

Protecting the Atlantic salmon:

Assessing areas with high transmission risk of infectious salmon anemia virus, Maine 2016

Introduction

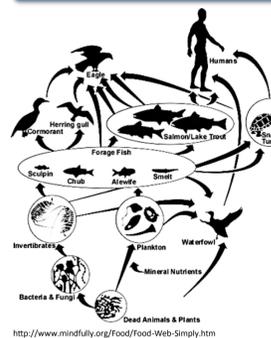
With an abundant human population there is an increase in the demand for food. Society makes an effort to provide food security through mass production of food resources, which is how aquaculture became an important and growing field. Salmon farms take advantage of the conditions in the natural ecosystems by locating the hatcheries in coastal zones that are part of the species habitat. This is one of the reasons why maintaining a healthy ecosystem is so important for this industry.

In past years, there has been a higher concern regarding the transmission of pathogens between wild and farmed salmon, not only due to the risk of production losses, but also because it introduces a risk to the dynamics of their ecosystems and the population of wild salmon. **The main pathogens of concern that have caused outbreaks in salmon farms are sea lice and the infectious salmon anemia virus (ISAV)** (Crane et al. 2011, Bakke et al. 2015). ISAV is a highly contagious disease caused by the orthomyxovirus ISAV (OIE). It predominantly affects Atlantic farmed salmon *Salmo salar* during the grow-out phase in the marine environments (OIE). ISAV is listed as a reportable disease by the OIE due to the high mortality rate and highly contagious characteristics. However, the salmon louse *Lepeophtheirus salmonis* macroparasite, tends to be the main focus in many surveillance systems of salmon farms due to the fact that diagnostics for this type of pathogen are easier. This pathogen makes salmon populations highly vulnerable and serves as a vector for ISAV (Gustafson et al. 2005). In order to decrease the risk between farms and wild populations, proper surveillance systems and management techniques should be implemented.

This GIS analysis will focus on the dynamics of Atlantic Salmon farms and the ecology of wild salmon habitats within Maine, with the goal of determining areas at high risk of pathogen transmission between these populations. Additionally, this analysis will provide recommendations for water bodies better suited for salmon farms and for restoration of Atlantic Salmon, utilizing the results of the transmission risk analysis and natural habitat characteristics.

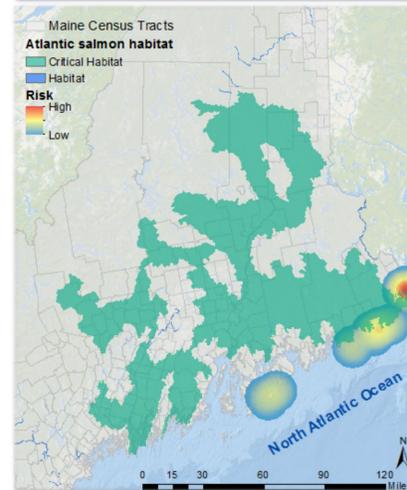


Relevance to Conservation Medicine

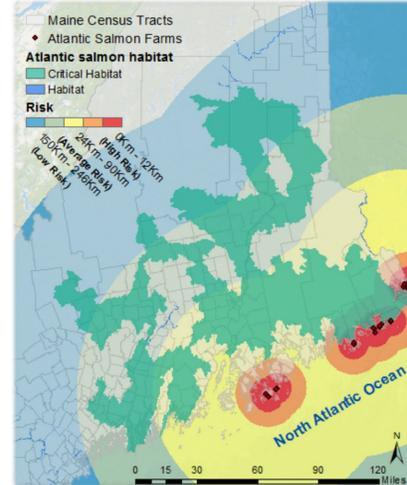


From the fish consumption by humans in the U.S. the National Marine Fisheries Service estimates that a 14% is salmon between all the species of salmon Atlantic salmon is one that is currently being farmed in Maine. Fish farms have been argued to play a role in the conservation of wild species, nevertheless this can be threatened by the transmission of pathogens between farmed and wild species.

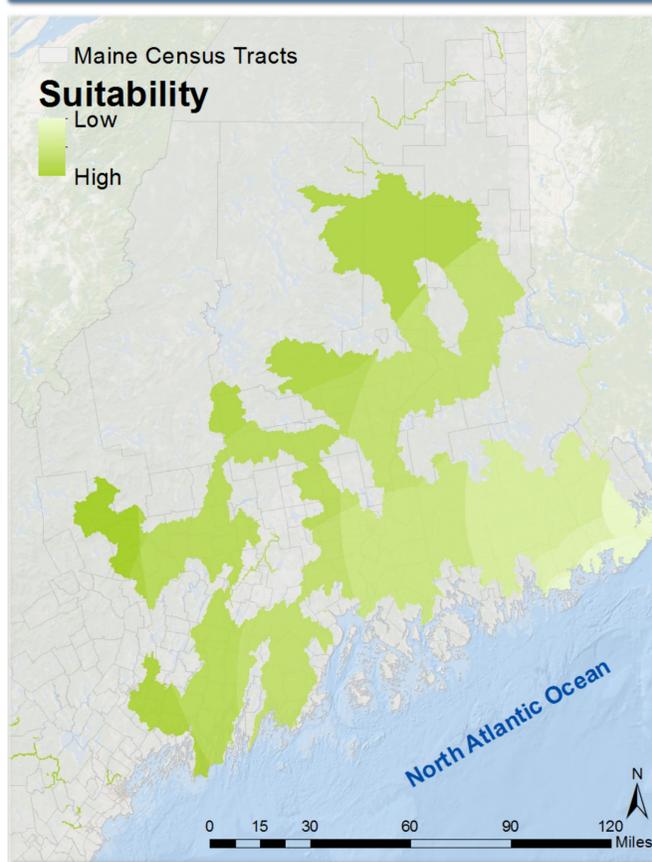
Density of Farms



Distance from Farms

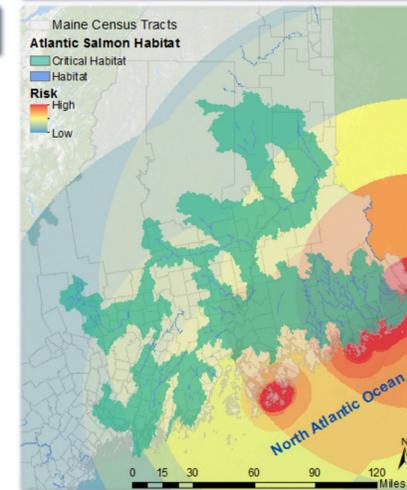


Area Suitability for Reintroductions

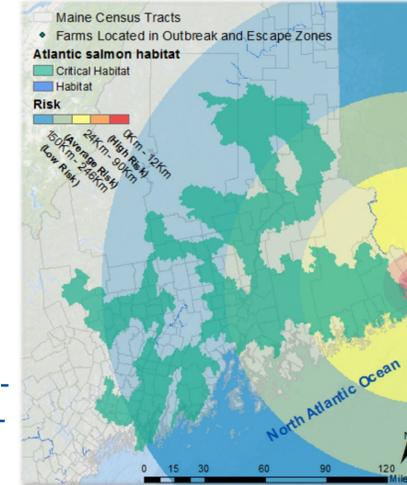


Using the results from the analysis of the total risk of transmission this final map shows the differences in the suitability for Atlantic salmon reintroductions in areas that are part of the Atlantic Salmon Habitat.

Total Risk of Transmission



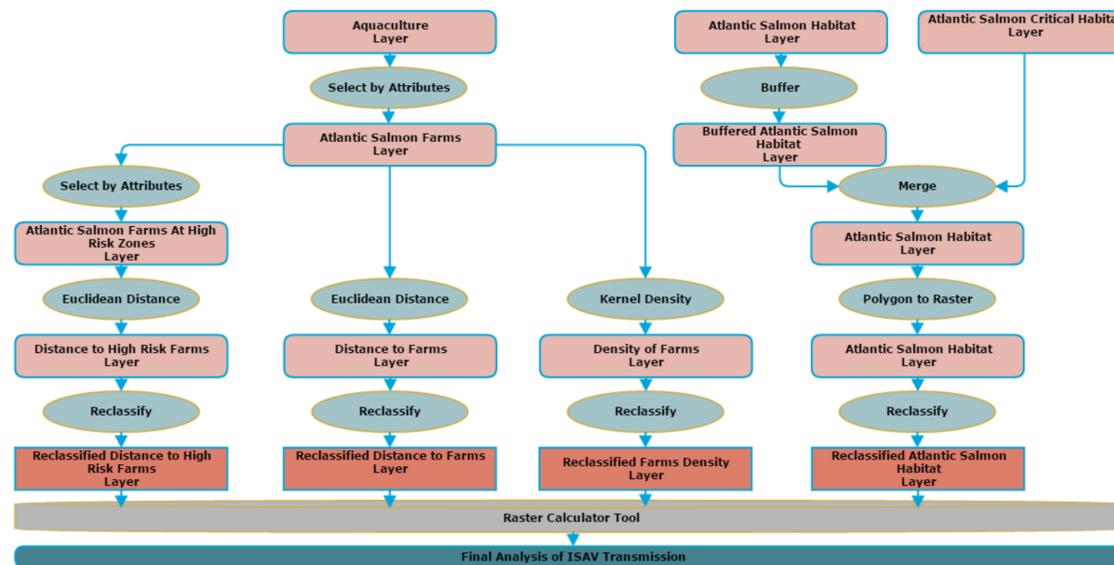
Distance from High Risk Farms



The total risk was determined by the kernel density of farms, as well as the Euclidean distance from farms, and the farms that are located in the Cobscook Bay area which is known for historic outbreaks and escapes from farms. The factors were weighted as follows:

Distance from farms=25%, distance from high risk farms=30%, density of farms= 35%, and Atlantic salmon habitat= 10%.

Methodology



Conclusion

Atlantic salmon farms are located inside the habitat of wild Atlantic salmon, especially in the areas that have been determined as critical for this endangered species. Asking the farmers to move to other areas is not a plausible thing to do, but after doing this analysis and showing that these areas have a high risk of transmission, biosecurity strategies should be more regulated. The established penalties for farmers that don't follow this strategies should be more reinforced.



Reintroduction of Atlantic wild salmon to the ecosystems is a key part of the conservation strategies that are taking place in the Gulf of Maine. This analysis can inform the agencies that are doing the reintroduction about the areas that are best suited by considering the risk of spillover from farmed salmon. The sea cages in which the salmon are harvested provide good breeding and feeding grounds for sea louse, which has been determined to be a vector of ISAV.

Limitations

Dealing with farm industries and outbreak information is a very sensitive task. Legally, the agencies that get the reports of disease outbreaks are prohibited to share any of this data with outside parties. The main reason for this comes from a confidentiality agreement. This analysis would've been a more complete one if the information of outbreaks by farms were available, since this wasn't the case this analysis selected all farms that were located in the bay that had outbreaks.

Another limiting factor was the lack of data on the incidence, distribution, and abundance of sea louse. This species has been identified as a vector for ISAV therefore it is a very important factor that should be taken into consideration in this type of analysis.



Cartographer: Andrea C. Rios Gonzalez

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Instructor: Carolyn Talmadge

Projection: NAD_1983_UTM_Zone_19N

Data Sources: Maine Office of GIS, National Hydrology Dataset USGS, ESRI, NOAA Fisheries

