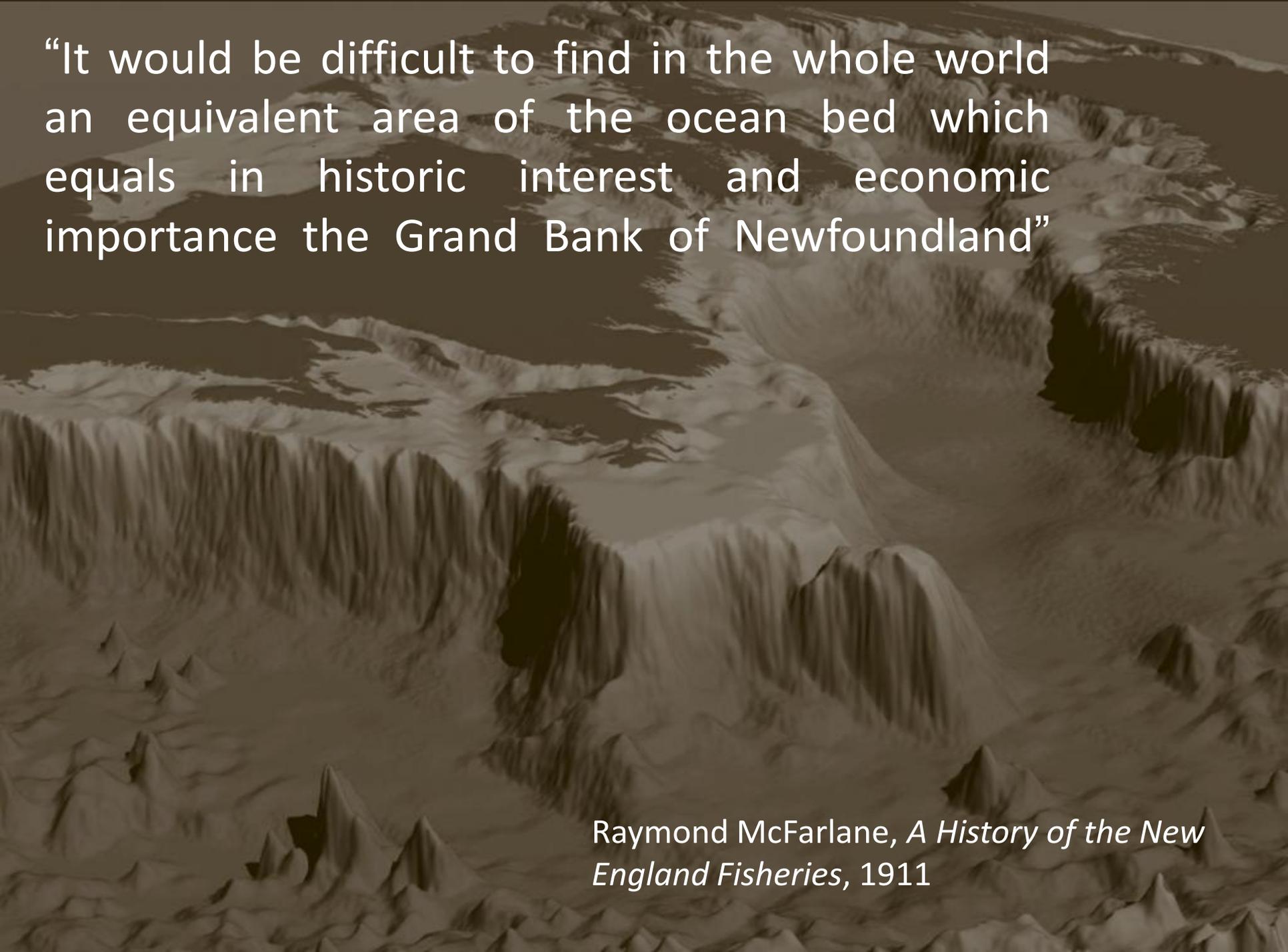


# Science to sustain fish stocks: *Facing the Grand Banks*

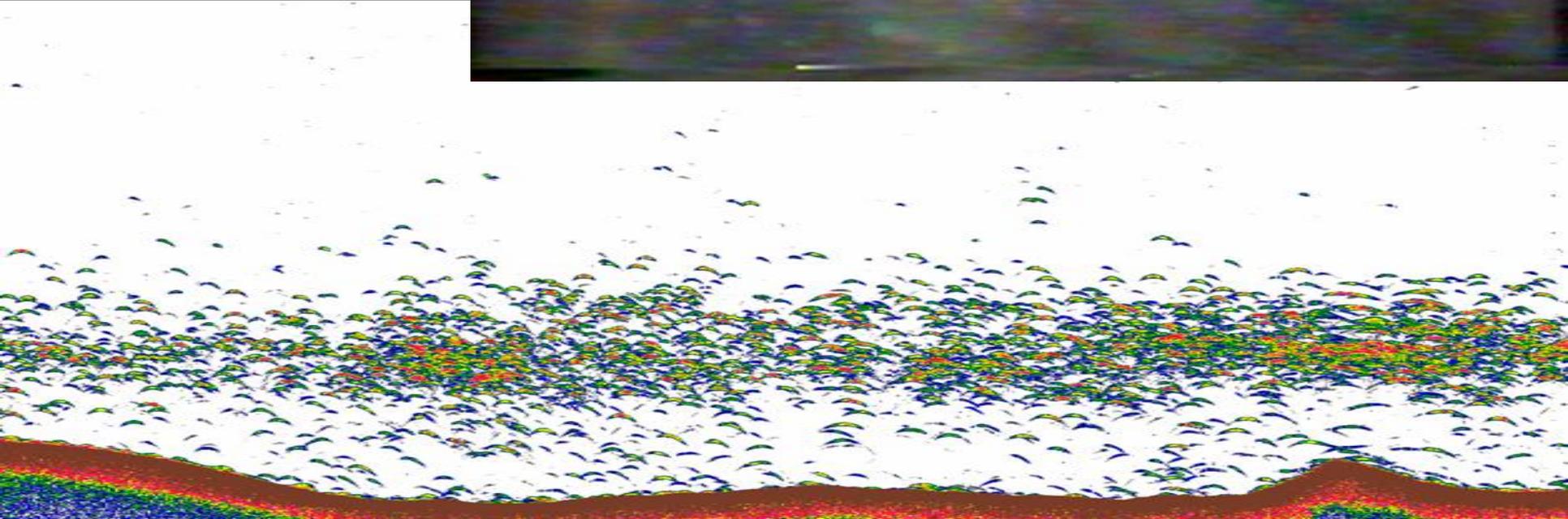
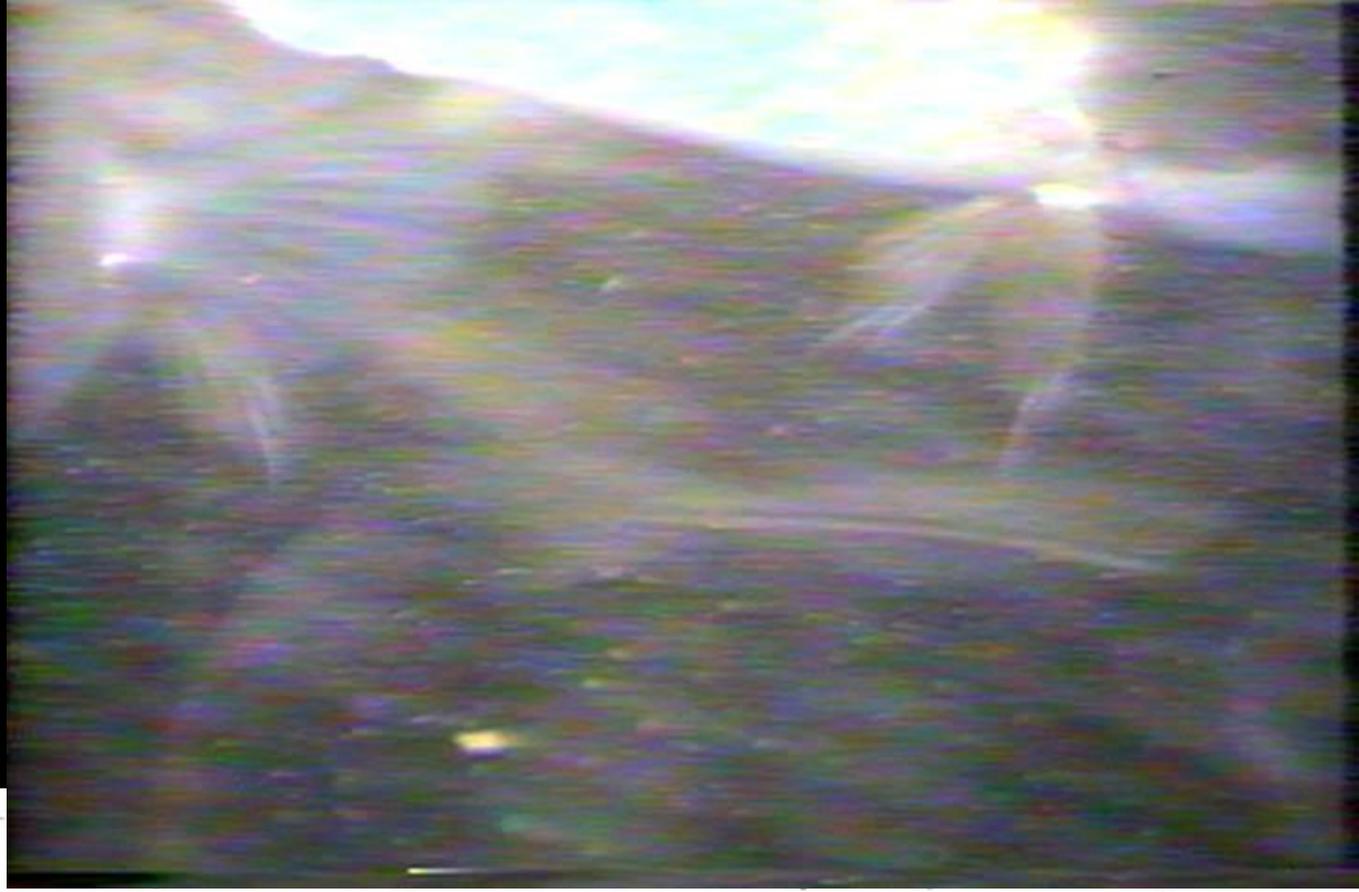
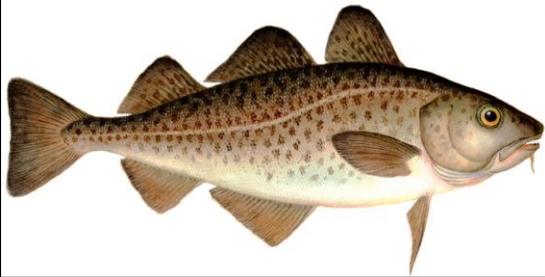
George Rose



“It would be difficult to find in the whole world an equivalent area of the ocean bed which equals in historic interest and economic importance the Grand Bank of Newfoundland”

Raymond McFarlane, *A History of the New England Fisheries*, 1911

# Atlantic cod



# Capt. John Davis, 1585 off Labrador



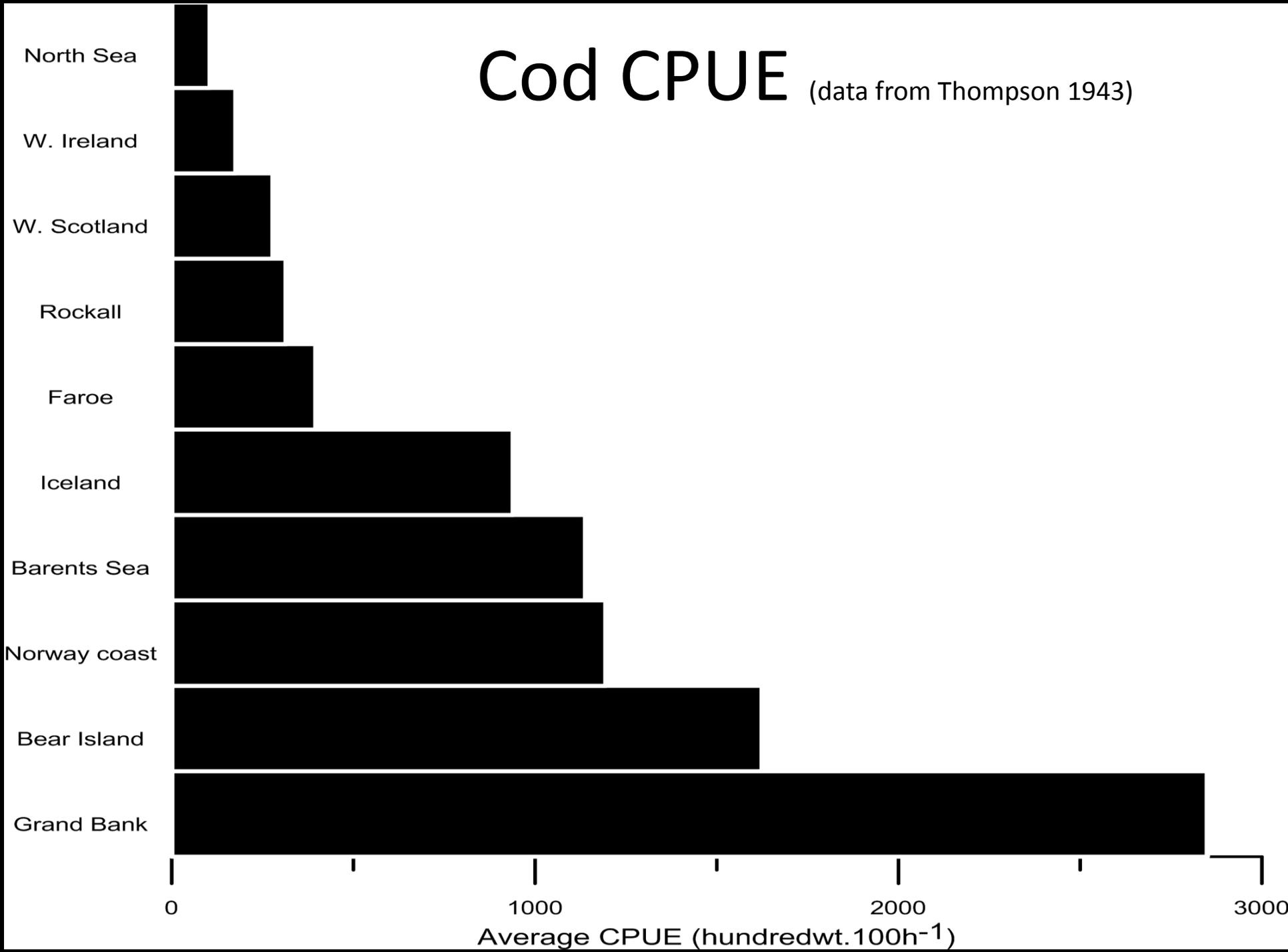
On September 1, 1585, Davis “found great abundance of cod, so that the hooke was no sooner overboard, but presently a fish was taken. It was the largest and the best fed fish that ever I sawe”



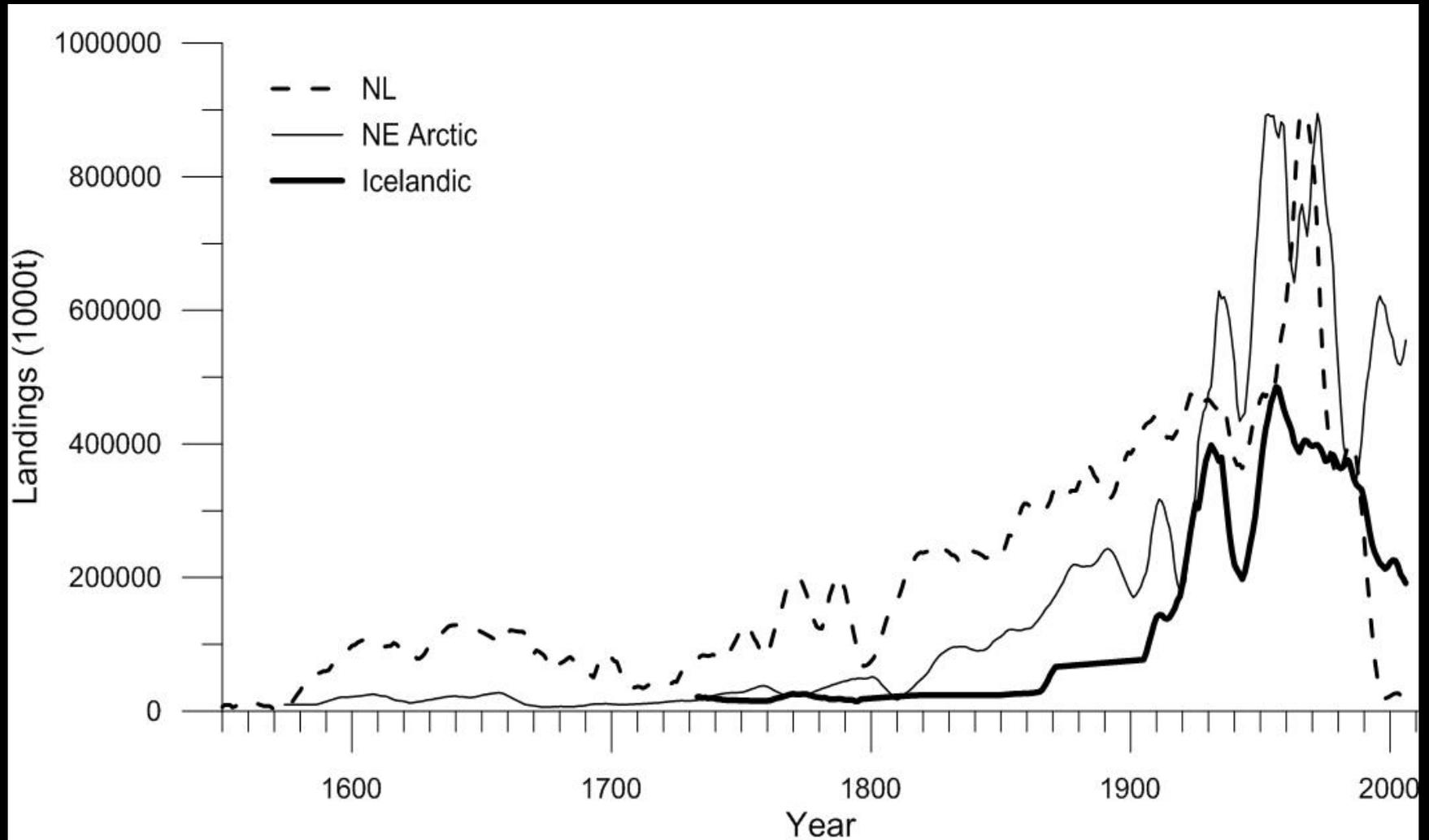
**“ For tho the British Channel and the German ocean [North Sea] are not without this fish, their numbers are so inconsiderable comparatively to those of Newfoundland, that they may rather be looked upon as stragglers”**

Antonio de Ulloa, 1800s

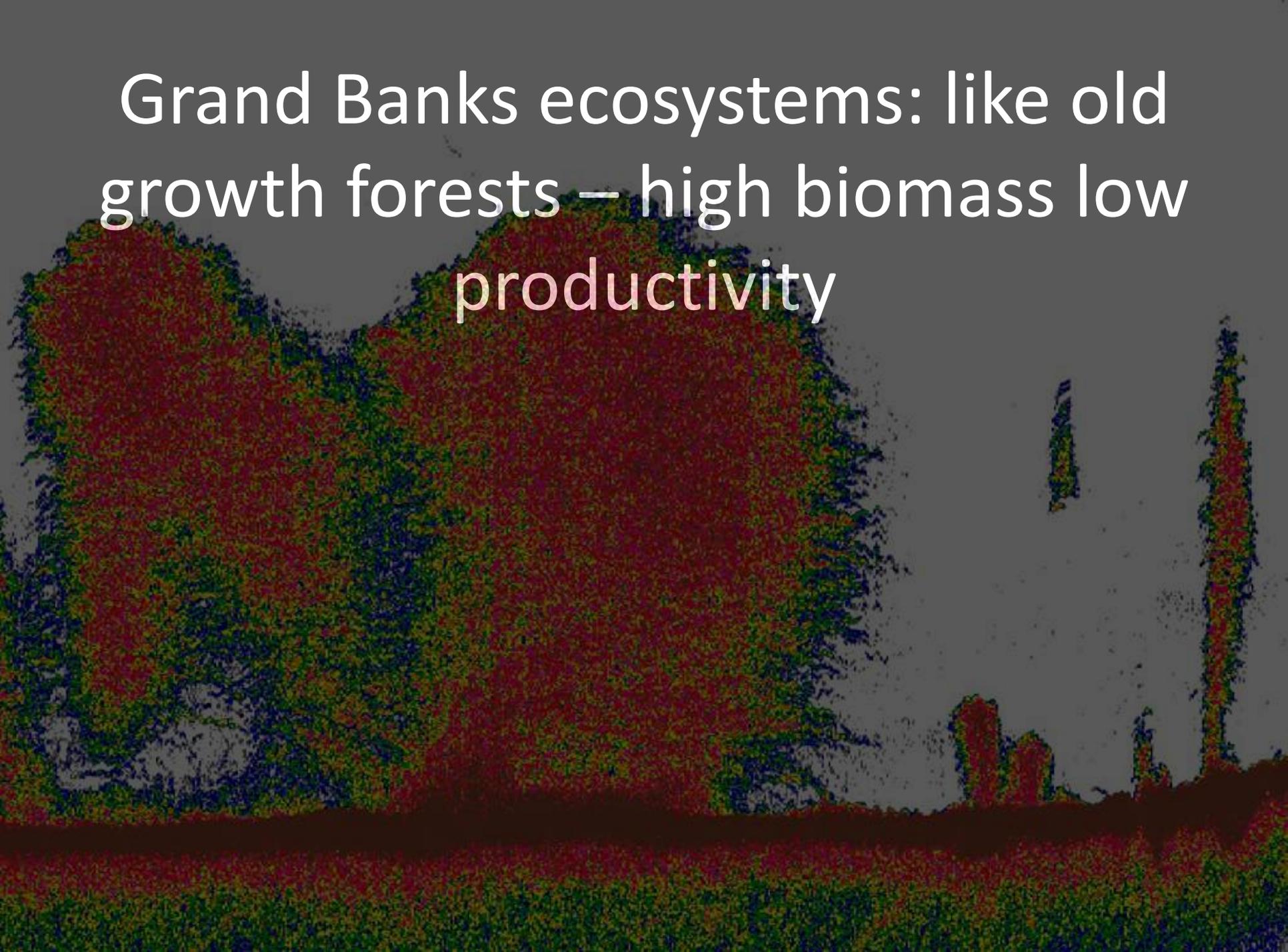
# Cod CPUE (data from Thompson 1943)



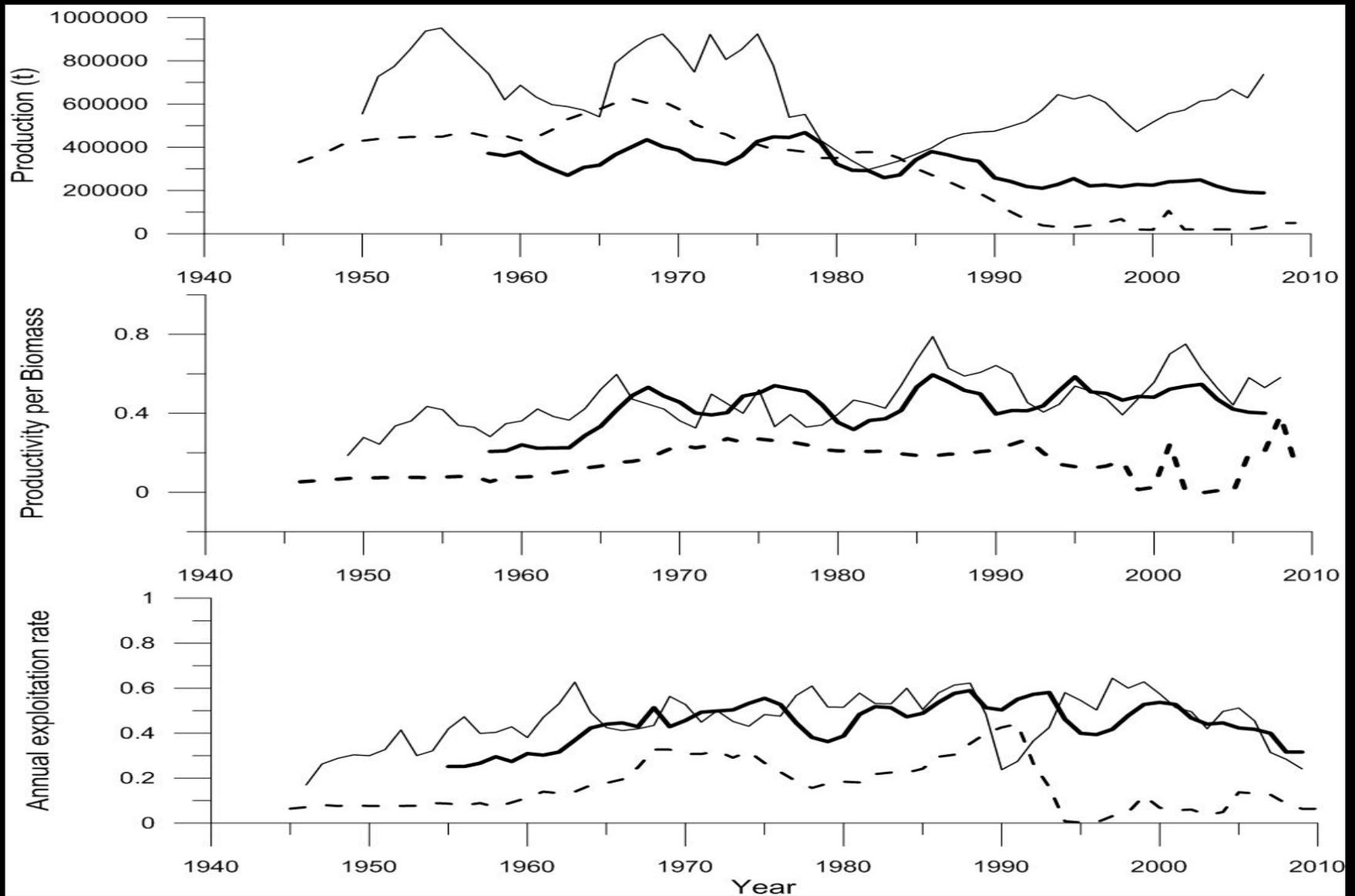
# Cod landings 1550- (from Rose et al. in press)



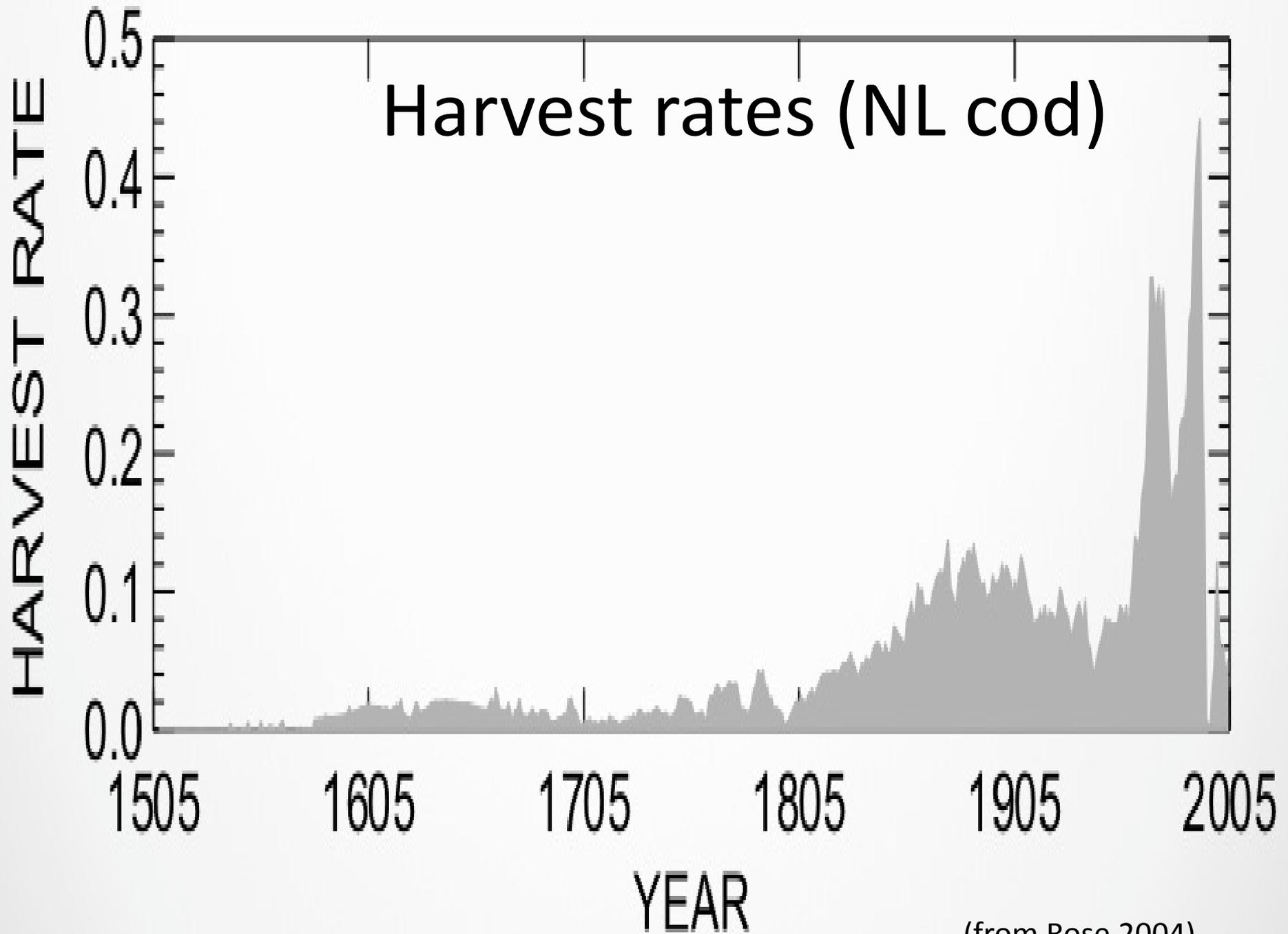
Grand Banks ecosystems: like old  
growth forests – high biomass low  
productivity



# Productivity-exploitation



from Rose et al. in press



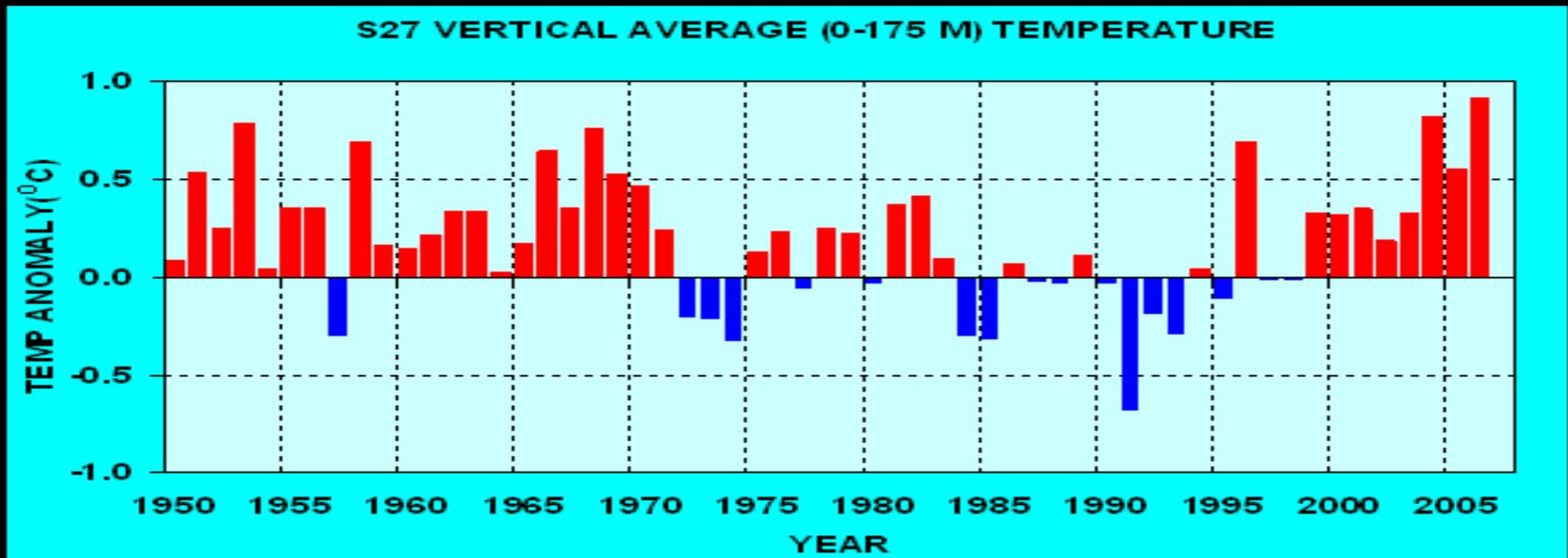
(from Rose 2004)

# Balancing production and removals



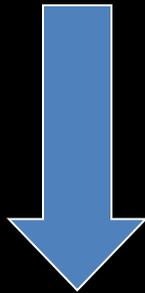
# Changing climate - productivity

- Climate influences productivity
- Productivity determines sustainable harvest
- Many complexities through the food web



# What went down and what up??

- Euphaasids (plankton)
- Capelin
- American plaice
- Atlantic cod
- Atlantic salmon

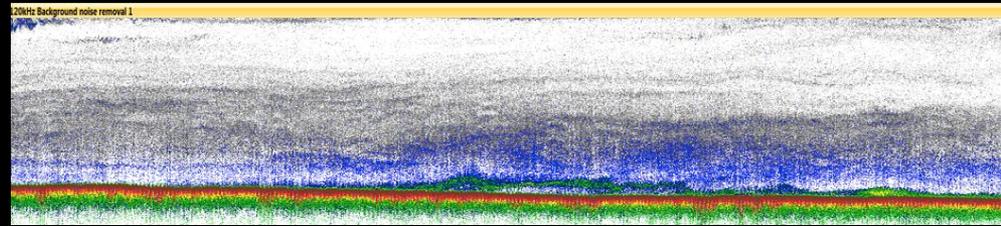
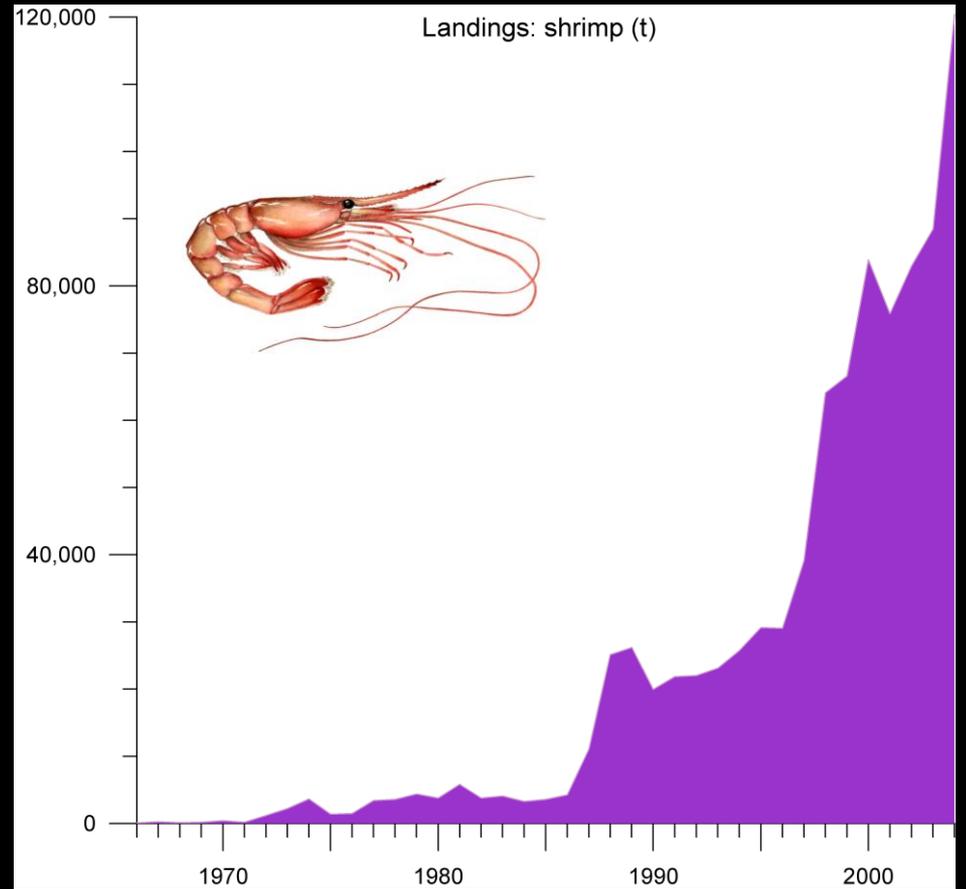
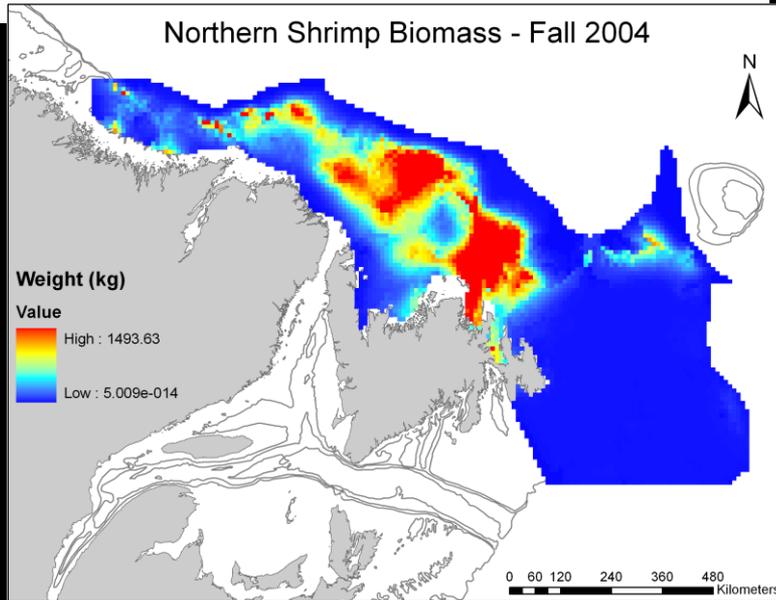
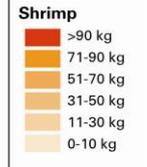
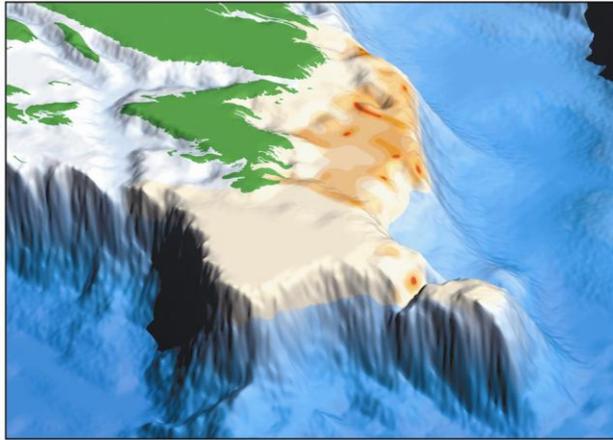


- Marine butterflies (Oikopleura plankton)
- Arctic cod
- Snow crab
- Pandalid shrimps

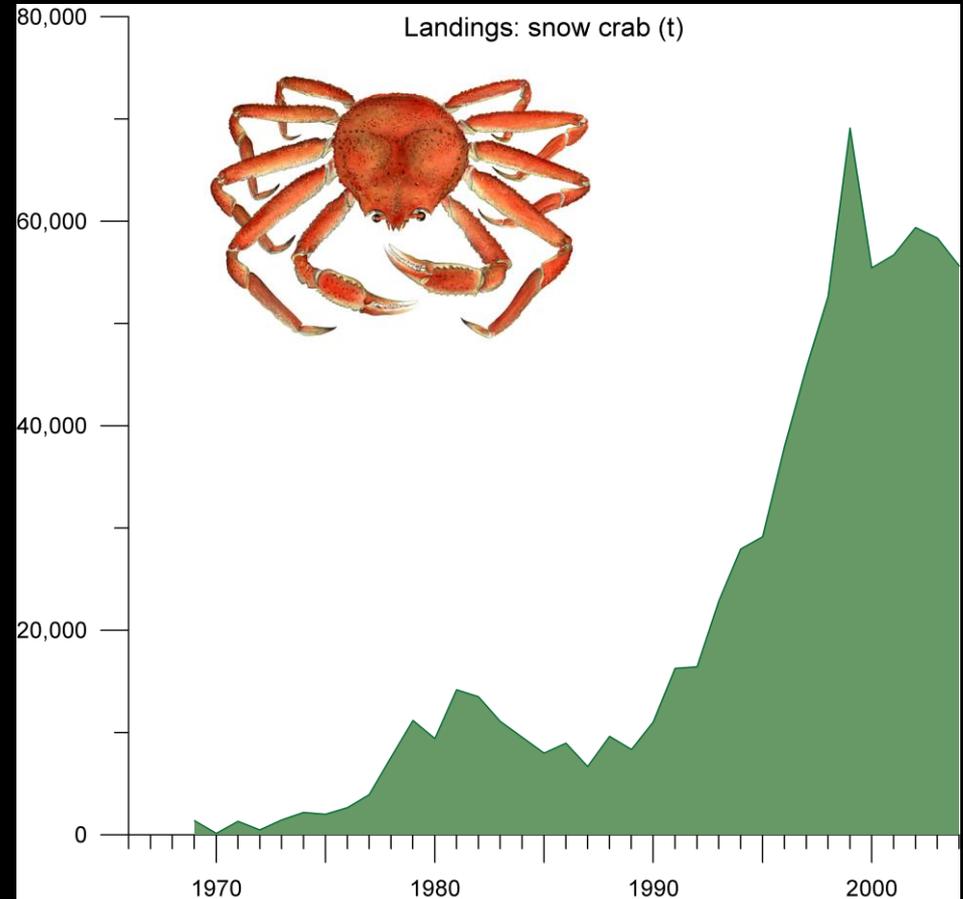
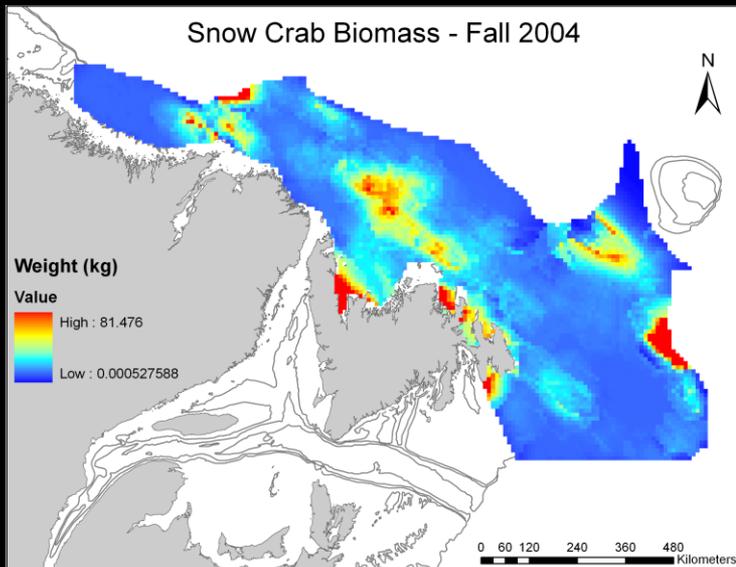
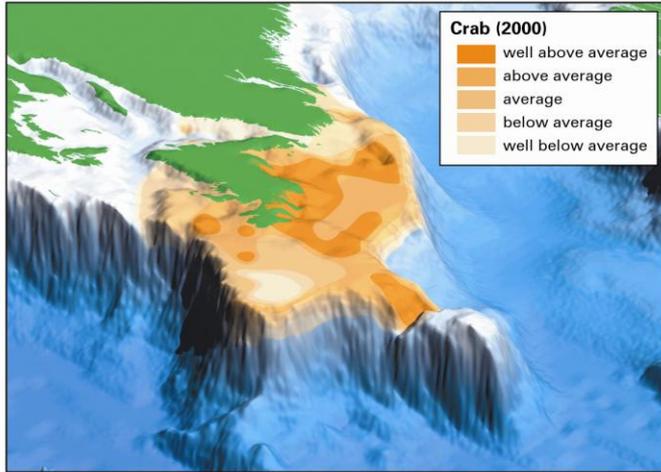
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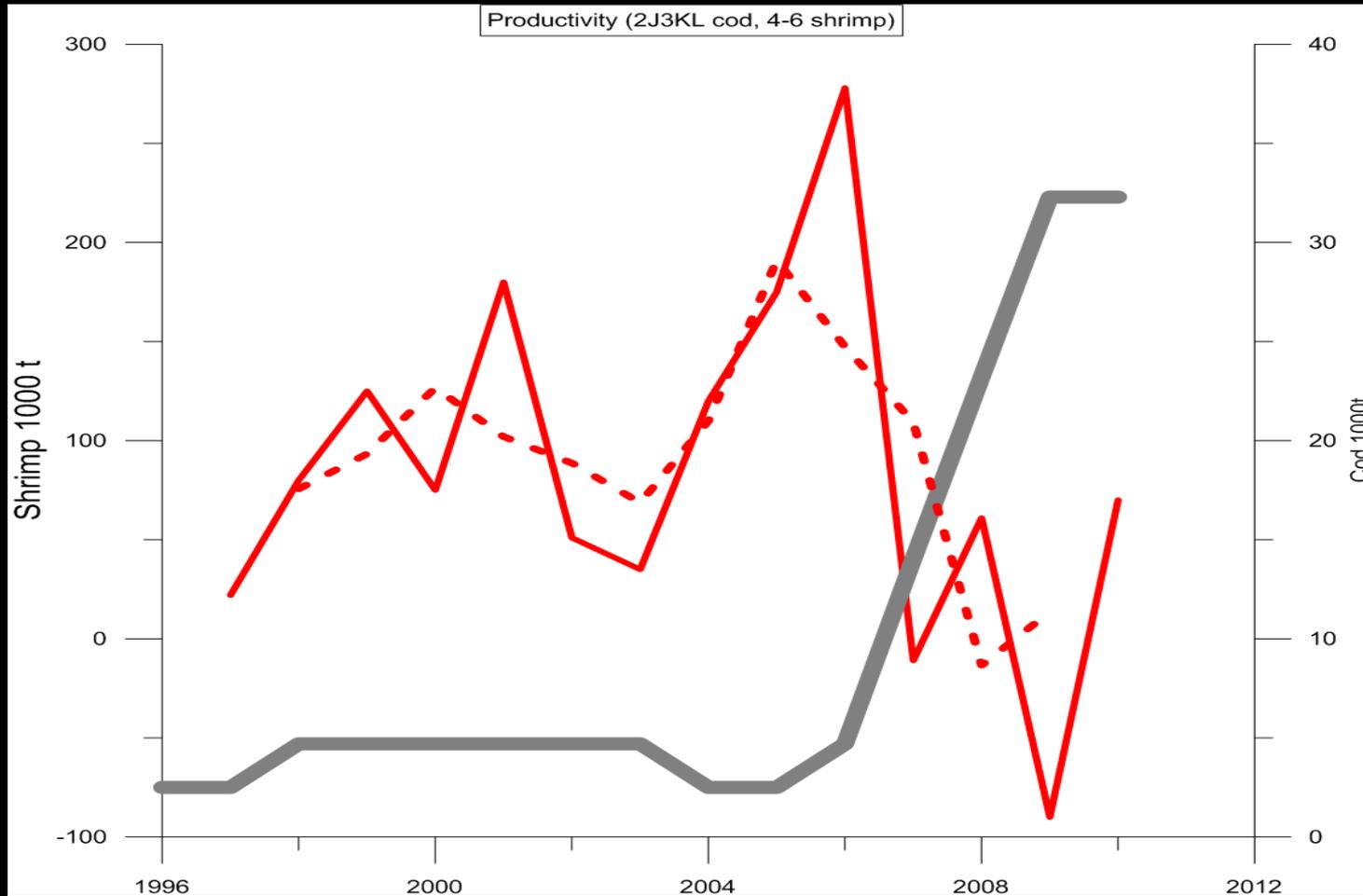
# Shrimp



# Snow crab



# Cod-shrimp productivity

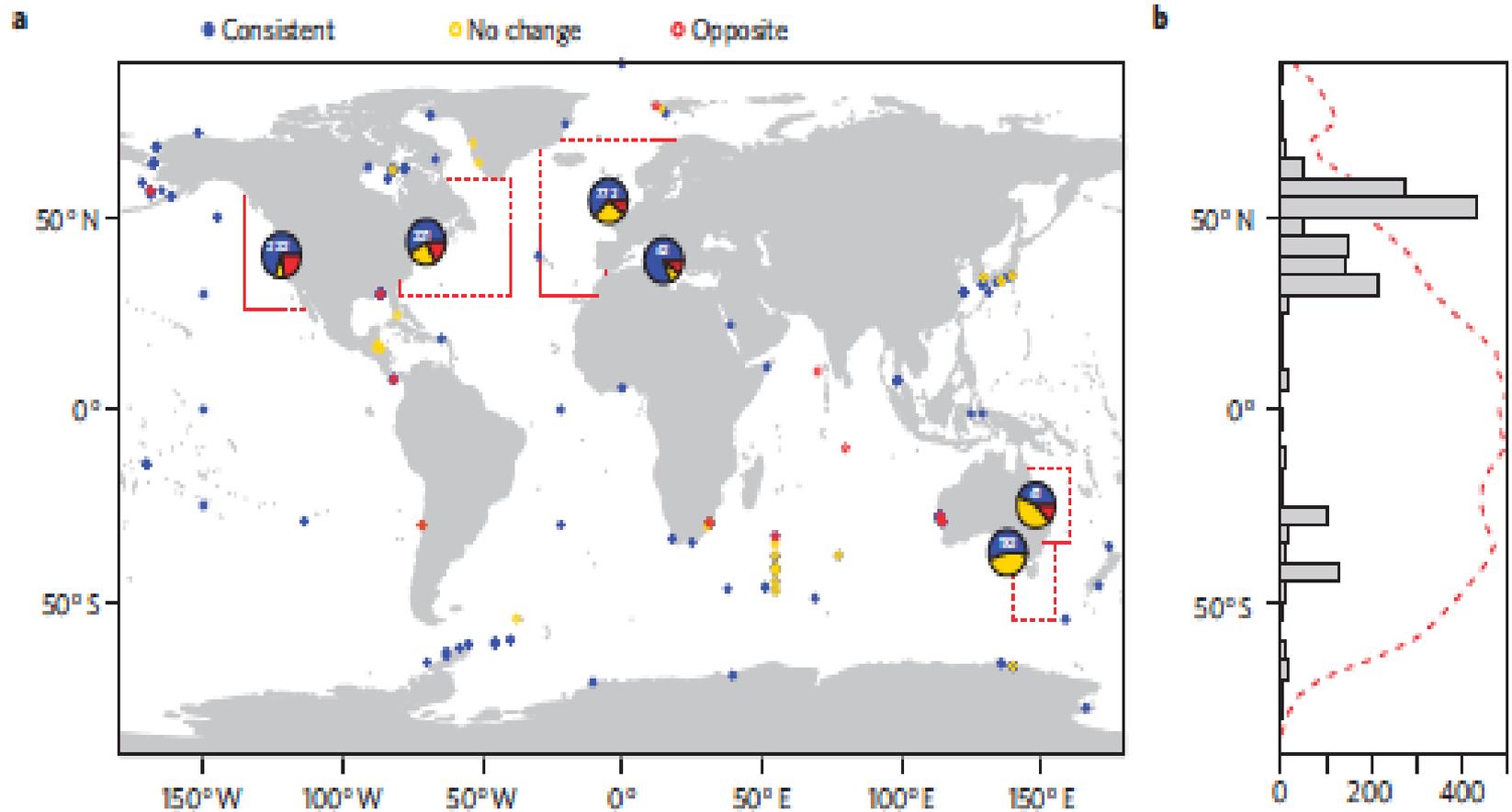


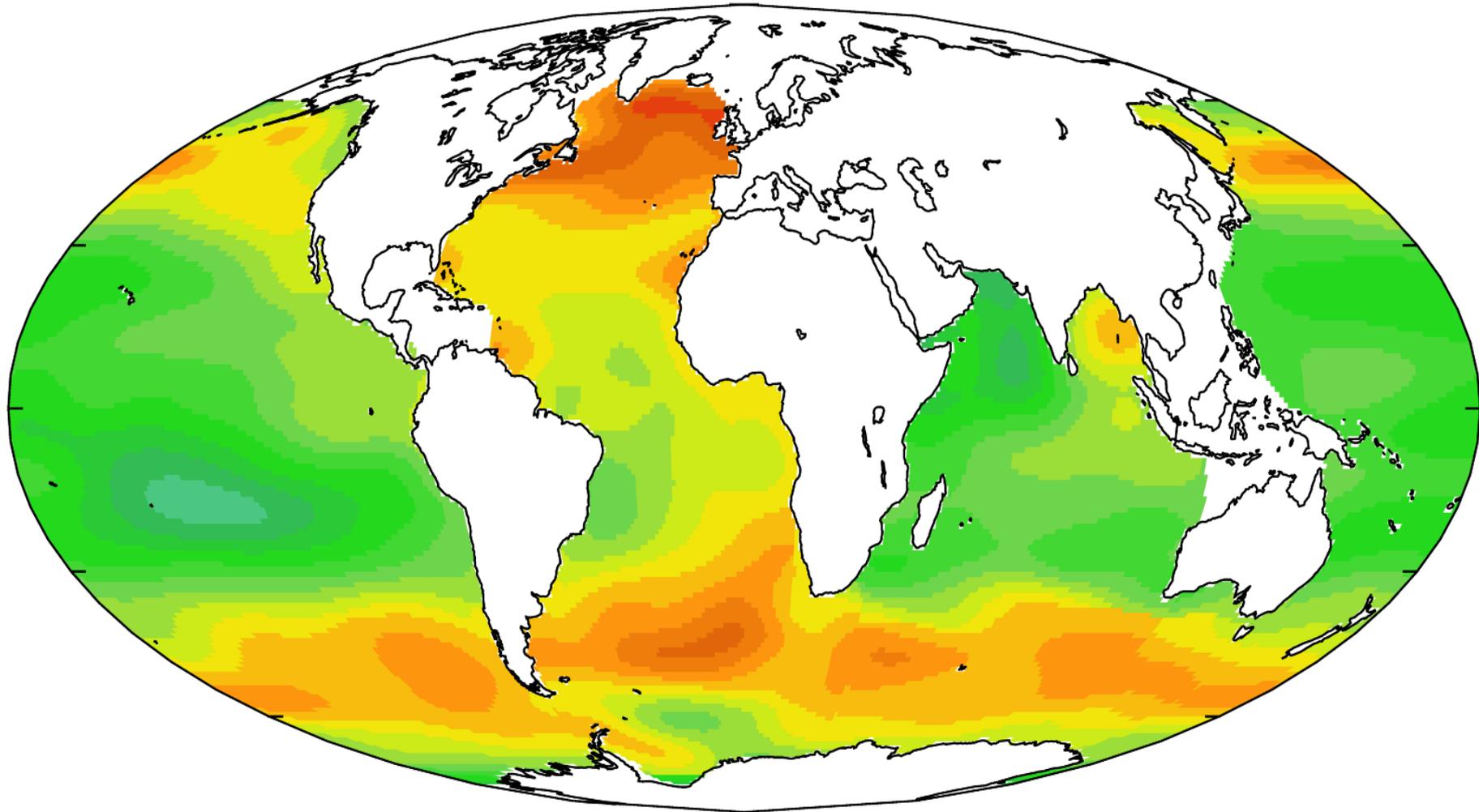
# What science has learned

- The dynamics of removals – production – an Ecosystem-based approach to deal with climate change
- More comprehensive observations (acoustics, electronic tagging, using fishing fleets)
- Better models for data-rich and poor fisheries – introduction of ecosystem models
- Science-based mgmt leads to sustainable fish stocks

Sustaining fish stocks isn't all about  
fishing

# >80% of marine life changes consistent with climate change predictions (Poloczanska et al. 2013)





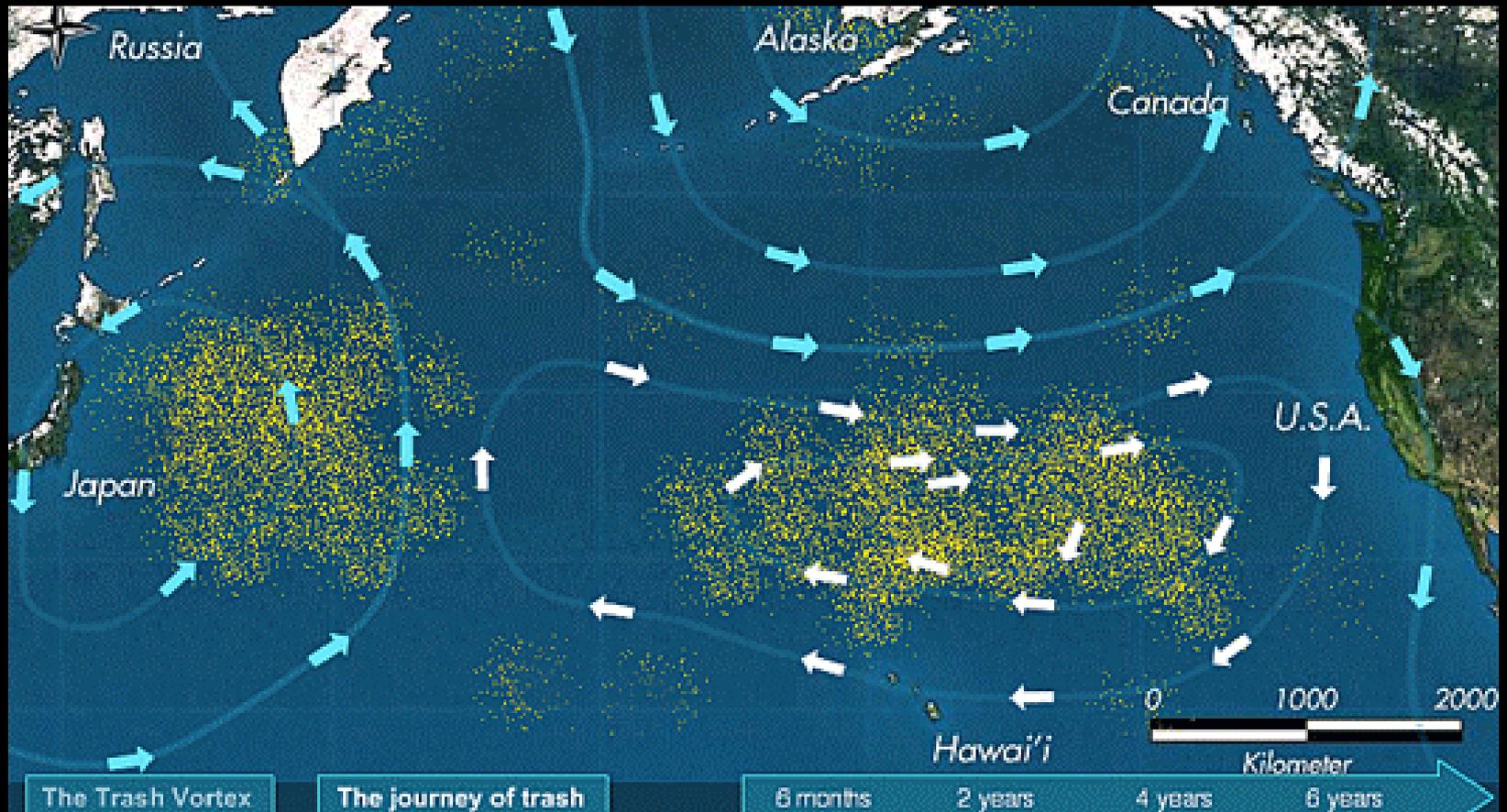
1700s-1990, from Global Ocean Data Project

$\Delta$  sea-surface pH [-]



-0.12      -0.1      -0.08      -0.06      -0.04      -0.02      0

# Pacific garbage bowls - 90% plastic



Like beauty, sustainability is in the  
eye of the beholder

# Acknowledgements

1. CFER colleagues and students
2. Marine Institute of Memorial University
3. Dep't of Fisheries and Aquaculture,  
Newfoundland and Labrador
4. NSERC