Fish Migration Prediction and Fishery Suggestions under Marine Environment Changes

Summary

The effect of global warming has caused more and more concern all over the world. In particular, global warming is driving up temperatures in the seas around Scotland, threatening the survival of fish species, including Scotland herring and mackerel. Fish are likely to migrate to the north, where sea temperatures are lower, for better conditions.

We begin with the grey prediction model to predict the sea surface temperature in the next 50 years by combining the historical world greenhouse gas emissions, forest coverage and world population data.

Then, we construct the Marine environment index for both species of fish. We weight the sea surface temperature, the average sea surface salinity and sea depth on different areas of the ocean to get scores of the current environment for the two species. Each species of fish has a preferred range for the environment, which we call the comfort zone.

In the fish migration model, we calculate the environment index of the two fish species based on the predicted temperature data. The fish judge the current environment and choose whether to migrate to a more suitable environment. We find that over the next 50 years herring would gradually move to the northeast near Norway, and mackerel will slowly move to the northwest, near Iceland.

Therefore, we have considered Scottish fishers. Due to technical shortcomings of small fishing companies, if fishing vessels are too far from the continental shelf, they will face problems such as insufficient energy, low safety, and difficulty in keeping fish fresh. Therefore, we estimate the elapsed time until the fishermen are unable to catch these two types of fish in their fishing area based on how fast the temperature changes, with the best, worst, and most likely scenarios. We find that in the most probable case, the number of herring captures will be 0 in 2063, and the mackerel will decrease year by year. In the worst case, herring may not exist in the waters as early as 2044, while mackerel will have difficulty catching fish in 2068. Therefore, we believe that the amount of fish in the Scottish waters will be reduced in the future so that the profits of small fishing companies will be reduced or even lost. The problem can be severe, and small fishing companies must take steps to prevent worse situations.

To consider how small Scottish fishing companies change their operations, we get the cost of fishing vessels, the number of fishing vessels, the quantity of fish caught and the price of fish. Based on these data, we forecast the company's net profit and help these Company analysis and decision making. At the same time, we analyze if a part of the fishery is transferred to another country and territorial sea.

In terms of the highly-potential tough situation of small-scaled Scottish fishing companies, we propose a "two-step" developing strategy, including domestic and overseas corporate assets transformation.

Finally, we discuss the advantages and disadvantages of the model and make scientific-based and practical suggestions for companies.