Using Pseudo-Science and Disease to Fear-Monger Against Aquaculture: A Veterinarian's Perspective Part 2

Last issue in Part 1, some motives and tactics of anti-salmon farming activists were reviewed. The notion of ulterior motives behind the "anti" movement is given credence by the non-compromising and non-scientific nature of the criticism.

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Many environmentalists have been duped into believing that aquaculture is a threat to conserving the oceans when it is actually the solution. There is never a civil discussion on what would be acceptable practices to mitigate fears or real risks, even when those are often readily available. For example, the progression to the current Washington State Atlantic salmon net pen ban seemed predetermined. This author attended the hearings and every time a concern was raised and evidence presented to alleviate that concern, focus shifted to another "problem." For example, when the already remote risk was exaggerated to the prospect of escapees taking over spawning beds and competing with the wild salmon, a proposed bill to stock only monosex fish in net pens - thus totally eliminating that risk – garnered no support or discussion. Instead, the attack switched and negligence on the part of an owner became the final reason.

Disease as an Anti-Fish Farming Fear Mongering Tactic

Of course, the Atlantic salmon net pen discussion in Washington State initially involved the notion of the potential to amplify and spread diseases to wild Pacific salmon. Any fish health professional who does clinical work for commercial and wild stock enhancement facilities knows that Atlantic salmon go to the net pens virtually disease free. The main concern is protecting them from what they pick up from the wild fish where diseases are a natural part of the ecosystem. Net pens actually tend to be "canaries" that often pick up pathogens that are already long established in the ecosystem. A veterinarian's role is to figure out how to lessen their impact. Fear-mongering with jargon like: "amplification" and "farm-associated footprint of virus released into the water column," really over-simplifies the disease process.

Nevertheless, through the years, activists have attempted to use disease as a tactic of disparagement. Disease is a scary thing to society and is often grossly misunderstood. It is far more complex than the popular notion of: "Avoid the germ, or if I failed to do so, give me the drug that will cure it." Disease is a natural, and arguably, necessary part of the ecosystem, and germs should not be confused with the diseases that they can be associated with. With that said: germs (bacteria, viruses and parasites) are common and diseases are rare. Figure 1 illustrates the three basic scenarios as a disease organism enters a population of animals and becomes "settled" (bottom to top). Figure 2, a quote from Ontario veterinary epidemiologists (who study how diseases move through populations) brings the message home that most viruses, bacteria and parasites don't want to wipe out their host and try to evolve to be unnoticed most of the time.

The interaction between the immune system and germs is extremely multifaceted and part of the challenge of medicine. Although avoiding a germ is a way of avoiding the disease and often put forward as a simple solution, this can be extremely tough to do, and may even be unwise in certain circumstances. Although ecosystems adapt to the introduction of new germs (as Fig. 1 illustrates), we don't necessarily want to accelerate that process with anthropogenic introductions, if the risks and consequences are deemed unacceptable. We do have criteria that help us sort out which of the countless of germs we should try and exclude from regions, and fish stock often has to be tested and found free (Fig. 3 provides an example) prior to any transport. The criteria are in place so that exclusion reasons are sound, based on real risk assessments, and not unduly influenced by political motives. Unfortunately, these are not always applied or adopted.

When veterinarians deal with disease, avoidance of a germ is just one strategy a fish culturist can employ. A list would include a combination

Fig. 1

Evolution of disease in wild populations (incl. salmon).

PATTERN	MEANING	IMPLICATION
SPORADIC (INCIDENCE OF DISEASE)	-infrequent and without discernable pattern	-infrequent appearance of pathogen OR pathogen usually present and clinical disease results from effects of others factors -GOOD BALANCE
ENDEMIC (INCIDENCE OF DISEASE)	-predicable pattern	-long term balance between pathogen and animal,the lower the level,the better the balance -BALANCE IS DYNAMIC
EPIDEMIC (INCIDENCE OF DISEASE, TIME)	-level of disease is generally greater than 2 standard deviations above normal and this was not predictable	-GROSS IMBALANCE with agent having upper hand (e.g.: newly introduced EXOTIC)

Fig. 2

"FROM AN ECOLOGIC VIEWPOINT THE PRODUCTION OF DISEASE OR DEATH RARELY FAVORS PERPETUATIONOF THE AGENT... THUS NATURAL SELECTION FAVORS LESS PATHOGENIC ORGANISMS."

-Martin,Meek and willeberg,1987: Veterinary Epidemiology: Principles and Methods

It is in the best interest of a germ to not be noticed by the fish... and most of the time they aren't.

of: reduction of contact; chemical use; modification of host resistance (e.g. vaccination); environment and/or management control; education; biological control; quarantine; and sometimes: radical stock destruction. The classic disease triad (Fig. 4) – albeit a bit simplistic - shows the 3 necessary elements to produce a disease. Take away any one, and you won't have disease.

In short, domestic animal (and fish) diseases need to be respected, dealt with, and solved. This is all part of medicine and what practitioners do when working with diseases. We don't ban day cares or schools because they are prime disseminators of infectious agents. We don't shut down lettuce farms, poultry production, cruise ships or even hospitals because they spread germs that actually kill people. We figure out the risk factors and take precautions, managing diseases by understanding their "Achilles heel."

However, disease control intricacies are not well understood by many, and with ignorance comes fear. With respect to salmon farming, disease has always been a tool used by unqualified (and unfortunately some qualified!) activists to try and seed the specter of danger posed to the wild. The prospect of disease being somehow initiated in a salmon farm and amplifying to scourge over the wild salmon, is a powerful one, albeit often flawed and simplistic from an epidemiological ("study of epidemics") perspective. Again, to those of us who have spent our careers studying and practicing with the complexities of salmon diseases (both farmed and wild), the conclusions and amateur perspectives of these activists and others who seem to be purposely misguided are actually dangerous to the overall conservation picture of our oceans.

Diseases Used by Activists to Fear-monger

In West Coast North American farmed Atlantic salmon, the litany of diseases that activists have tried to make the culprit and the "smoking gun" to justify that farming salmon is a threat continues to this day. Unfortunately, this is done with a dearth of epidemiological knowledge as previously touched upon. It becomes extremely frustrating how this is sensationalized and portrayed in the media and disease becomes a perfect weapon for the old adage that it is much easier to anger or scare people than make them think. Of the dozens of diseases that occur in farmed and wild salmon, there are 4 major ones that have been used to try and disparage salmon farming in the Pacific Northwest. We will discuss 3 of them here and save the last and most recent one for Part 3.

1) Infectious Hematopoetic Necrosis (IHN)

Infectious Hematopoetic Necrosis is a disease associated (you will notice that I will never say "caused by" because of the triad) with a virus that attacks the blood-making tissues in salmon. It can be extremely devastating to farmed Atlantic salmon. It is also a rhabdovirus, or a bullet-shaped virus that is related to rabies (but it CAN'T infect mammals). If you thought that calling it "salmon rabies" would be a cheap tactic that no one would stoop to when trying

Fig. 3

Criteria for listing an aquatic disease

Disease proposed for listing should meet the relevant criteria as set out in A. Consequences, B. Spread and C. Diagnosis. Therefore, to be listed, a *disease* should have the following characteristics: 1 or 2 or 3; and 4 or 5; and 6; and 7; and 8. Such proposals should be accompanied by a *case definition* for the *disease* under consideration.

No.		Criteria for listing	Explanatory notes
		A. Consequence	
1		The disease has been shown to cause significant production losses at a national or multinational (zonal or regional) level.	There is a general pattern that the disease will lead to losses in susceptible species, and that morbidity or mortality are related primarily to the infectious agent and not management or environment factors. (Morbidity includes, for example, loss of production due to spawning failure). The direct economic impact of the disease is linked to its morbidity, mortality and effect on product quality.
2	Or	The disease has been shown to or scientific evidence indicates that it is likely to cause significant morbidity or mortality in wild aquatic animal populations.	Wild aquatic animal populations can be populations that are commercially harvested (wild fisheries) and hence an economic asset. However, the asset could be ecological or environmental in nature, for example, if the population consists of an endangered species of aquatic animal or an aquatic animal potentially endangered by the disease.
3	Or	The agent is of public health concern.	
		And B. Spread	
4		Infectious aetiology of the disease is proven.	
5	Or	An infectious agent is strongly associated with the disease, but the aetiology is not yet known.	Infectious diseases of unknown aetiology can have equality high-risk implications as those diseases where the infectious aetiology is proven. Whilst disease occurrence data are gathered, research should be conducted to elucidate the aetiology of the disease and the results be made available within a reasonable period of time.

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to instill fear in the public's psyche, you would be wrong. It is thought to have originally been from Pacific Northwest sockeye salmon and has followed farmed salmonids around the world via natural and unnatural introductions. It is now endemic ("naturally occurring") in the wild Pacific salmonids.

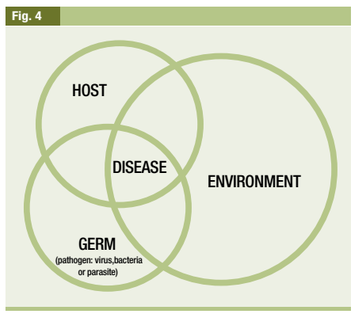
Between 1992 and 1996, an epidemic ravaged through the farmed Atlantic salmon industry of British Columbia providing fodder for the anti-farm activists. Different species of Pacific salmon have different levels and susceptibilities, but in summary, they are "used to it being around." Disease in wild populations is a natural occurrence, and again referring to Figure 1, it could be classified in the top or "Sporadic" pattern and in a good balance with wild populations. Atlantic salmon aren't a natural host, because it isn't known to be in their natural habitat. So, in essence, the wild salmon are a danger to farmed salmon, and not vice versa. Above and beyond that, there is an extremely effective vaccine that all farmed salmon receive before they enter the sea cages that could also be applied to wild stock-enhancement salmon if the pathogen was a serious concern. The activists soon dropped this disease as a ploy.

2) Sea lice dermatitis

Salmon farming is a relatively new domestic "agriculture" entity (about a ½ a century old). This new frontier is exciting to many because domestication problems do crop up and need to be solved. Diseases are an example. What has adapted to be a natural part of wild salmon populations in their wild environment (see Figure 1 again), has not for the culture conditions of farmed salmon. A farmer's job is to push their stock for production while being humane and not stressing their animals to the point of waning productivity and disease associated with existing or new pathogens. A veterinarian's role is to assist with this. Over the years, there have been several disease problems (germs all originated from wild fish) that have affected farmed salmon with environmentally-sound solutions successfully applied. Currently, the most serious problem is sea lice, an external copepodid parasite that initially grazes on the fish's slime without any ill-effect (there are stories that they used to be a sign of freshness in wild caught salmon). However, with increasing numbers they will exhaust the slime and start on the skin, causing dermatological ulcerations of the skin that can lead to lethal infections and osmotic failure.

The anti-farming activists have tried to use sea lice to fear-monger the dangers of Atlantic salmon farming and tie variations in wild salmon returns to farmed salmon sea lice numbers. For example in 2007, a scientist at a Canadian university developed a model that calculated proliferation of sea lice on salmon farms in British

Fig. 4



Columbia would make pink salmon populations extinct in 4 years. The model had both premise and epidemiological flaws and the extinction didn't happen as predicted. It did force regulations that salmon farmers had to adopt that mandated unnecessary chemical sea lice treatments to protect the wild salmon. Of course, the claims from the activists were that these treatments prevented the fruition of the model's prognostications, but that is a soothsayer's trick as old as time – not science. Sea lice continue to be a challenge for the industry and novel, creative and environmentally-friendly solutions are being developed. The science of the impact on wild salmon is very scant and not universally accepted as a real concern. At any rate, this problem will be solved as there are huge financial incentives in the salmon farming industry to do so.

3) Infectious salmon anemia (ISA)

Infectious salmon anemia (ISA) is associated with an orthomyxovirus, similar to our human flu viruses (transmission to humans does not happen). It is in the Atlantic-based salmon farming regions but has never been found in the Pacific Northwest. Nevertheless, anti-salmon farming activists decided to sound the alarm bells and somehow found the virus when industry and government veterinarians and researchers never had before, despite continual and vigilant diagnostic oversight over the years, and extreme susceptibility in farmed Atlantic salmon. Media headlines pointed to salmon farms spreading a "deadly salmon flu," but intense activist-precipitated surveys resulted in the conclusion that it isn't in the Pacific Northwest. Most likely the activist's results came from an East Coast Canadian veterinary college lab where cross-contamination had occurred. OIE pulled its accreditation from that laboratory, but not before significant funds had been diverted to a new search along the Pacific Coast for the ISA virus. For example, Washington State spent US $400,000 trying to find it. Farmers and taxpayers still must endure the diagnostic costs of monitoring for it because of this (dubious?) error.

Fig. 5

"Science will continue to be the victim of antiscience sophistry until the defenders of science learn to use rhetoric as skillfully"

-Leah Ceccarelli

Moving Forward

The question is how do aquaculturists and fish health professionals contend with disease fear-mongering. We know full well that it is in fish farming's best interest to control diseases. Again, net pens are canaries of what is going on in the wild and they can be important tools in understanding wild fish pathogen occurrences and diseases. Research has to demonstrate the ridiculousness of media jargon such as "amplification" and "virus footprint." National and state regulatory agencies have to generate and apply *a priori* pathogen exclusion criteria (as per Fig. 3) incorporating algorithms so that sound determinations can be made as to when a disease is worth controlling in this fashion. The disease process is too complex to be so strongly influenced by media and political forces.

In Part 3 we will discuss the current disease salvo against Atlantic salmon farming, focused on a curious virus called Piscine Orthoreovirus (PRV) which seems to be sometimes mysteriously associated with heart skeletal muscle inflammation (HSMI) and erythrocytic inclusion body syndrome (EIBS) in salmon.

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