Implications of a Warming Eastern Bering Sea for Bristol Bay Sockeye Salmon

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BASIS

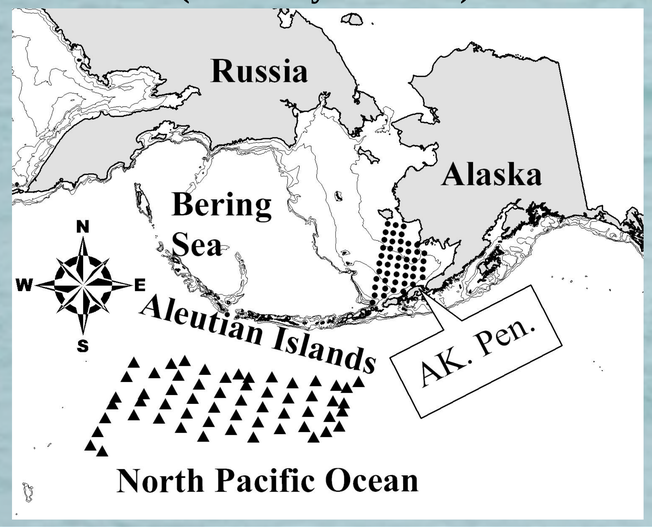
NOAA FISHERIES

Issue: Winter is a critical period for juvenile salmon where survival is a function of ecosystem productivity and salmon size and energetic status

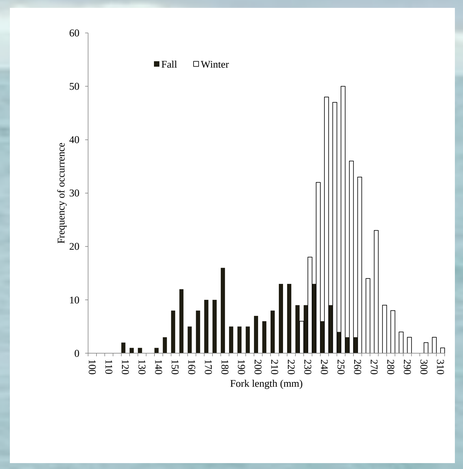
Survey Area

Eastern Bering Sea : 2002 – 2008 (August – September)

North Pacific: 2009 (February – March)

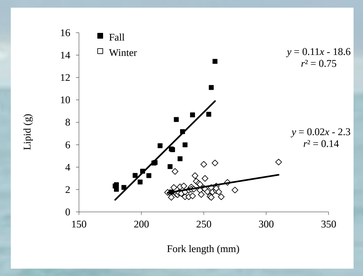


Critical Period

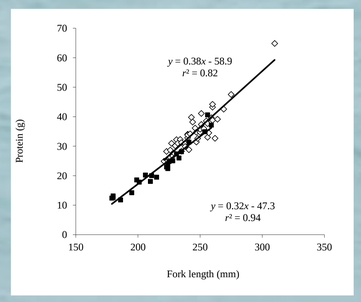


Size-selective mortality occurs between Fall 2008 (juvenile) and Winter 2009 (immature ocean age 1) for Bristol Bay sockeye salmon.

Conclusion

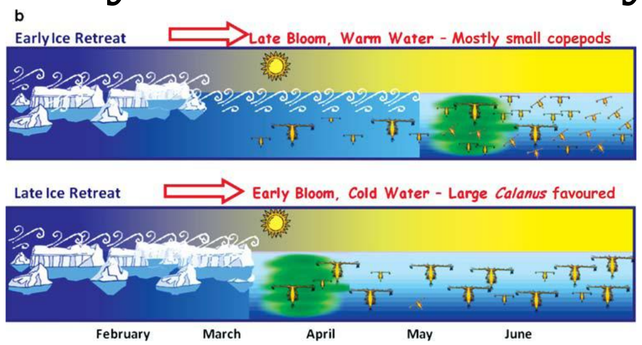


Larger fish utilize energy (lipid) to survive winter; likely a response to predator avoidance (feed less often, thus avoid size-selective predation).



Fish that survived winter did not appear to be starving as the protein signature of fish captured after winter matched that of those caught before winter.

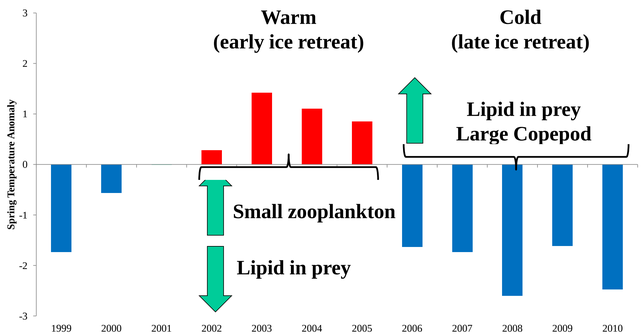
Ecosystem Productivity



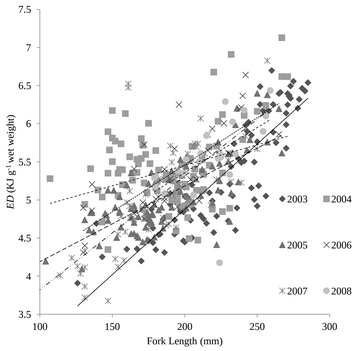
Eastern Bering Sea Shelf Productivity

Revised Oscillating Control Hypothesis; (Hunt et al. 2012)

Bering Sea Spring Temperature Anomaly

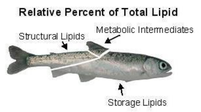


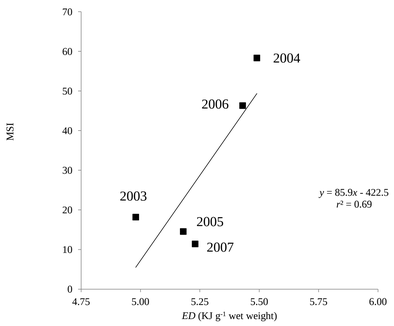
Fish Response



Energy density (ED) is related to size; however, the slope is significantly different among years, suggesting the amount of energy stored for a given fish length is related to ecosystem productivity.

Adjusted mean ED was found to be significantly higher during 2004 than 2005 and 2007; adjusted mean ED for 2005 was significantly lower than 2006.





Survival of juvenile sockeye salmon is related to energy they accumulate during their first year at sea.

Data

Genetics

Mean, standard deviation (SD), median, and 97.5% confidence intervals for genetic regional group identification of ocean age 1 sockeye salmon collected during Winter 2009 in the North Pacific Ocean.

Regional Group	Mean	*SD*	2.5%	Median	97.5%
Norton Sound	0.00	0.00	0.00	0.00	0.00
Western Bristol Bay	0.21	0.03	0.15	0.21	0.27
Eastern Bristol Bay	0.34	0.03	0.27	0.34	0.41
Alaska Peninsula	0.12	0.03	0.07	0.12	0.18
Eastern Kamchatka	0.00	0.00	0.00	0.00	0.01
Western Kamchatka	0.06	0.02	0.02	0.06	0.10
Western GOA	0.18	0.03	0.13	0.18	0.24
Eastern GOA	0.10	0.02	0.03	0.10	0.14

Relative Abundance/Marine Survival Index

Estimates of relative abundace (RA) and marine survival index (MSI) with 95% confidence limits (lower and upper) for juvenile sockeye salmon collected during Fall 2002 to 2007 in the eastern Bering Sea and subsequent adult sockeye salmon returns.

	RA				MSI		
Year	LCI	Est	UCI	Adult Returns	LCI	Est	UCI
2002	64.2	136.9	209.6	59.2	21.1%	46.4%	71.7%
2003	98.4	181.6	264.7	33.0	8.9%	19.3%	29.6%
2004	36.3	65.8	95.4	38.4	31.6%	61.5%	91.4%
2005	160.8	338.3	515.8	49.2	7.5%	15.5%	23.6%
2006	27.2	83.4	139.5	38.6	9.6%	52.7%	95.9%
2007	46.3	359.4	672.6	41.0	-%	14.8%	36.2%