

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

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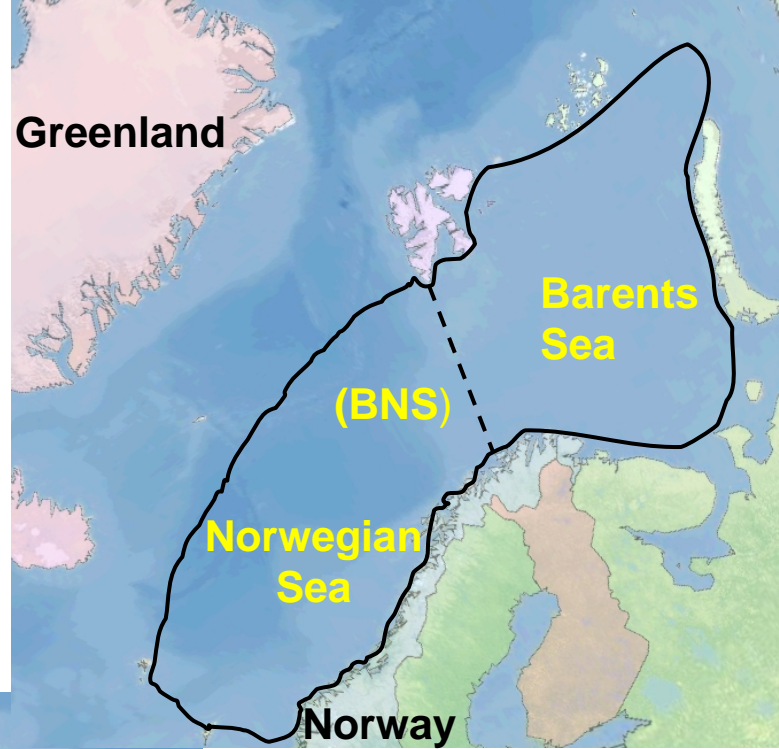
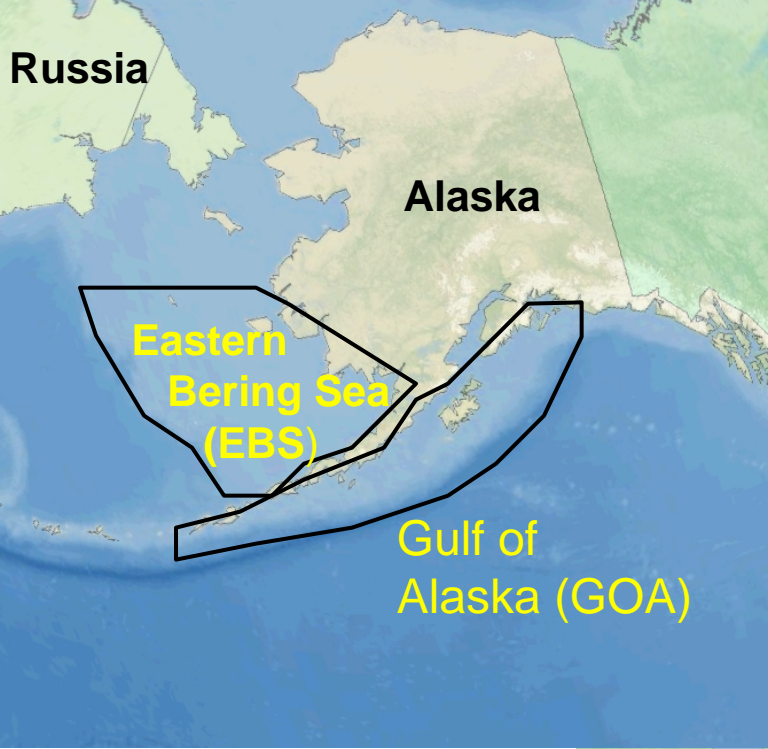
Objectives

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

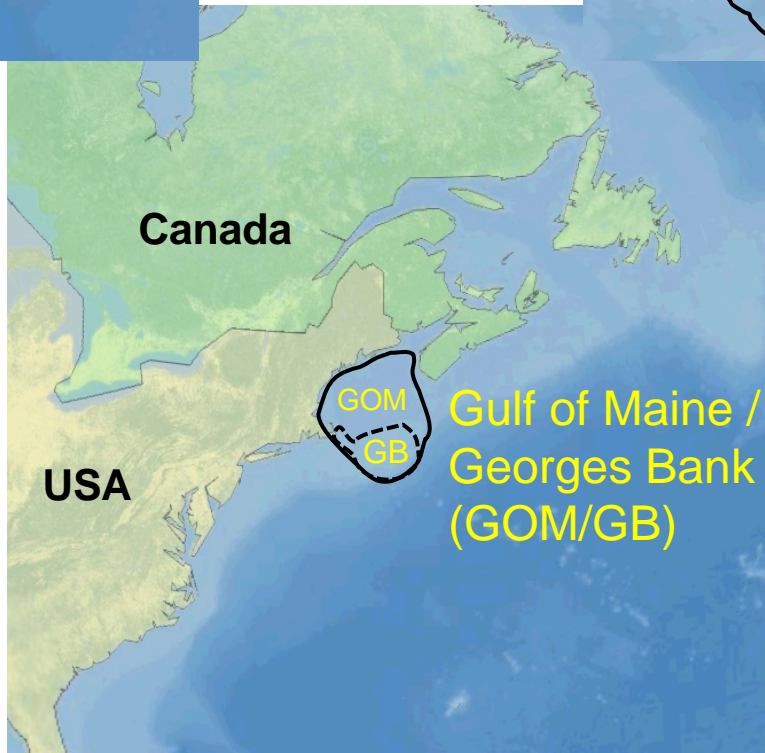
Methods

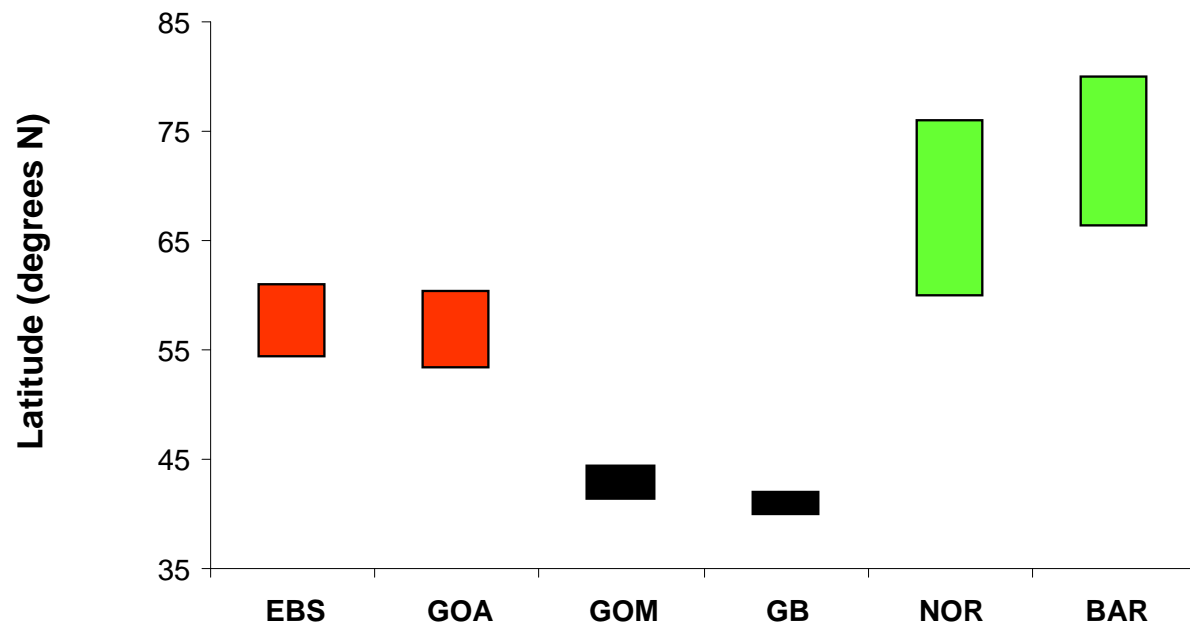
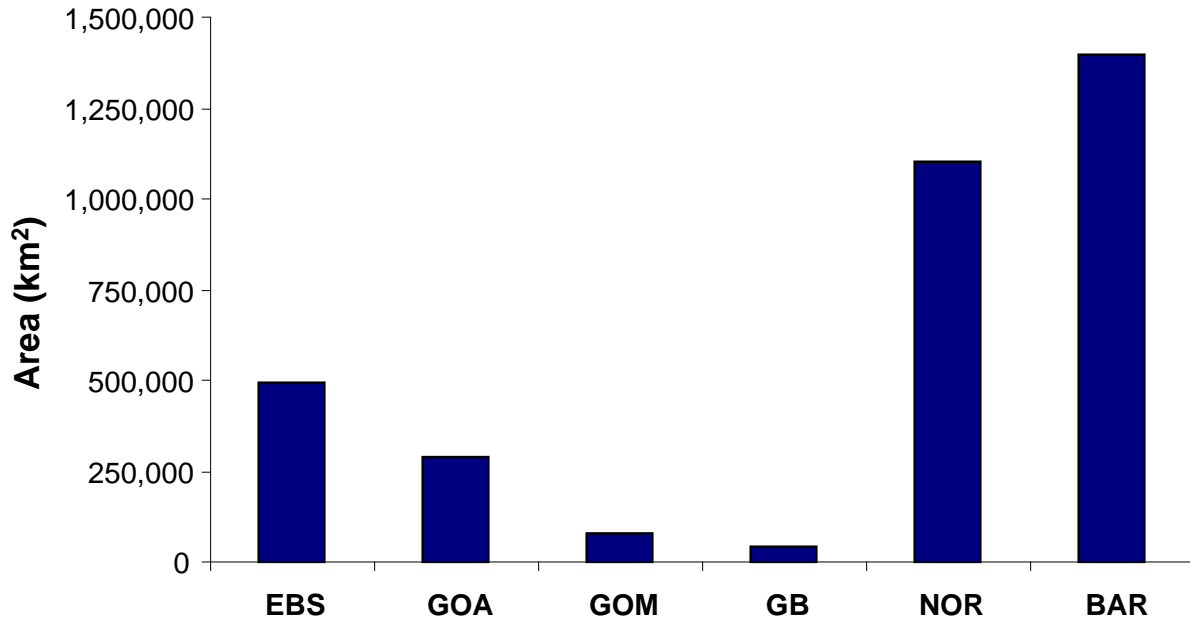
- Time series from various fishery independent and dependent surveys
- Normalized to mean
- Presented as anomalies to facilitate cross-system comparisons

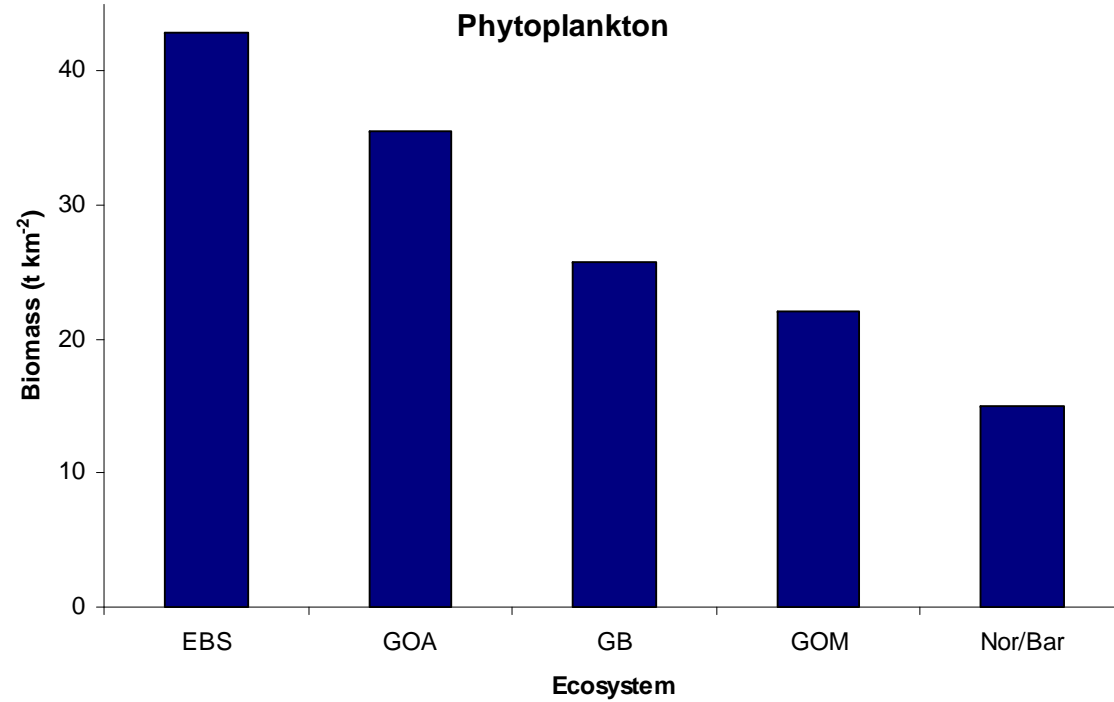
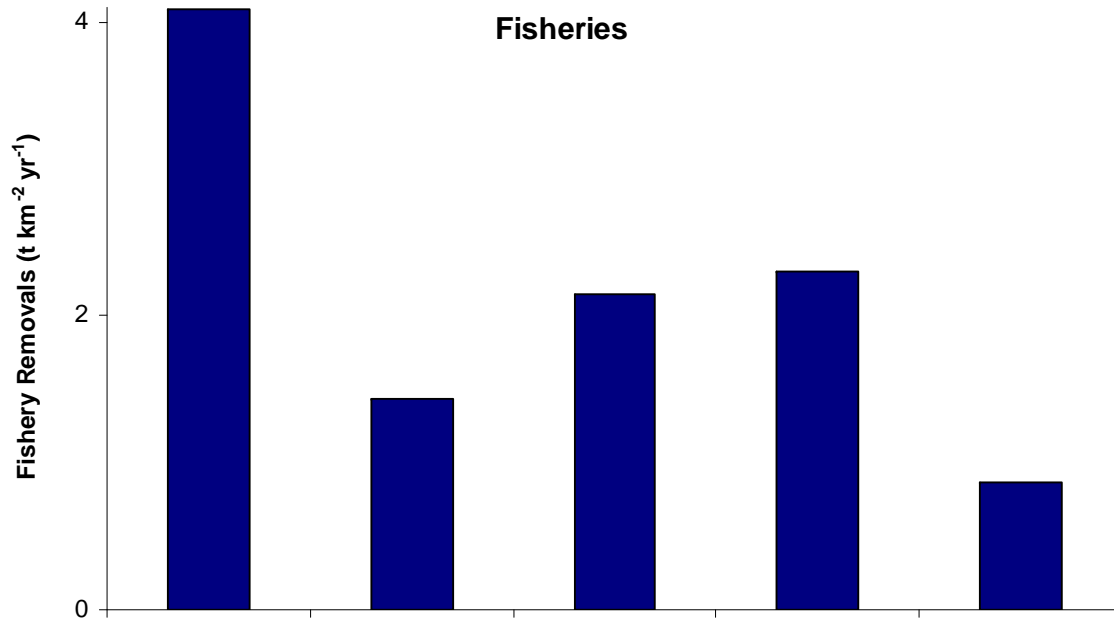
- Bartlett's correction for auto-correlation
- Cross-correlations among ecosystems

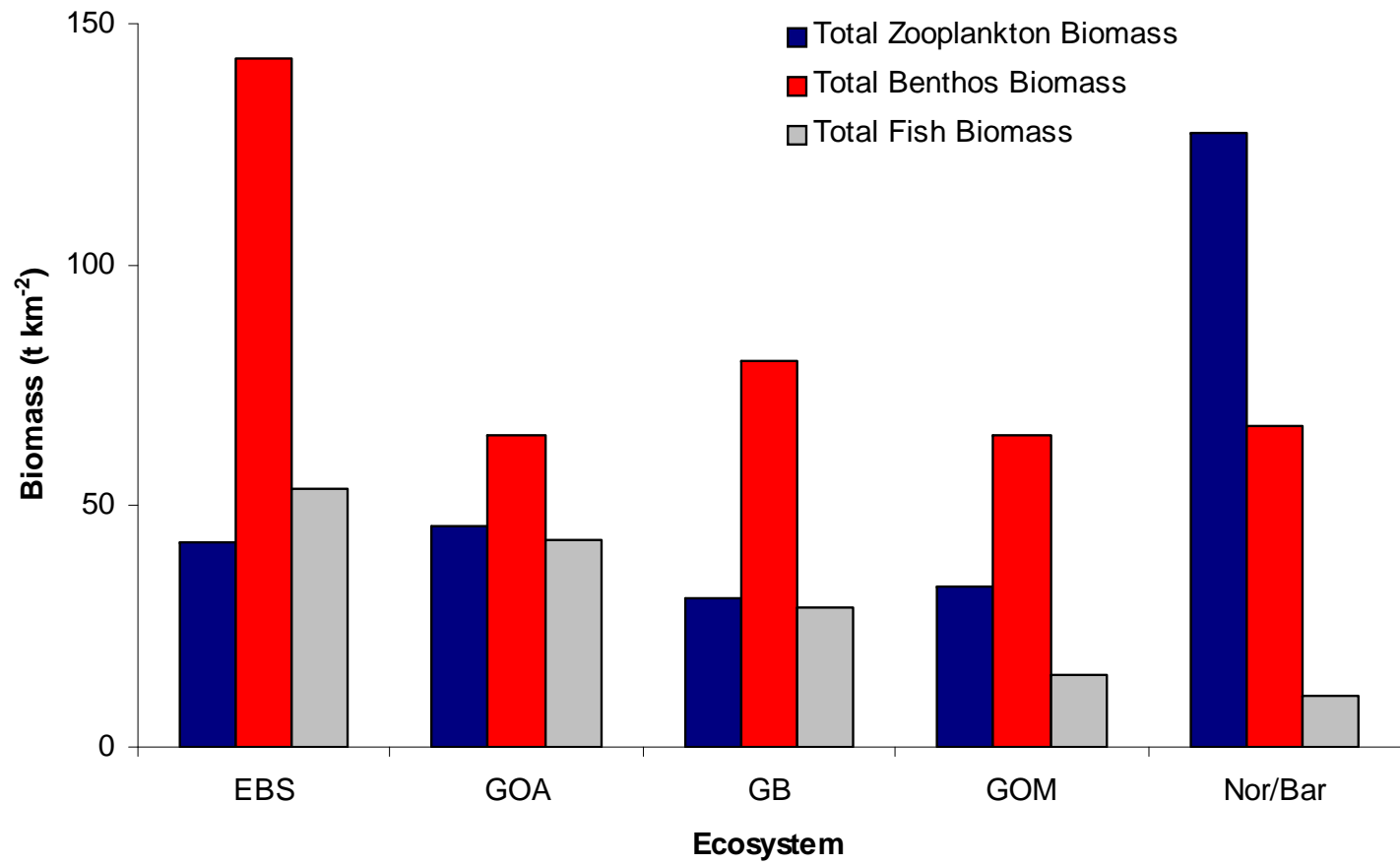


4 Major Ecosystems

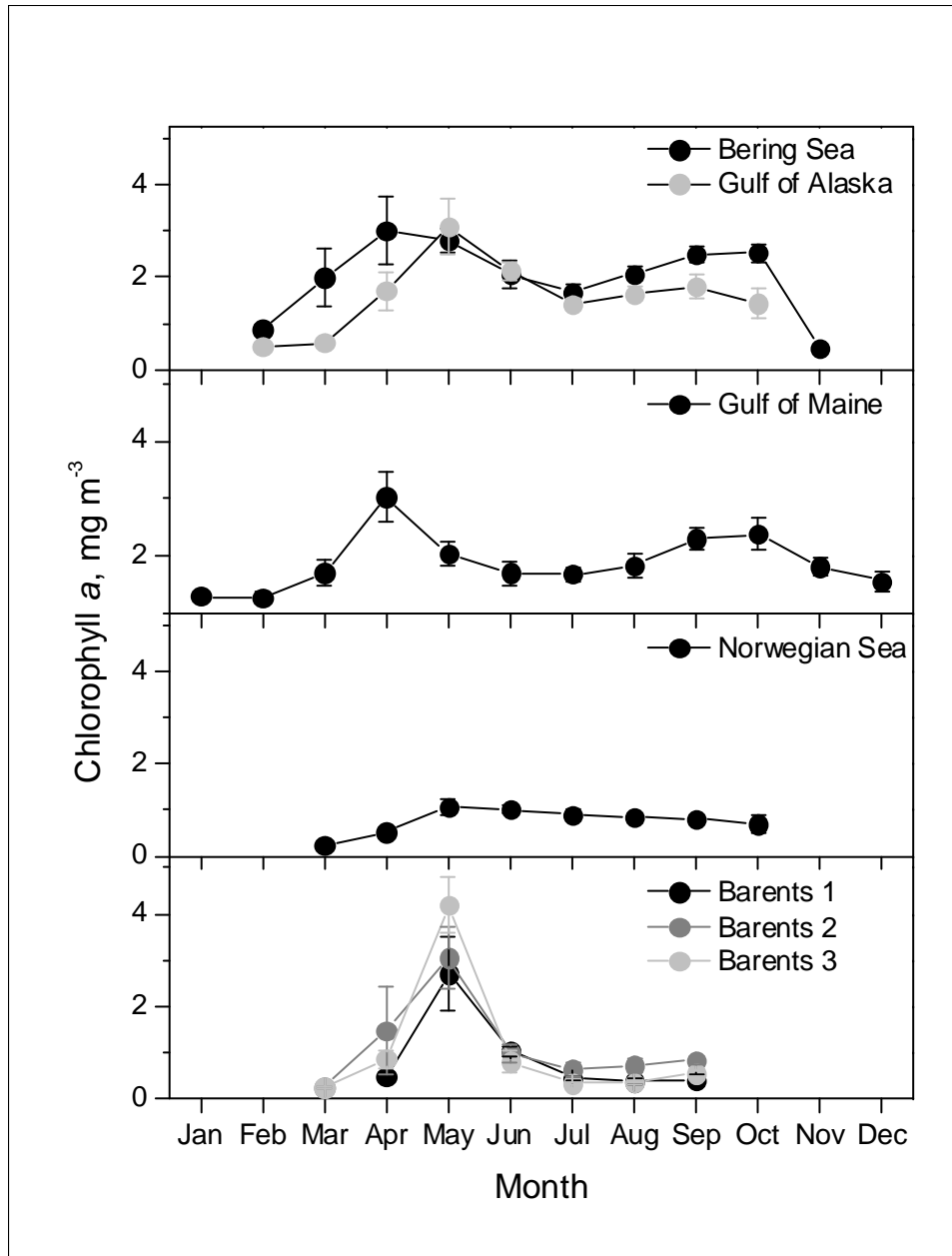




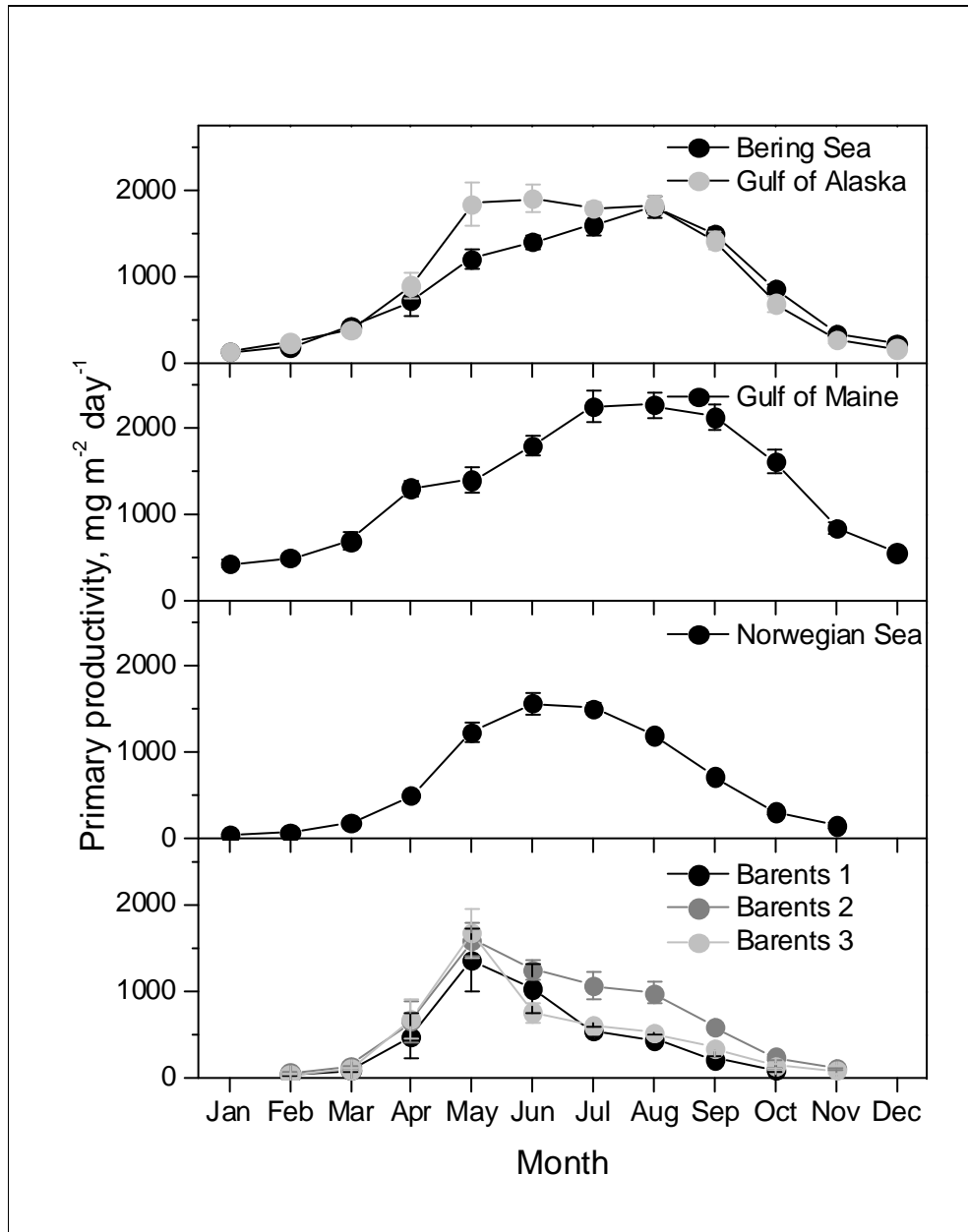




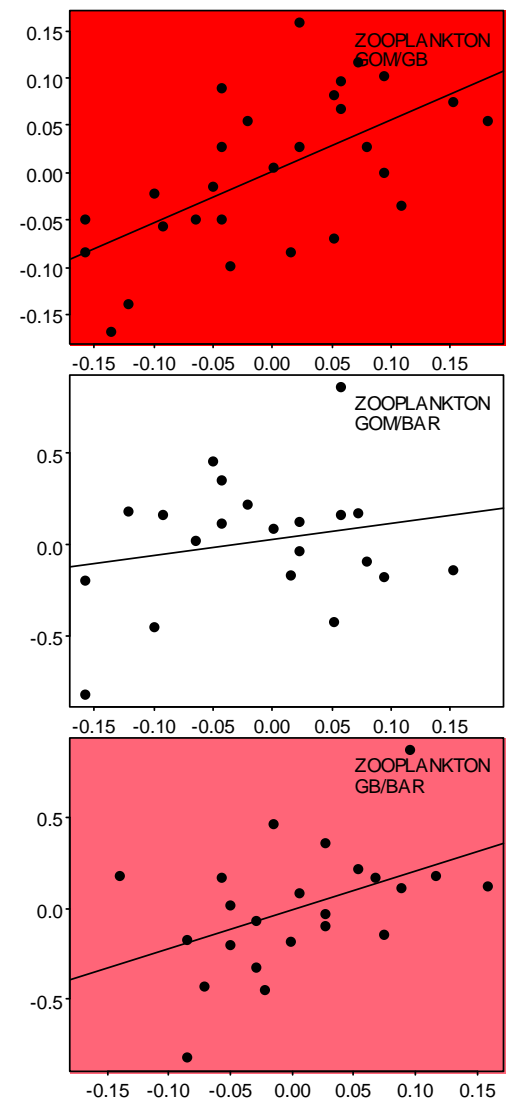
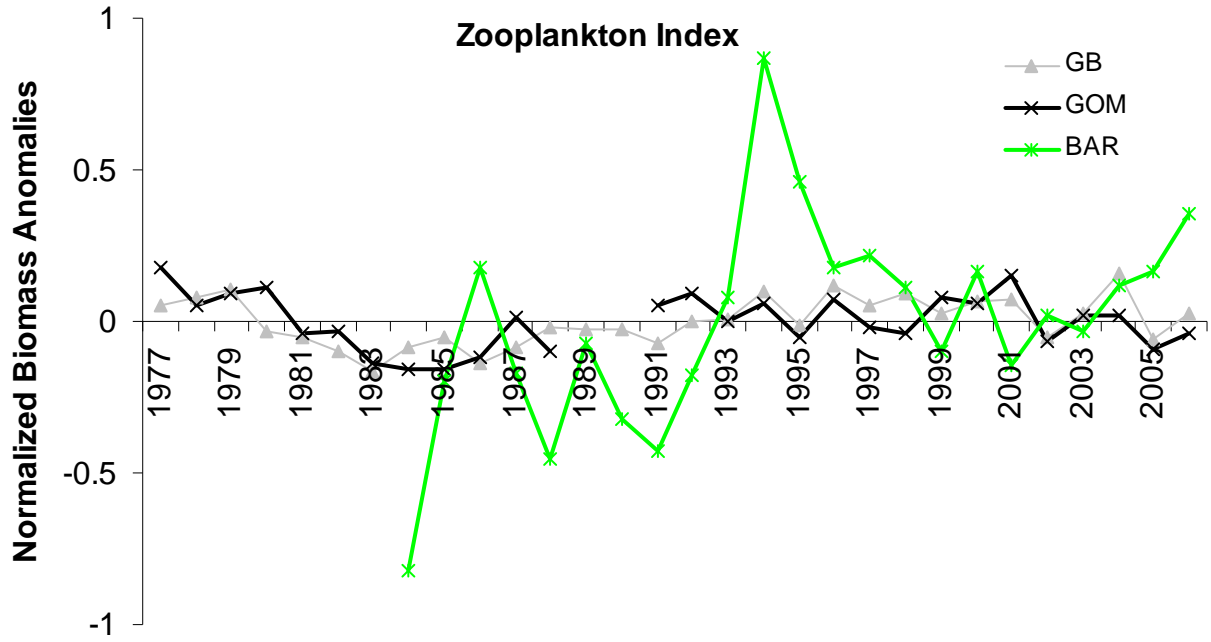
For further details on systemic metrics, see Gaichas et al.



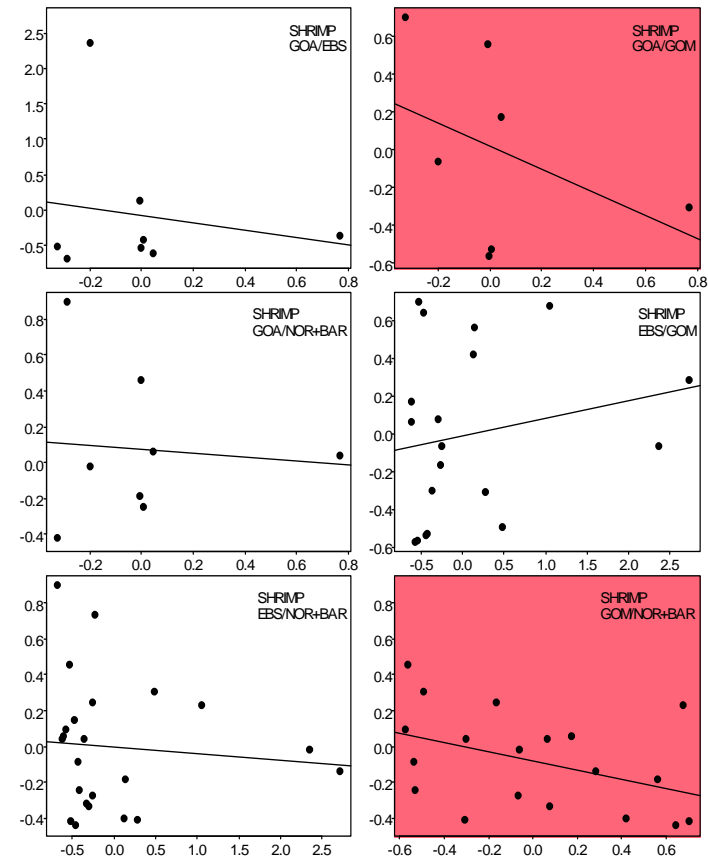
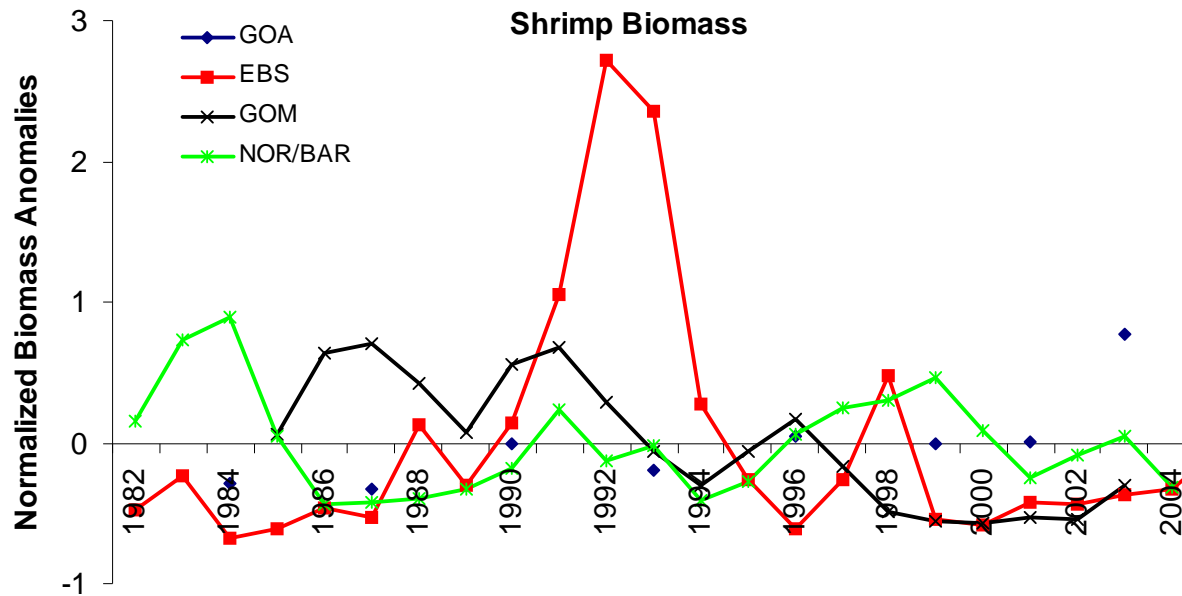
For further details on lower TL and climate, see Drinkwater et al., Mueter et al.



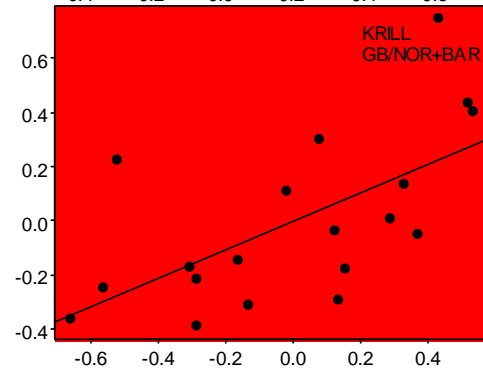
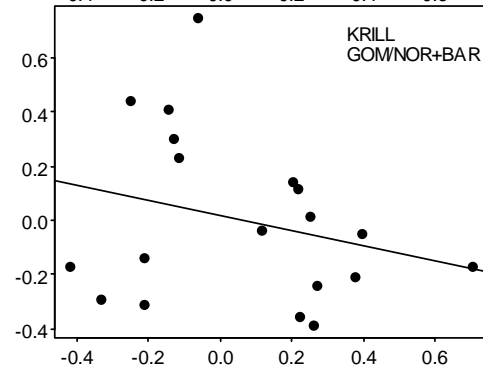
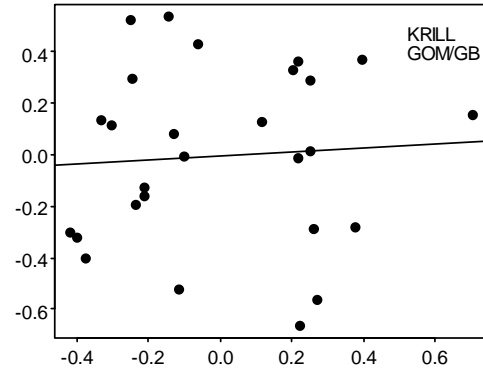
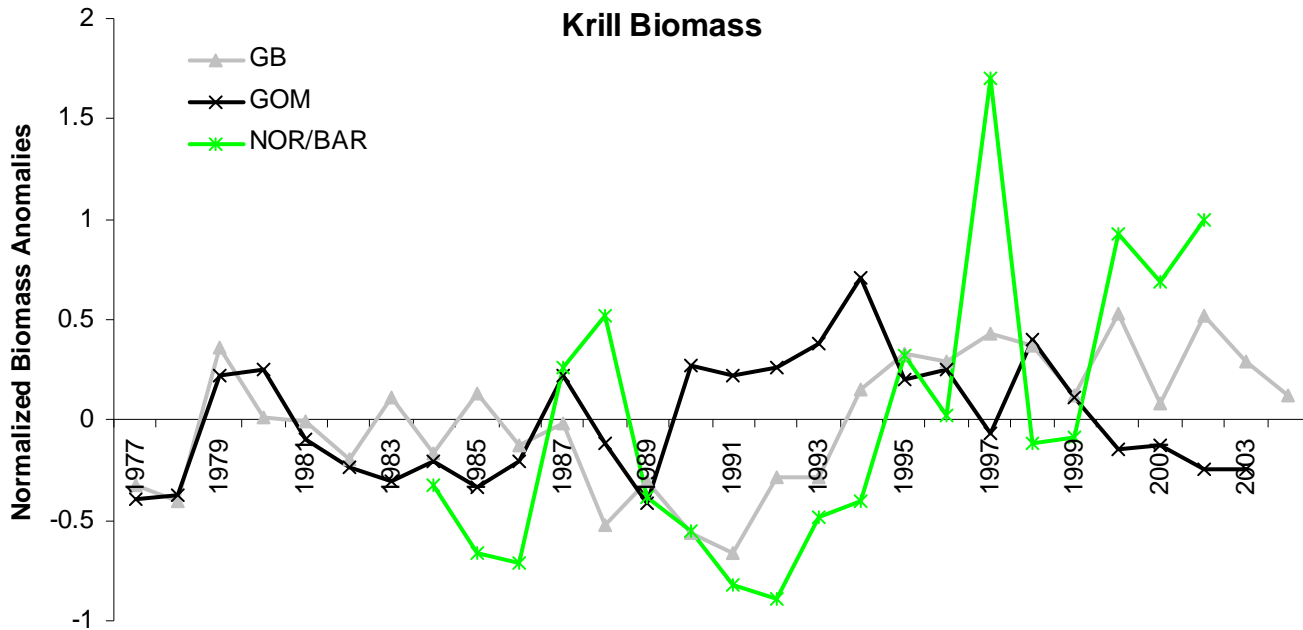
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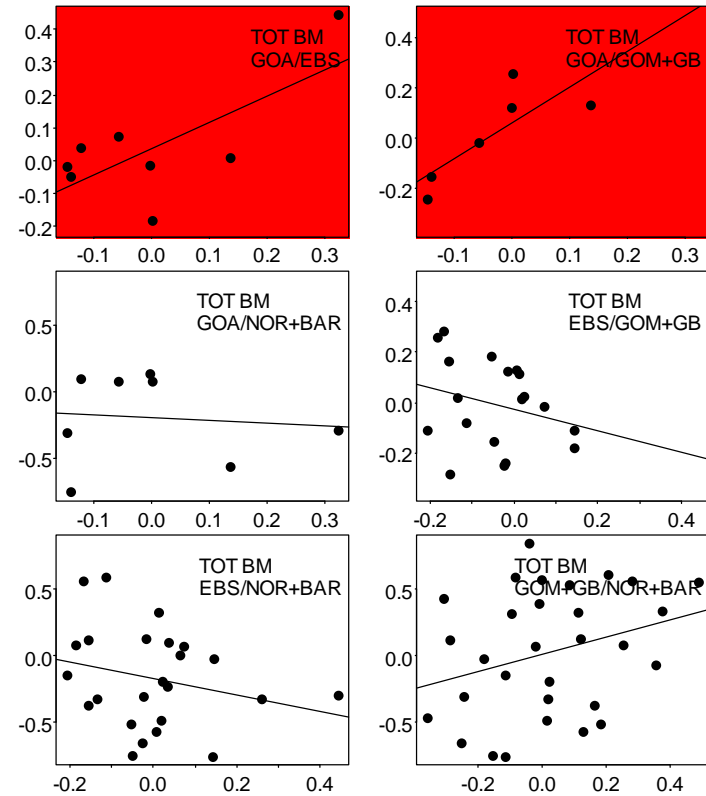
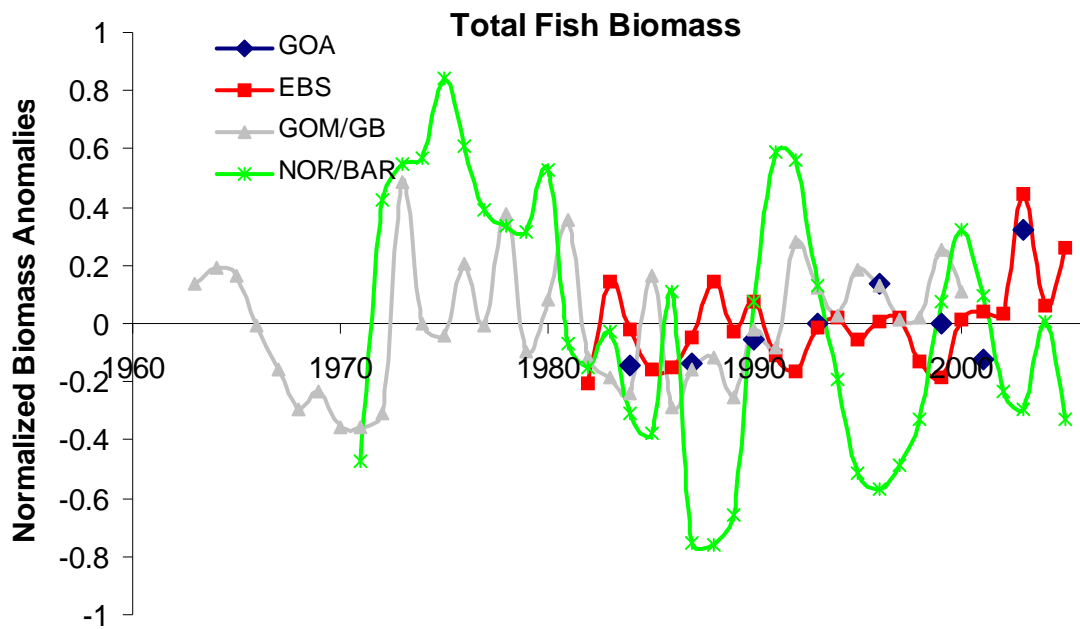
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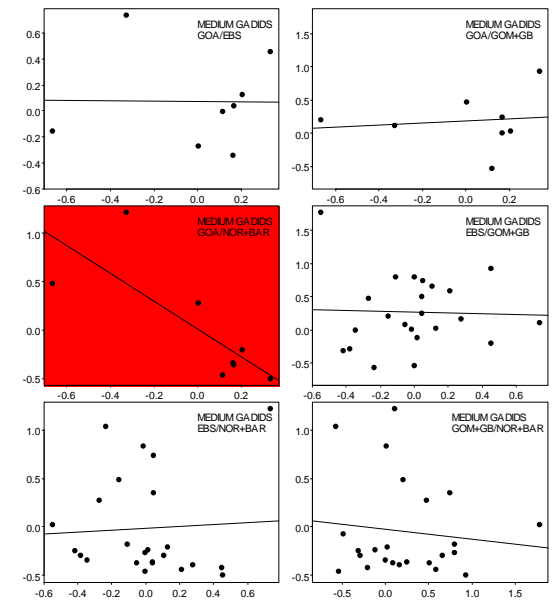
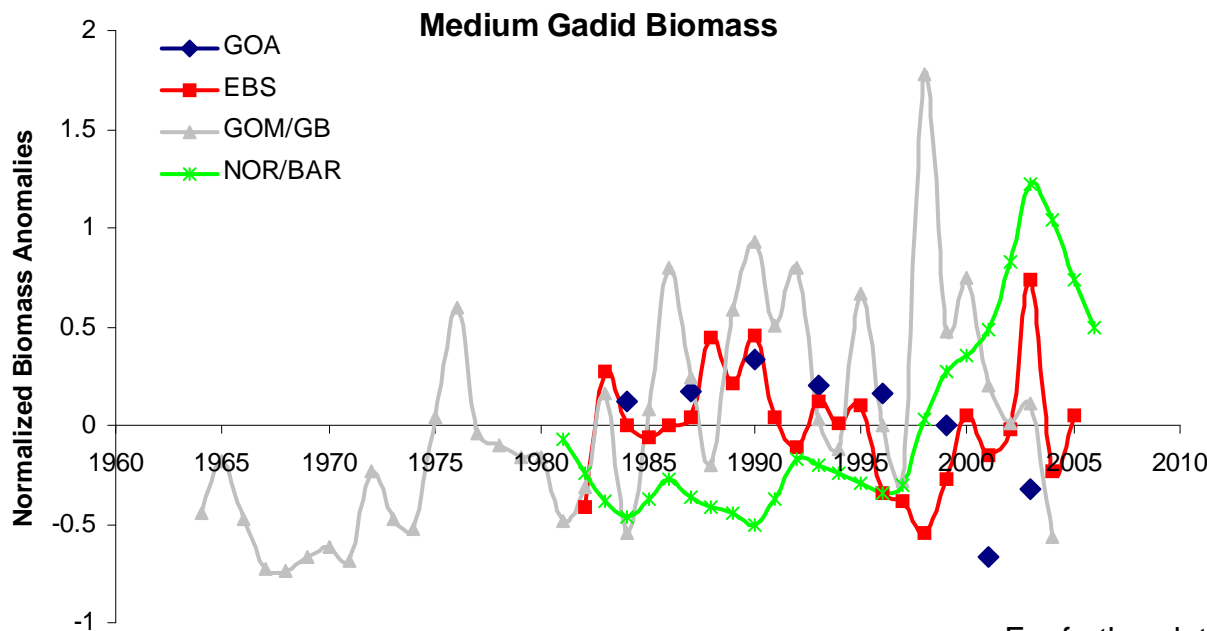
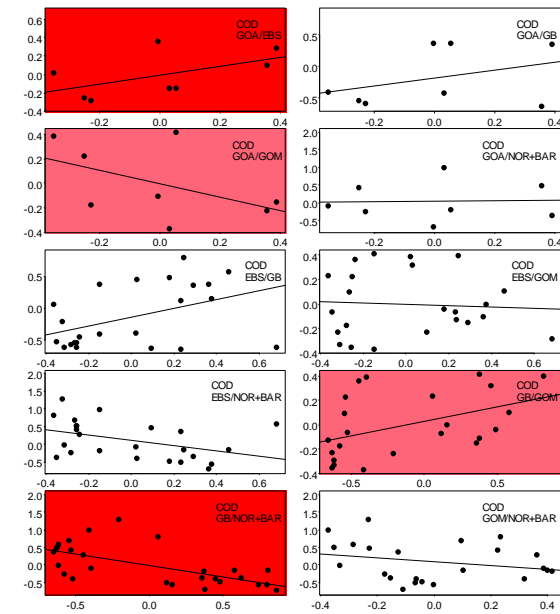
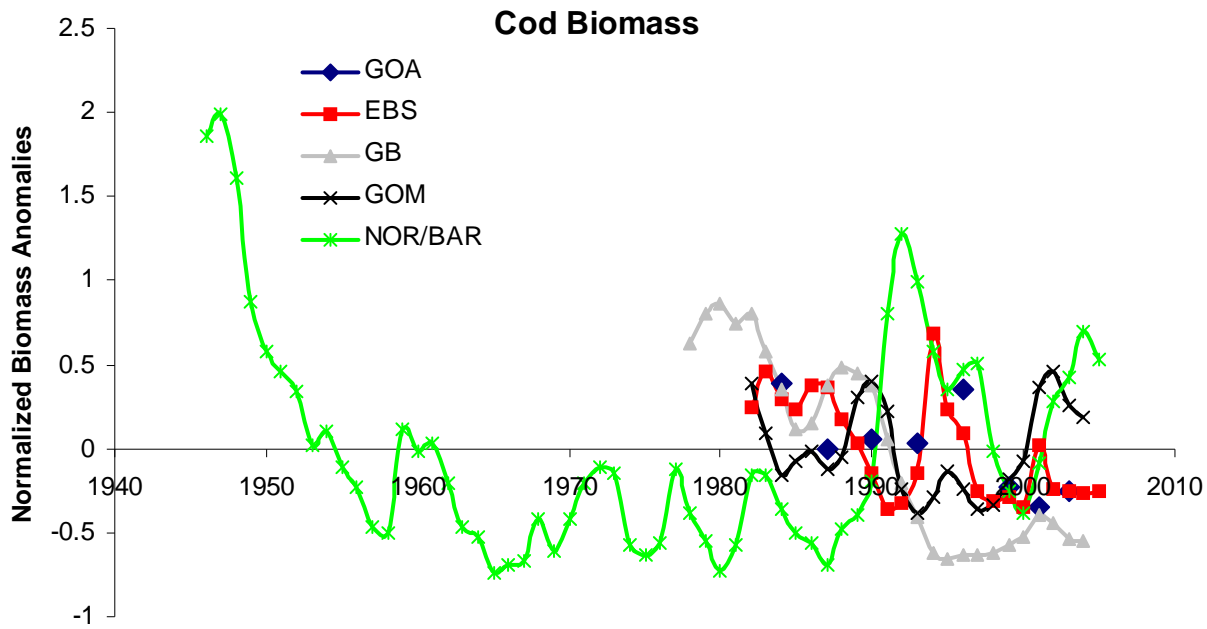
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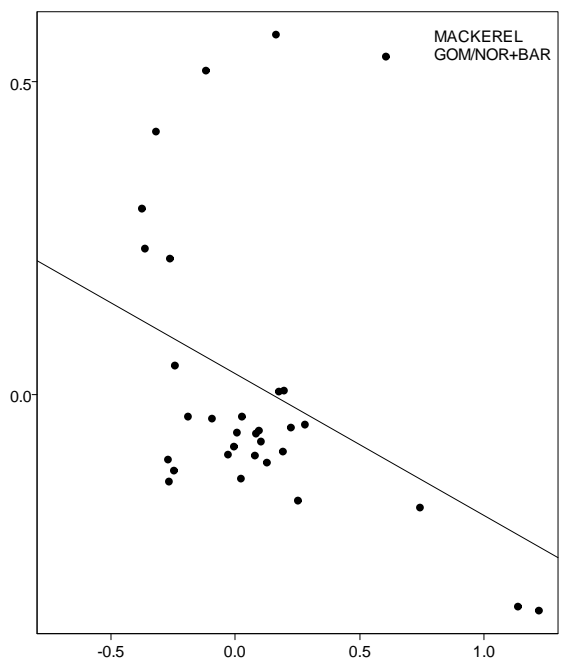
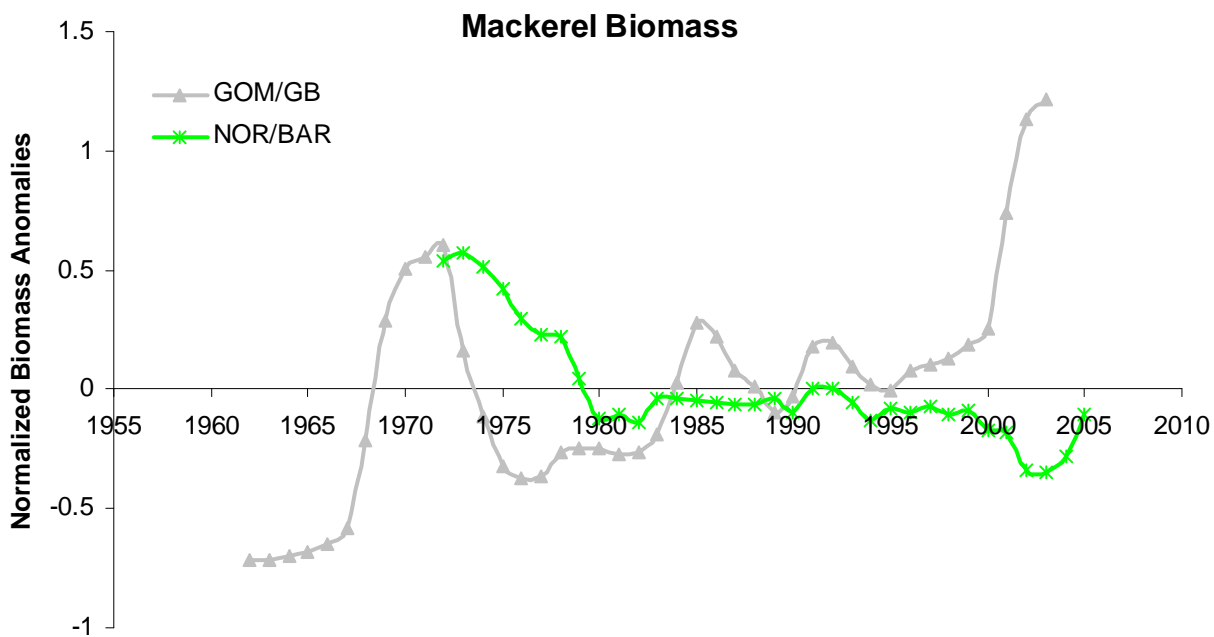
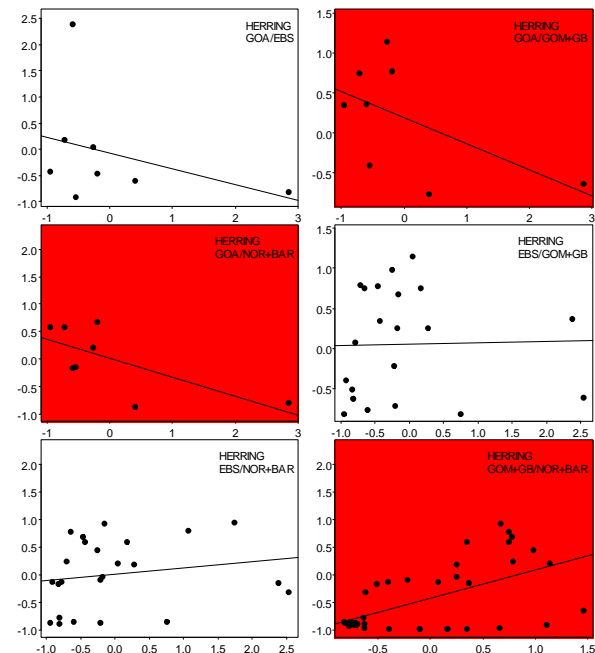
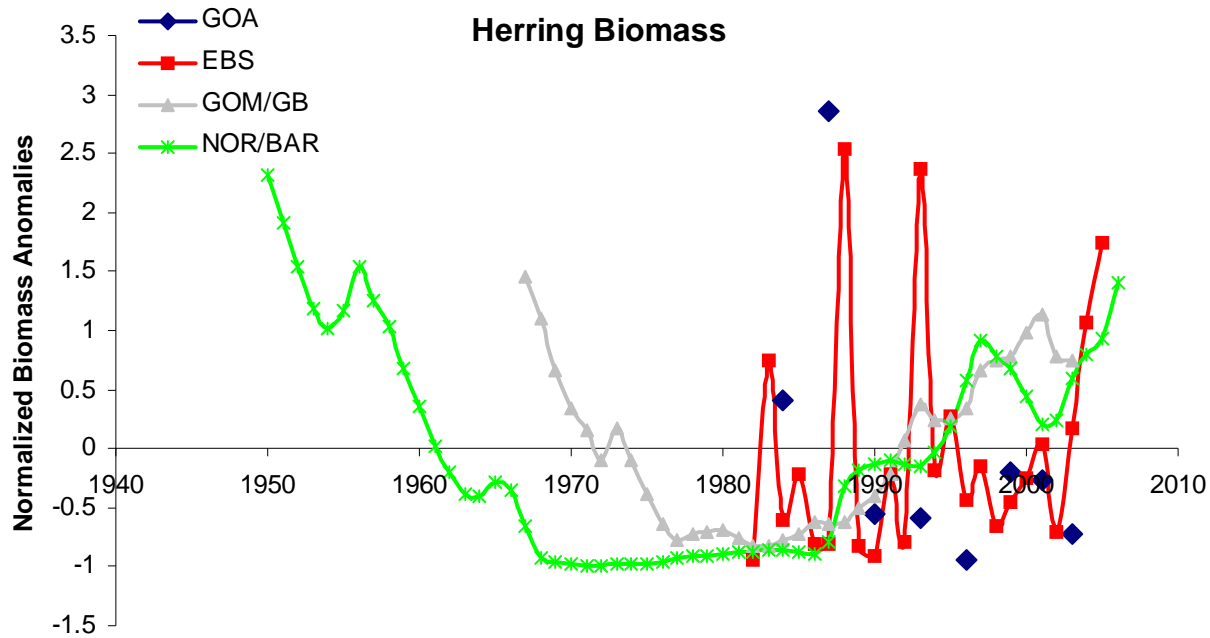
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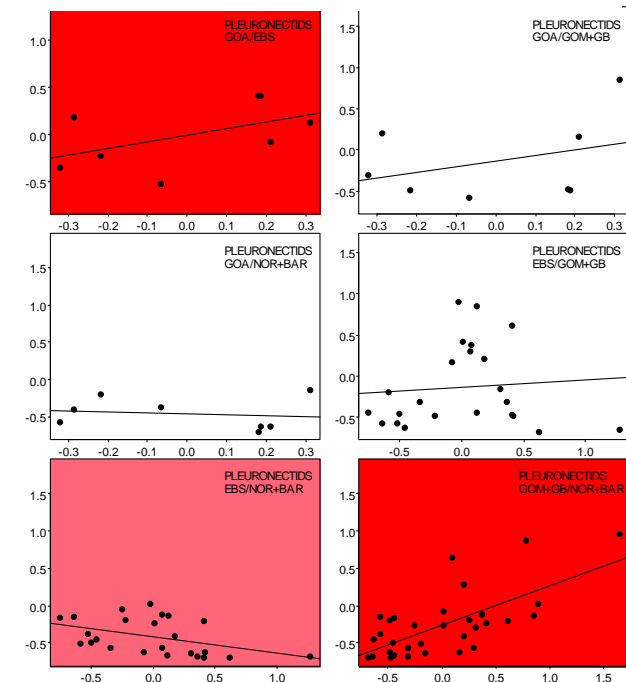
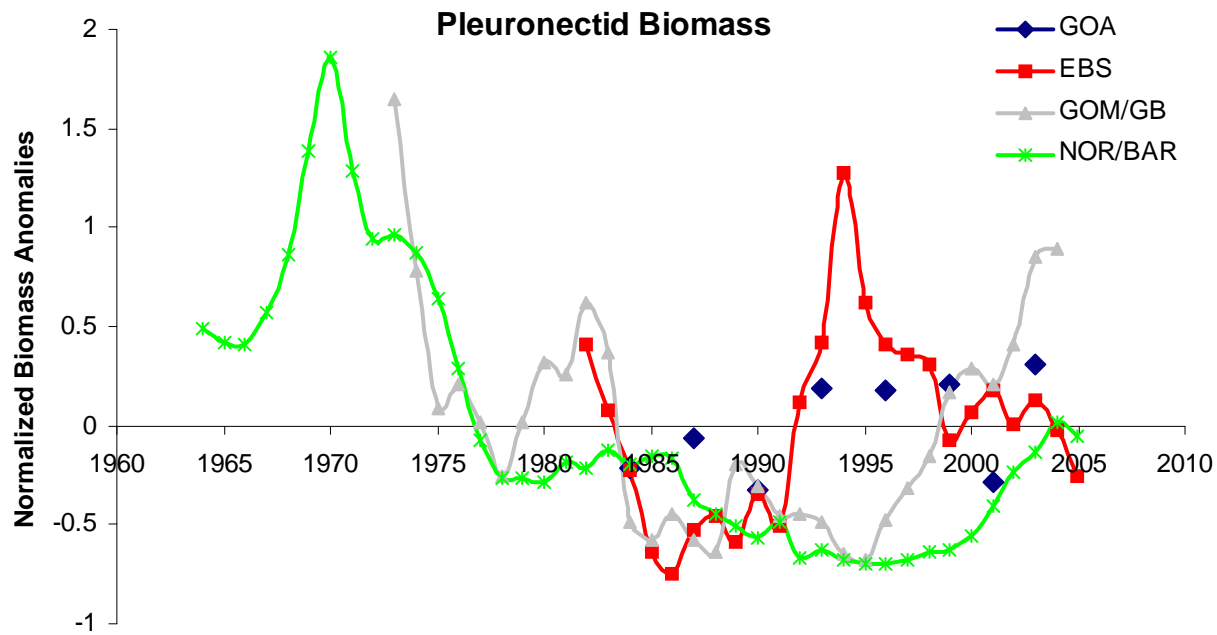
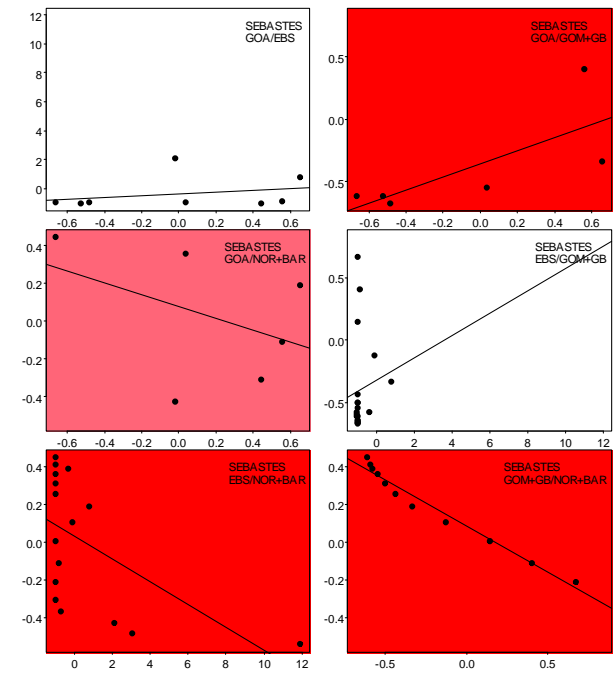
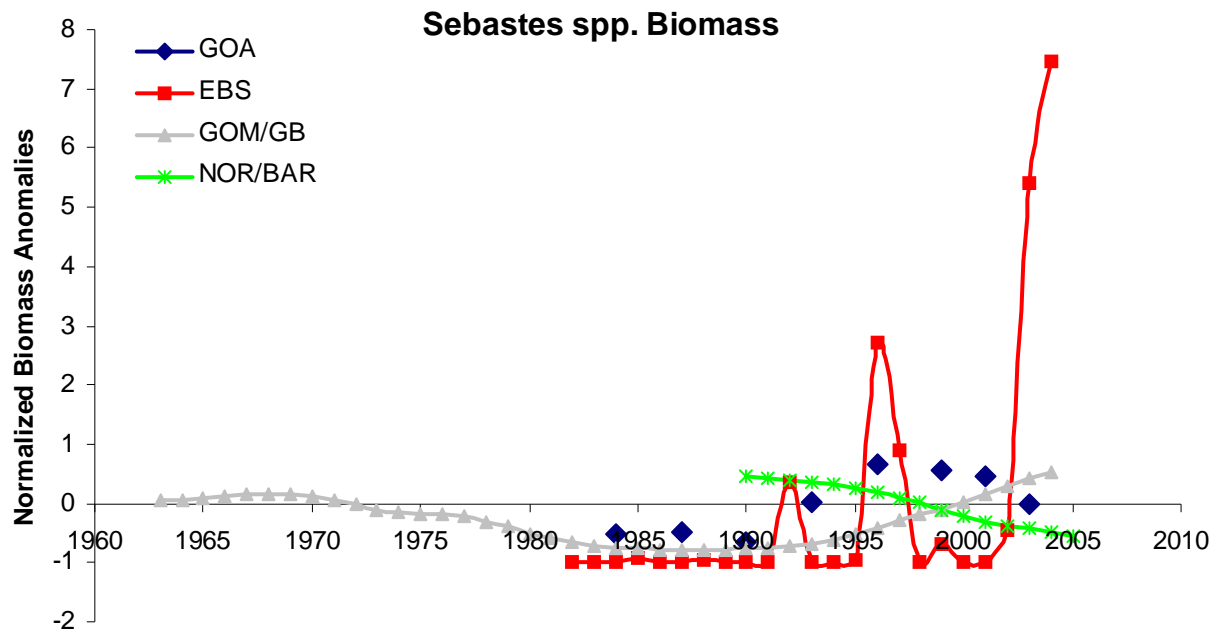


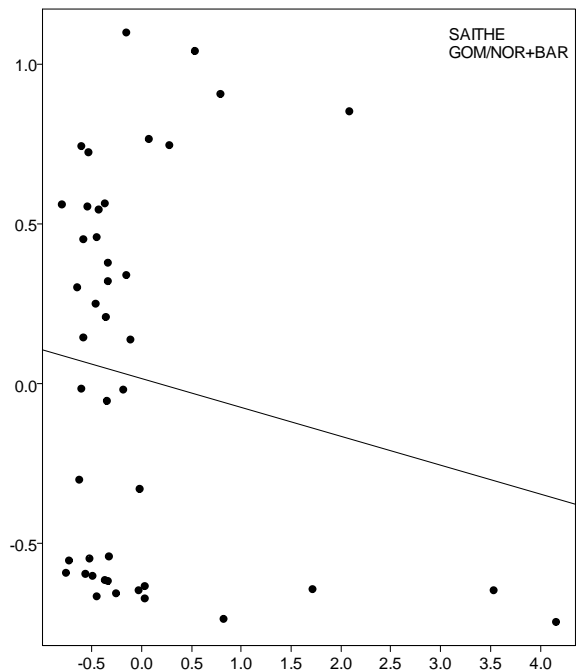
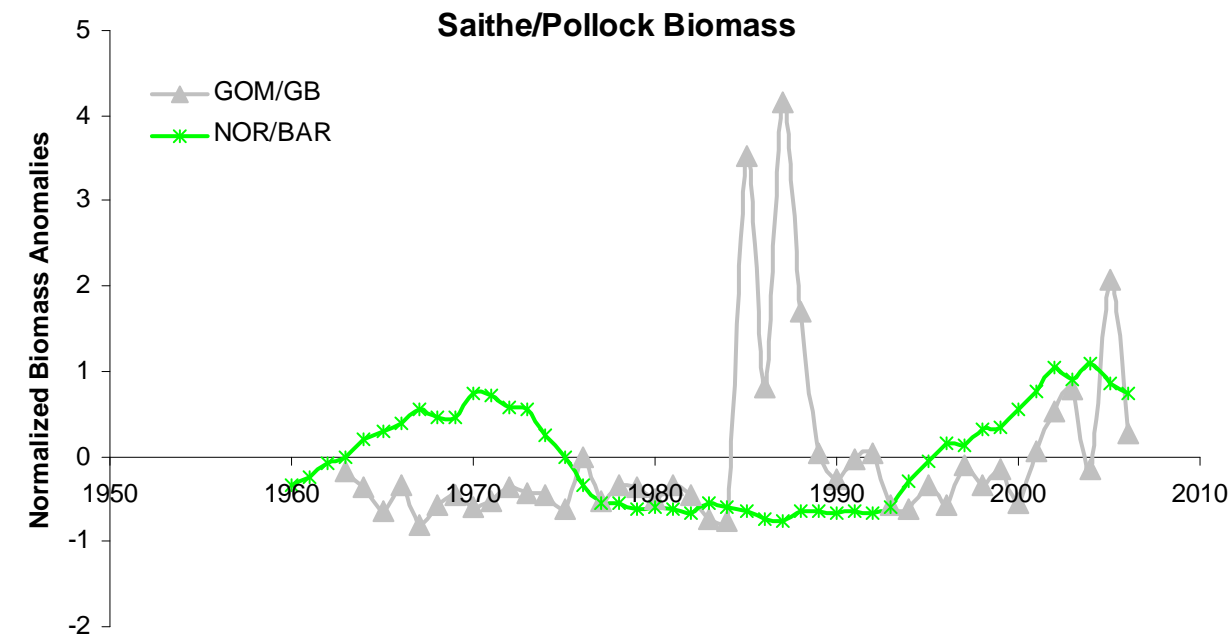
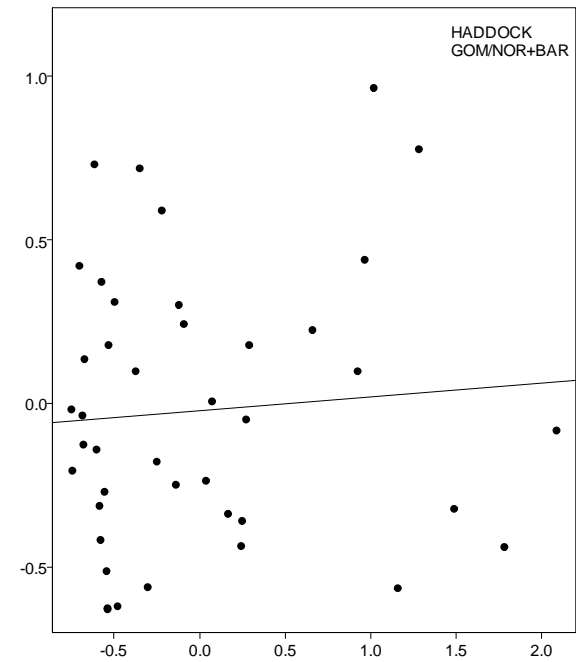
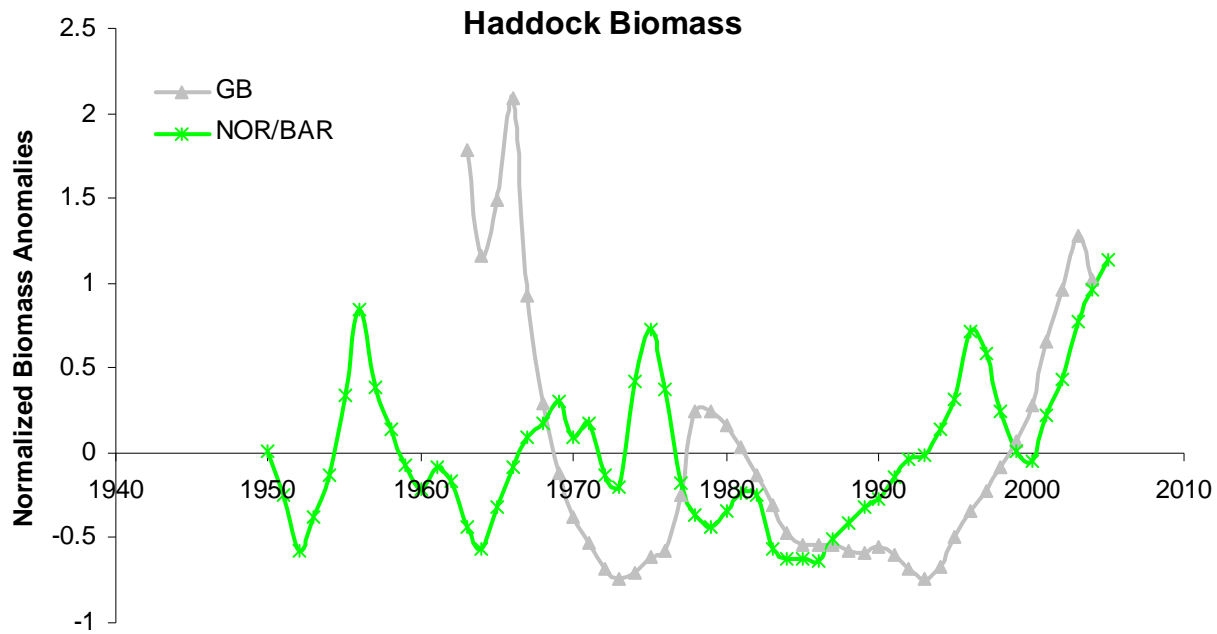
For further details on fish related to climate, see Mueter et al.

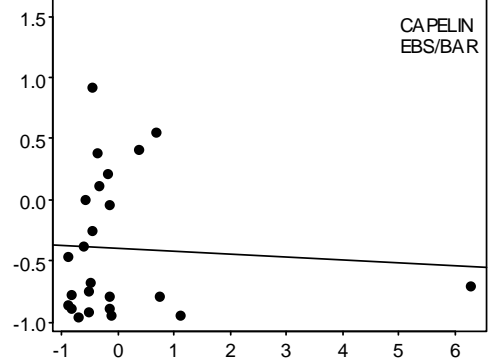
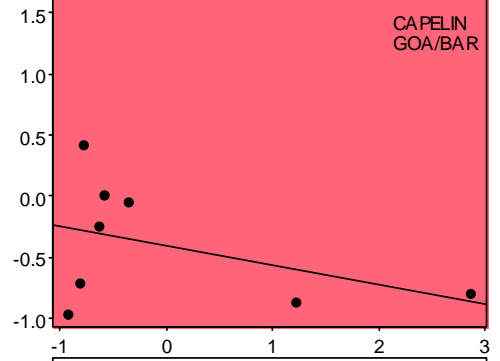
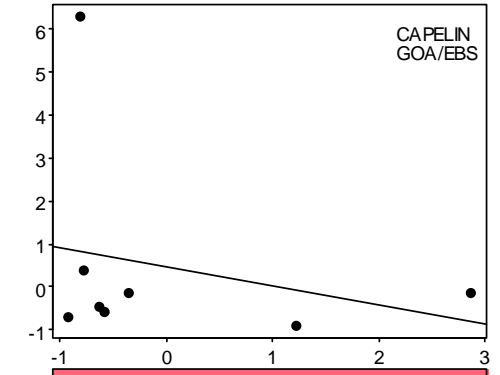
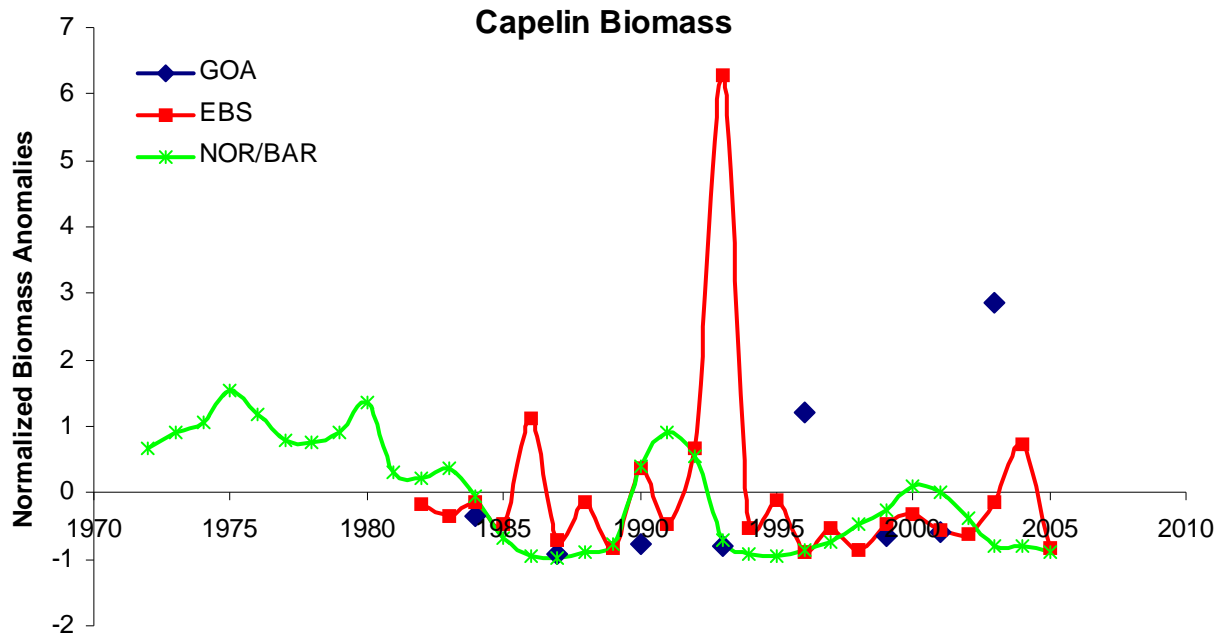


For further details on fish recruitment, see Megrey et al.









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

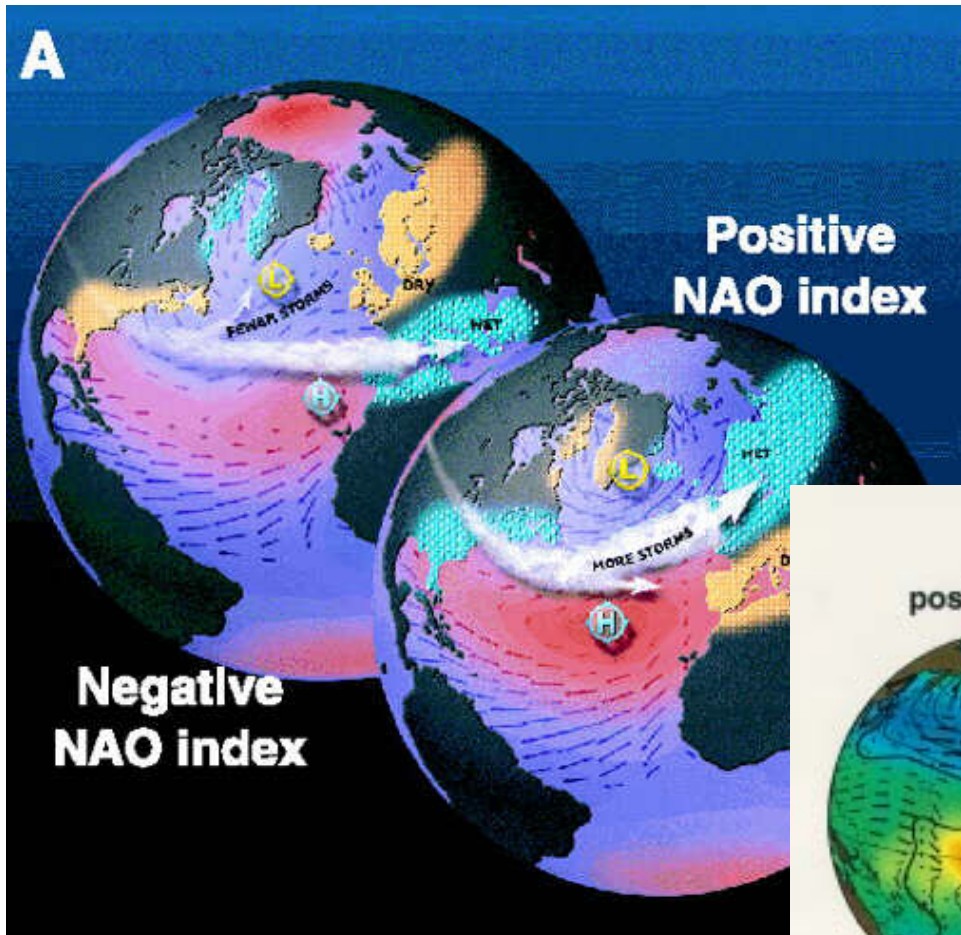
Summary- Differences

- 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

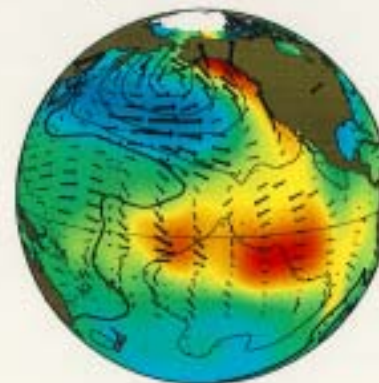
- Strongest synchronies: among two Atlantic systems and among two Pacific systems
- Strongest asynchronies: between Atlantic and Pacific systems
- Pacific and Atlantic distinctions indicative of Global oceanic processes
- Differences within Atlantic or Pacific systems indicative of basic scale processes

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



Pacific Decadal Oscillation

positive phase



negative phase

