Fish Health 101: A Refresher

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Fish culture health can be divided into 5 key areas, each of which should be examined whenever there is a disease problem that needs to be solved or prevented. Elements within can be both specific and general for the diseases of concern. As per many other things on a fish farm, the key to success is the old adage: "doing the common things uncommonly well" and this should be kept in mind as each area is discussed later in the context of ***integrated fish health management***.

First, a reminder of what integrated fish health management is and isn't. It IS NOT simply: "Have a disease, find a treatment". The mentality should be that medicating or treating a disease is a band aid and it means that something has gone wrong – that **you and your crew** most likely could have controlled. This is both a settling and unsettling sentiment as it means that you and your crew are largely responsible for disease in your fish (at least that should be the mindset for your business and you should refrain from "blaming the bug"). Studies in agriculture have shown, that given the same systems across livestock facilities, the most significant difference to herd health and productivity are the people and the level of "**stockmanship**" in those people. Integrated health management realizes that the pathogen (disease-associated organism) doesn't equal the disease. There is rarely one simple solution ("silver bullet") in curing or preventing a disease. Furthermore: **pathogens are common, disease is rare.** This is because, from an ecologic viewpoint, production of disease or death rarely favors perpetuation of the pathogen; **thus *natural selection favors less pathogenic organisms***. This can be a tough concept to grasp, but if the pathogen's interest was ever-increasing death and destruction, we wouldn't be here! When an organism first enters a population, there is a marked disease spike, then an -increasing balance sets up, with regular disease spikes progressing to rare and sporadic (this latter most balanced and common set-up between the fish and the pathogen). Changing conditions can change this balance (which is more frequent in a fish culture facility), but the take home message is the same*:* ***too often we concentrate on trying to get rid of the pathogen instead of the factors that lead to disease***. In MOST cases, if husbandry and environmental conditions are good, fish will be refractory to disease even if the pathogen is present in low numbers in the water or in the group of fish themselves (Remember again: infection does not equal disease). In many cases, the cost and effort of trying to keep out the pathogen is greater than that of trying to deal with the factors that bring on disease.

These factors can be divided into five areas of disease management: **1) Good genetics and a genetic improvement program, 2) Vaccination, 3) Risk factor minimization, 4) Infectious pressure reduction, and 5) Vigilant surveillance and early treatment.** The factors can be thought of as a dam that you are setting up to prevent disease from wreaking havoc on your operation. The higher the dam, the lower the risk that a disease will impact your operation BUT the higher you build the dam, the higher the cost to your operation. The key is to find the proper height between risk and productivity. This can be dynamic, and although many elements are general across several diseases, they can be very specific (e.g.: too much egg-jostling or too little flow in incubation can predispose fry later on to "coldwater disease"). Each of these factors is a "brick in the dam", and you can make them as thick as you can for any particular disease, but there has to be a net return to your productivity, especially long term (e.g.: extremely low densities may be a good preventer of "columnaris" but you won't have enough fish to sell to pay the bills). Sometimes you cannot include one of the "bricks" and need to concentrate on the remainders (e.g.: many diseases do not have a cost-effective vaccine available).

Again, in trying to deal with or prevent a particular disease, carefully examine and determine what you can do in each area (i.e.: each "brick"). It is often useful to get an outside consultant perspective in order to avoid the "being too close" phenomena and ensuring that you have all that is known and unknown issues for that disease. Each area below could be a whole article itself, but briefly:

1) **Genetics** – this is more long term, but essential. Traditional agriculture has shown that marked improvement over the past half century in productivity and disease prevention through improved genetic stocks. It is a "no brainer" except that resistance to specific diseases is tricky as it is often linked to something undesirable (eg:

slower growth). Nevertheless, every facility has programs in place to either continually select for better stock, or test stock from various sources. This can be expensive, but the pay-offs are enormous.

2) **Vaccination** is older than the "germ" (or at least our knowledge of the existence of them). There is also no question that vaccines have revolutionized society and animal agriculture. If possible, vaccinate for a particular disease. Calculate what a vaccine has to save in order to pay for itself and that will give you an idea of value. If there is an ongoing disease, realize that vaccination may not be the "silver bullet" (as previously discussed), but still might function to reduce the disease or risk to a cost-effective level. Remember that there can be several reasons than the obvious for vaccination, including: *protecting against shedding pathogens or raising the threshold of a pathogen load required for infection* (see below). Unfortunately, this may be a "missing brick" in the dam as there may not be a specific vaccine that is cost-effectively available for a disease. However, one thing we are learning is that there can be non-specific cross-protection among diseases so, in fish, a vaccination against one disease may actually shore up the immune system to other diseases!

3) **Risk Factor Minimization** –

Disease prevention and control in a fish culture facility (or any agri-business) is an "odds game". Getting disease or preventing it is not an absolute thing, it is predisposed by a set of risk factors. The whole "game" is to do what you can cost-effectively to minimize those factors that are known to contribute to the likelihood of a disease happening. Non-specifically "density" is a prime example of a risk factor to disease. You may carry high densities – pushing the water quality that your facility is able to consistently maintain – and you may get away with this for a while. That is fine, but realize that if you get hit by a disease you may have been "asking for it". Pushing the envelope isn't a wrong approach from a business stand point (depending on your business goals and risk aversion). Just be aware of what you are doing, and if you get a disease that is density related ("columnaris" is an example), then you may have to take drastic density-reducing measures that will cut into your bottom-line. The author has consulted with many facilities where this has happened ("Why do I have disease when I haven't changed anything in three years …"). In retrospect, it often is a "forehead-slapping moment" for everyone on the farm ("We knew that our water quality parameters were fluctuating in and out of optimum"). Some disease-precipitating risk factors are: water chemistry; oxygen saturation; swimming speed; container shape, size and material; temperature; fish strain/species; handling; etc. Again, optimizing all of these can be done but there is a cost. Figuring out the risk aversion of the farm owner and how much should be put into each area for disease risk reduction is very specific to each facility and situation. Sometimes there is no choice and a compromise has to be made (e.g.: water availability and densities or fish numbers). In the end, the prime goal is to minimize the over-used term: "stress". What the real objective is, is *minimizing the activation of hypothalamopituitary interennnal axis and the release of catecholamines and cortisol.* All this really means is that "stress" of suboptimal husbandry can be tolerated once in a while, but too frequent, or continual, and this "activation" which is intended to allow the fish to cope short term, will actually turn the fish's immune system "way down" and make the odds game in favor of a pathogen causing disease. Interestingly, we are just starting to discover fish health compounds to help in this. Aqui-S 20E, for example, which is available through an Investigational New Animal Drug exemption, can actually reduce this "activation" in the wake of stress (e.g.: handling, transport, grading, etc.) and may turn out to be an extremely important risk reduction tool.

4) **Infectious pressure reduction –**

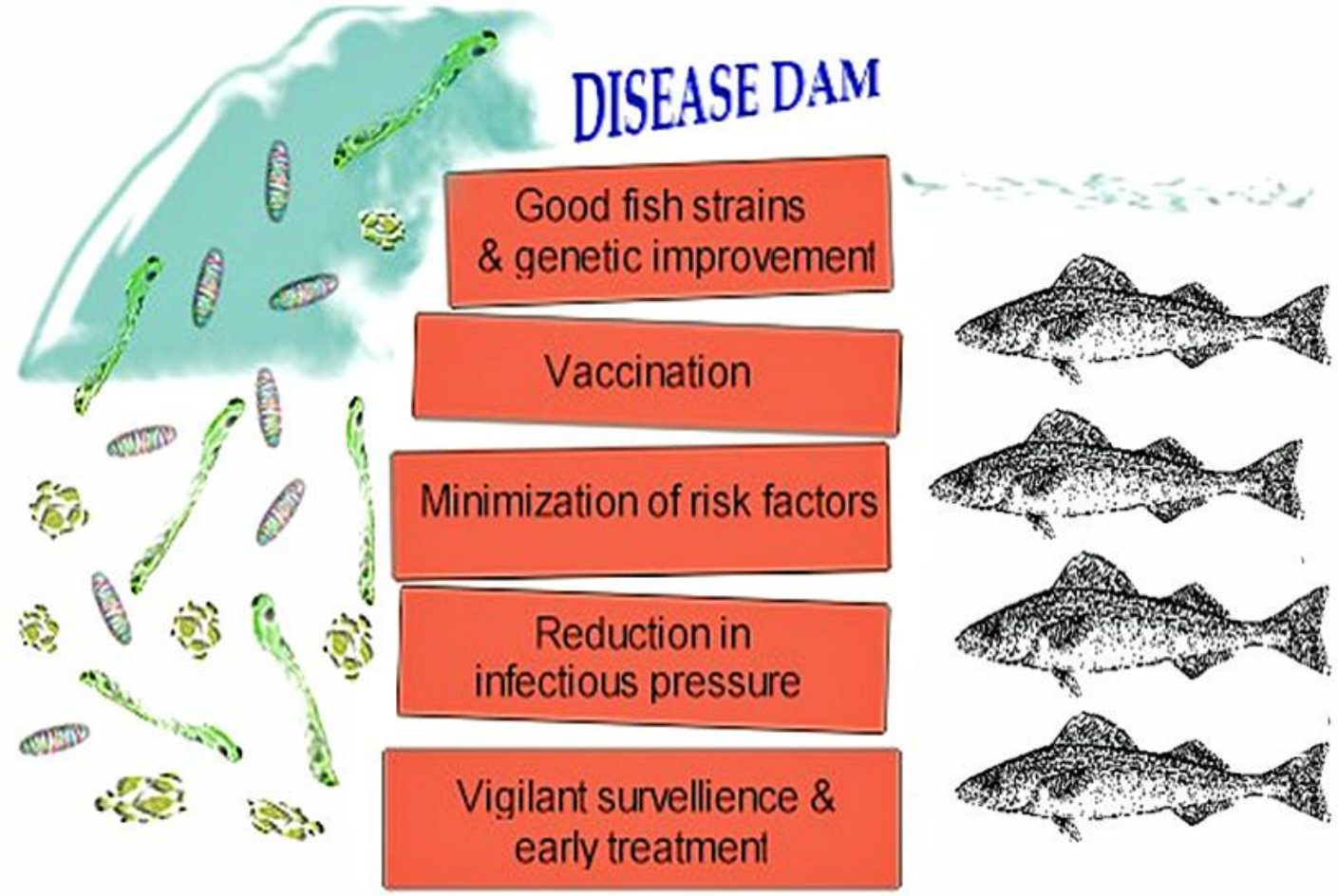
Biosecurity is often thought of as steps and measures to keep a pathogen out of a facility or an area. This can be very tough to do (as has been experienced in terrestrial animal husbandry). What the focus should be (along with minimization of risk factors), especially for pathogens that are always around (eg: "columnaris"; "pychrophilus"; "fungus") is to keep numbers of pathogens below the "minimum infective dose". The elegant paper by Rose et al 1989. J. of Fish Diseases (12:573) very nicely illustrates this concept with *Aeromonas*

salmonicida, the agent associated (not causal – as per the above discussion!) with furunculosis. For a particular strain of *A. salmonicida* they showed that it takes greater than 10,000 "pathogens" (actually: "CFU"'s, an index of pathogen number) and 1 to 3 days to infect Atlantic salmon in laboratory experiments. Any less bacteria or time and infections didn't result. If they put in 100 "pathogens", they could achieve infection if held for 3 weeks (not 1 week). So, this tells us that even if pathogens are present, risk of infection can be reduced if we strive to keep the pathogen numbers down. How do we do this? With good water flow and tanks that self-clean; good disinfection between batches; in-line disinfection with UV, ozone, and/or chemicals (e.g.: H_2O_2), etc. In this same vein, the study looked at how many pathogens sick and dead fish were shedding into the water. They found that 10^5 to 10^8 pathogens (CFU's) were shed by sick and dead fish an hour - virtual petri plates of bacteria in your tank, pond or raceway! Get them out with automatic removal systems or at least frequent dipping in the morning and through the day.

5) **Vigilant surveillance and early treatment –**

And returning back to the theme of "doing the common things uncommonly well". The importance of continually testing and monitoring the fish cannot be overstated. Contrary to the notion of not treating "prophylactically", EARLY treating (I like to call: "anticipatory") is much more effective (and could be argued fosters LESS antibiotic resistance) than waiting for a raging disease with mortality. Look for disease and get on it quickly before it has a chance to really "ignite" in a group of fish or facility. Traditional agriculture does this through both clinical and production parameter recording systems. Based on subsets of productivity measurements, swine farmers, for example can actually have a good idea of what is affecting their herd even before getting any clinical results! Fish farming will eventually get there!

Through integrating the five basic areas of fish health and building a disease dam with each area seen as a brick in the dam, you can solve a current disease problem or minimize the odds of a production disruption to your business in the future. Remember, although many of the elements can be applied across all diseases, each particular disease has its own particular set of known and unknown factors which will require dam "bricks" of different heights (if they exist at all for that particular disease). AquaTactics (as the name implies) is here to help you build this dam for your facility with an expanding level of services and products, so check us out at aquatactics.com.


DISEASE DAM
Good fish strains & genetic improvement
Vaccination
Minimization of risk factors
Reduction in infectious pressure
Vigilant surveillience & early treatment

WARM FISH ... ***COLD FISH ...***

...HEALTHY FISH!

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