled. We mandate that 50% of dissolved and particulate nutrients be recycled via polyculture/integrated aquaculture of other native species. While this runs counter to the general trend to farm single species, integrated aquaculture is technically feasible and has been shown to have net ecological benefits (Folke et al. 1998; Neori et al. 2004; Whitmarsh et al. 2006). While offshore environments are likely to reduce the local impact of nutrients relative to nearshore net pens, Lee et al's (2006) findings in Hawaii clearly document that net pen discharges can be a concern even in open ocean environments.

By mandating substantial nutrient recycling, no detectable impacts on benthic habitats, and ecosystem modeling to ensure remaining inputs are not beyond the assimilative capacity of the surrounding ecosystem, open net pens may be capable of meeting the organic goal to "promote and enhance biodiversity, biological cycles and soil biological activity" at least as well as terrestrial organic production.

As with the escape standard, the nutrient and habitat standard may exclude a large fraction of present-day open net pen producers from being certified organic. This is especially true for nearshore producers with demonstrable habitat impacts, at least unless they substantially reduce stocking densities. However, we set a realistic starting point for polyculture and provide an eight year period to scale up this production to reach the 50% benchmark. Moreover, by growing sea cucumbers and other particulate-consuming species under net pens, it may be possible to dramatically reduce benthic impacts of fish net pens. We expect that offshore fish farms, where technical hurdles are still substantial, may find it difficult, but not impossible, to achieve the performance metric for nutrient cycling.

Impact on Predator Populations

While the OFPA makes no provisions (beyond compliance with local laws) for the killing of farm predators, this issue must be addressed in open net pen production to meet the expectations of organic consumers and to ensure compliance with organic production principles (i.e. promotion and enhancement of biodiversity and the development of a harmonious relationship between production and the surrounding ecosystem). Predators can not always be effectively and safely separated from open net pens. However, careful site selection, low stocking densities, and vigilant attention to predator exclusion and deterrence methods may allow the performance goal of no predator mortality events to be achieved.

Under our standard, we would require three years of no predator events to be eligible for organic certification combined with revocation of certification for farms that experience more than a rare marine mammal death due to entanglement or other accidental cause. As production practices can not guarantee success at avoiding predator events, only a performance-based metric can be applied to meet the expectations of both organic customers and compliance with organic principles.

Risk of Disease and Parasite Transfer

The most daunting challenge for organic production in net pens surrounds the risk of disease and parasite transfer to wild fish and ecosystems. Organic open net pen production of aquatic animals requires a very strict standard because water is an especially powerful vector for any disease that is amplified by farming operations. Moreover any chemicals used to treat farmed animals are readily dispersed to the surrounding ecosystem. The deleterious effects of both disease transfer and chemical residues from net pens on aquatic systems are well documented in the scientific literature.

This standard thus strictly adheres to the core principle of organic farming that animals should be raised under healthful conditions such that the occurrence of disease is rare. Because fish farmers would lose the price premium for organic aquatic animals should their animals become diseased, they should have a strong economic incentive to maintain the health of their animals. This (dis)incentive structure is similar to the one established for terrestrial livestock, whereby animals treated with antibiotics or other prohibited substances may not be sold as organic. In the of case aquatic animals, fish could not be sold as organic if they had suffered disease because the presence of disease violates this organic principle by putting both farmed stock and wild stocks at risk.

This performance based standard may be the most difficult standard for any open net pen producer to achieve. Predicting disease risk of novel species in new conditions is very difficult to do *a priori*. Sea lice are an ongoing conservation and husbandry concern of many of the world's salmon producers. While synthetic parasiticides such as Slice (emamectin benzoate) are effective at reducing infection rates, these chemicals are potent toxins in the marine environment and their use is not consistent with organic principles. As with escapes, nutrients and predators, most salmon production would likely be excluded from potential organic certification because of this performance standard for disease. New species (such as amberjack, cobia, sablefish, cod, etc) may be more viable candidates as their shorter culture history inevitably results in a shorter track record for disease. However as production scales increase and a longer track record of disease performance is developed, these species may not be able to meet the "no disease/no treatment" standard. In these cases, either previously certified operations would have to lose their organic certification or producers would have to petition the National List for the inclusion of effective drugs to treat the disease(s). While the latter option is available under current OFPA regulations, we conclude that such a measure would violate the original spirit of organic production, and unless the chemical was environmentally-benign, pose ecosystem risks that would be unacceptable to organic customers.

Use of Marine Resources for Feed

Our standard is consistent with the organic principle requiring that all feed ingredients for livestock be from organic constituents and provides an incentive for industry to innovate to achieve this goal. We allow inclusion of organic poultry byproducts but not organic mammalian byproducts because of potential health risks, however remote, associated with prion exchange (and resulting consumer concerns over BSE) from mammals to fish. At present, there is little evidence that BSE poses a risk of prion exchange from avian species to fish (Sapkota et al. 2007). Strong conservation gains are achieved by allowing

inclusion of organic poultry products as this reduces the reliance of farmed fish on marine-derived protein sources as well as encourages recycling, which is an important organic goal. It should be acknowledged that the trade-off we have accepted is a violation of the organic principle that livestock shall be fed a diet as close to natural as possible. In addition, we acknowledge that some "vegetarian" consumers that eat fish may be troubled by the inclusion of terrestrial animal products in organic farmed fish.

Our standard sets the initial Fish In: Fish Out (FCE) ratio at 1:1, embracing the sustainability concept that carnivorous farmed fish must become net fish protein producers. We acknowledge that few organic sources of fishmeal and fish oil are currently available and that only a small number of producers will be able to meet this initial standard given the supply limitations. However, an eight year transition period to zero inclusion of wild caught fishmeal and fish oil should create incentives to grow the supply of organic fishmeal and fish oil as well as scale up other potential organic substitutes such as algal oils, worm castings, and other organically-grown feed ingredients. This transition period also ensures that, in the interim, wild inputs are sourced preferentially from trimmings of sustainable food grade fisheries and barring that, sustainable forage fisheries. Our standard ensures that "sustainable" is not defined in the traditional single species fishery context but rather is defined in an ecosystem context where sufficient fish remain to support the associated marine food web. This standard is substantially stronger than the current AWG proposal that allows fishmeal and fish oil (at 12% inclusion each) from wild sources without sustainability requirements.

Finally, by having a transition period with interim benchmarks for reducing fisheries products in feeds, the standard will help compel the development of alternative feeds. Producers will not potentially be faced at the end of a transition period with having to change their feeds from relatively high inclusion to zero inclusion of fisheries products – a scenario which could result in political pressure to continue the "transition period" *ad infinitum*.

A Way Forward?

As the debate about potential USDA organic certification of carnivorous, open net pen has heated up, two camps have become established. The first is representative of those in the aquaculture industry who want to ensure as much of the current species and production technologies are open for organic certification as possible. This is entirely logical, as organic certification is the one ecolabel that has shown the ability to carry a consistent price premium in the marketplace. In contrast, the second camp, consisting mainly of environmental NGOs, sees organic certification of open net pens and wild fish as violating the core principles of organic production as well as enabling substantial ecosystem risk to persist under the cover of a government sanctioned label that U.S. customers have come to trust. There is considerable merit to these concerns, especially as they concern salmon farming and they thus can not be easily dismissed. Environmental risks of wild fish-dependent species produced in open systems are both well-documented and difficult to solve. Should USDA develop standards for these kinds of species and production systems that enable these impacts to continue, there is the very real risk that the trusted organic label may be undermined. With the growing criticism

about the growth of “big organic” (e.g. Pollan 2007) in terrestrial production, additional criticism around organic aquaculture may be more than the label can bear.

Our approach in this work was to attempt to chart a third course – one that was true to the spirit and letter of the OFPA and the ensuing work of the NOSB while substantially enhancing the probability of environmental sustainability going forward. The five performance-based standards discussed above succeed on some fronts but pose considerable challenges on others. The feed, escapes and pollution standards meet these two goals and are feasible, at least for a small and growing percentage of the aquaculture industry. Success on the predator and disease fronts will be substantially more challenging given the limits of current feed-lot style net pen systems and the track record of much of the industry. Perhaps most demanding, both standards are predicated on an ongoing record of “no events:” conditions largely out of the direct control of farmers using current ecologically problematic production systems. Future, innovative production systems may, however, allow farmers considerably more control and meet these standards. In either case, these performance standards would result in a much smaller amount of organic production than under the existing AWG draft standards but with a substantially higher environmental threshold.

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