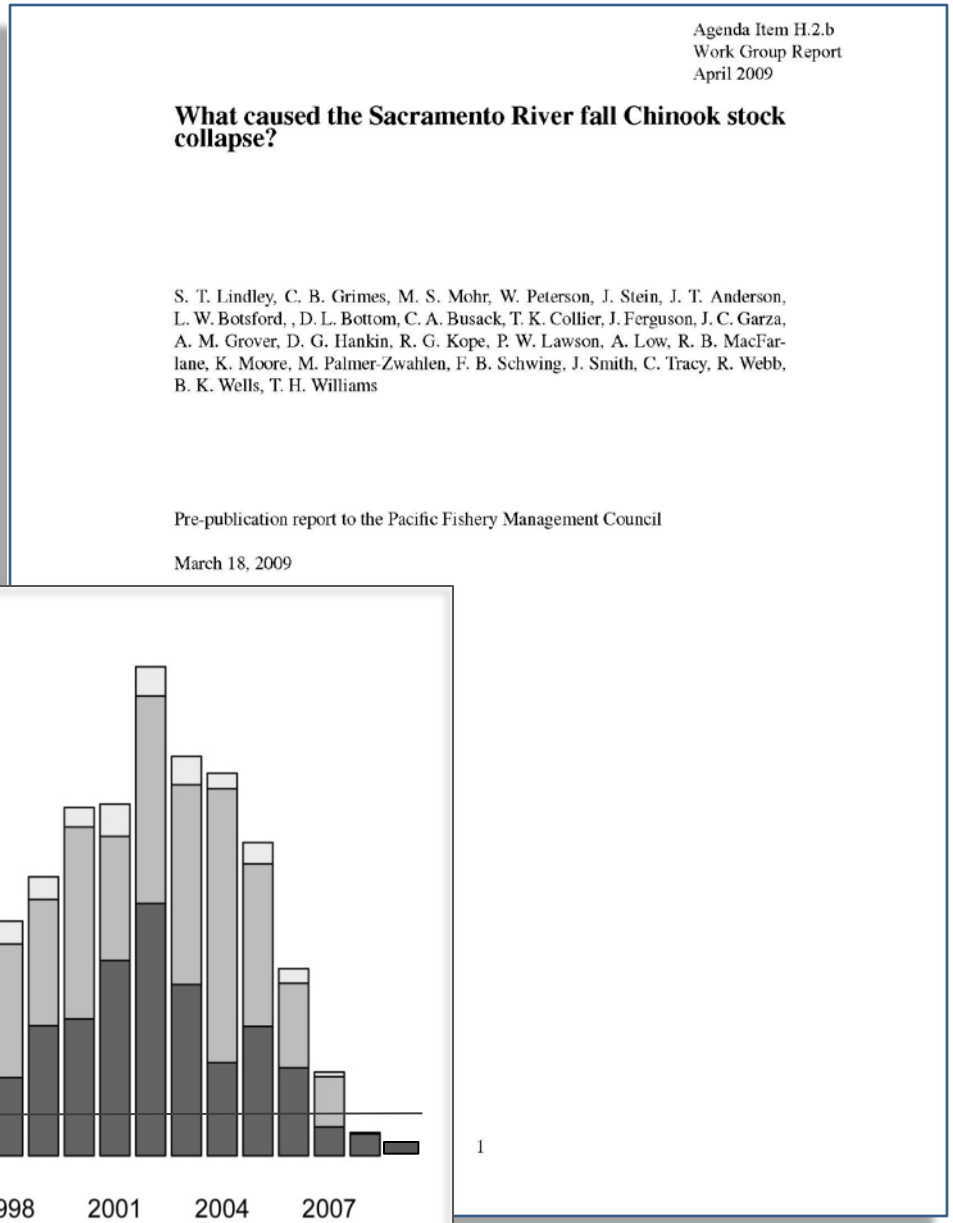
Utilizing Ecosystem Information to Improve Decision Support for Central California Salmon

Results from Salmon Applied Forecasting, Assessment and Research Initiative (SAFARI)

Chavez, F.[1], **B.K. Wells[2]**, E. Danner[2], W. Sydeman[3], Y Chao[4], F Chai[5], S. Ralston[2], J. Field[2], D. Foley[2], J. Santora[3], S. Bograd[2], S. Lindley[2], and W. Peterson[2].

1. MBARI
2. NOAA
3. Farallon Institute
4. JPL Jet Propulsion Laboratory California Institute of Technology
5. MAINE

Recent declines in the fishery and the need to forecast and manage the fishery instigated our interest in this work.



Agenda Item H.2.b
Work Group Report
April 2009

What caused the Sacramento River fall Chinook stock collapse?

S. T. Lindley, C. B. Grimes, M. S. Mohr, W. Peterson, J. Stein, J. T. Anderson, L. W. Botsford, , D. L. Bottom, C. A. Busack, T. K. Collier, J. Ferguson, J. C. Garza, A. M. Grover, D. G. Hankin, R. G. Kope, P. W. Lawson, A. Low, R. B. MacFarlane, K. Moore, M. Palmer-Zwahlen, F. B. Schwing, J. Smith, C. Tracy, R. Webb, B. K. Wells, T. H. Williams

Pre-publication report to the Pacific Fishery Management Council

March 18, 2009

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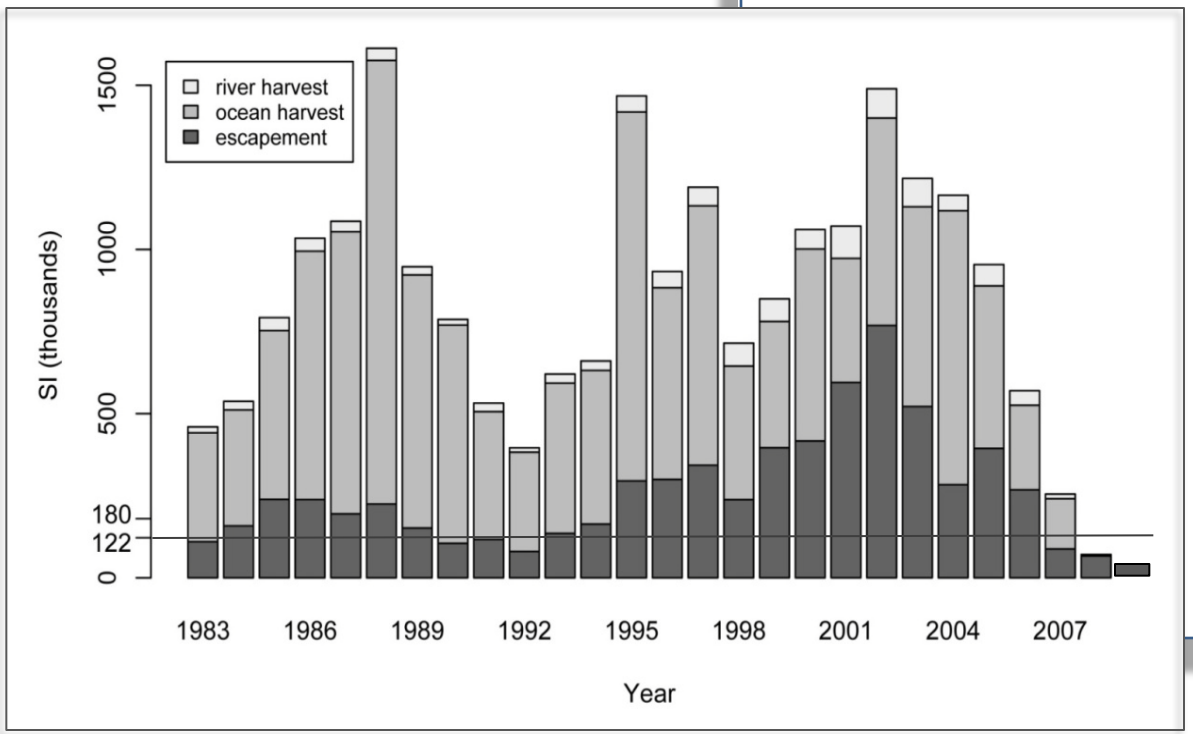
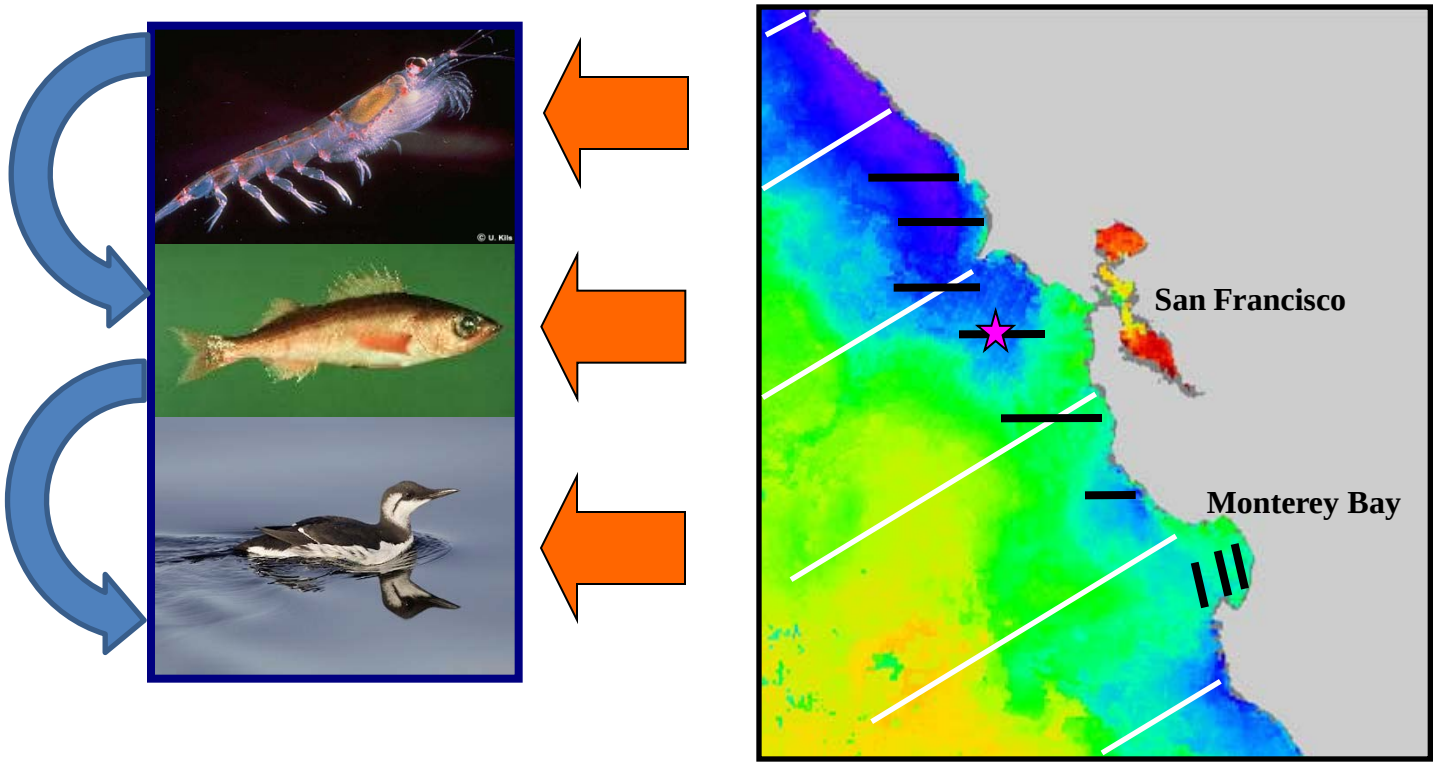


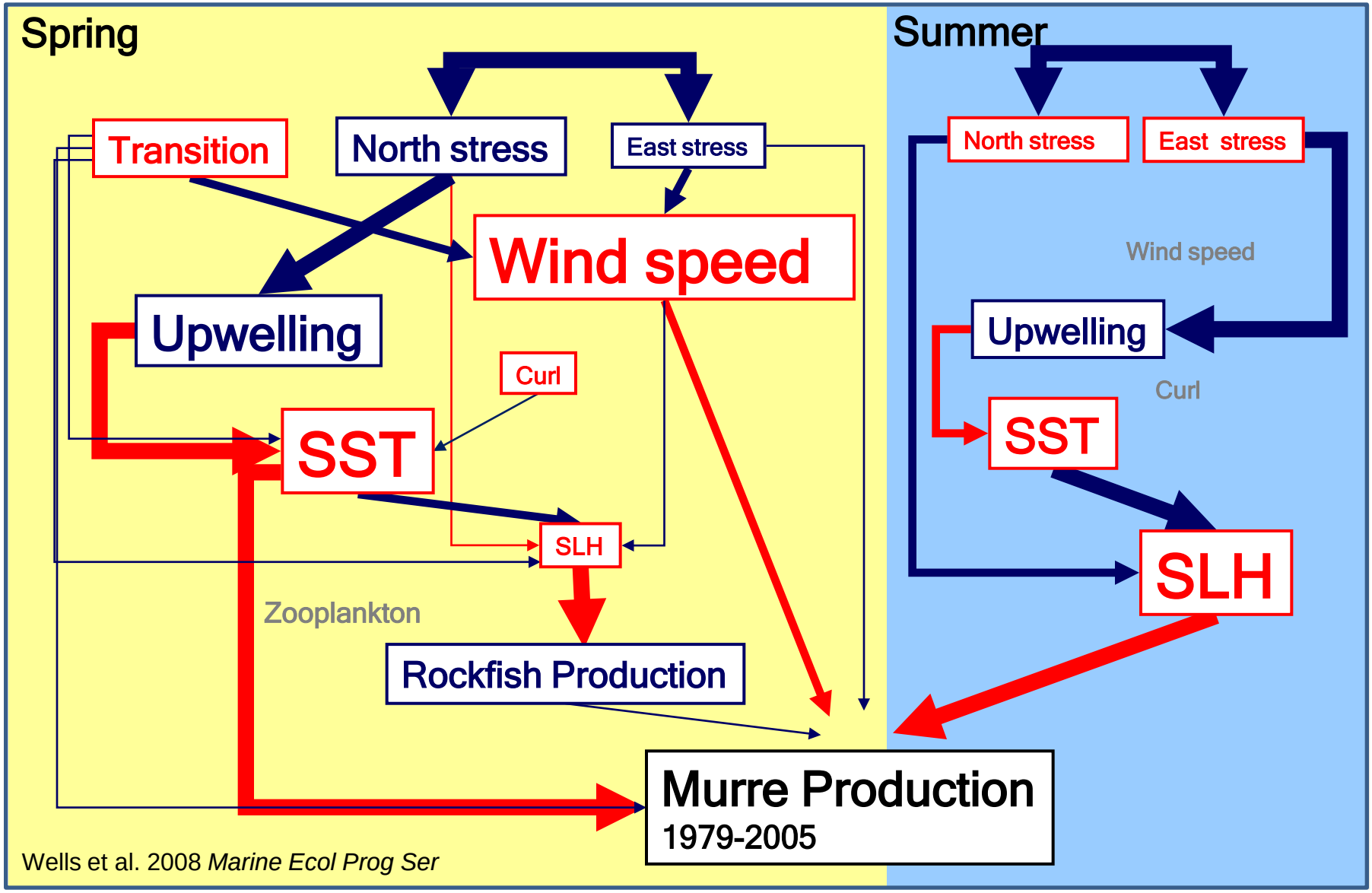
Objective 1: Forecast and incorporate appropriate environmental variability into current management models for CA Chinook salmon

Objective 2: Develop regional models to determine the mechanisms forcing early survival of salmon.

Objective 1: Forecast and incorporate appropriate environmental variability into current management models for CA Chinook salmon



These ocean conditions are extremely complicated but can be modeled with observed data to understand likely connections and estimate overall productivity of the system.



Wells et al. 2008 *Marine Ecol Prog Ser*

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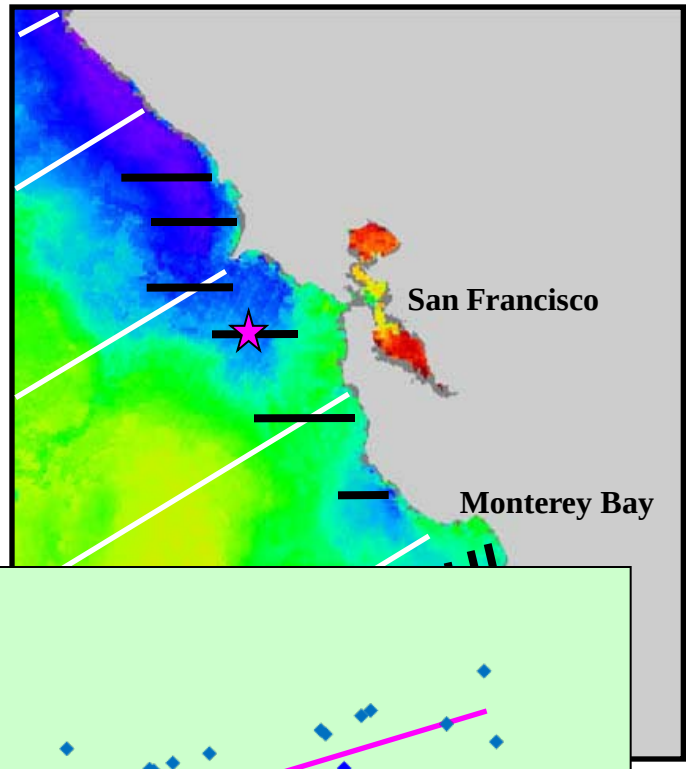
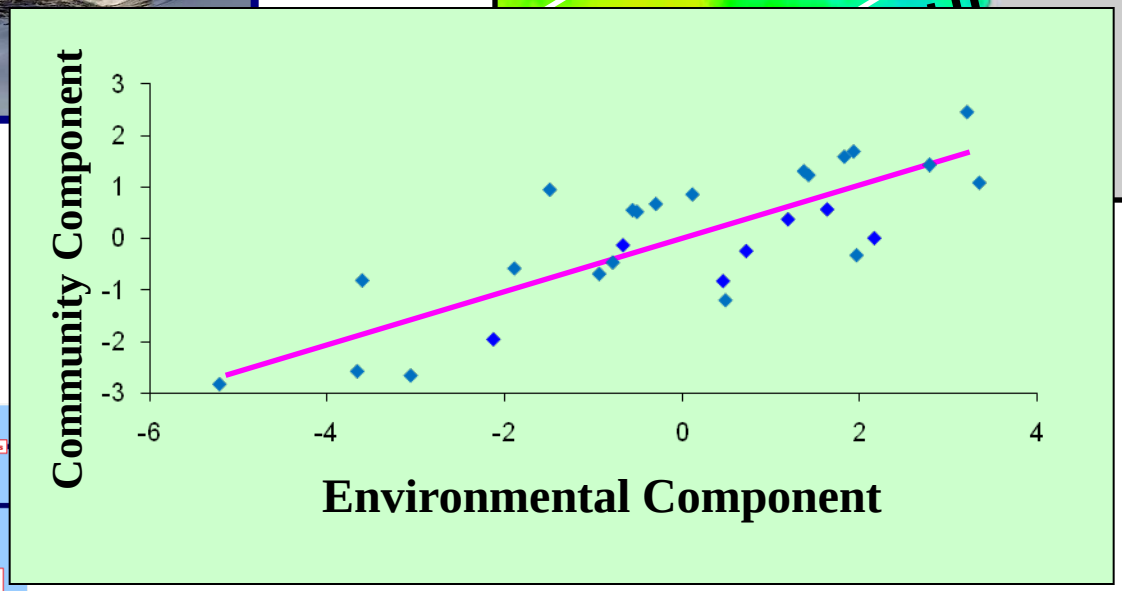
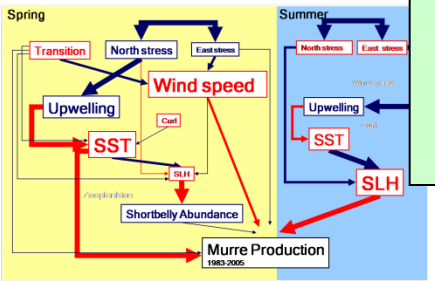
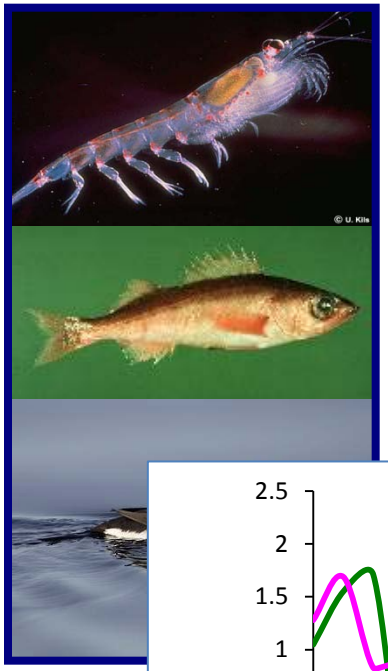






Wells et al. 2008 *Marine Ecol Prog Ser*



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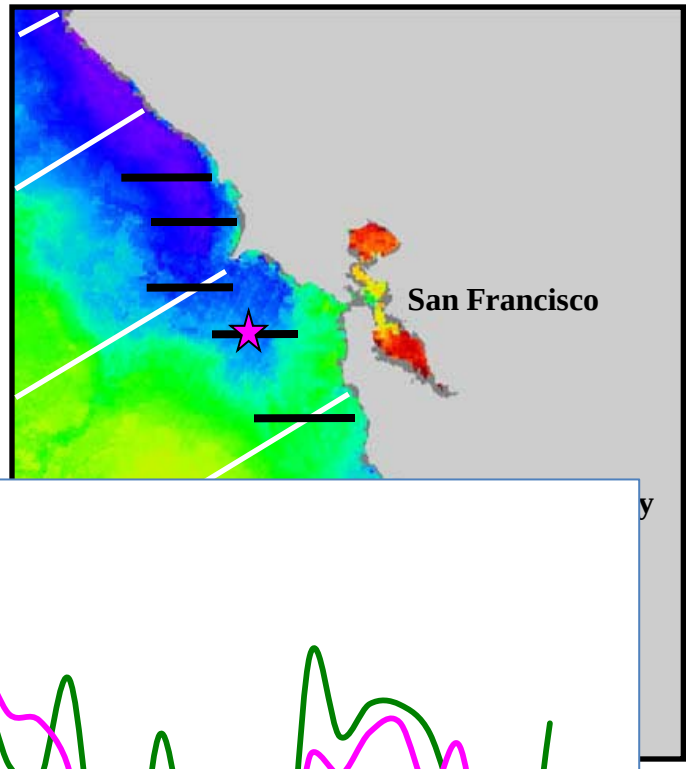
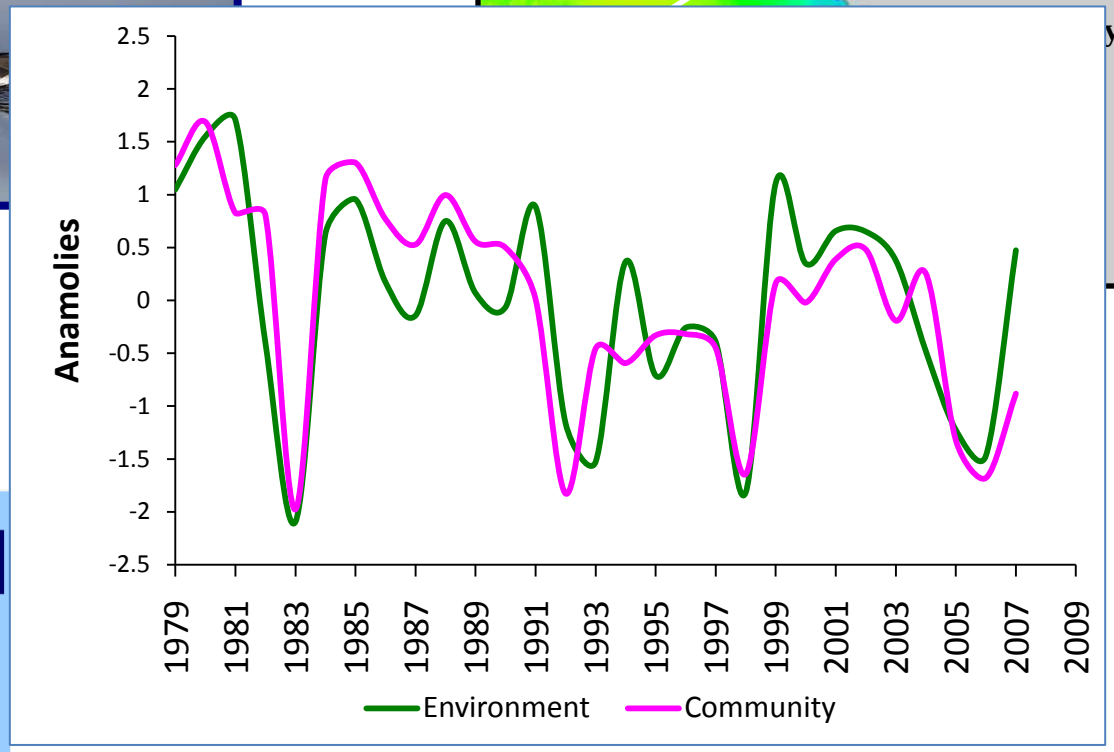
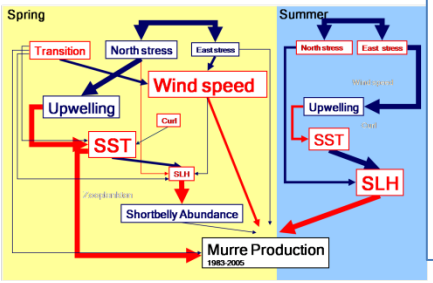
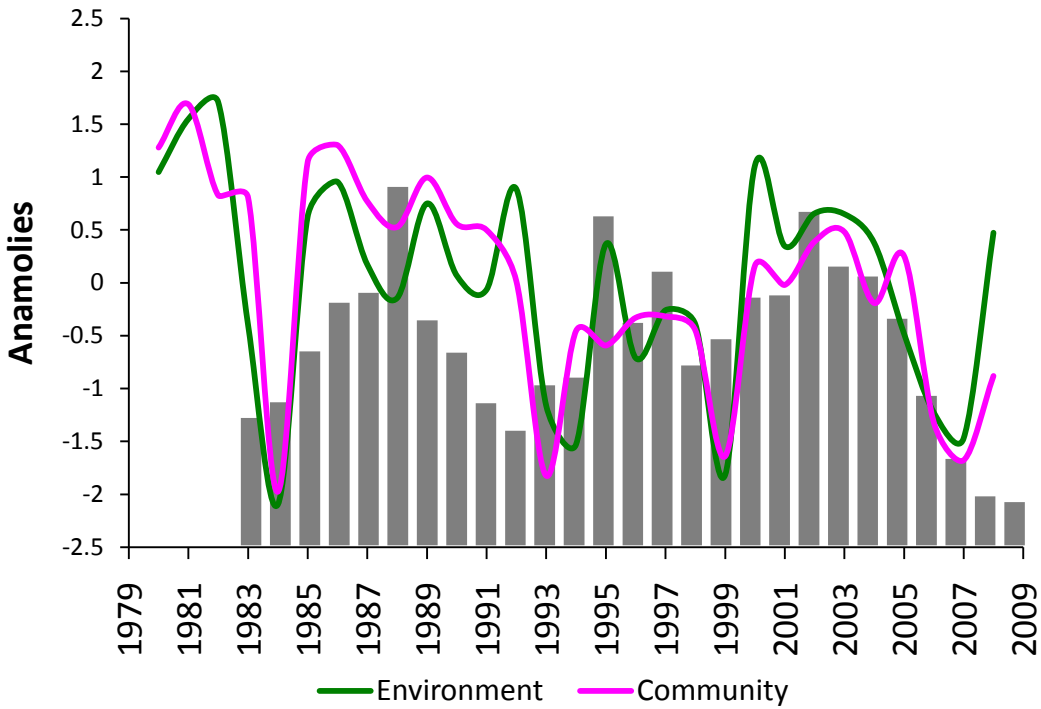


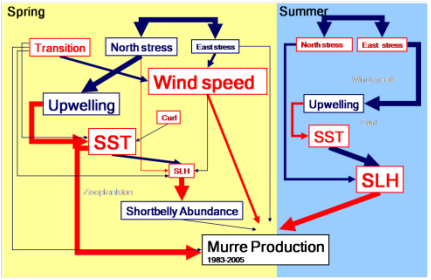




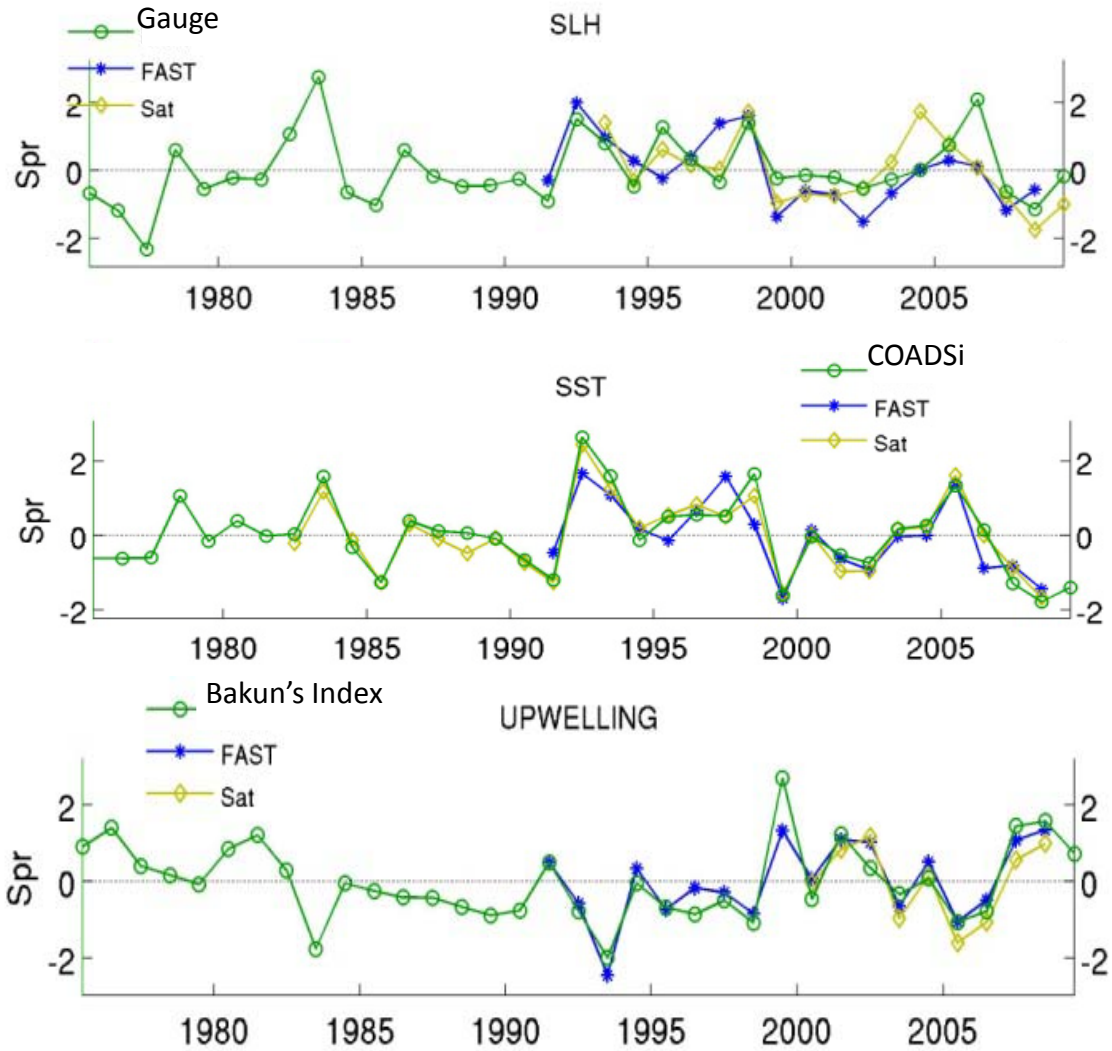
Wells et al. 2008 *Marine Ecol Prog Ser;* Sydeman et al *2009 CalCOFI*

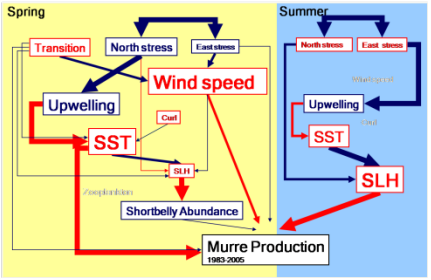
40% of the variability in salmon stock abundance is accounted for by this index.





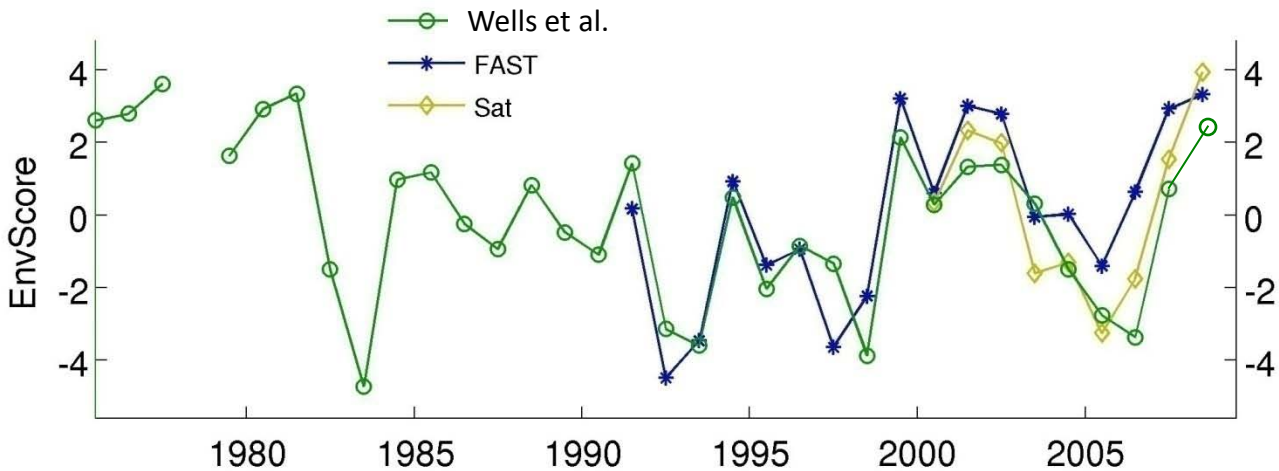
We used results from FAST models to fit the individual variables considered important to ecosystem productivity regionally.

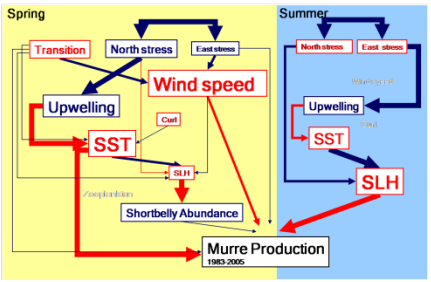




New Result

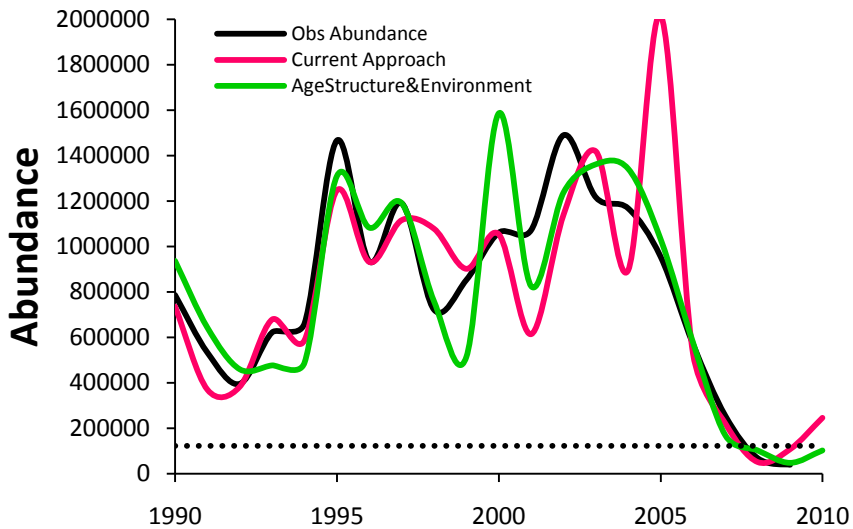
As a test of the strength of these results we then used them to fit the ecosystem index.

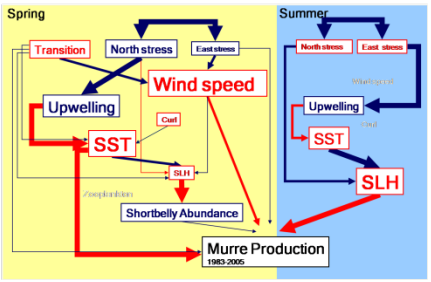




New Result and future management application

Current models used to forecast salmon production do not include environmental variability. Below we show how the inclusion of environmental variables can be used to potentially improve the forecast models. This becomes essential during low abundance years





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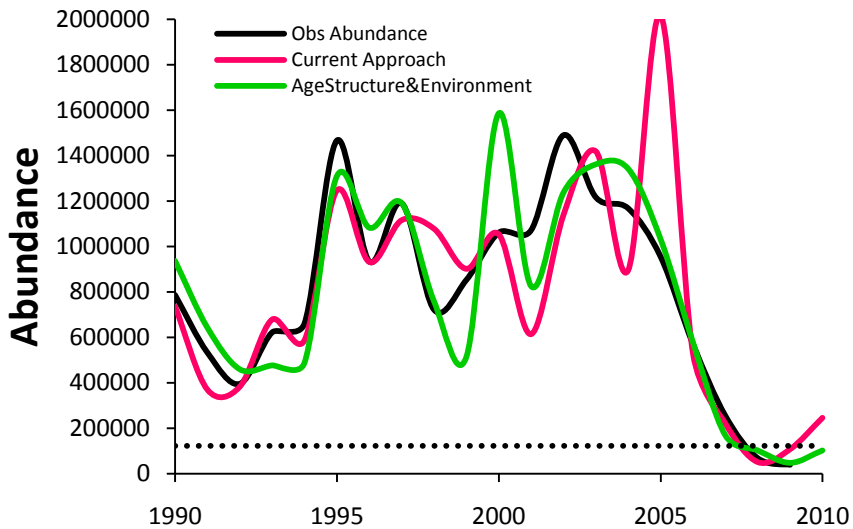

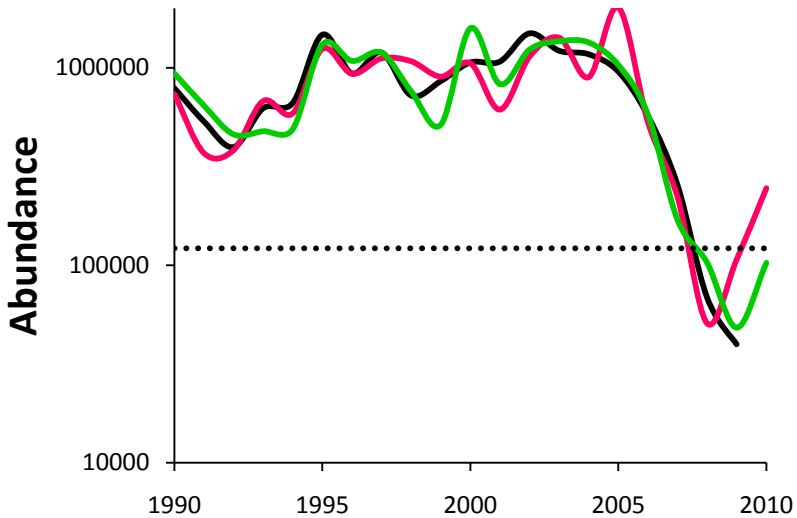

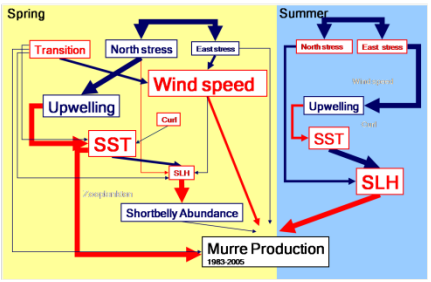

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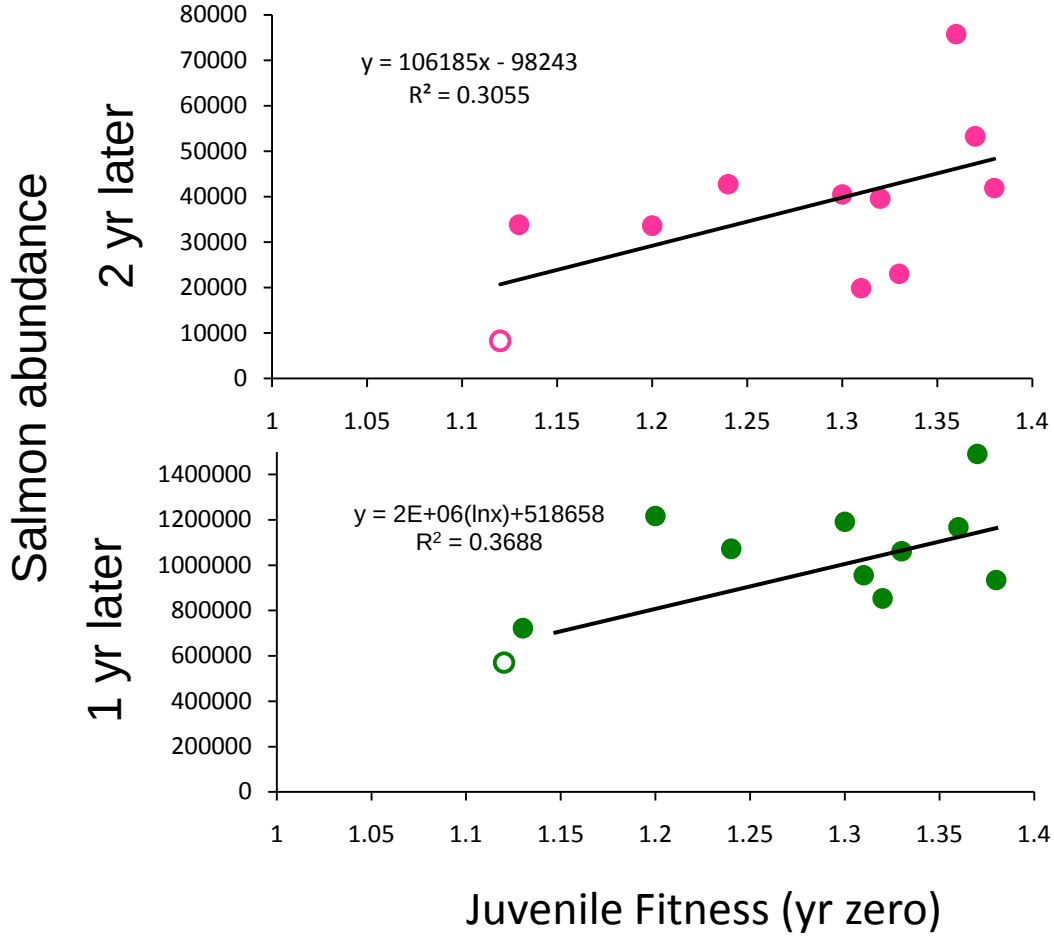
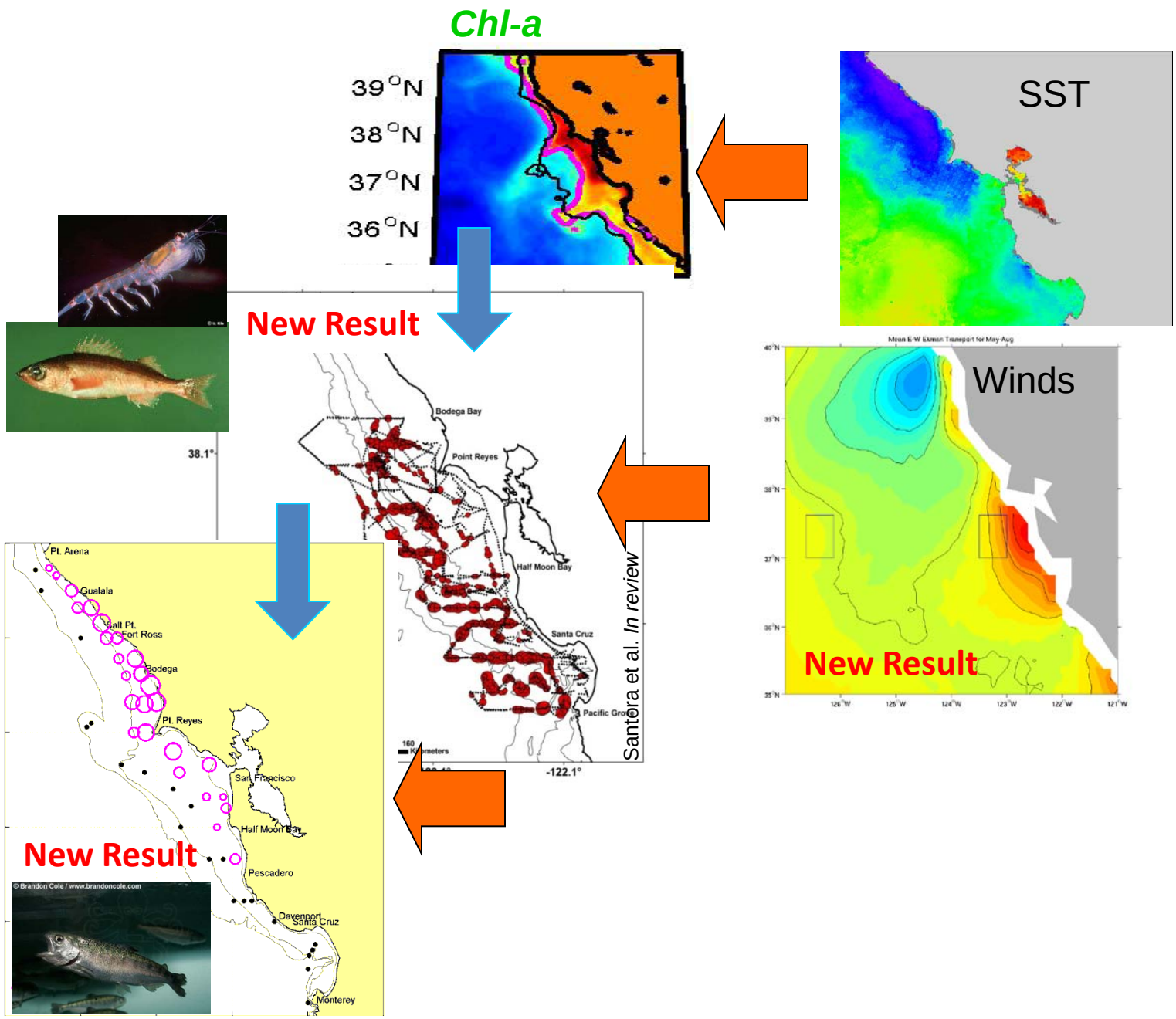
New Result

Much of what we have been addressing here has been to improve our estimates of adult abundance but nothing speaks toward understanding the mechanisms that control survival of California salmon.




Chl-a
39°N
38°N
37°N
36°N
SST
New Result
Winds
New Result
Bodega Bay
Point Reyes
Half Moon Bay
Santa Cruz
Pacific Grove
38.1°
-122.1°
Santora et al. In review
Pt. Arena
Gualala
Salt Pt.
Fort Ross
Bodega
Pt. Reyes
San Francisco
Half Moon Bay
Pescadero
Davenport
Santa Cruz
Monterey
New Result
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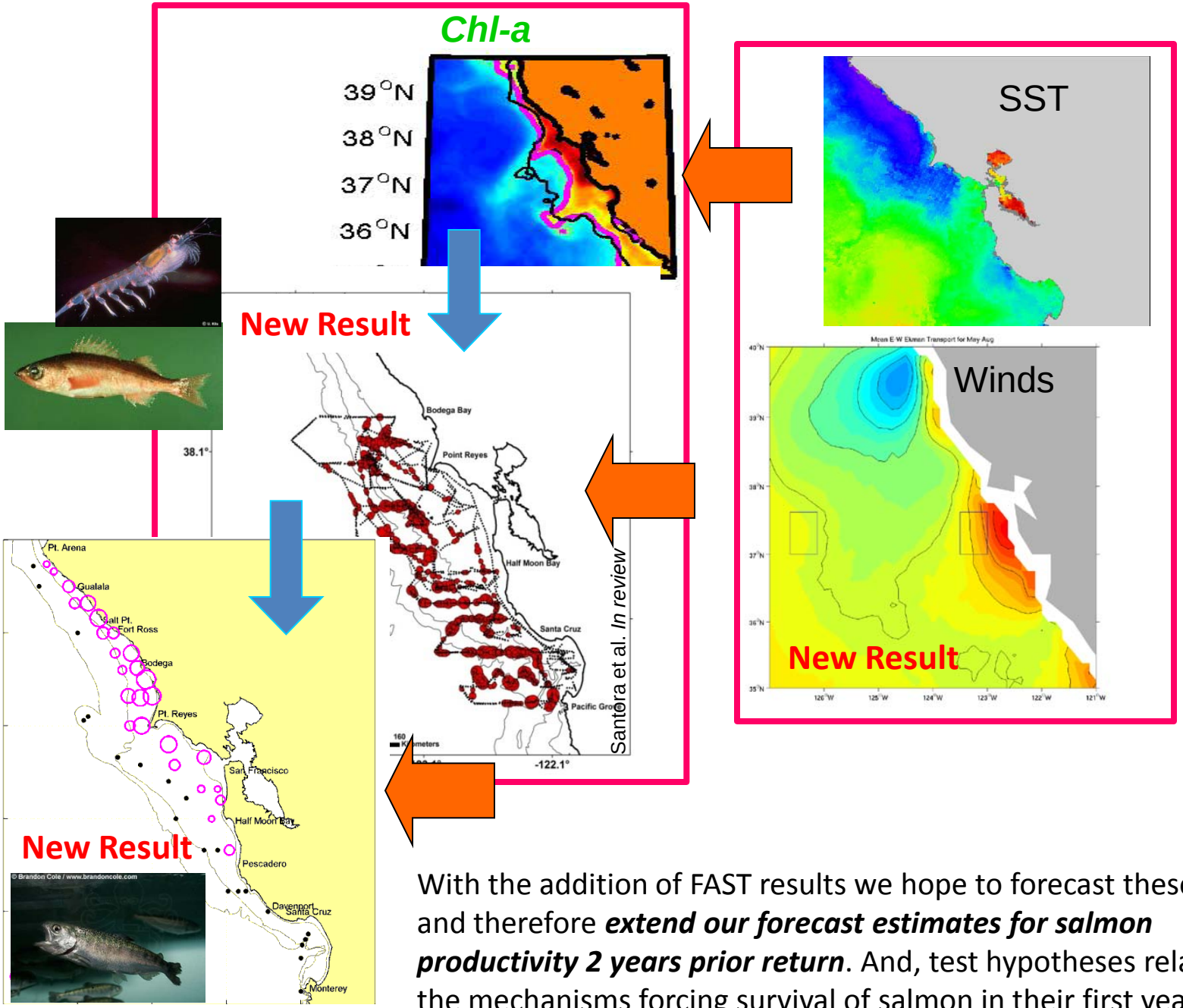

With the addition of FAST results we hope to forecast these habitats and therefore ***extend our forecast estimates for salmon productivity 2 years prior return***. And, test hypotheses related to the mechanisms forcing survival of salmon in their first year at sea.

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Funding:
NASA, Decision Support through Earth Science Research Results

Parameter	Dependencies	Source	Provider	Latency	Availability
Chlorophyll a	$nL_w(l)$	Orbview-2/SeaWiFS Aqua/MODIS ROMS/CoSINE	Geoeye Inc. OSU JPL/Maine	18 hours 3 hours	1997 - now 2002 – now 1975 - now
K_{490}	$nL_w(l)$	Aqua/MODIS	OSU	3 hours	2002 - now
Salinity	Undetermined	Aquarius ROMS	JPL JPL	Unknown	2010[1] 1975-now
Sea Surface Temperature	Good cloud and land masks	Aqua/MODIS Aqua/AMSR-E ROMS	JPL RSS Inc., JPL	12 hours 12 hours	2002 - now 2002 – now 1975 - now
Wind Vectors	Good rain flag	QuikSCAT/Seawinds	JPL	6 hours	1999 - now
PrimaryProductivity	Chlorophyll a SST Insolation	Aqua/MODIS Aqua/MODIS Orbview-2/SeaWiFS	CoastWatch	18 hours	1997 - now
Frontal Probability	SST	Aqua/MODIS GOES/Imager	CoastWatch	18 hours	2001 - now
Sea surface height	Good Navigation	Jason -1 Jason -2 ROMS	FNMOC NOAA JPL	2 days 1 day	2001 - now 2008 – now 1975 - now
Thermocline deviations	SST SSH	Aqua/MODIS,AMSR Jason-1, Jason-2 ROMS	CoastWatch FNMOC JPL	2 days	2001 – now 1975 - now
Eddy Kinetic Energy	SSH	Jason-1, Jason-2 ROMS	CoastWatch JPL	1 day	2002 – now 1975 - now