Future prospects for the Cumbrian lakes: Applications of the PROTECH lake model

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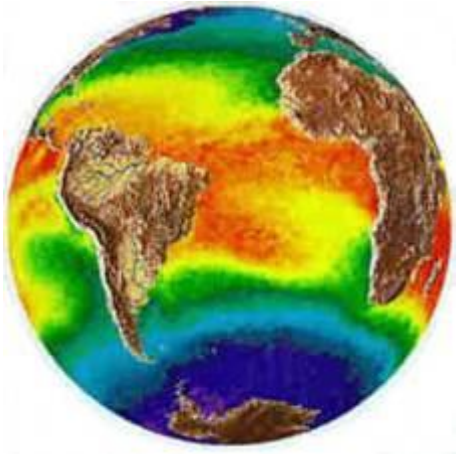
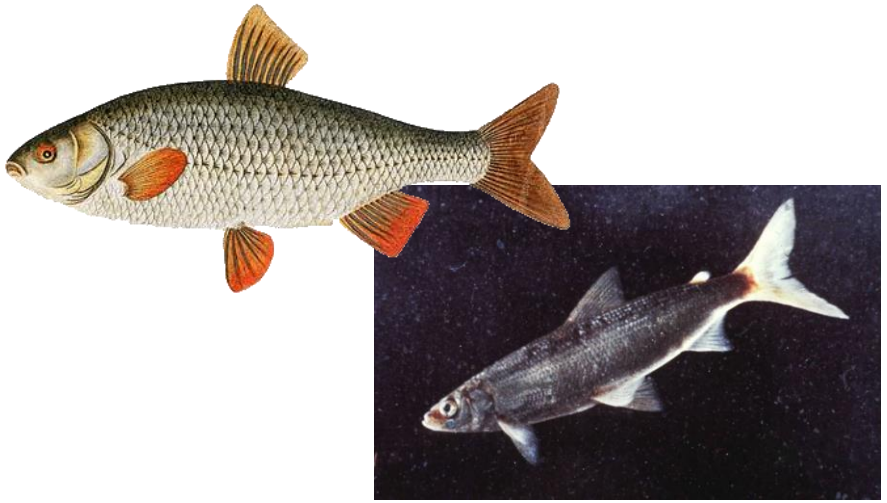
NERC SCIENCE OF THE ENVIRONMENT

Future threats

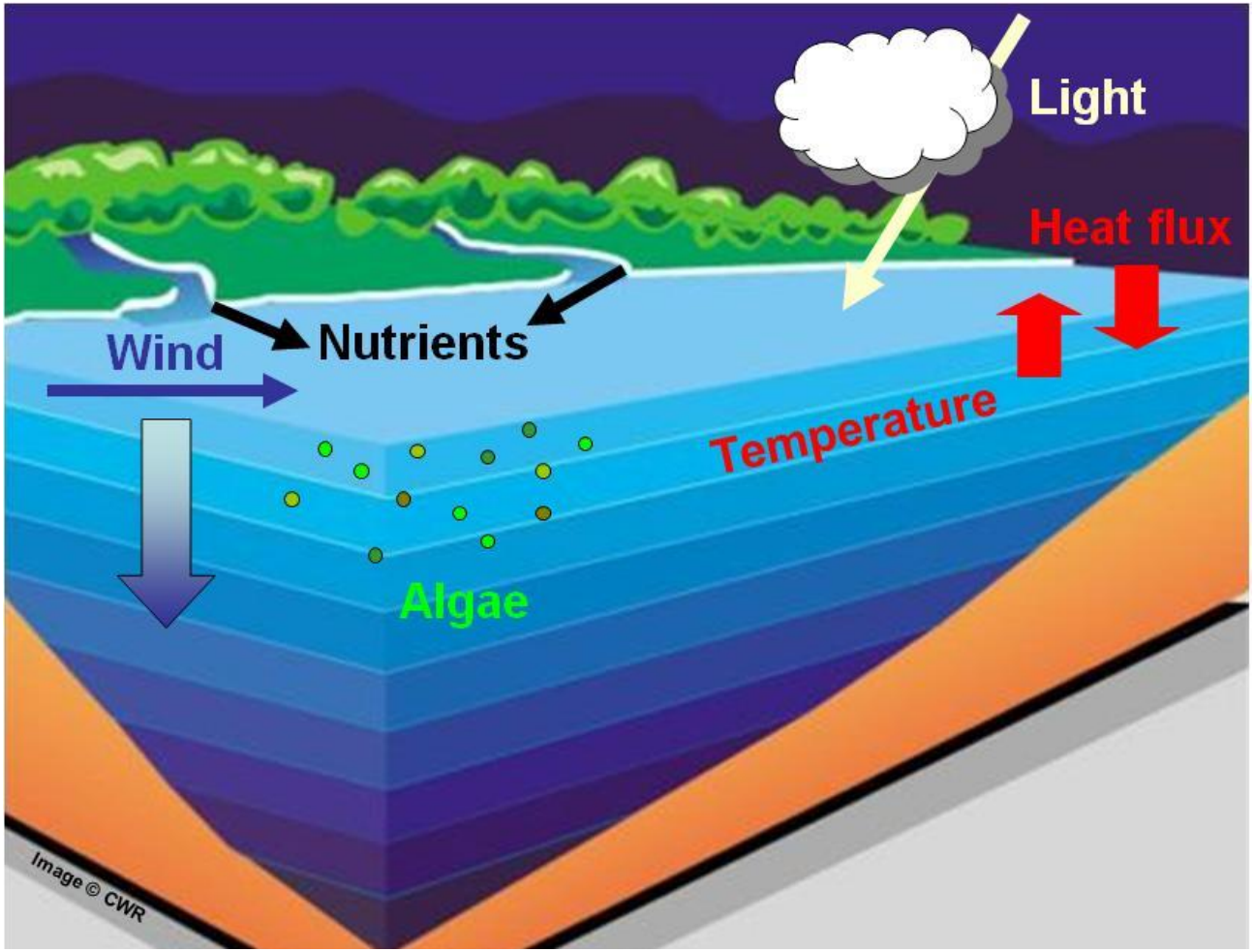
- Nutrient enrichment
- Climate change
- Species invasion/loss
- All inter-linked





PROTECH

(Phytoplankton RespOnses To Environmental CHange)



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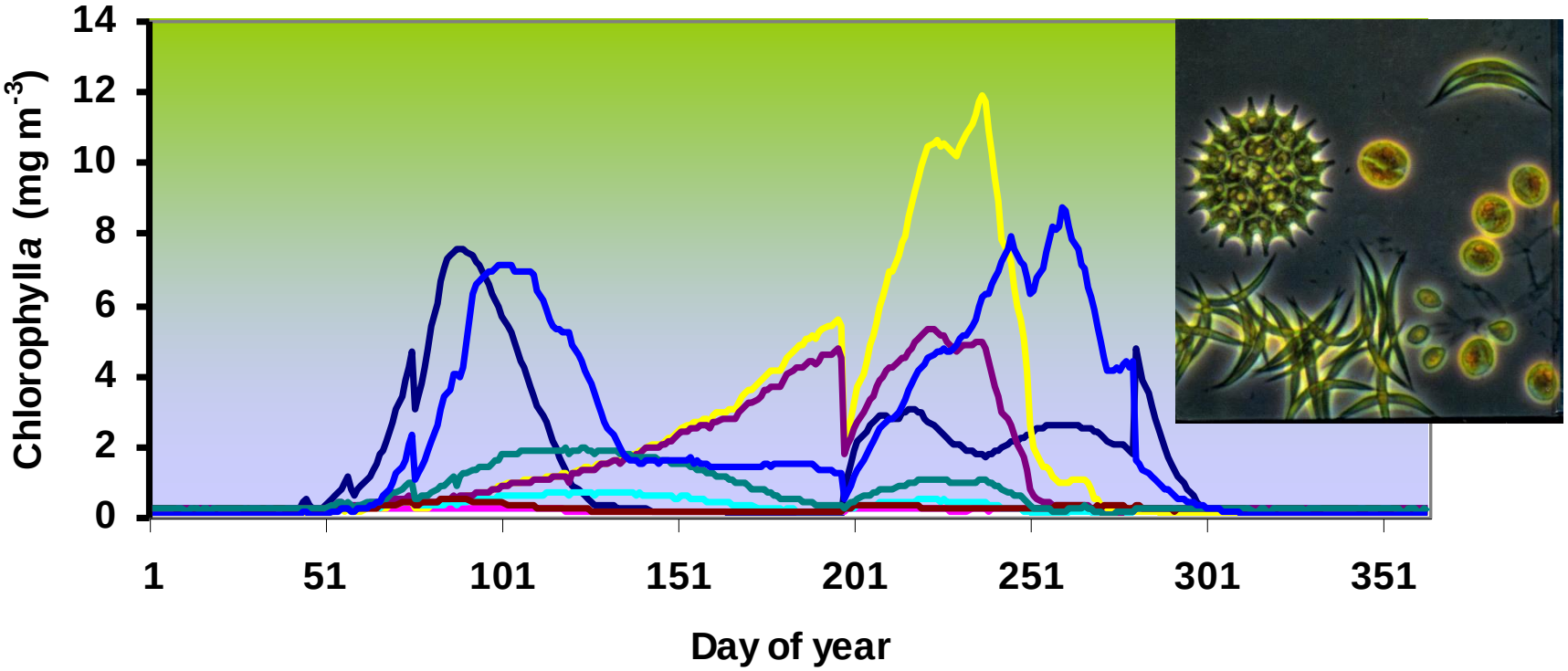
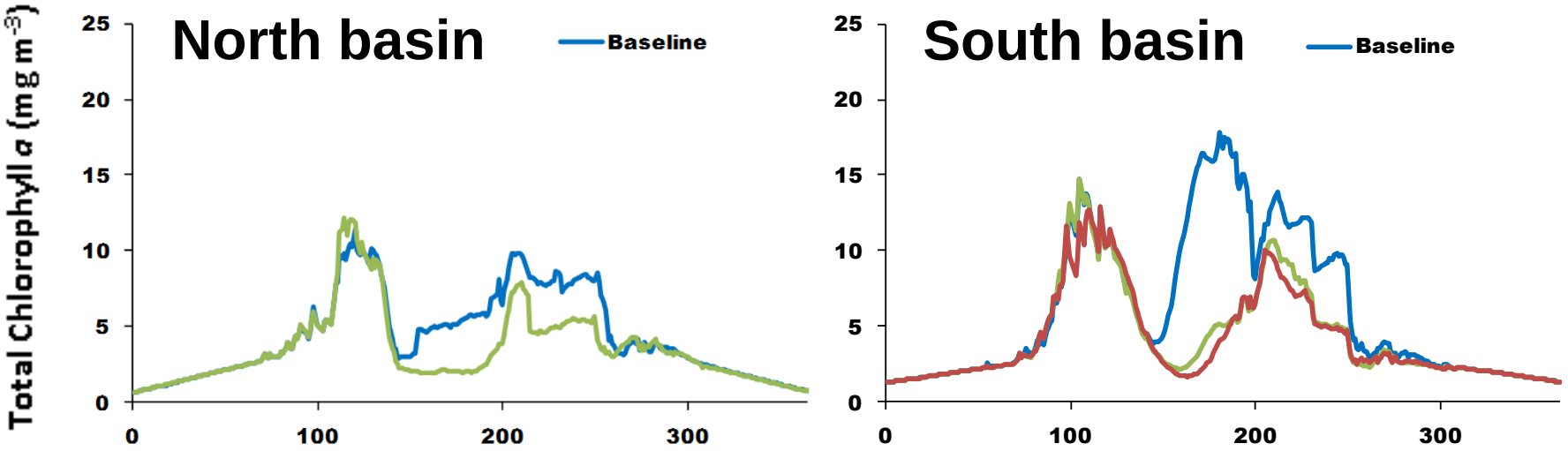
PROTECH



- **PROTECH predicts the biomass and species composition of the algal community giving it a unique world status**

Future threats: Nutrient enrichment

- Testing future strategies for United Utilities
- Sewage treatment work improvements



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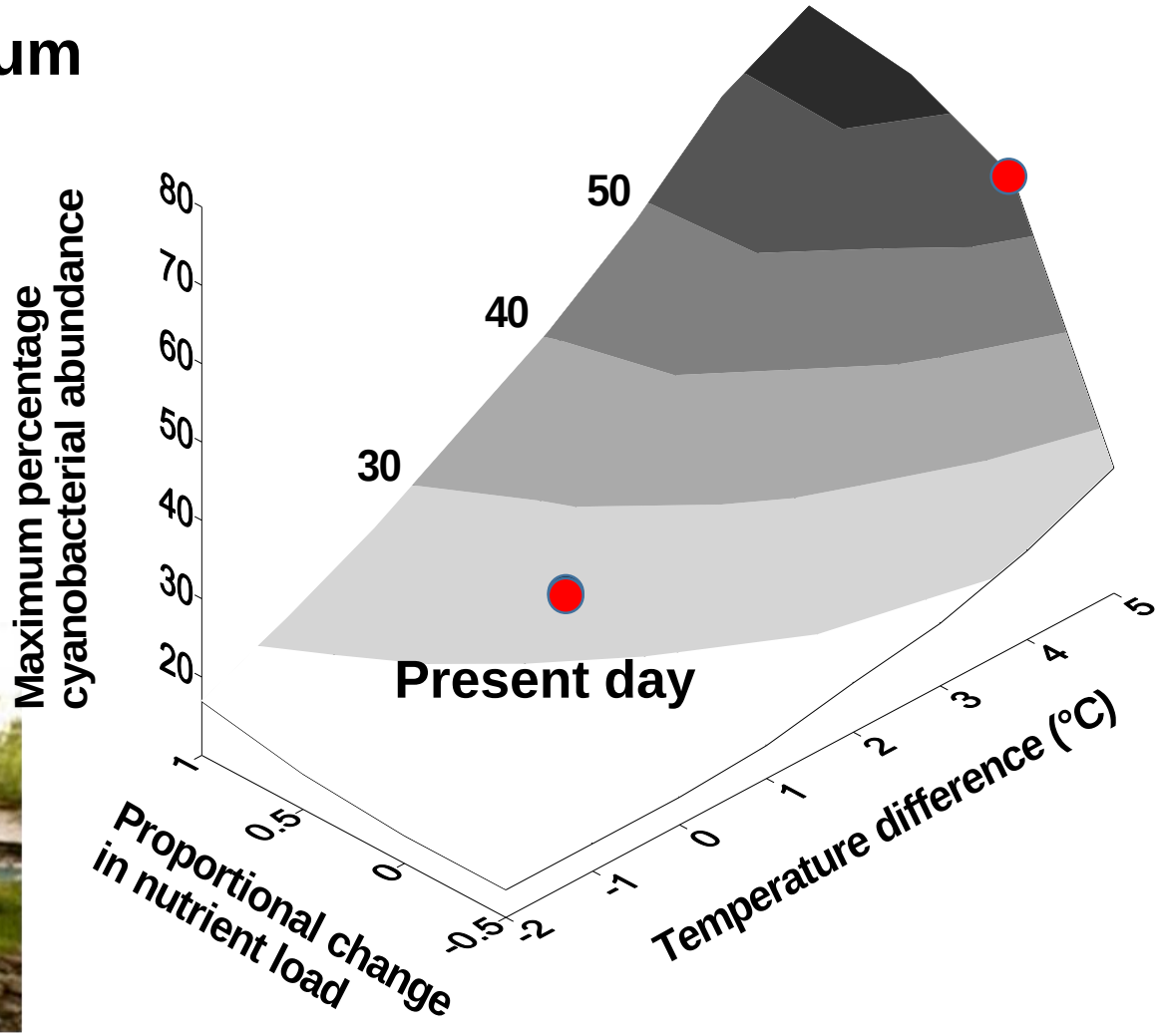
Future threats: Climate change

- **Changes in maximum abundance of cyanobacteria**



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Future threats: Species loss

- Vendace *(Coregonus albula)*
- Maximum length 250 mm
- Low temperatures (<15°C)
- High oxygen levels (>5 mg L^{-1})

Future threats: Species loss

- **To predict how vendace habitat volume will be affected in Bassenthwaite Lake under predicted future climate change**

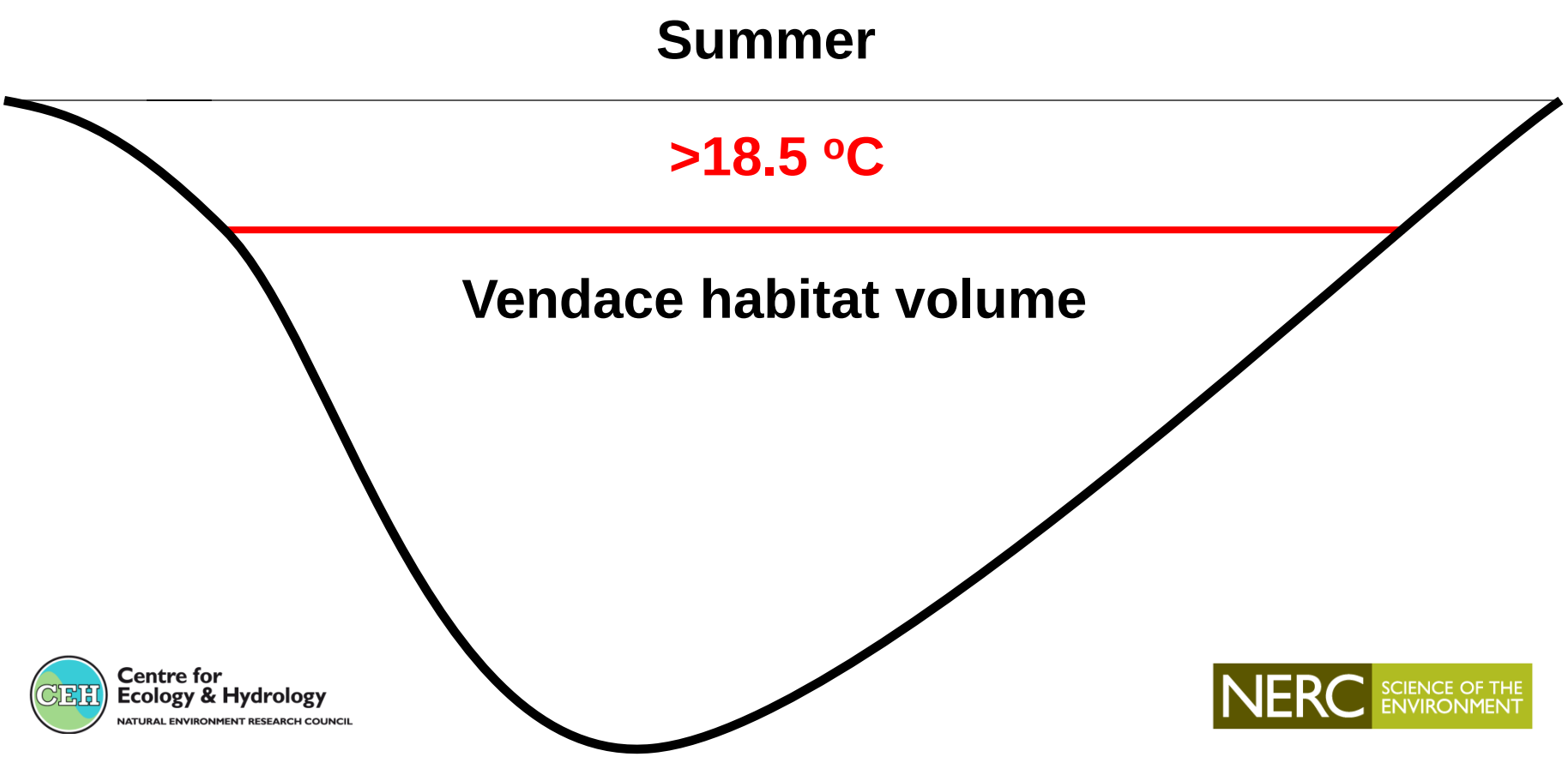
Bassenthwaite Lake

- **Max Depth = 19.0 m**
- **Mean Depth = 5.3 m**
- **Length = 6.2 km**
- **Volume = 27.9 x 10^6 m^3**
- **Area = 5.28 km^2**

Future threats: Species loss

Habitat volume

- **Volume of water that does NOT exceed critical temperature and oxygen limits**



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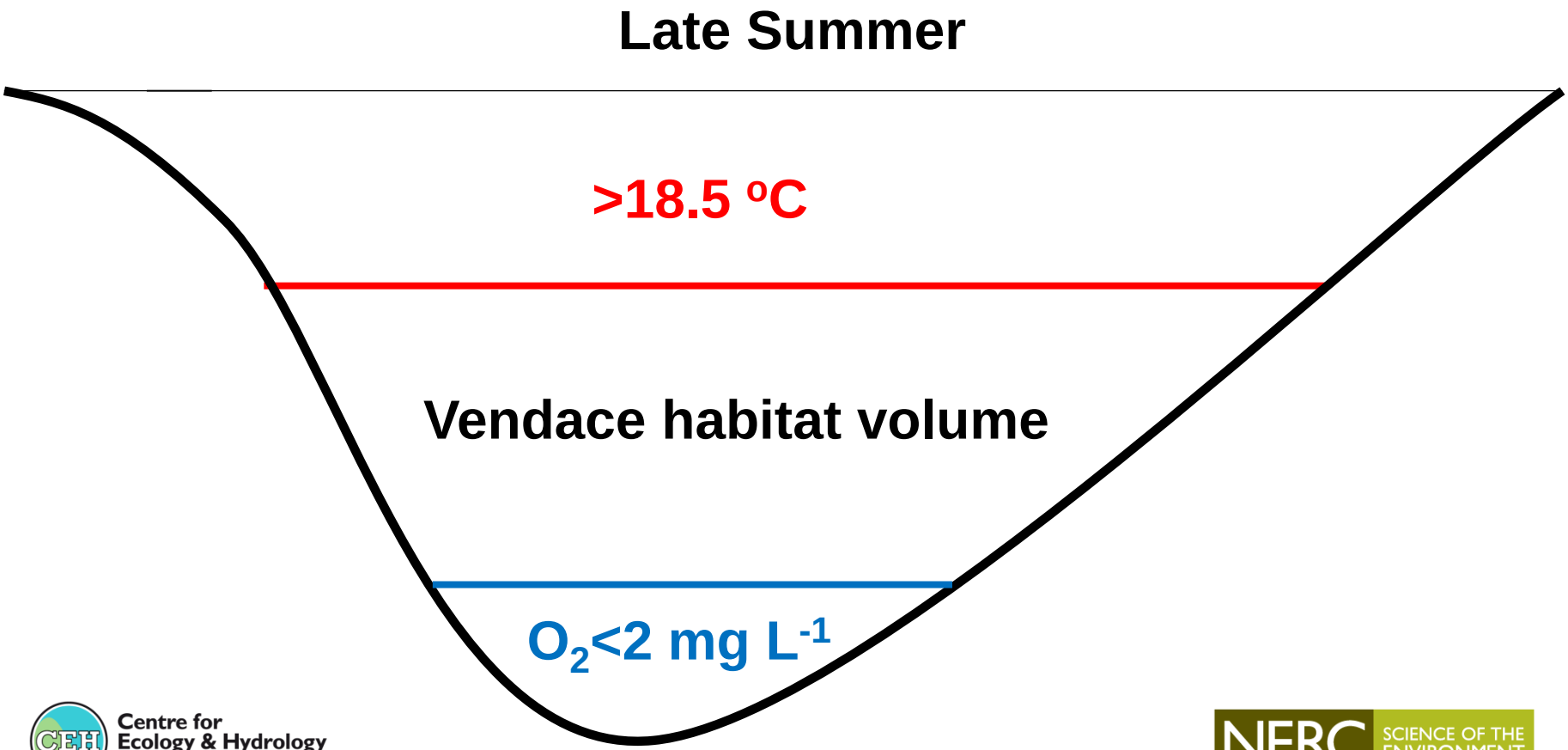
Future threats: Species loss

Habitat volume

- **Volume of water that does NOT exceed critical temperature and oxygen limits**



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Future threats: Species loss

The method

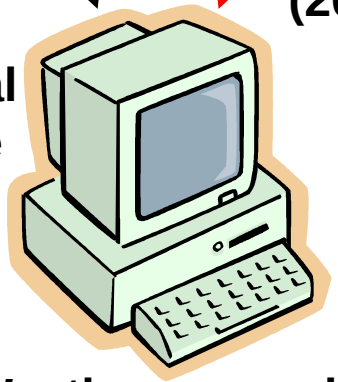
Weather scenarios (UK Met Office)

Present

Future

(2070-90)

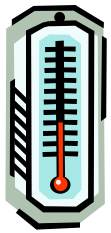
Regional Climate Model



Weather scenarios

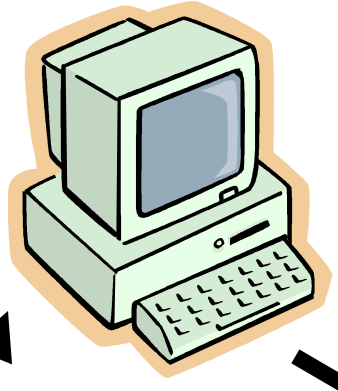
Cloud

Wind



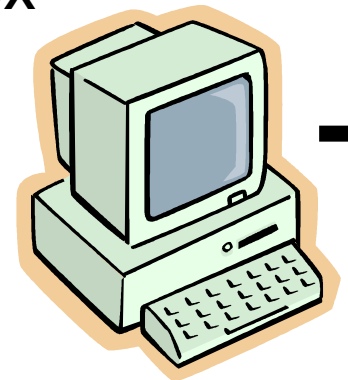
Air temperature

PROTECH



20 years of algal and temperature output for both present and future

LOX

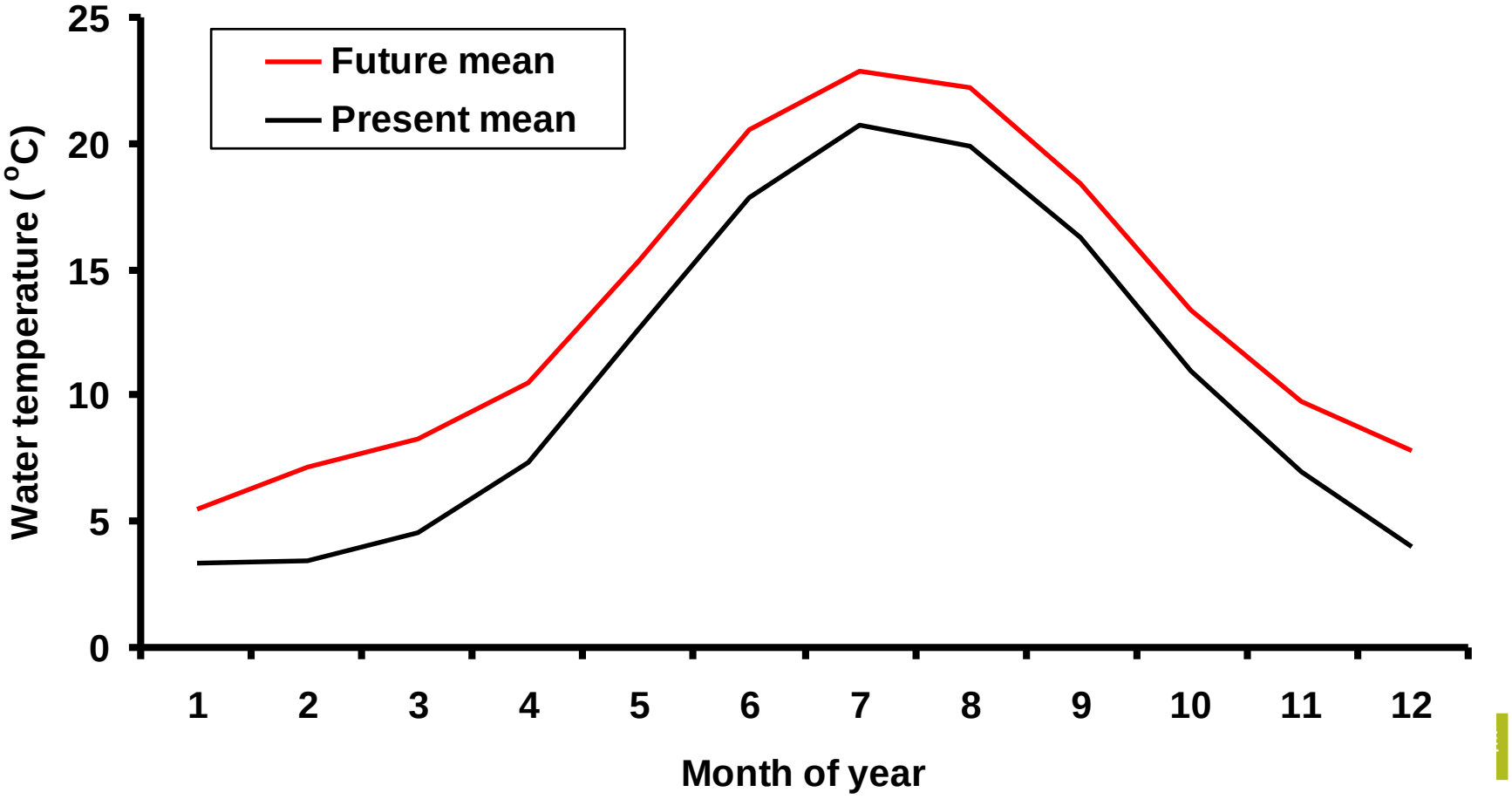


Habitat volume

Future threats: Species loss

Comparison between present and future

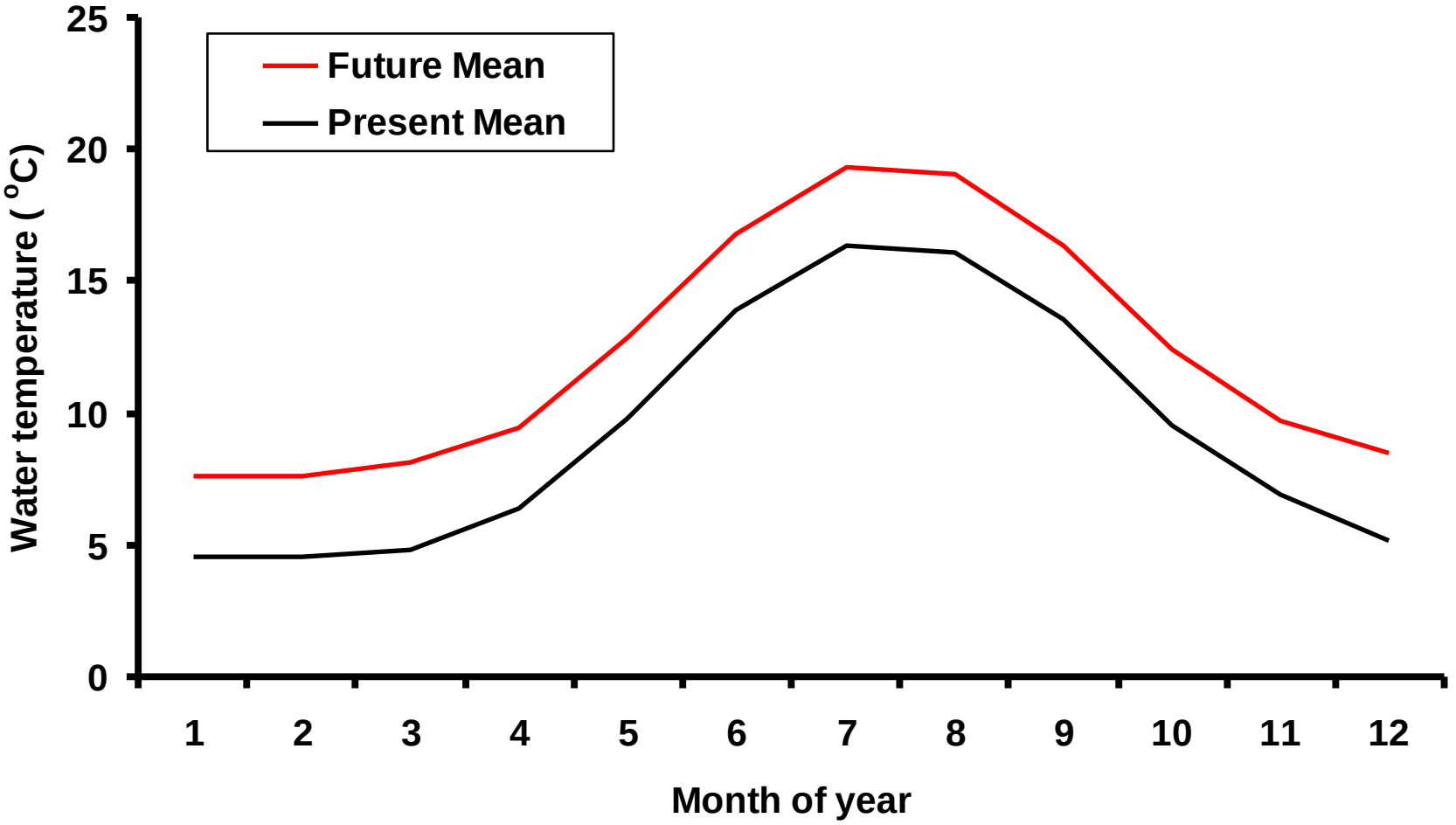
Surface water temperature



Future threats: Species loss

Comparison between present and future

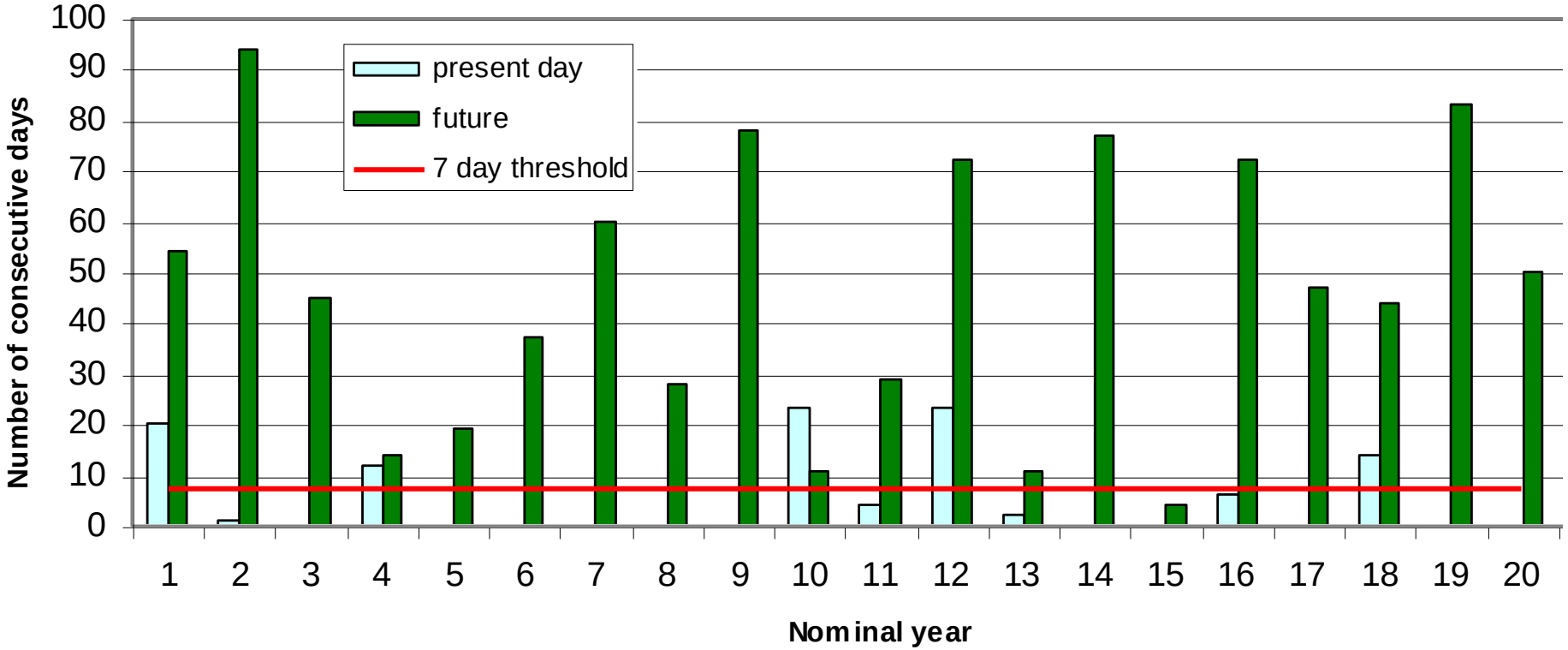
Deep water temperature



Future threats: Species loss

The future for Bassenthwaite Lake

Habitat volume



- **Temperature had the biggest effect**
- **Every year in the future has days of 0 habitat volume**

Conclusions

- **Predicting the impact of the future requires knowledge of the present**
- **CEH's PROTECH model provides a method for utilising that knowledge**
- **PROTECH provides a tried and test way of quantifying those future changes and the impact of management strategies**