

## RELATIONSHIP BETWEEN MICROORGANISMS ACROSS THE SOUTHERN OCEAN

### **Introduction**

On 2006, researchers conducted the BROKE-West survey of the Southern Ocean on Voyage 3 of the Aurora Australis between January and March to investigate the microbial concentrations. Transects were mapped from 30 to 80 degrees east of the ocean surrounding Antarctica, the chosen transects were where there were CTD stations. Researchers were keen on discovering whether the phytoplankton concentration varies among transects and with depths, whether the effect of depth was the same across the transects and whether there was a connection between phytoplankton concentration and protozoa concentration.

### **Method**

The concentration of phytoplankton/mL and protozoa/mL was sampled and measured by FACScan flow cytometer in 6 transects in the Southern Ocean (1, 3, 5, 7, 9, 12): phytoplankton were distinguished based on the autofluorescence of chlorophyll-a, protozoa number were collected after staining with the acid vacuole stain LysoTracker Green

A multiple linear regression was utilized to examine the association between dependent variables phytoplankton concentration (phytoplankton/mL) and the independent variables protozoa concentration (protozoa/mL) and transect and depth. A large number of the Phytoplankton concentration and Protozoa concentration observations were small and distributed on the left of the data set (right-skewed), which was distorted from the normal distribution so we logged them to make the model more reliable to analyse.

### **Result**

There was very strong evidence ( $p\text{-value} < 0.001$ ) suggesting there is an effect of the Protozoa concentration and transects on the median concentration of the Phytoplankton concentration. There is strong evidence that the effect of depth where the sample was taken on the median of phytoplankton concentration varies between transect 1 and transect 3 ( $p\text{-value} = 0.007$ ) and some evidence for the effect between transect 1 and 7 ( $p\text{-value} = 0.01$ ). Protozoa concentrations, depth of the sample and transects explained about 71.3% of the observed variation in the Phytoplankton concentration.

If the model is correct, we are 95% confident that at a given depth in a given transect, if we double the concentration of the Protozoa in the Southern Ocean, the median of the Phytoplankton will increase by between 62.5% and 85.9%. With 95% confidence, we can also conclude that for every 50 meters deeper in the Southern Ocean, the estimated phytoplankton concentration on transect 3 is between 7% and 38% less than that on transect 1, provided that our model is correct.

Based on our model, we predict that at the 100 meters deep in the Southern Ocean, if there are 150 protozoa/mL, the phytoplankton concentration will be between 842 and 6040, with the estimated median 2256 phytoplankton/mL in transect 1. Whereas, in transect 3 that amount of Phytoplankton will be between 1304 and 9120 phytoplankton/mL with the expected median of 3449 phytoplankton/mL. From figure 1, we can see that the relationship between the log of the Phytoplankton concentration and log of the Protozoa concentration is steeper in transect 3 and 7 than in transects 1, while this relationship is similar between the other transects. If we double the concentration of protozoa in transect 1, we are likely to get the estimated median phytoplankton concentration of 3921 phytoplankton/mL, and 95% of the time that number will be between 1457 and 10554 phytoplanktons/mL.

### **Summary/Discussion**

Phytoplankton concentration escalates with Protozoa concentration, and that relationship is steeper for transect 1, 9, 12 than for transect 3, 7. There was a large overlap between the predicted concentration of phytoplankton of the investigated transects, so if we are given Protozoa concentration and Phytoplankton concentration from a sample, it's unlikely that we can tell which transect it was from. The data was collected in the summer only, which have a lot of sunlight for Photosynthesis so there will be less phytoplankton and protozoa than in wintertime. It is suggested that phytoplankton and protozoa might have herbivory relationship but there will need to be more investigation in another time of the year.

## Appendix

Relationship between  $\log(\text{Protozoa/mL})$  and  $\log(\text{Phytoplankton/mL})$  across 6 transects in Southern Ocean

The chosen transects were where they put CTD stations

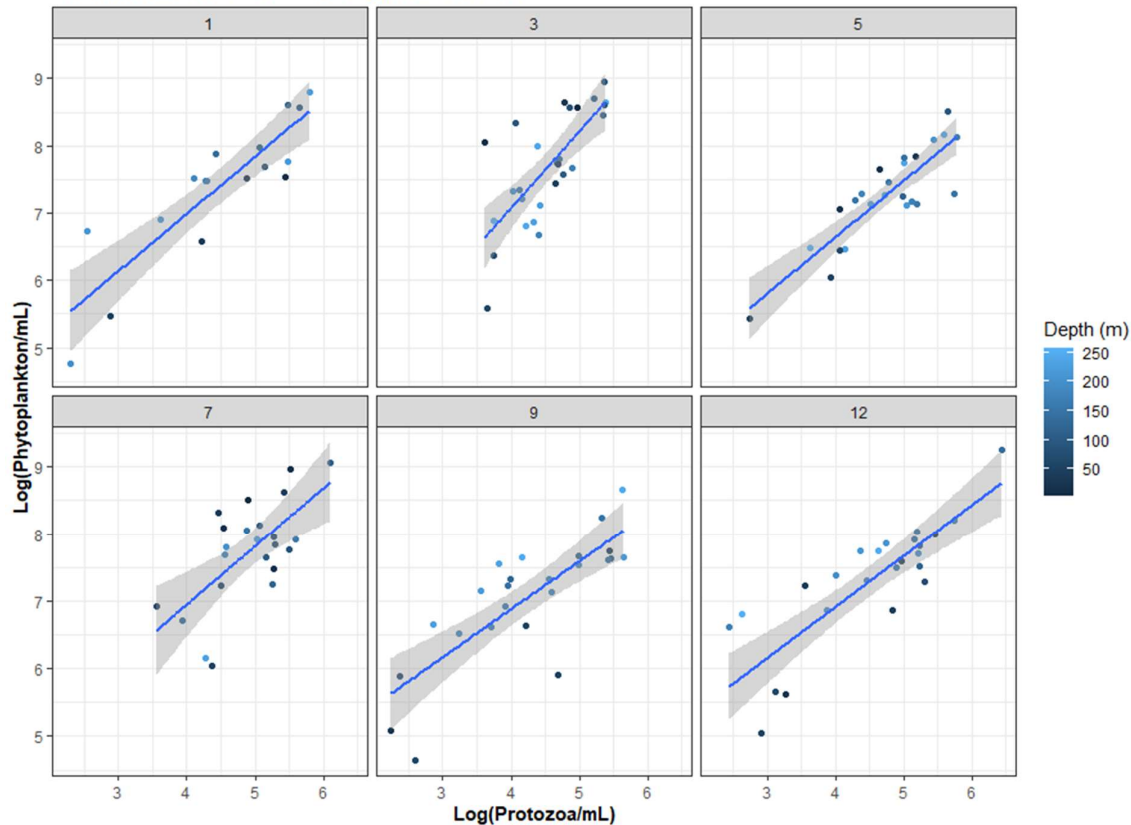


Figure 1:  $\log(\text{Phytoplankton/mL})$  and  $\log(\text{Protozoa/mL})$  across 6 transects of the Southern Ocean surrounding Antarctica, transects were chosen by the location of the CTD (an oceanography instrument to measures conductivity-temperature-depth) stations. The plot suggests there might be a positive linear relationship between  $\log(\text{Phytoplankton/mL})$  and  $\log(\text{Protozoa/mL})$ , and that relationships seems different between transect 3,7 and other transects.

Reference:

Thomson, P.G. (2010) BROKE-West microbial concentrations - Voyage 3 of the Aurora Australis 2005/2006, Ver. 1, *Australian Antarctic Data Centre* - [doi:10.4225/15/59890669dda1a](https://doi.org/10.4225/15/59890669dda1a), Accessed: 2020-10-26