

A comparison of biological trends from four marine ecosystems: synchronies, differences, and commonalities

Jason S. Link, William Stockhausen, Georg Skaret,
William Overholtz, Bernard A. Megrey, Harald
Gjoesaeter, Sarah Gaichas, Are Dommasnes, Jannike
Falk-Petersen, Kerim Aydin, Joseph Kane, Franz
Mueter, Kevin Friedland and Jon Hare

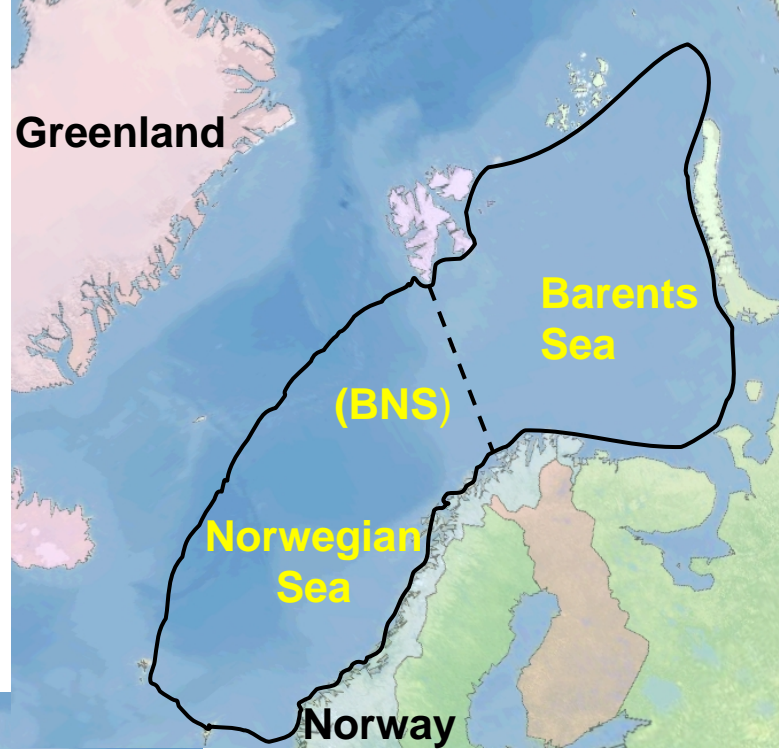
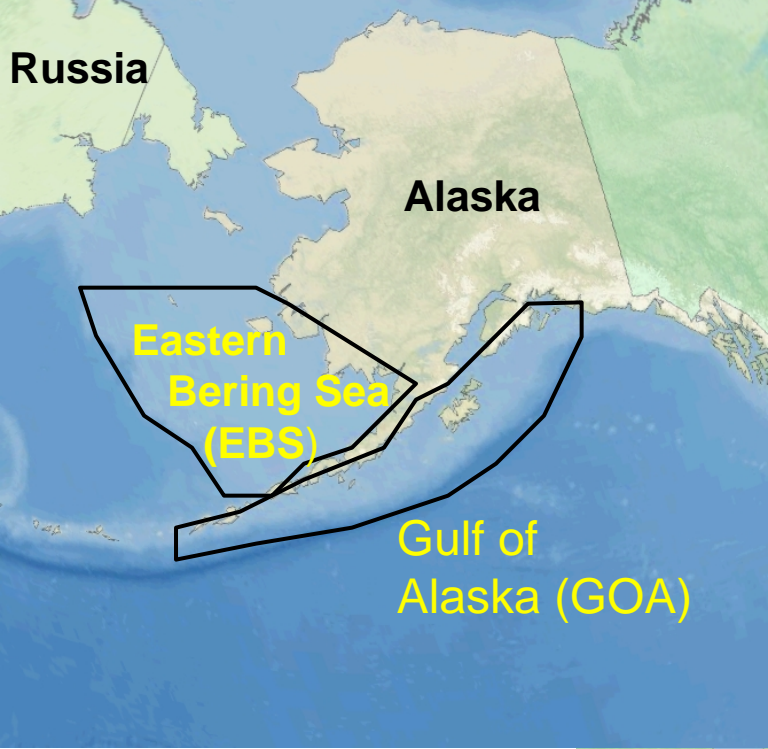
Objectives

- MENU project
- Compare 4 Northern Hemisphere Marine Ecosystems
 - Environment
 - Biota
 - Fisheries
- Elucidate pan-basin synchronies and differences
- Particular emphasis on climate change relationships

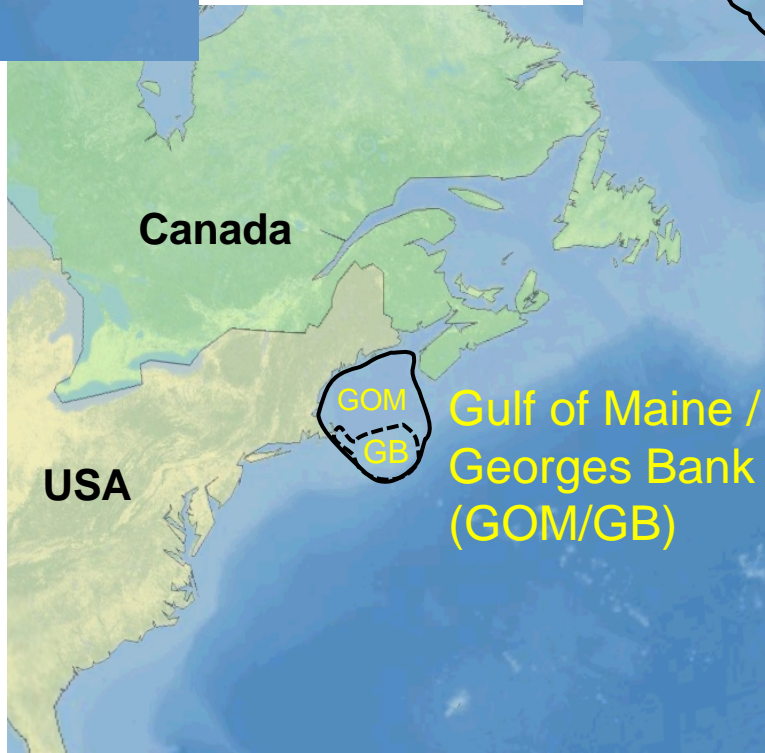
Methods

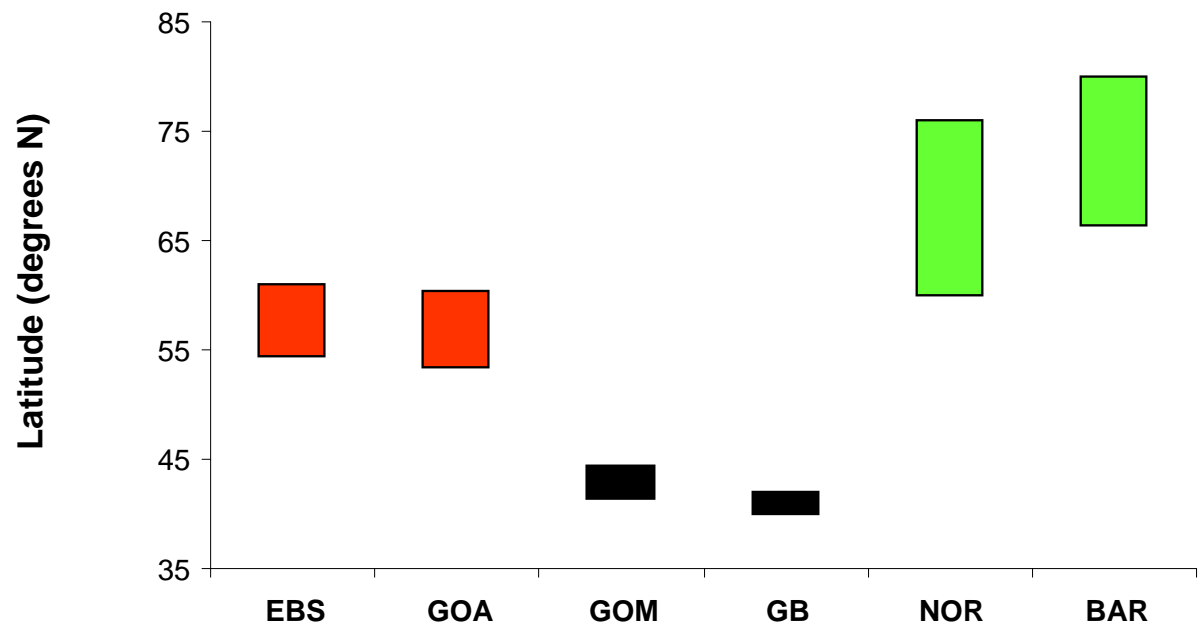
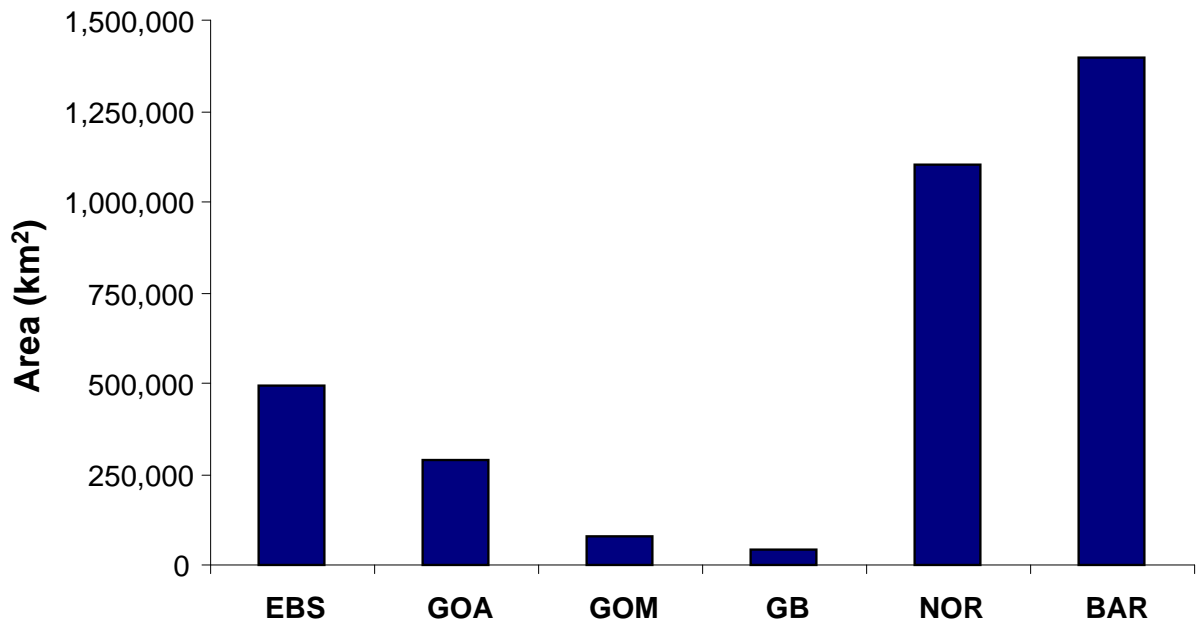
- Time series from various fishery independent and dependent surveys
- Normalized to mean
- Presented as anomalies to facilitate cross-system comparisons

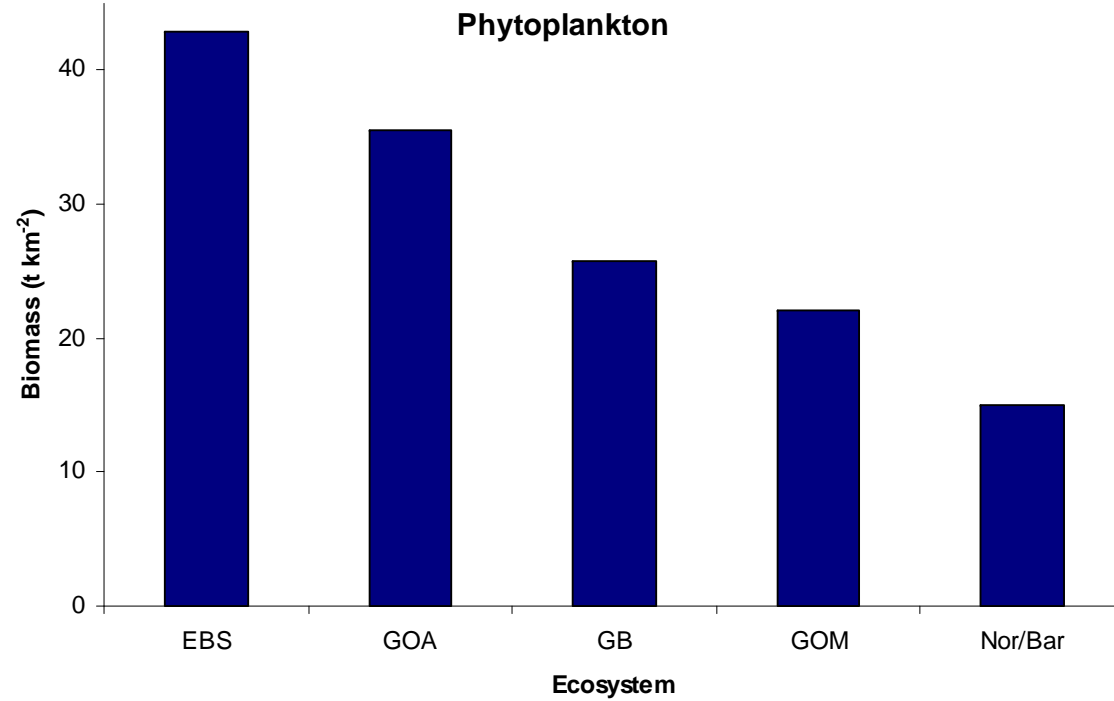
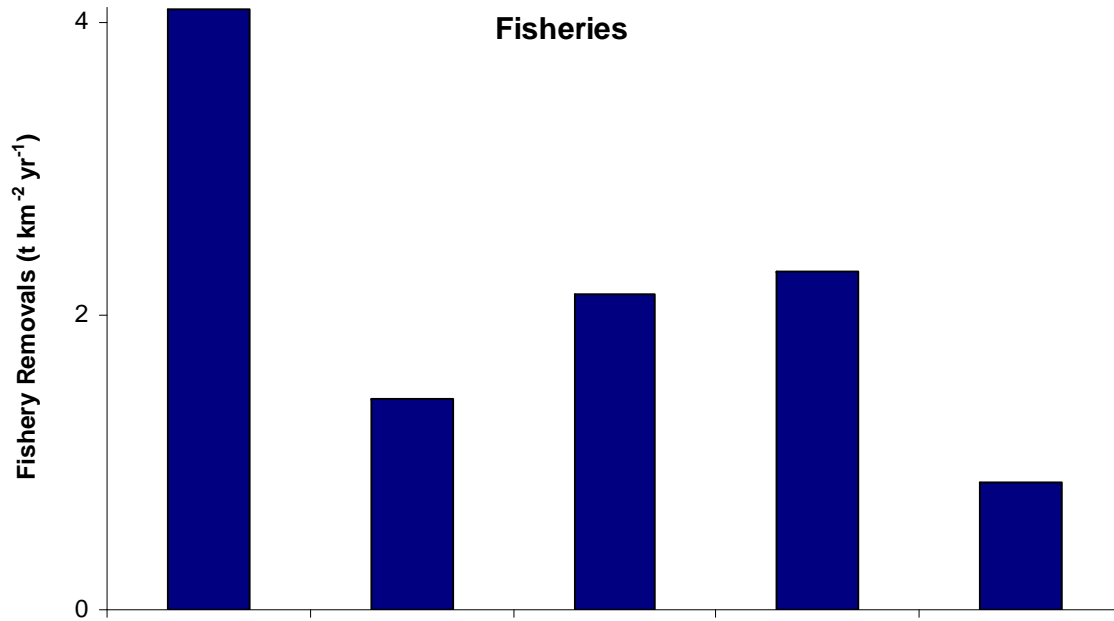
- Bartlett's correction for auto-correlation
- Cross-correlations among ecosystems

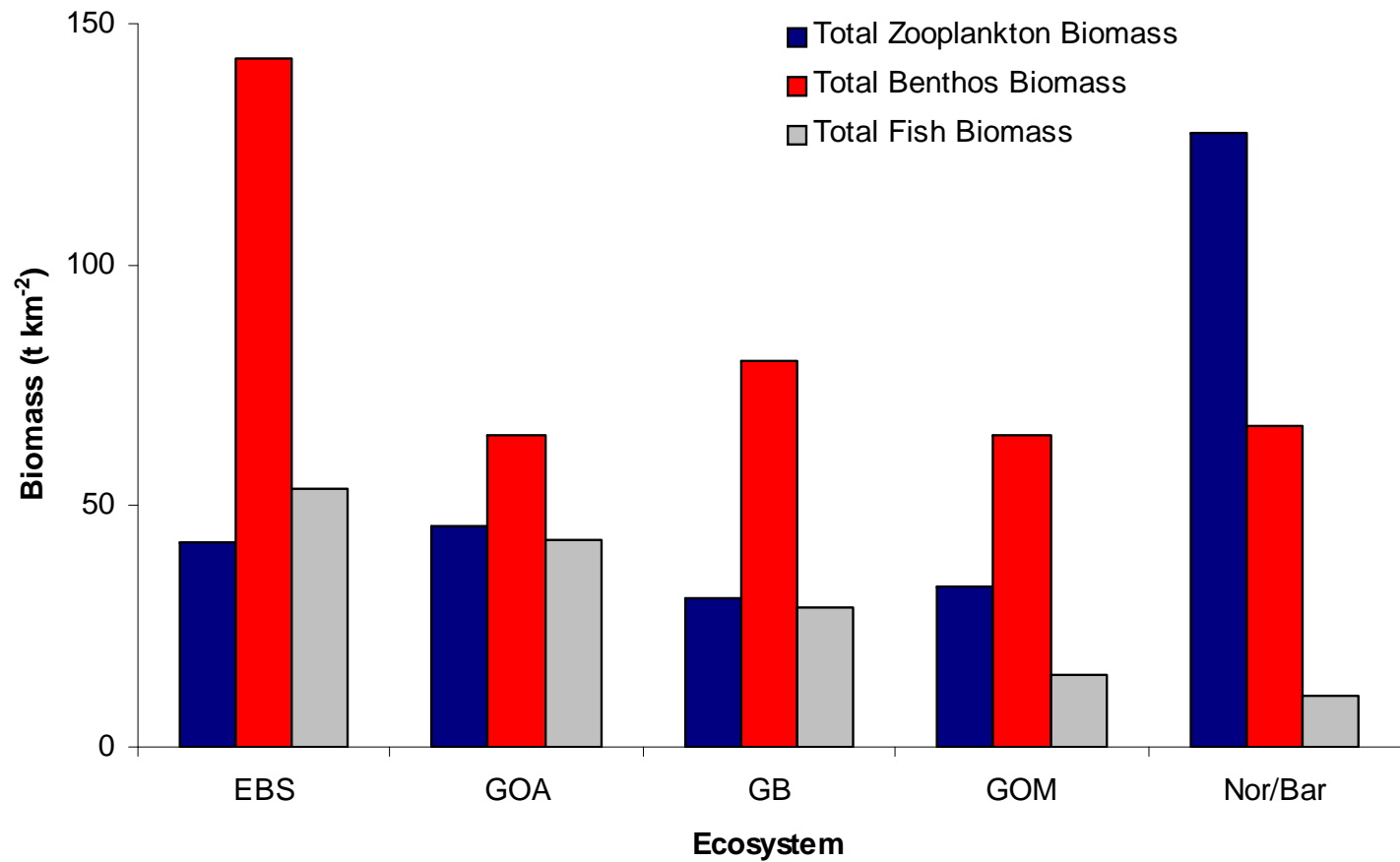


4 Major Ecosystems

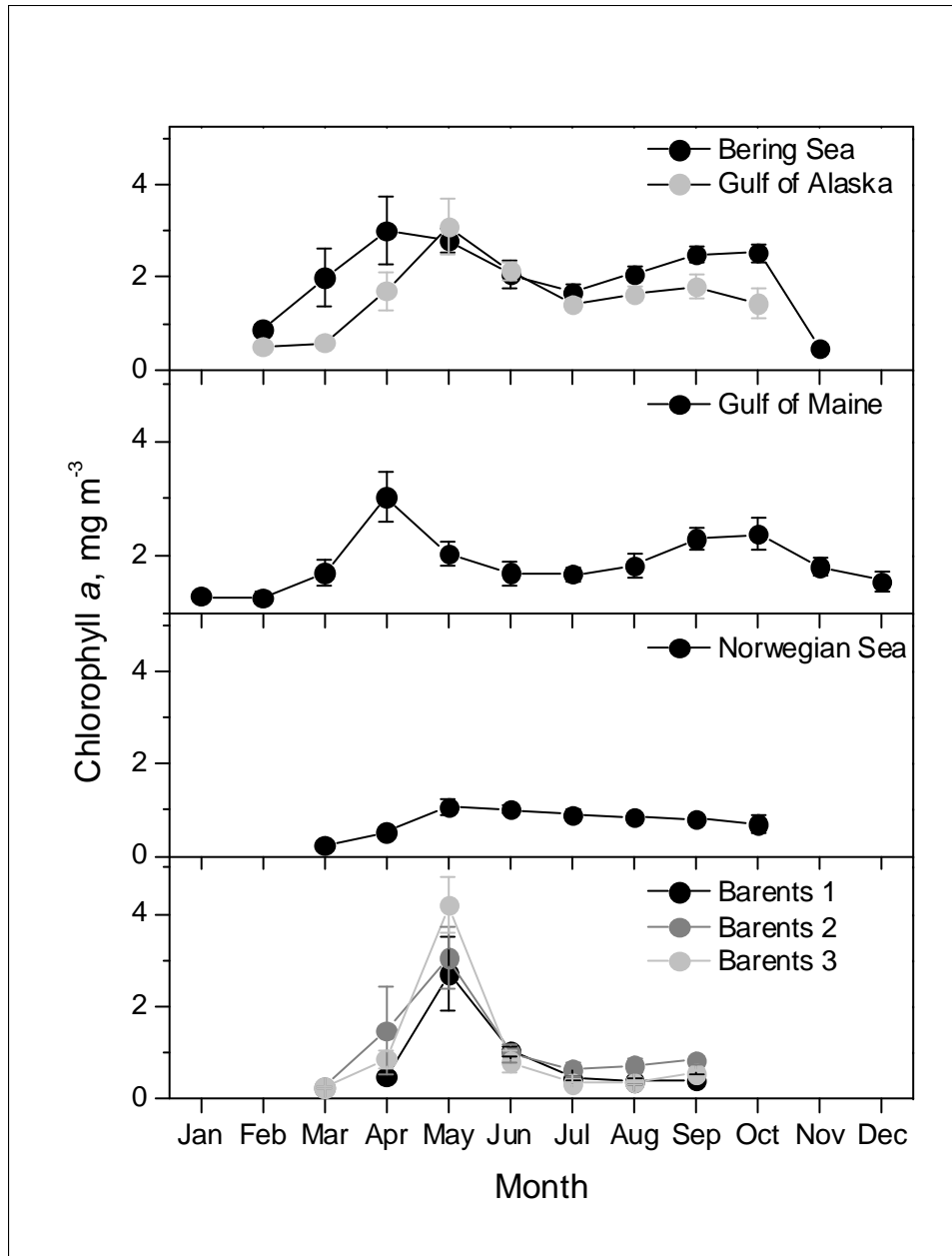




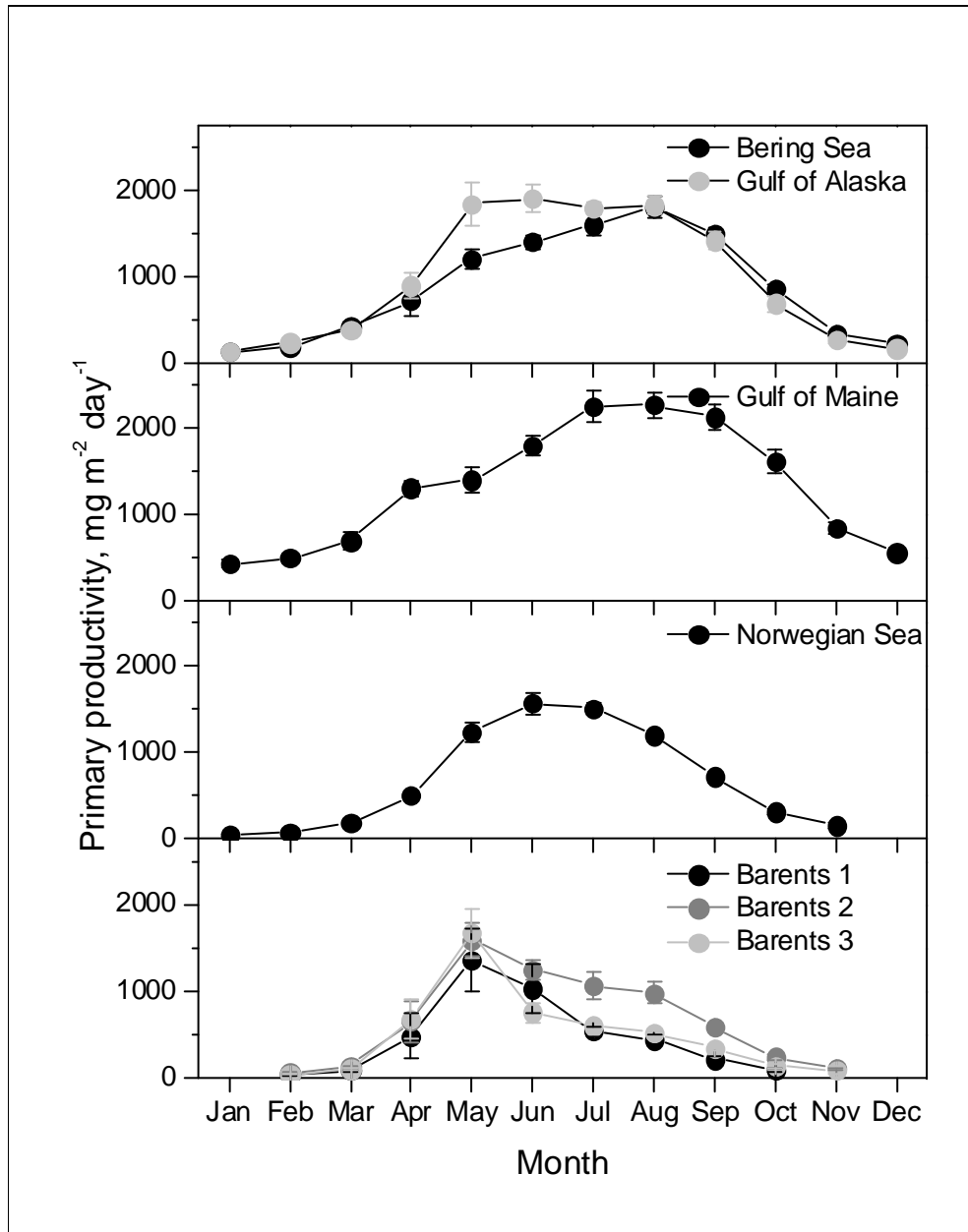




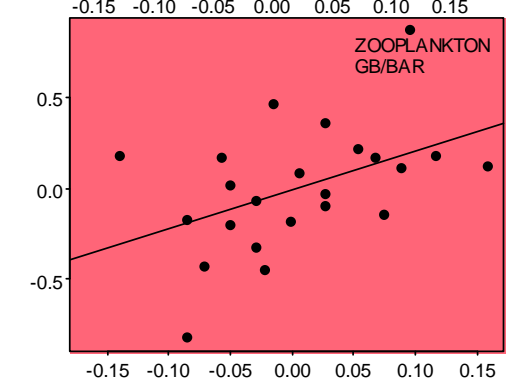
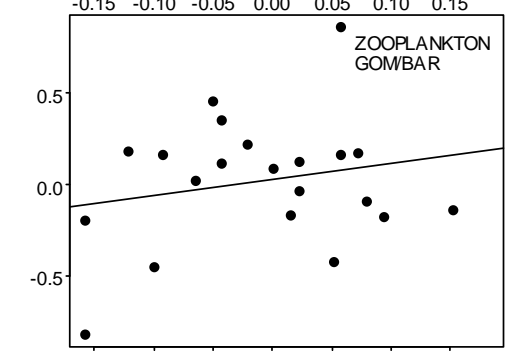
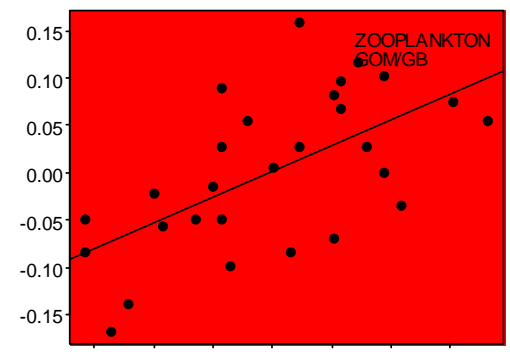
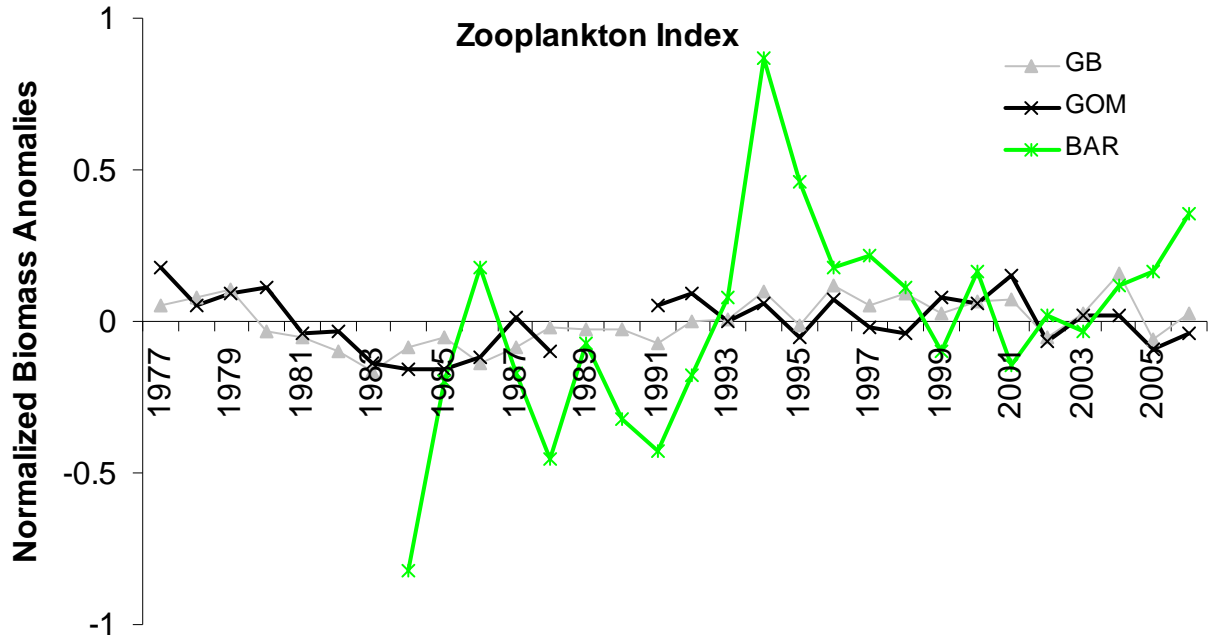
For further details on systemic metrics, see Gaichas et al.



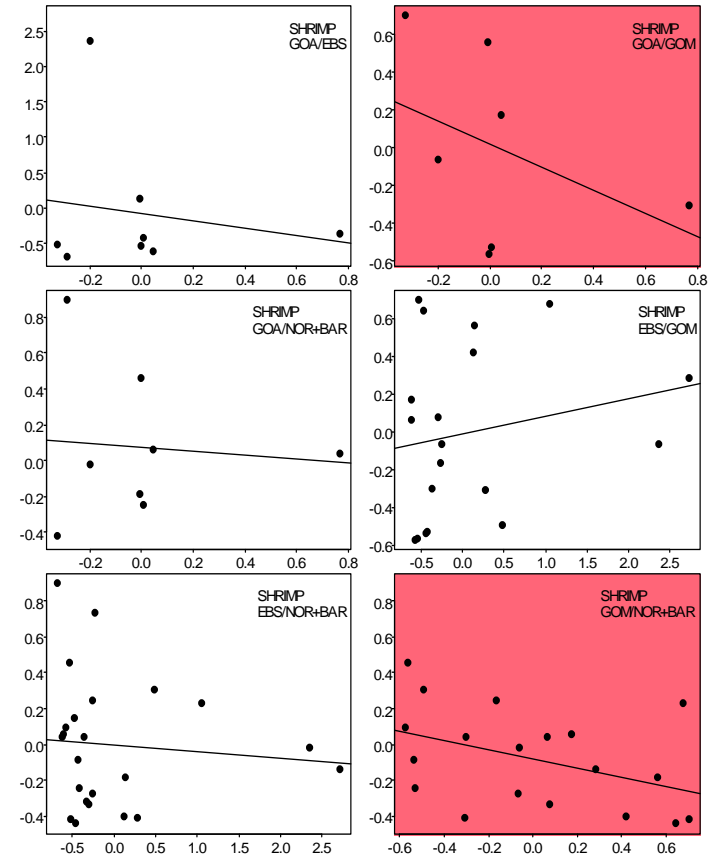
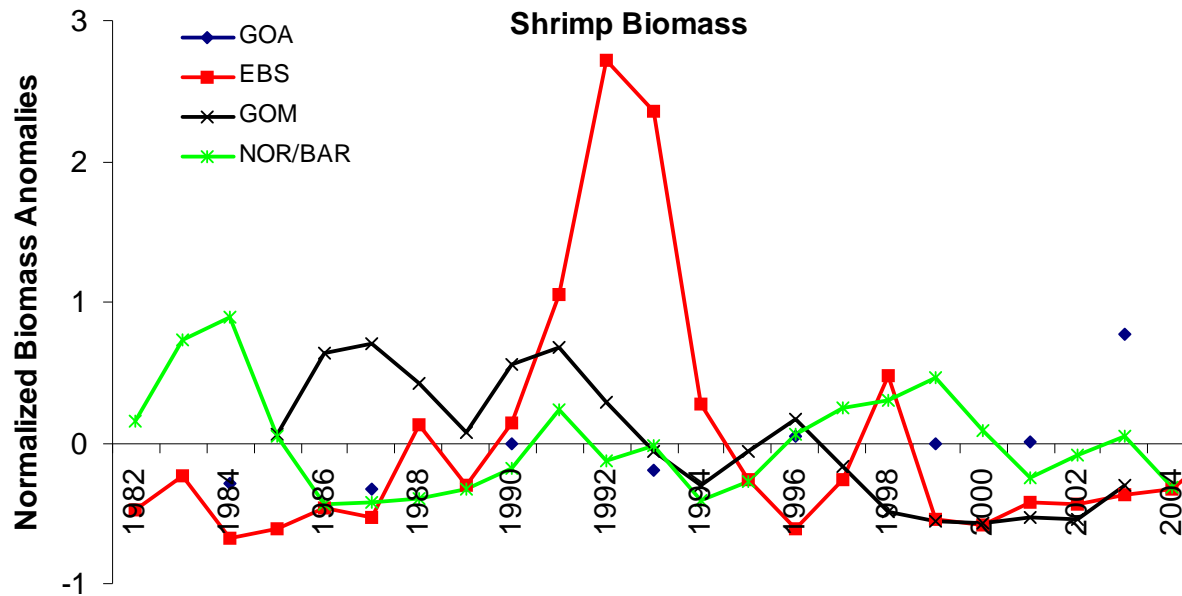
For further details on lower TL and climate, see Drinkwater et al., Mueter et al.



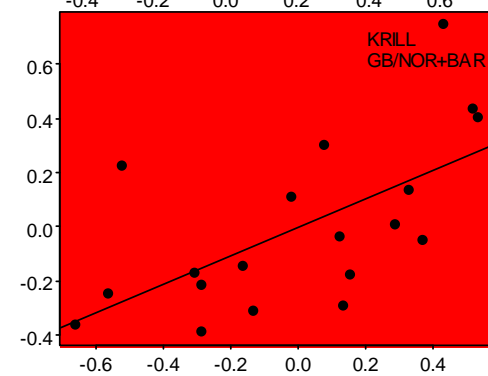
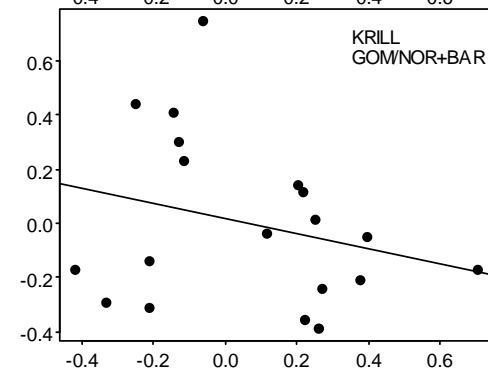
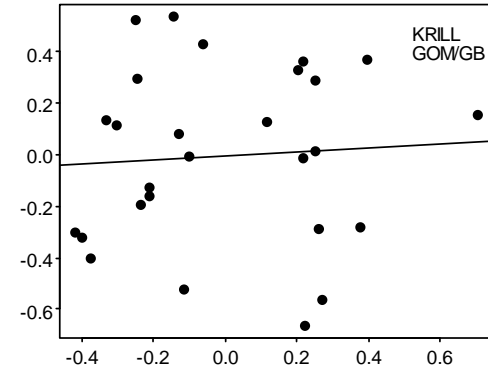
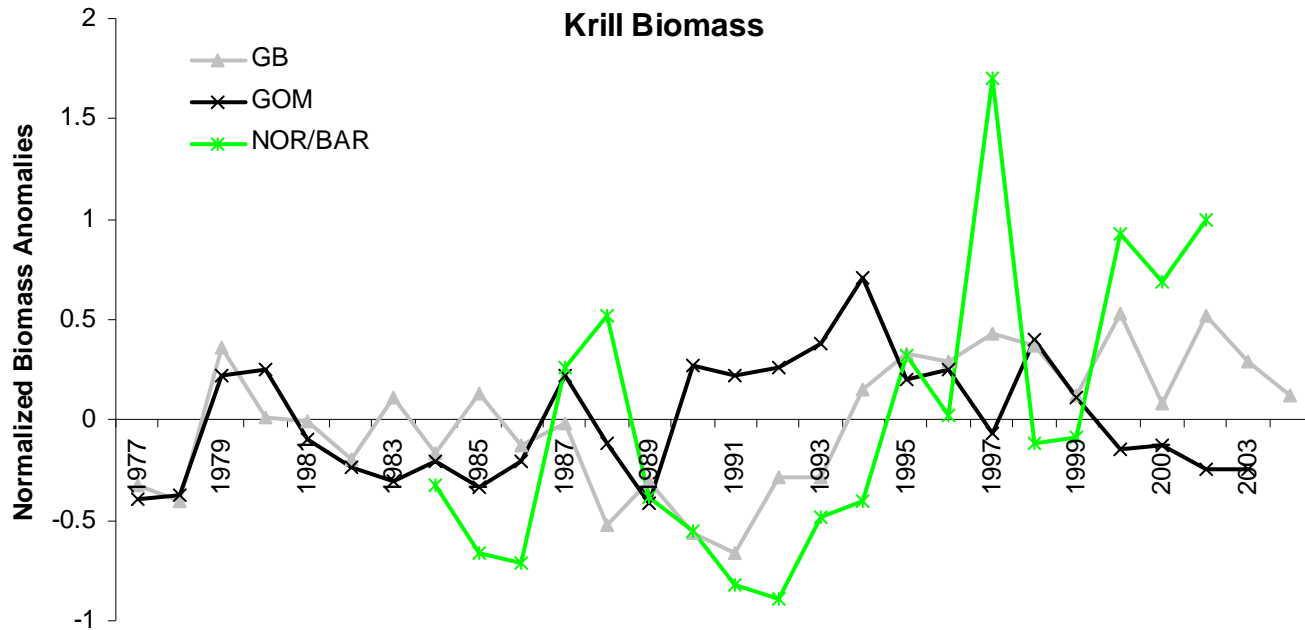
For further details on lower TL and climate, see Drinkwater et al., Mueter et al.



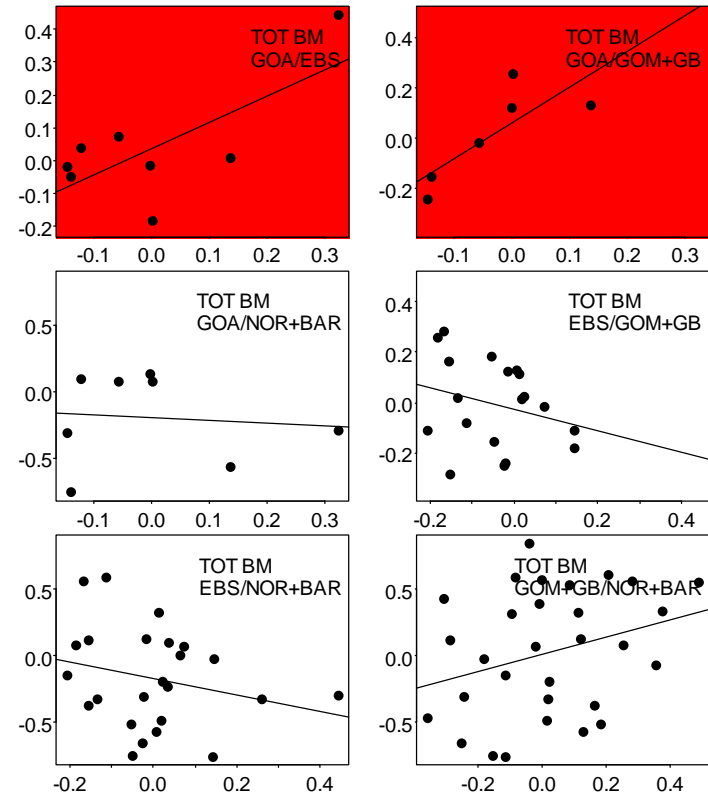
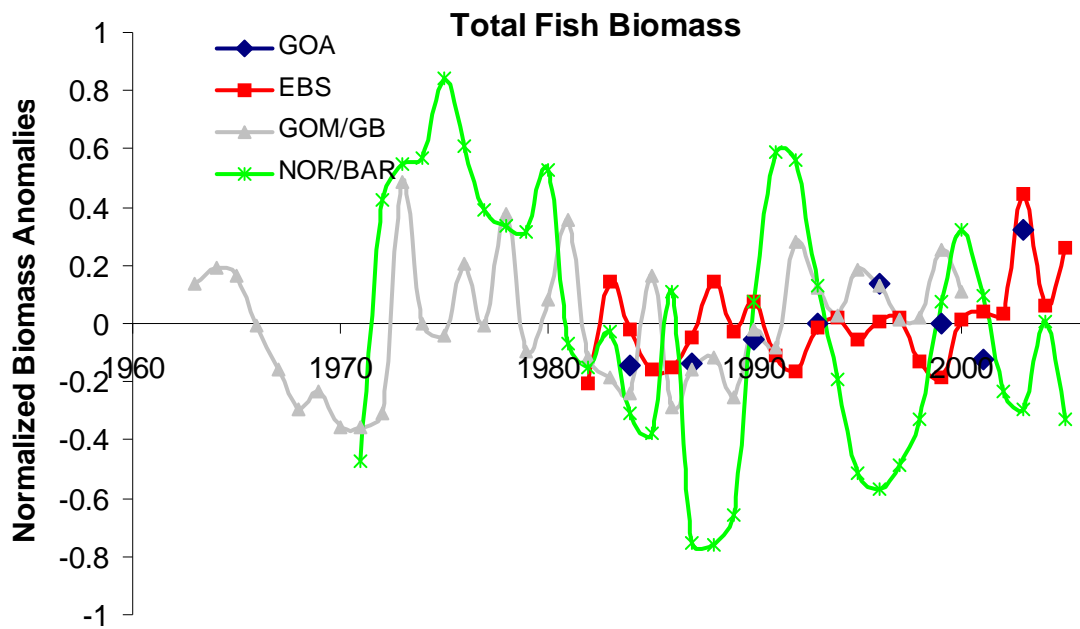
For further details on lower TL, see Mueter et al.



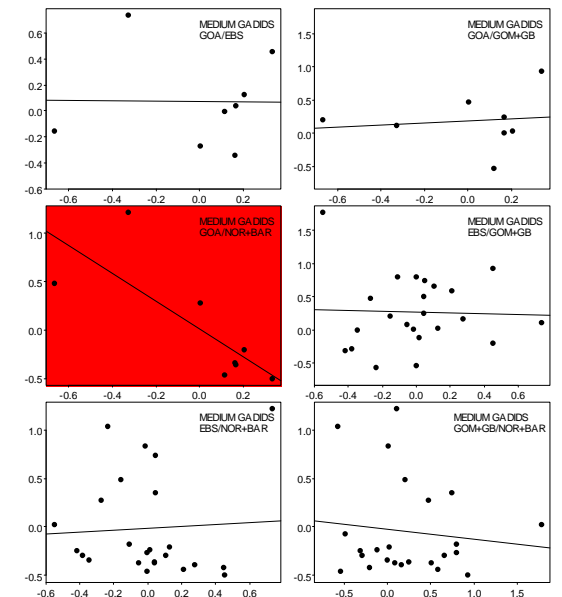
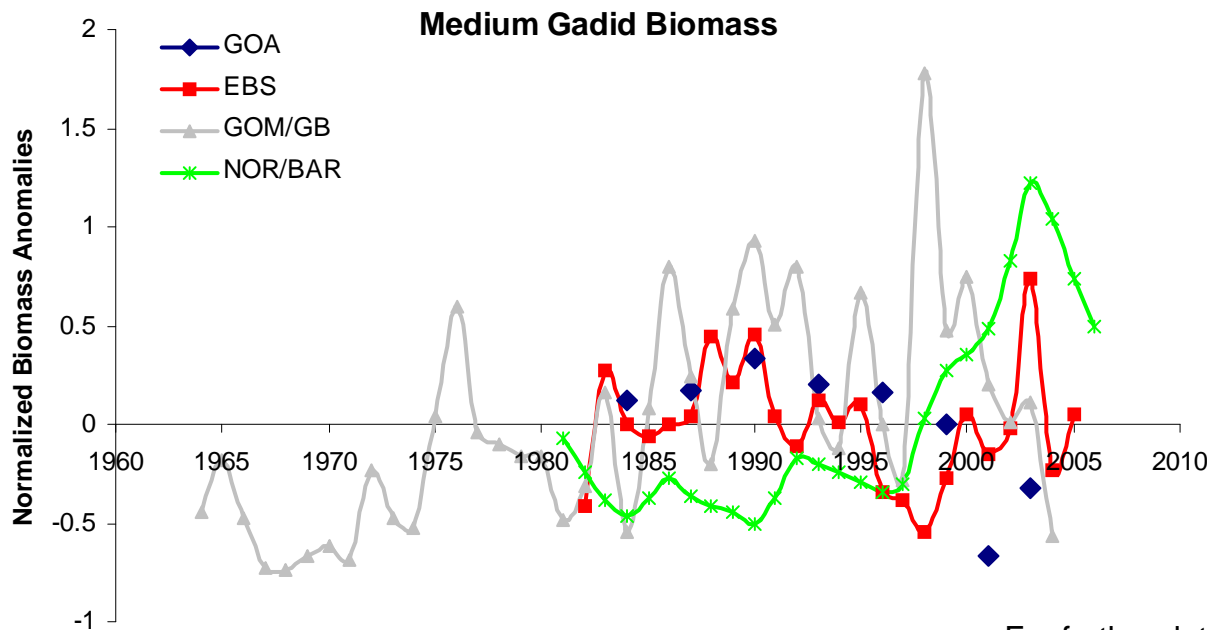
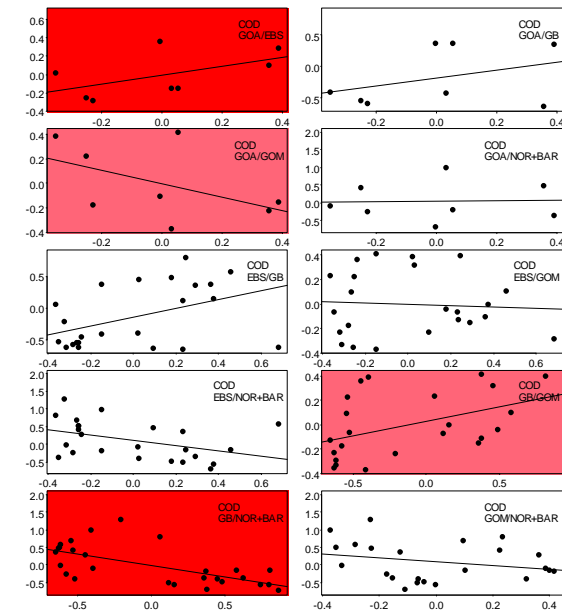
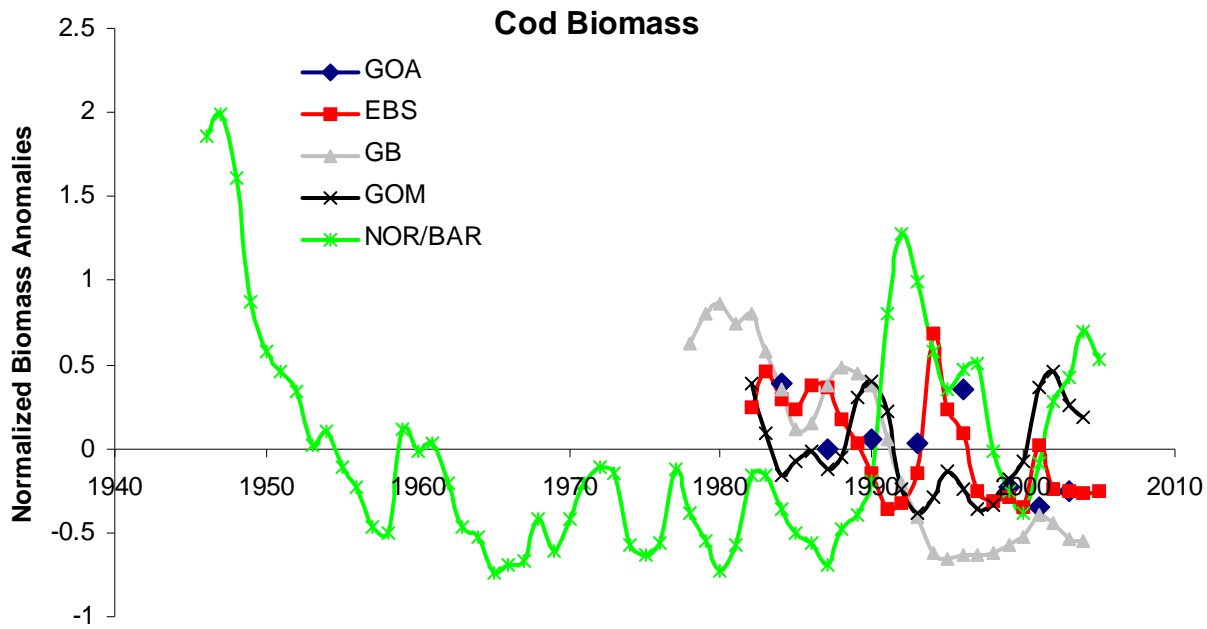
For further details on lower TL, see Mueter et al.



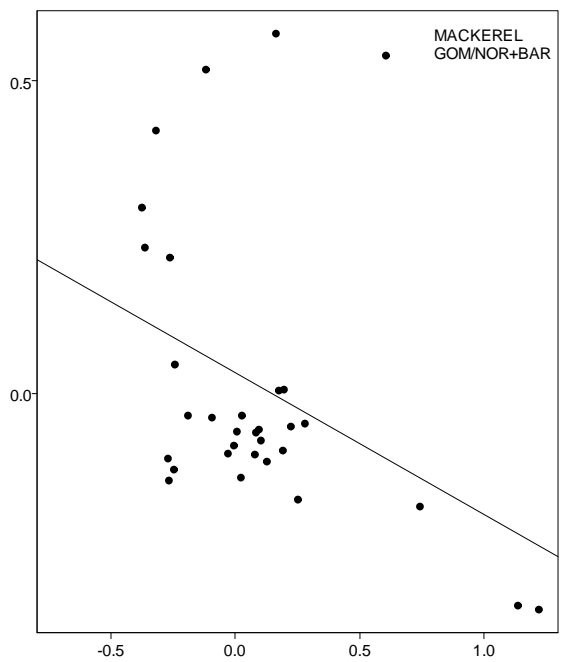
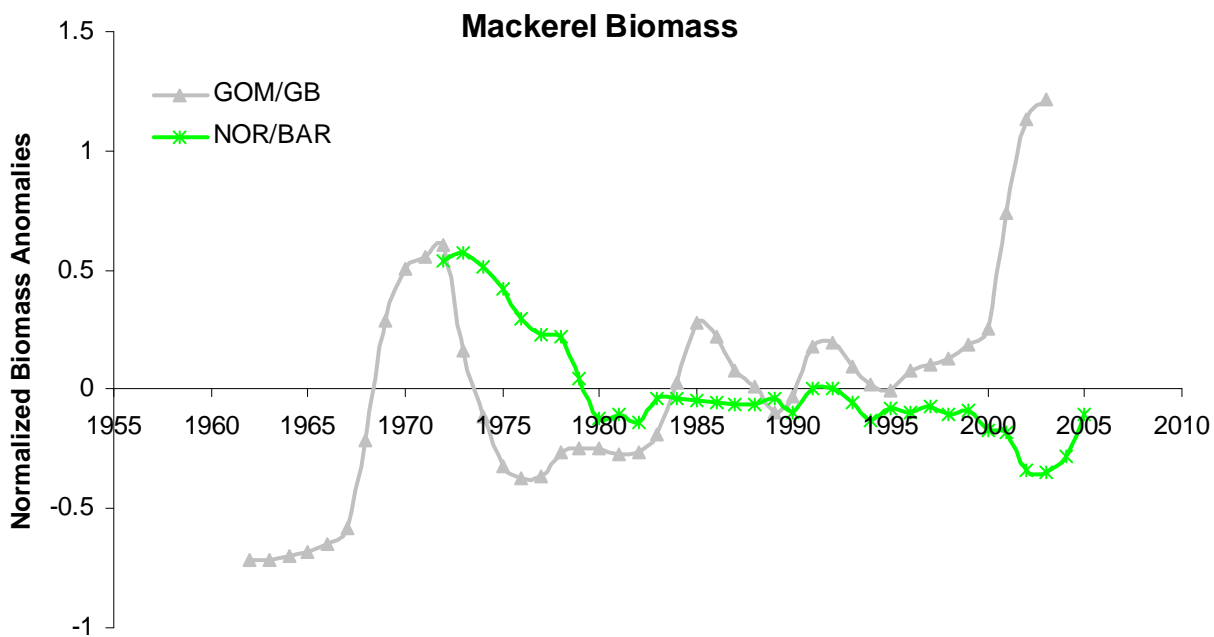
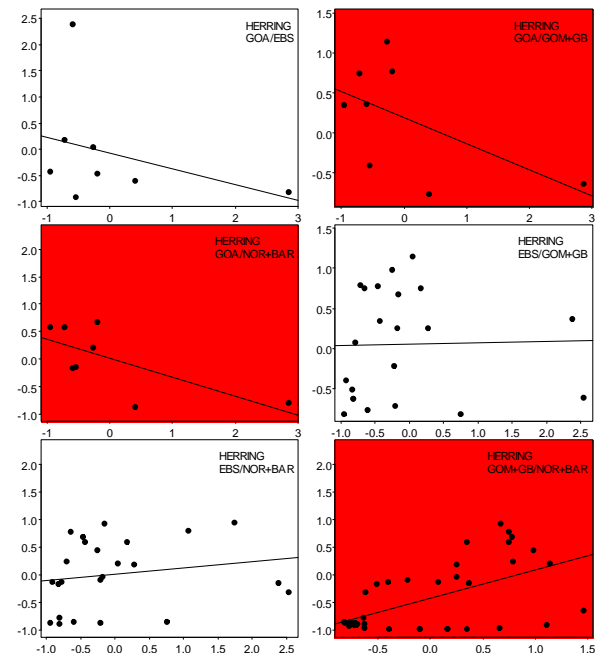
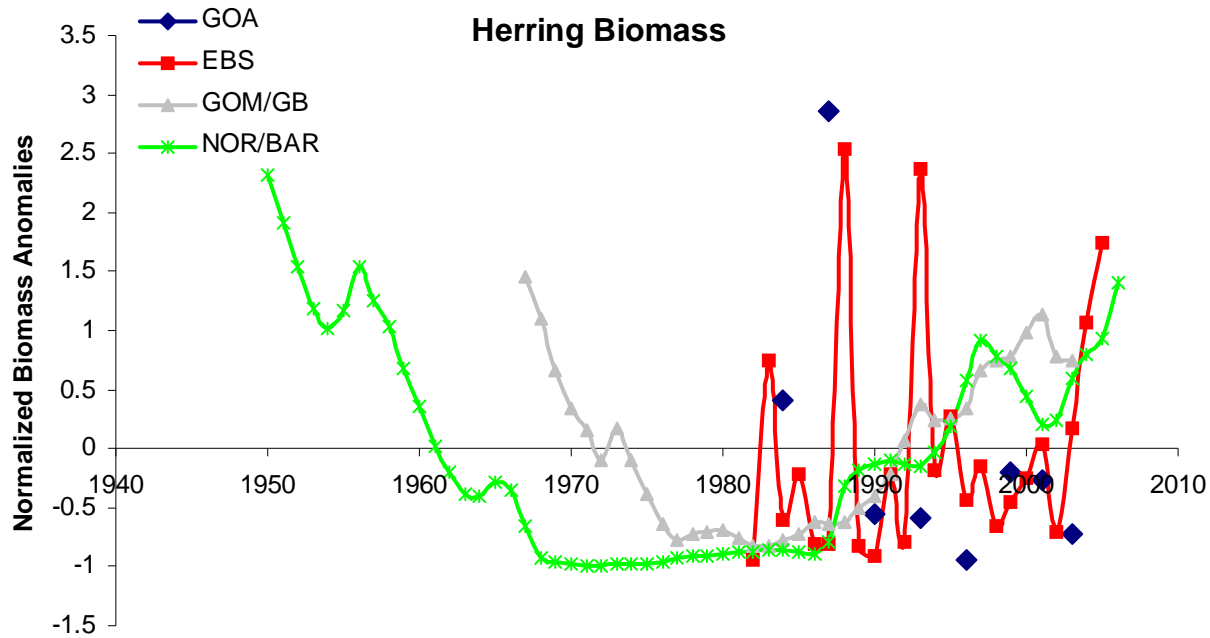
For further details on lower TL, see Mueter et al.

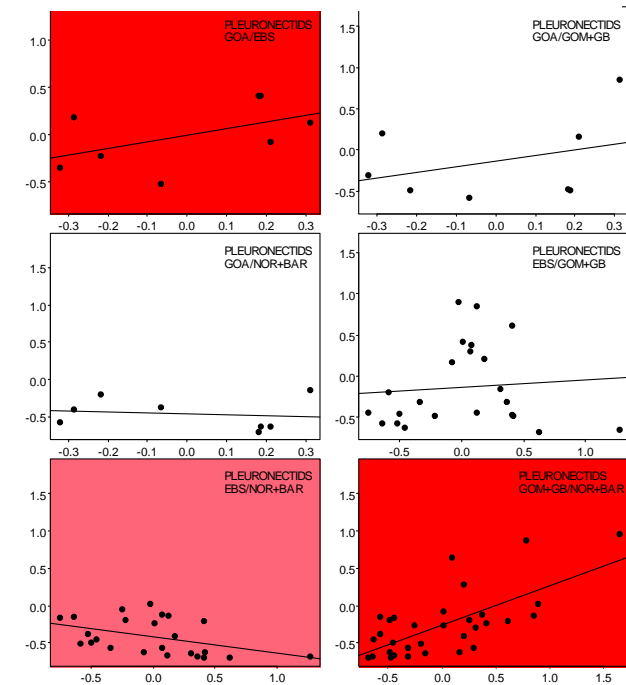
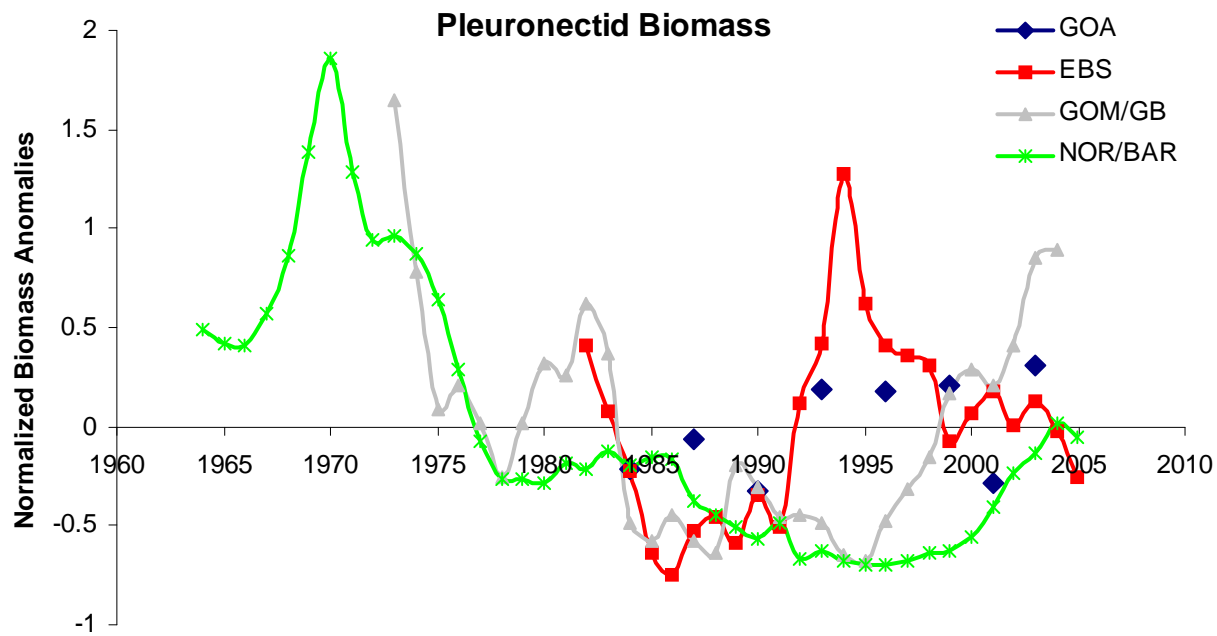
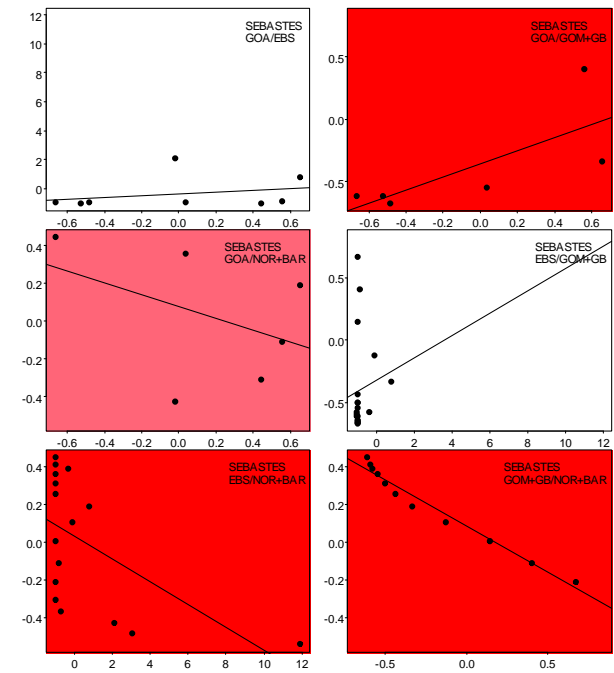
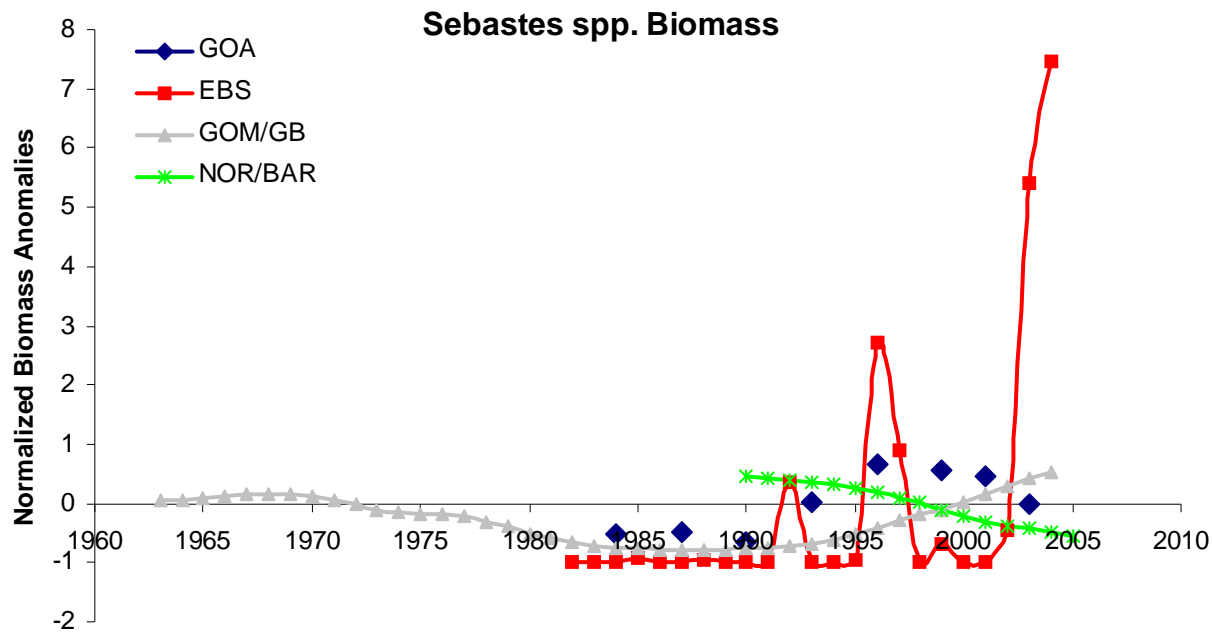


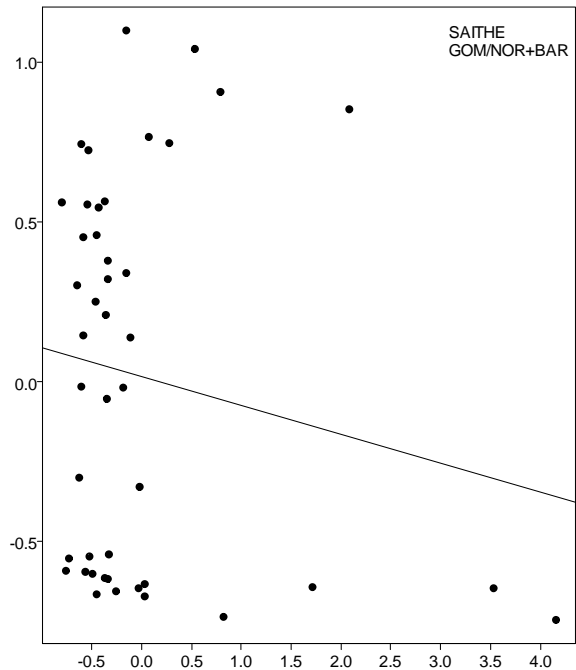
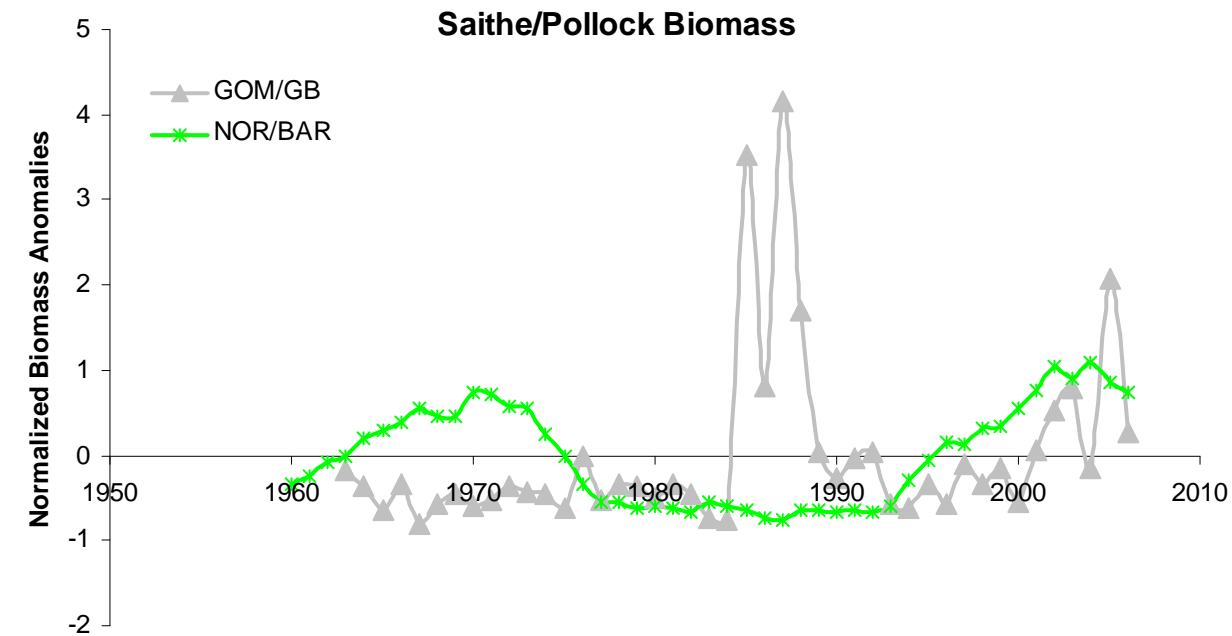
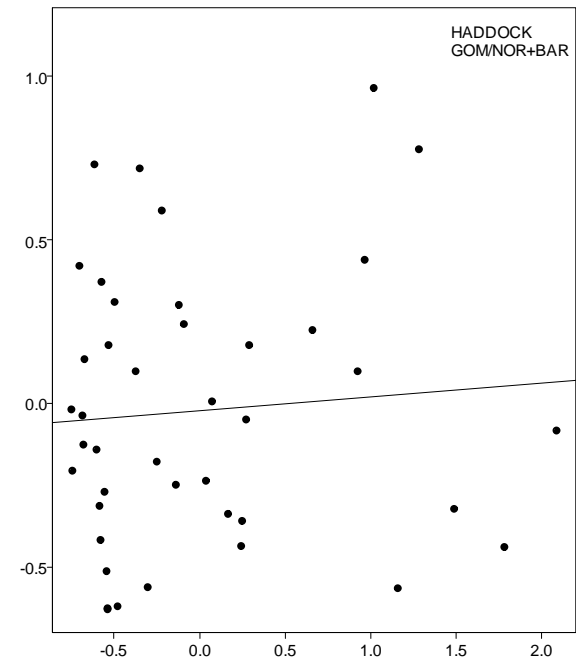
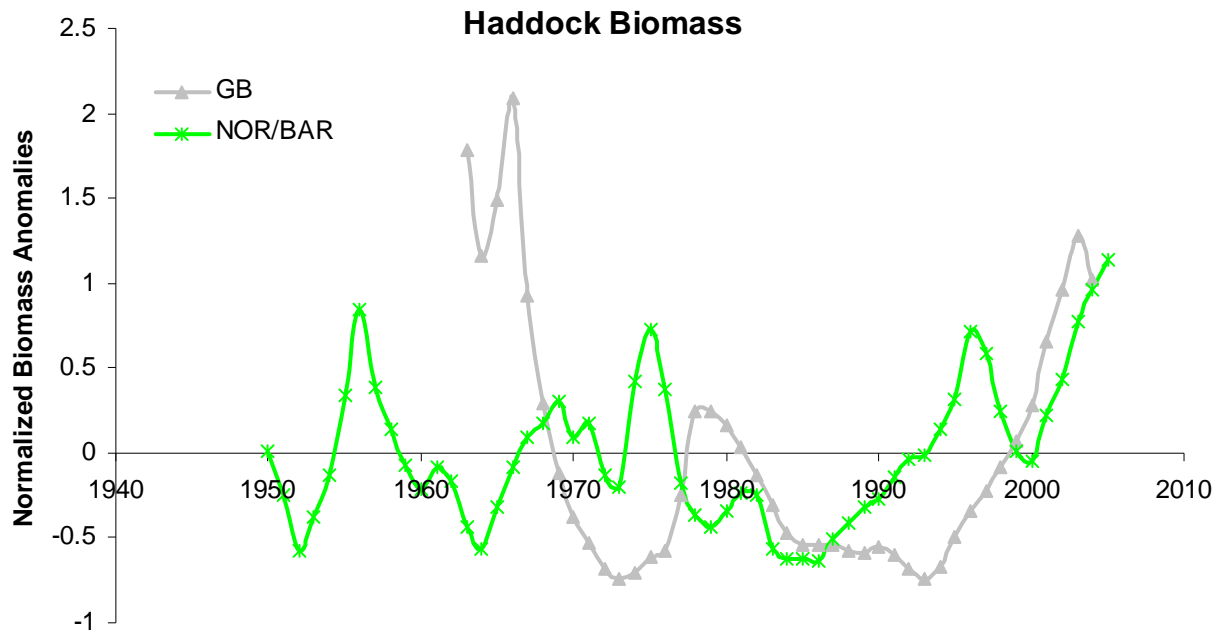
For further details on fish related to climate, see Mueter et al.

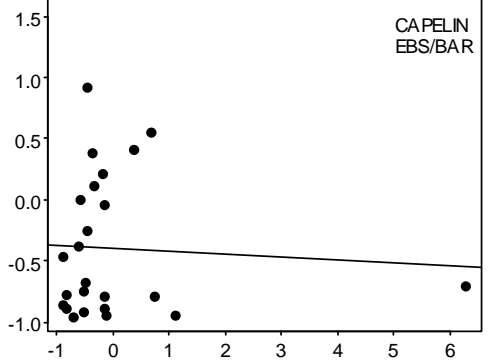
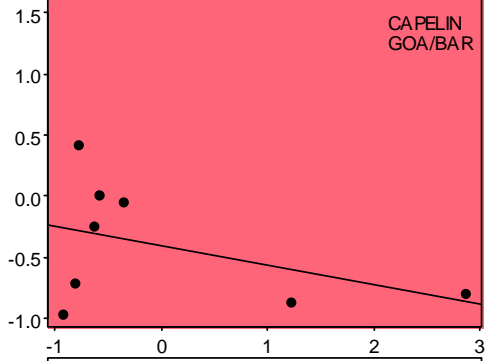
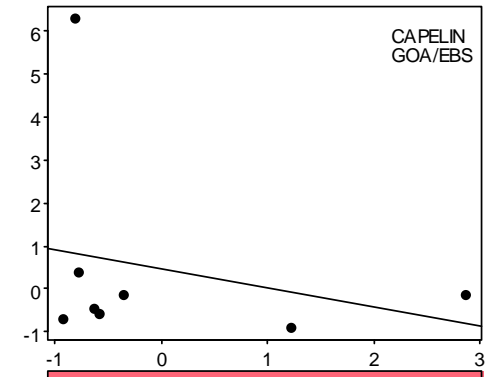
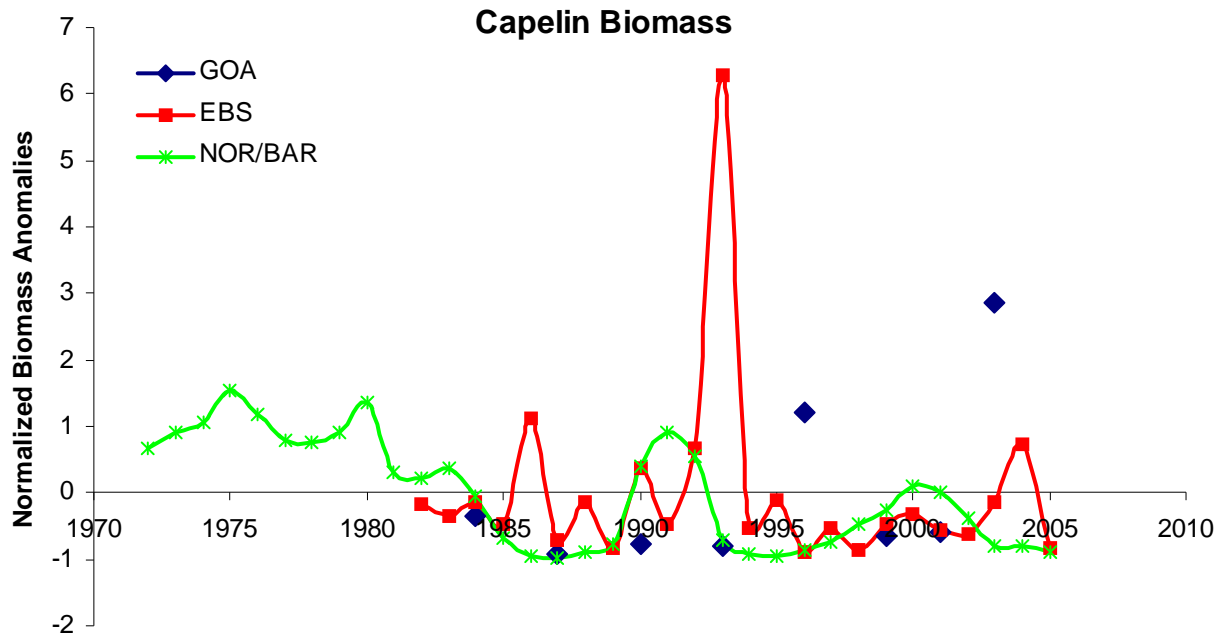


For further details on fish recruitment, see Megrey et al.









Significant Correlations

	-	+
<i>Shrimp</i>	- GOM:NOR/BAR, - GOA:GOM	
<i>Krill</i>		++ GB/NOR
<i>Zooplankton</i>		++ GB:GOM, + GB:BAR
<i>Total Fish Biomass</i>		++GOA:EBS, ++GOA:GOM
<i>Cod</i>	- GOA:GOM, --GB:NOR/BAR	++ GOA:EBS, +GB:GOM
<i>Medium Gadids</i>	-- GOA:NOR/BAR	
<i>Herring</i>	--GOA:GOM/GB, --GOA:NOR/BAR	++ GOM/GB:NOR/BAR
<i>Mackerel</i>	N/A	N/A
<i>Haddock</i>	N/A	N/A
<i>Saithe/Pollock</i>	N/A	N/A
<i>Sebastes spp.</i>	-GOA:NOR/BAR, --EBS:NOR/BAR, -- GOM/GB:NOR/BAR	
<i>Pleuronectids</i>	- EBS:NOR/BAR	++ GOA:EBS, ++GOM/GB:NOR/BAR
<i>Capelin</i>	- GOA:NOR/BAR	
<p>++ or -- ≤ 0.05 + or - $0.05 < \leq 0.10$ N/A</p>		

Summary- Commonalities

- Importance of *Calanus* spp., small pelagics, and gadids in each ecosystem
- GOA & GOM/GB total fish and *Sebastes* spp. biomass synchronous
- GOA & EBS total fish, cod, and pleuronectid biomass synchronous
- GOM/GB & NOR/BAR herring and pleuronectid biomass synchronous
- Total fish biomass relatively stable in all systems

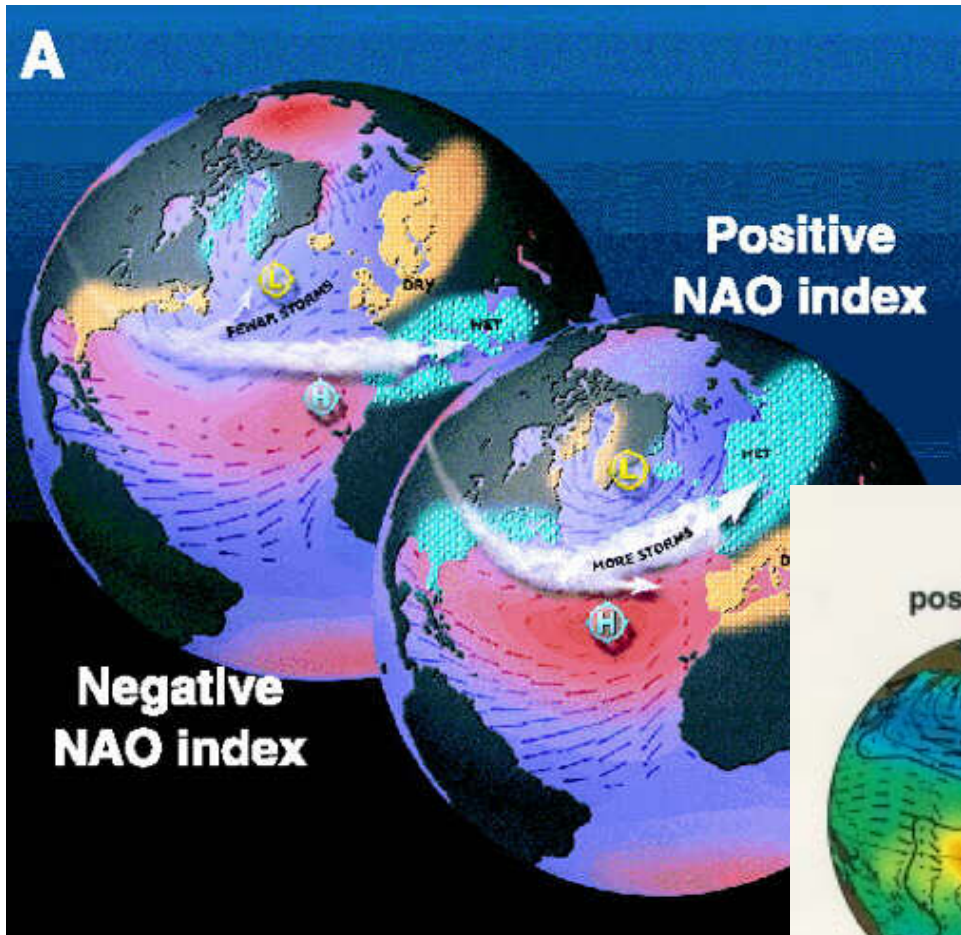
Summary- Differences

- Magnitude of total fish biomass, fisheries, and lower TLs distinct across all ecosystems
- GOM/GB & NOR/BAR cod and *Sebastes* spp. biomass asynchronous
- GOA & GOM/GB herring biomass asynchronous
- GOA & NOR/BAR herring biomass asynchronous
- EBS & NOR/BAR *Sebastes* spp. Biomass asynchronous
- Differences in timing of primary production

Conclusions

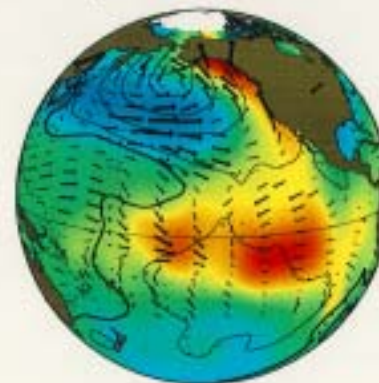
- Strongest synchronies: among two Atlantic systems and among two Pacific systems
- Strongest asynchronies: between Atlantic and Pacific systems
- Pacific and Atlantic distinctions indicative of Global oceanic processes
- Differences within Atlantic or Pacific systems indicative of basic scale processes

+/- Signal Indicates Ecosystem Responses to Global Processes in the Ocean



Pacific Decadal Oscillation

positive phase



negative phase

