

A machine learning approach: Seasonal impact of climate change on *Vibrio* contamination on food products in the Dutch market

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Background

Global climate change is predicted to alter precipitation and temperature patterns worldwide, affecting a range of infectious diseases and particularly foodborne infections from *Vibrio* pathogens. Vibriosis is a serious illness caused by an infection with *Vibrio* bacteria. Infections caused by non-cholera *Vibrio* spp. have expanded globally over the last decades, with continued increases expected in the future. The emergence of *Vibrio* pathogens associated with human illnesses in Europe is linked to climate change, namely the increase in global sea surface temperature that is affecting our oceans. Recent heatwaves in northern Europe in 2018 and 2019 have also shed light on non-travel-related vibriosis as related to seasonality; an increase in future associated *Vibrio* spp. human infections are projected. Given predicted global climate changes, also as related to the burden of human infections with vibriosis, it is crucial to be able integrate data on regional climate change and adapt, when needed, current food monitoring programs in the Netherlands.

Societal relevance

With an innovative data science approach, this project contributes to climate adaptation solutions for the food safety authority and food business operators to adapt and integrate climate change concerns into the current food safety monitoring program. The outcome can be used as input for policy-making related to human health risks associated with *Vibrio* contamination.

Objective

This research aimed to develop a data-driven model as a climate adaptation solution to study the impact of climate change on *Vibrio* spp. contamination in food products of the Dutch market. Ultimately, the modelling approach aims to contribute to evidence-based climate adaptation solutions for food safety authorities and food business operators (FBOs) to be able to adapt and integrate climate change concerns into the current food safety monitoring programs.

Key findings

Two *Vibrio* spp. databases

- We created two databases from literature on *Vibrio* spp. prevalence and concentrations in the Netherlands, Brazil, France, Italy, Japan, Spain, US and Taiwan, which are of great value for any data analysis and model/algorithm development in the future.

Influencing factors

- Factors that can influence *Vibrio* spp. concentrations in food products are temperature, genotype and phenotype such as species, strain, and pathogenicity, ecology, salinity and pH.
- Sea surface temperature and salinity have predictive value on *Vibrio* contamination in measured foodstuffs (Figure 1).

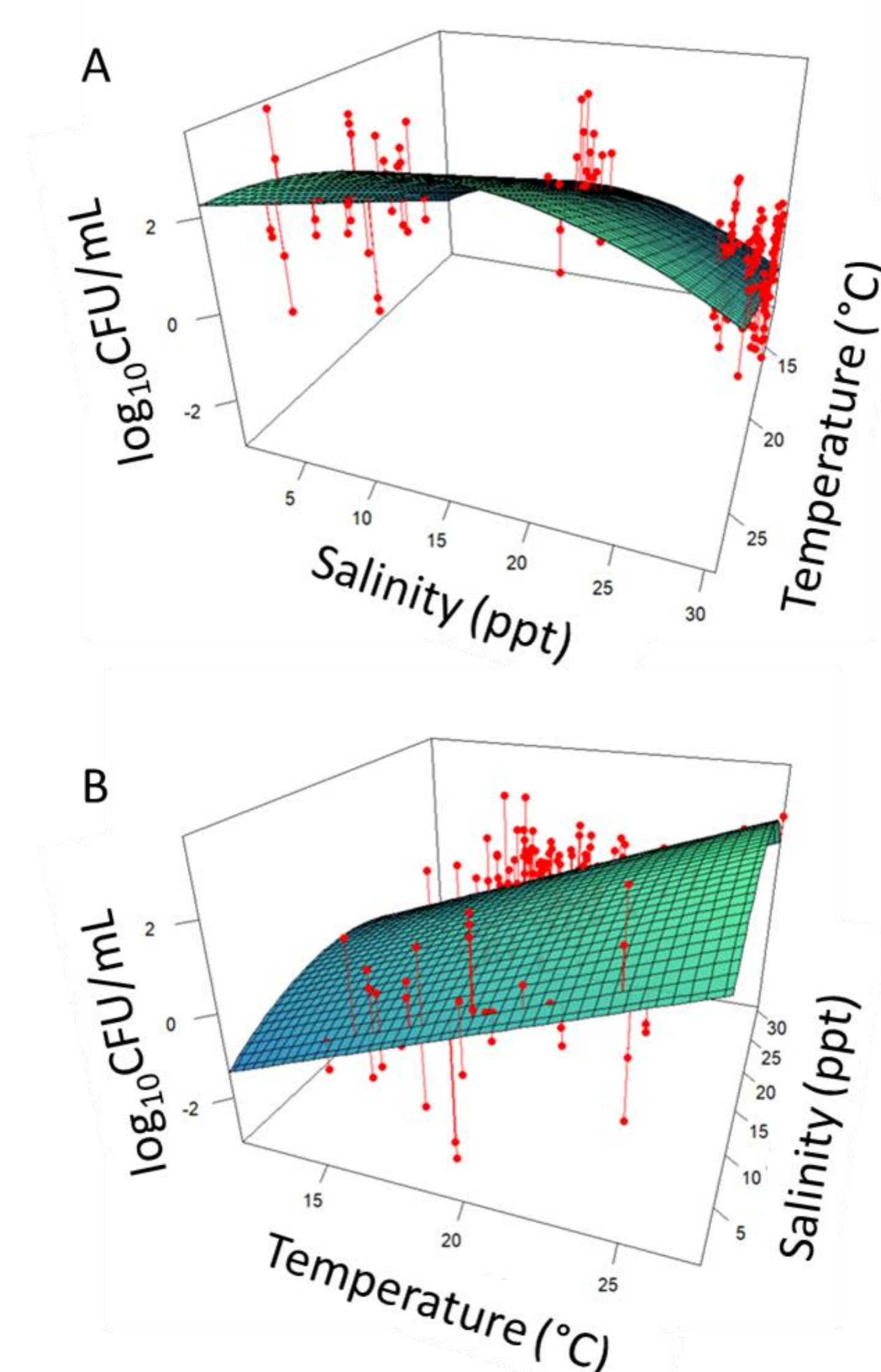


Figure 1. 3D plot showing the relationship between *Vibrio* spp. concentration (z-axis, log₁₀CFU/mL) as a function of (A) salinity and (B) temperature (rotated image). The blue-green surface shows the mean predictions for concentration. The red points indicate raw data while the red lines indicate the distance between mean predictions and raw data.

Vibrio species vs product type

- Oysters and clams have on average higher *Vibrio* concentrations compared to mussels and shells.
- The difference of *Vibrio* concentrations per product type are bigger than concentrations per *Vibrio* species.
- Sea water can be used as an indicator for *Vibrio* spp. concentration in sea food products.

Conclusions

- *Vibrio* spp. concentration will increase with higher temperature, but the increase is rather small by 2050 even with climate warming.
- Data availability and quality are essential. Due to the low number of positive samples, the machine learning model does not have enough information to learn the differences between positive and negative *Vibrio* spp. samples. Regression models are used to analyse the concentration data.
- Risk based monitoring data are not ideal for prediction modelling compared to randomly sample data.

