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Estimation of spatiotemporal transmission dynamics and analysis of management scenarios for sea lice of farmed and wild salmon

Parasite transmission between farmed and wild salmon affects the sustainability of salmon aquaculture in Pacific Canada. Understanding and managing parasites in aquaculture is challenged by spatial and temporal variation in transmission dynamics. We developed a mechanistic model that connects sea louse (Lepeoptheirus salmonis) outbreak and control on farmed salmon (Salmo salar) to spatiotemporal dynamics of sea lice on migrating wild juvenile salmon (Oncorhynchus keta and Oncorhynchus gorbuscha). The model is based on a microparasite infection equations coupled to a partial differential equation describing spatial movement along fjords where the sea louse larvae can spread as the juvenile salmon migrate. We fitted the model to time series of sea lice on farmed salmon and spatial surveys of juvenile wild salmon in the Broughton Archipelago. We used the parameterized model to evaluate alternative management scenarios based on the resulting sea louse infestations and predicted mortality of wild salmon. Early and coordinated management of sea lice on salmon farms was most effective for controlling outbreaks in wild salmon, while uncoordinated treatments led to a resurgence of sea lice on salmon farms during the juvenile salmon migration. This study highlights the importance of incorporating spatiotemporal variability when considering infectious disease dynamics shared by farmed and wild hosts, particularly when migratory wildlife are involved. This is joint work with Stephanie Peacock, Martin Krkošek, and Andrew Bateman.