OUR SOUND, OUR SALMON

Atlantic Salmon Net Pen Information Sheet

POLLUTION

There is no mechanism to capture animal waste from open water Atlantic salmon net pen aquaculture. Unlike terrestrial animal production where animal manure is collected and composted, waste (feces, urine, medicines, and uneaten feed) from open water Atlantic salmon facilities is discharged directly into public water. The most prominent organic nutrient waste involved are phosphorus (P) and nitrogen (N). Discharge of these nutrients into public waters from point sources such as municipal waste treatment facilities are regulated under the Clean Water Act.

The amount of P and N discharged to sediment and the water column from Atlantic salmon net pen facilities is considerable, but its environmental impacts are poorly, if ever, monitored. The amount of P and N discharged, however, can be estimated from the basic biological requirements for fish growth. A recent study of the average nutrient discharge by inland and coastal finfish aquaculture worldwide[1] estimated a global average of 152 pounds of N and 22 pounds of P are released into the environment for every ton of fish produced.

These numbers may actually under-estimate the amounts of P and N discharged from Cooke Aquaculture's Puget Sound facilities, based on calculations made by Wild Fish Conservancy[2] (WFC) using a bioenergetics program and monthly data for total fish weight and total amount of feed for each Puget Sound facility provided by the industry to WDOE in monthly National Pollution Discharge Elimination system (NPDES) reports. The spreadsheet program was developed for WFC by Dr. Ray Canale, Emeritus Professor of Department of Civil Engineering at the University of Michigan. Dr. Canale has published widely on finfish aquaculture and bioenergetics modeling of fish growth and nutrient discharge.

Our calculations indicate that per ton of adult Atlantic salmon produced at Cooke Aquaculture's facilities, an average of 256 pounds of N and 54 pounds of P are produced, approximately twice the global averages amount estimated by Bouwman and co-authors.[1]

For comparison, the estimated amount of untreated N discharged by Atlantic salmon net pens in Puget Sound on a daily basis is roughly equivalent to the amount of N discharged in waste treated by the city of Tacoma. For the same comparison with regards to P, the amount of discharge is roughly equivalent to the cities of Port Angeles, Everett, Bellingham, and Tacoma combined.

References

[1] A. F. Bouwman, A. H. W. Beusen, C. C. Overbeek, D. P. Bureau, M. Pawlowski, and P. M. Glibert. 2013. "Hindcasts and Future Projections of Global Inland and Coastal Nitrogen and Phosphorus Loads Due to Finfish Aquaculture," Rev. Fish. Sci., vol. 21, no. 2, pp. 112–156

[2] Gayeski, N. (2017, November 3). "Estimation of total phosphorus and nitrogen waste during a 20-month grow-out period for Puget Sound Atlantic salmon net pen aquaculture facilities." [PDF]. Wild Fish Conservancy. Available at: http://wildfishconservancy.org/p-and-n-puget-sound-estimations/at_download/file

OUR SOUND, OUR SALMON

Atlantic Salmon Net Pen Information Sheet

ESCAPES AND ESTABLISHMENT

Escapes of farmed Atlantic salmon, of both large and small quantities, have been a regular occurrence worldwide since the industry's inception.[123]

The escape of farmed Atlantic salmon poses three major ecological threats to the natural environment:

1. competition for food and spawning habitat by escaped adults attempting to survive and spawn in the wild
2. colonization and establishment of self-sustaining populations in local rivers home to federally-protected and economically-important Pacific salmon and steelhead
3. spread of disease and parasites to wild salmon and steelhead.

Farmed salmon escapes are generally under-estimated and under-reported worldwide, and reports from commercial and recreational fishing show that Puget Sound is no exception to this trend.[4] The probability of successful invasion increases with repeated introduction and is frequently preceded by numerous escape events (Naylor et. al., 2005).

In 2012, the threat of invasion and colonization of Atlantic salmon escapes to Alaskan wild salmon populations prompted Alaska researchers to conduct a risk assessment.[5] The researchers concluded that the risk of colonization is significant and requires rigorous and extensive monitoring of Alaskan rivers. Similar to other reports, researchers put forth the notion that large and often under-reported numbers of Atlantic salmon escape from aquaculture operations in the Pacific Northwest.

In a rigorous study of escaped Atlantic salmon on Vancouver Island, researchers systematically snorkel-surveyed 41 known Pacific salmon-supporting rivers and streams over the course of three years in an effort to document the presence and distribution of escaped Atlantic salmon in BC.[3] At the end of three years, it was estimated that two-thirds of rivers surveyed had Atlantic salmon, including escaped adults and juveniles from successful spawning. More importantly, the streams that were most likely to have escaped Atlantic salmon, or their offspring, were shown to be rivers with high diversity of native Pacific salmon and steelhead. All major rivers and streams in Puget Sound meet this qualification.

Colonization and eventual establishment of self-sustaining populations of non-native fish, including farmed Atlantic salmon, often requires multiple attempts and is facilitated not only by large events, but by regular low-level escapes.[6]

Post-Cypress, rigorous, systematic monitoring is necessary for several years to determine whether non-native farmed salmon have colonized Puget Sound rivers.

OUR SOUND, OUR SALMON

Atlantic Salmon Net Pen Information Sheet

References

[1] Forseth T, BT Barlaup, B Finstad, P Fiske, H. Gjosaeter, M. Falkengard, A Hindar, TA Mo, AH Rikardson, EB Thorstad, LA Vollestad, and V Wennevik. 2017. The major threats to Atlantic salmon in Norway. ICES Journal of Marine Science 74(6): 1496 – 1513.

[2] Fry J, D Love, G Innes. 2017. Ecosystem and public health risks from nearshore and offshore finfish aquaculture. Science Brief: John Hopkins Center for a sustainable future. https://www.jhsph.edu/research/centers-and-institutes/johns-hopkins-center-for-a-livable-future/_pdf/research/clf_reports/offshor-finfish-final.pdf

[3] Fisher AC, JP Volpe, and JT Fisher. 2014. Occupation dynamics of escaped farmed Atlantic salmon in Canadian Pacific coastal salmon streams: implications for sustained invasions. Biological Invasions 16: 2137 – 2146.

[4] Bisson, Peter A. 2006. Assessment of the risk of invasion of national forest streams in the Pacific Northwest by farmed Atlantic salmon. doi:10.2737/pnw-gtr-697.

[5] Piccolo, JJ, and EH Orlikowska. 2012. A biological risk assessment for an Atlantic salmon (Salmo salar) invasion in Alaskan waters. Aquatic Invasions 7: 259 – 270.

[6] Naylor et. al. 2005. Fugitive Salmon: Assessing the risks of escaped fish from net-pen aquaculture. BioScience 55(7): 427.

OUR SOUND, OUR SALMON

Atlantic Salmon Net Pen Information Sheet

DISEASE

Like any extreme-density livestock operation, open net pen salmon farms are breeding grounds for pathogens and parasites.

In 2017, startling data was released documenting a strong correlational connection between disease prevalence in net pens and disease transfer to wild fish populations. The study, by a group of researchers in British Columbia, demonstrated that 37-45% of wild salmon migrating through corridors containing net pens were infected with piscine orthoreovirus, compared to only 5% of salmon utilizing corridors far away from pens.[1]

In 2012, three commercial salmon farms off of Bainbridge Island in Puget Sound experienced an outbreak of IHNV[2], one of the most virulent salmonid pathogens. The high densities of Atlantic salmon in the net pens, which are highly susceptible to IHNV, are thought to have artificially amplified the number of viral particles present.

These three net pens are located within wild salmon habitat. Juvenile salmonids—those most susceptible to IHNV—must migrate past these commercial salmon farms on their way to sea.

The viral outbreak occurred in April and May when juvenile Chinook salmon emigration nears its peak. The Atlantic salmon industry reacted by euthanizing and disposing of over one million pounds of their product. Due to Washington State's lax regulations, an assessment of the outbreak's impact on native fish in Puget Sound was never conducted.

PARASITES

Sea lice are small marine copepods that live and feed on fish. Sea lice are ectoparasites, meaning that they attach to the outside of the fish, either on the skin, gills, or fins.

Sea lice eat the mucous, blood and skin of salmon. While a few lice on a large salmon may not cause serious damage, the feeding activity of sea lice can cause serious fin damage, skin erosion, constant bleeding, and deep open wounds. Large numbers of lice on one fish, or just a couple of lice on a juvenile salmon, can be harmful or fatal.[3]

Sea-lice outbreaks cost the Atlantic salmon farming industry in the hundreds of millions of dollars annually[4], and have raised the global price of salmon[5]. The industry combats sea lice outbreaks by applying pesticide treatments in the pens.

Several studies have documented the amplification of sea lice in the marine environment as a result of Atlantic salmon aquaculture. While sea-lice are a naturally occurring parasite, Pacific coastal salmon are seeing alarming rates of lethal infection in salmon-farming areas.[6]

OUR SOUND, OUR SALMON

Atlantic Salmon Net Pen Information Sheet

References

[1] Morton, A., Routledge, R., Hrushowy, S., Kibenge, M., & Kibenge, F. 2017. The effect of exposure to farmed salmon on piscine orthoreovirus infection and fitness in wild Pacific salmon in British Columbia, Canada. Plos One, 12(12). doi:10.1371/journal.pone.0188793

[2] The Associated Press. "Wash. fish farm kills stock after virus found." The Seattle Times, 26 May 2012. Available at:https://www.seattletimes.com/seattle-news/wash-fish-farm-kills-stock-after-virus-found/.

[3] P. Woo and D. Bruno, Eds. 2014. Diseases and disorders of finfish in cage culture. Wallingford: CABI.

[4] M. J. Costello. 2009. The global economic cost of sea lice to the salmonid farming industry. J. Fish Dis., vol. 32, no. 1, pp. 115-118.

[5] Butler, S. "Salmon retail prices set to leap owing to infestations of sea lice." 13 Jan 2017. The Guardian. Retrieved from https://www.theguardian.com/business/2017/jan/13/price-of-salmon-leaps-50-as-sea-lice-epidemic-wors¬ens

[6] Krkosek, M., Ford, J. S., Morton, A., Lele, S., Myers, R. A., & Lewis, M. A. (2007). Declining Wild Salmon Populations in Relation to Parasites from Farm Salmon. Science, 318(5857), 1772-1775. doi:10.1126/science.1148744