Recirculating Land-Based Systems – Reducing Conflicts Between Farmed and Wild Salmon

Erik Sterud, Krüger Kaldnes AS, Norway

The wild Atlantic salmon is under more pressure than ever before. Not least from the growing salmon farming industry. However, this industry is undergoing a major transition. The urge for profit, new technologies and increasing concern for environmental impacts have initiated this. We see that new technology and new production regimes erase the strict borders between smolt and salmon, between fresh water and salt water, between land and sea. The question is: can these new ways of producing salmon reduce the conflicts between farmed and wild salmon?

The problems / conflicts

This will be a talk about solutions and not problems, but the negative impacts of salmon farming need to be mentioned. The most serious is escaping farmed salmon. Although the modern farmed salmon is a product of good old-fashioned traditional breeding, it is a fish adapted to farming conditions. The best way to illustrate the difference between farmed and wild salmon is by asking the rhetorical question – why can fish farmers not be forced to use offspring of wild salmon in their pens? The answer is long, but the short version is that it would mean a major setback to the industry. It would simply not be possible (economically viable).

The second most serious conflict is dissemination of diseases – including parasites such as the salmon louse. It is important to stress that no disease or pathogen has spontaneously generated in a fish farm. The problem is that every pathogen specific for a host that is very scarcely distributed in the wild, has a masters' degree in finding its host. So for them a fish farm open to the environment is a never-ending party.

It is important also to mention the link or synergistic negative effects, between diseases and escaping. This especially applies to the salmon louse. To combat the lice, the farmers depend on non-medical methods as resistance to antiparasitics has evolved and spread. All non-medical methods depend on the use of cranes, well boats or barges. The combination of heavy machinery and thin vulnerable nets has shown to be bad.

Technological paradigm shift

For decades, 6 – 12 months production of 100 g smolts in land-based hatcheries followed by 15 – 18 months production in open net pens in coastal areas, has been the normal way of producing salmon. The increased use and rapid development of recirculating aquaculture systems – RAS – has opened up for alternative ways of farming salmon: RAS alone, such as in 100 % land-based production (Atlantic Sapphire in Miami, Florida); RAS in combination with traditional net pens (most salmon companies); offshore farming platforms (Salmar and Nordlaks, Norway); or semi-closed marine pens / tanks (several ongoing projects). All these new production regimes involving production of larger smolts (200 – 1,000 g) have in common a transfer of production time from open to closed systems and, in most cases, from the sea to land.

RAS

RAS technology is, in theory, more about water treatment than fish production. However,

alongside the initial idea of saving water and energy, RAS allows us to tailor-make the water quality and control the development of the fish even more than what is possible in flow-through systems. For production of harvestable fish, the use of RAS is almost a necessity. Very few countries in the world have the Norwegian combination of a small population, available land and *ad libitum* water resources.

But the use of RAS exclusively for production of smolts (and the 'new' entity post-smolts) enables production that is not dependent on the natural annual cycle of the salmon. Today smolts are produced and stocked in the net pens every month of the year from the arctic regions to the temperate regions.

Effects of reducing production time in the sea

By moving all production on land (or in closed floating systems) and including functional water treatment (disinfection) to eliminate or significantly reduce the exchange of pathogens between wild and farmed salmon, one can obviously reduce the negative effects of salmon farming. However, even if a total transition to closed farming is not implemented, reducing the time any given farmed salmon individual spends in open net pens could have a positive effect. Exposure time is a factor in all epidemiology. The shorter you are exposed to infectious organisms, the smaller the risk of being infected. This again will reduce the total infection pressure along coast lines – for farmed salmon and for wild.

Another effect of reducing production time in the sea can be accomplished if production time is reduced from today's 15 – 18 months to 12 months or less. A synchronisation of production with the calendar will reduce the problematic effect of 'the second year in the ocean'. It will also lead to shorter intervals between fallowing, thus breaking the life cycle of infectious organisms more often.

Effects of increased smolt size

Disease is a story about both the pathogens and the hosts. Robust and healthier hosts are less likely to encounter infective diseases and to spread the disease to new hosts. One of the main ideas behind increasing smolt sizes is to increase the robustness of the smolts put into net pens. This will have positive effects on the prevalence of infectious diseases. Again a benefit for both farmed and wild salmon.

Effects of new possibilities

Governments will play an important role in this technological transition. Regulations and legislation are very often limited by the technological possibilities. They will not be put into play until the possibilities for success exist and have been proved. The mandatory (and some said premature) use of closed containment systems for sea lice treatment in Norway (executed by the former minister of fisheries Mrs Lisbeth Berg-Hansen) was an exception. Regulations for protecting wild salmon and ecosystems in general are more likely to be adopted by governments once the technology is there. This can be mandatory collection of wastes, mandatory use of bigger smolts, mandatory use of RAS and other closed containment systems and technologies to mention a few.

Who should reap the benefit?

New production regimes can be used to increase turnover, flexibility, production and, finally, revenue for the farmers. And they can be used to reduce the conflicts and the negative impacts on wild salmon and ecosystems in general. But not necessarily both at the same time.

If reduced ecological impact of production volume X is used to allow a new production of X + x, the benefits for the wild salmon could be small. However, if X is constant the reduced

ecological impact will benefit the wild salmon. This means that the technological paradigm shift occurring right now will walk hand-in-hand with governmental legislation and management regimes.

What could go wrong?

Environmental awareness is a rich man's hobby. Today's fish farmers are rich men. Few people want to harm the environment. Thus, less negative impact from established production can probably be expected. But new technologies open the possibilities for salmon farming by new investors, new cultures, new jurisdictions. When newcomers head into new industries they often need to fight the establishment. Very seldom the environment is the winner. With new technologies salmon farming could be established in places where no wild salmon exist. But increased production in places where salmon are already under pressure can also be expected. The key is to reduce the negative impact per farmed salmon individual, without filling up the gap with new individuals and, by doing so, reducing the gain.

Conclusion

New technologies and methods for farming salmon are rapidly evolving. Land-based production (RAS or other technologies) for the whole or part of the production cycle,will be a useful tool for reducing the conflicts between farmed and wild salmon. But only if the primary goal is to reduce the conflicts and new tools are being used wisely.