Spatial and temporal patterns of variability in Scyphomedusae in the central California coastal marine ecosystem

(With a few thaliaceans thrown in for good measure)

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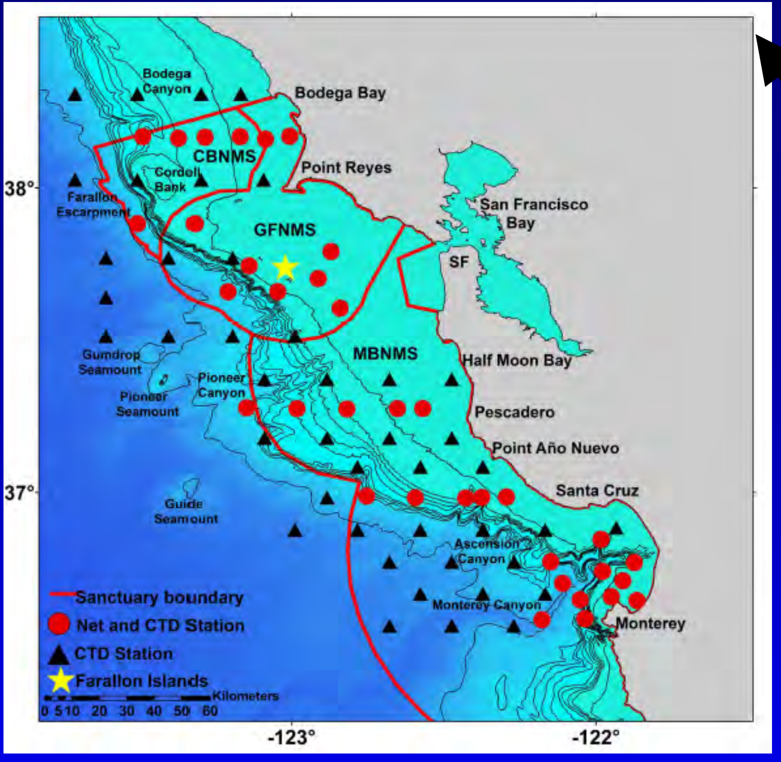
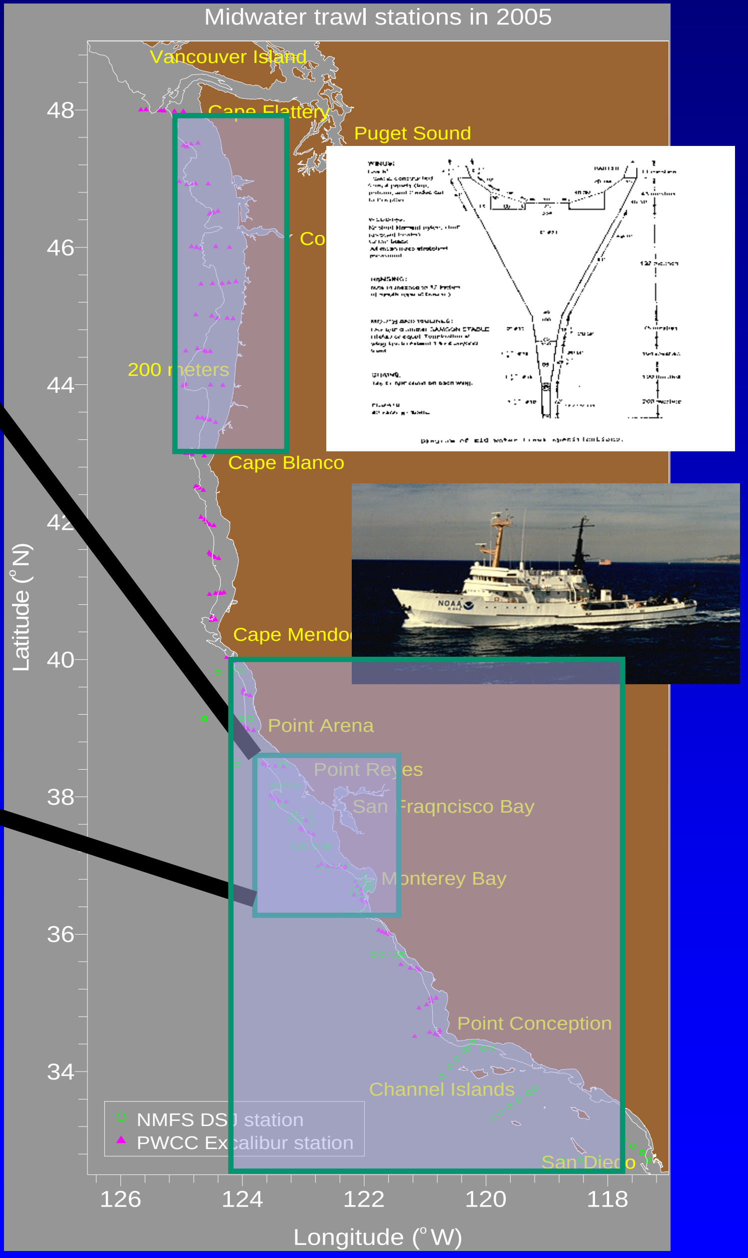
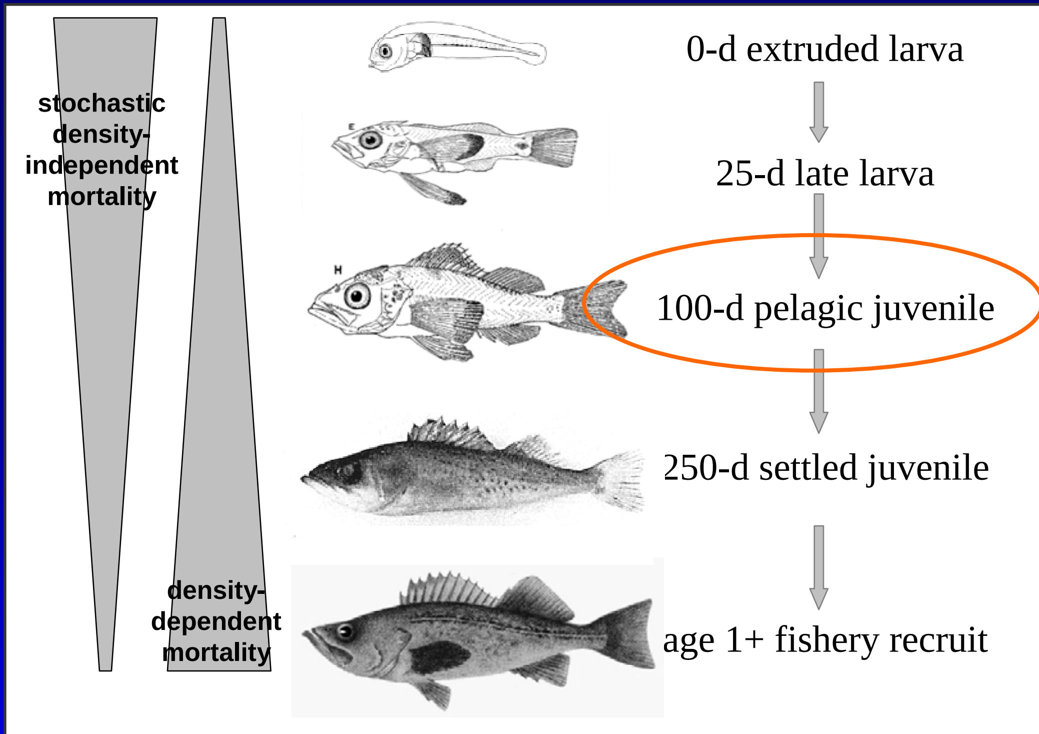
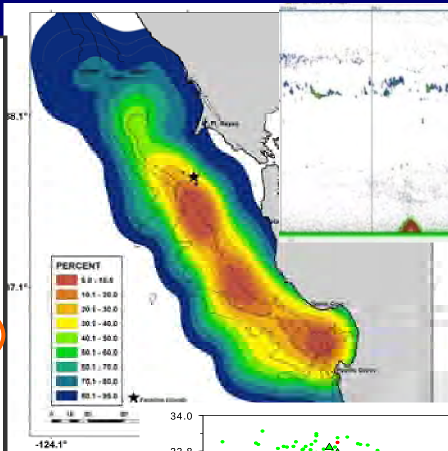
Area Surveyed

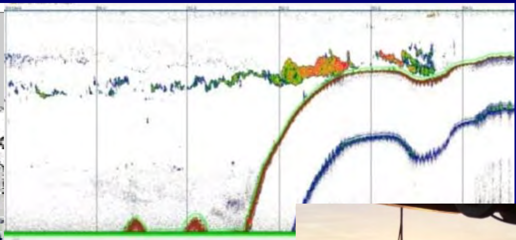


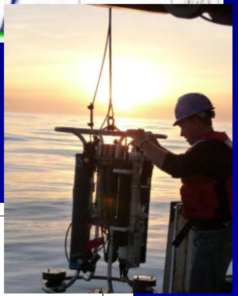


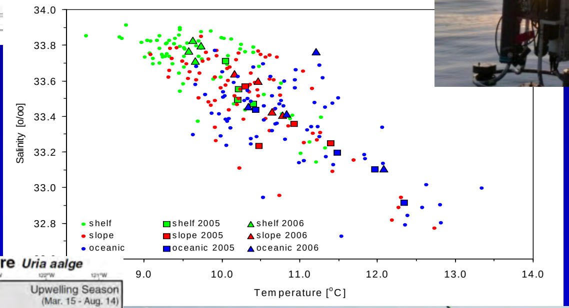
The SWFSC juvenile survey has sampled a "core" area of Central California in May-June since 1983, expanded the survey range in 2004 from the U.S./Mexico border to Cape Mendocino. We use a modified Cobb midwater trawl (much smaller than rope trawls used by salmon and coastal pelagic surveys), and fish only at night (targets avoid net during day).

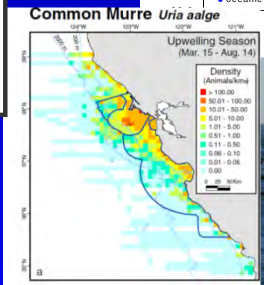


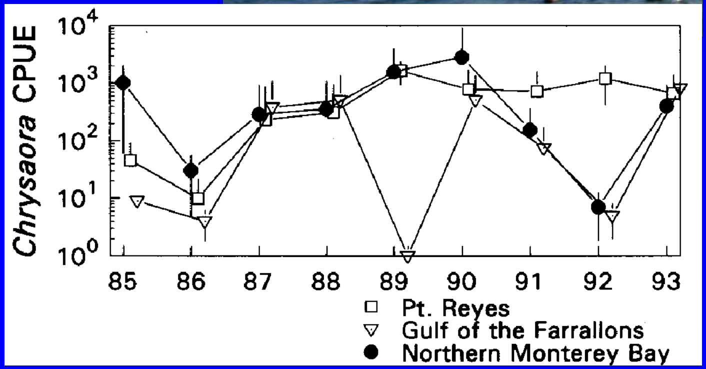










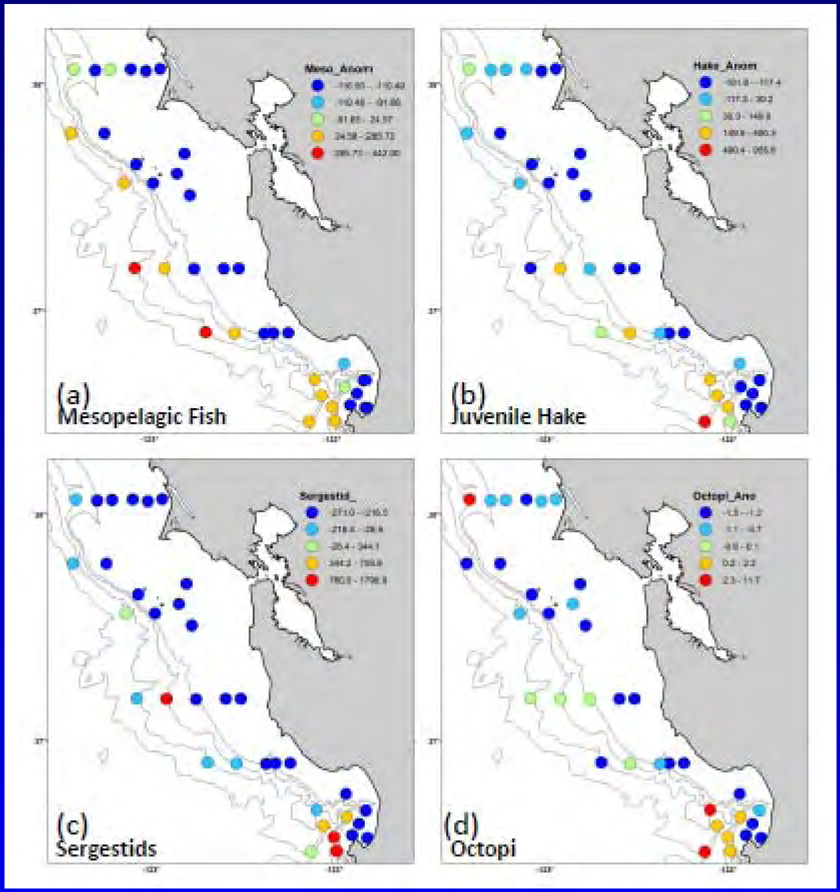


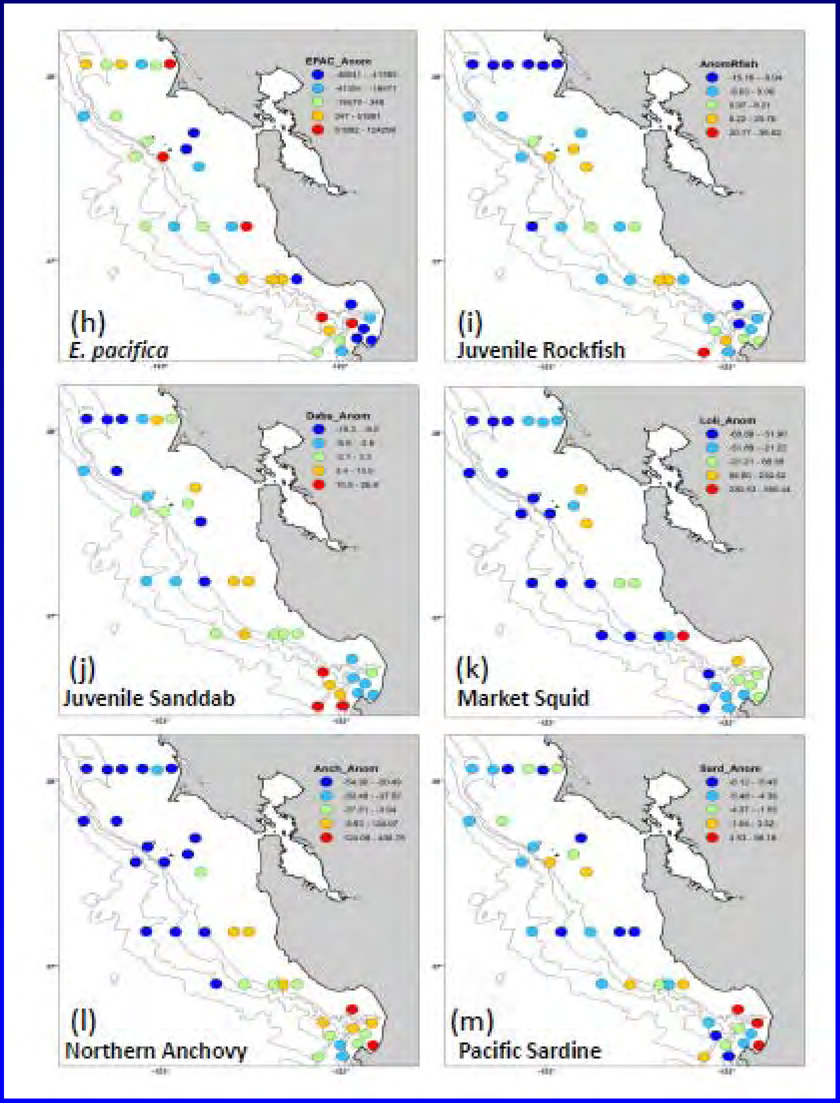
Primary target is pelagic juvenile (age 0) rockfish, which are used as recruitment indices in stock assessments. However, we survey the whole ecosystem, and a broad range of additional physical and biological data are collected. Jellyfish data have not been evaluated since early 1990s (Graham 1994, Lenarz et al. 1995) until now.



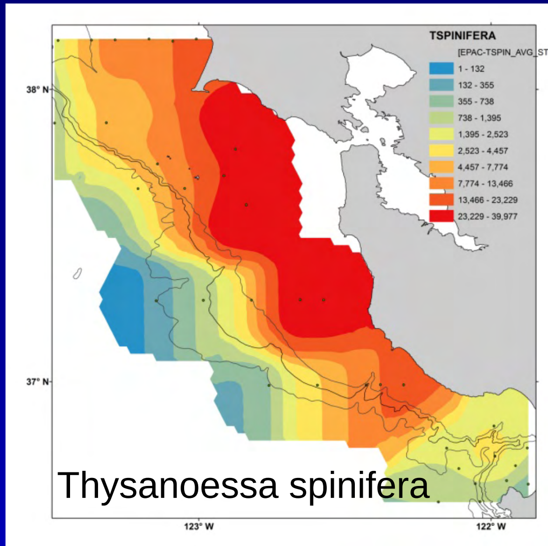


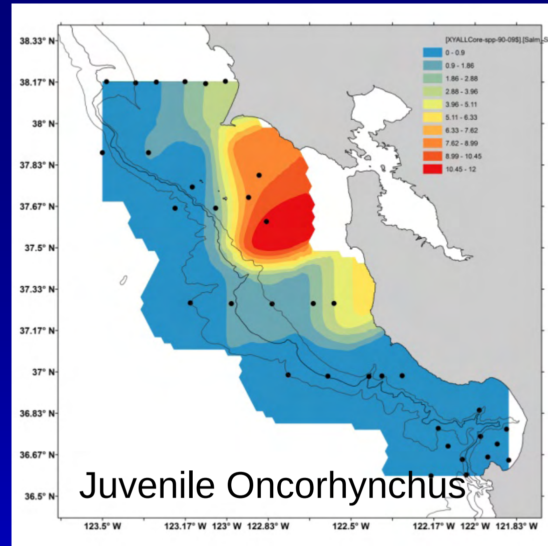
Rockfish and other micronekton are sorted, measured and enumerated

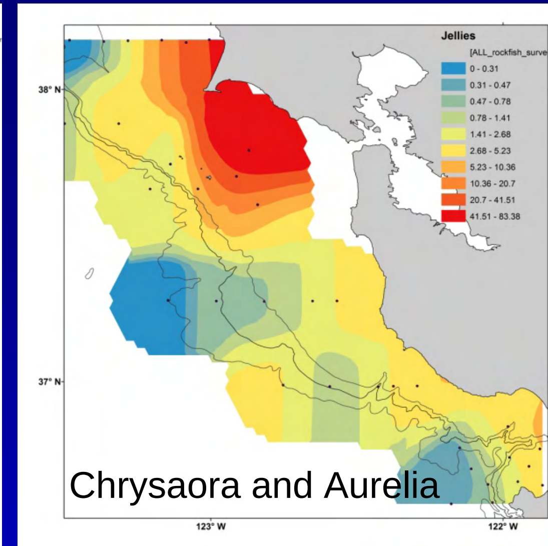


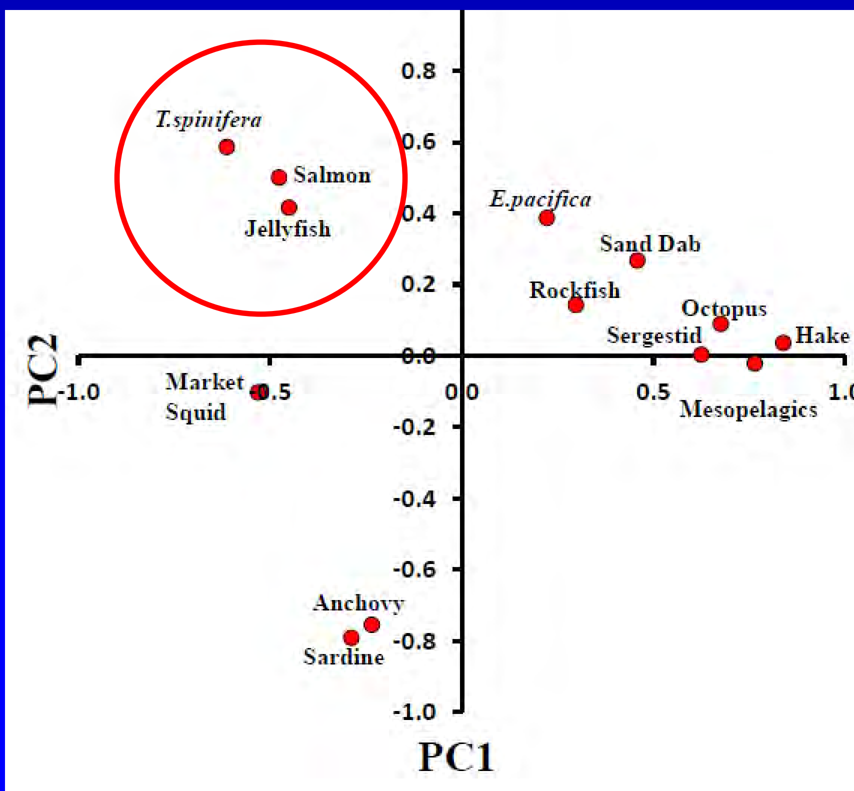


Santora et al. (in press, Prog. Oceanogr, and in Bio Session as we speak!) have characterized the spatial distribution (climatology) of the micronekton assemblage based on long term means by station for the most frequently encountered species or groups



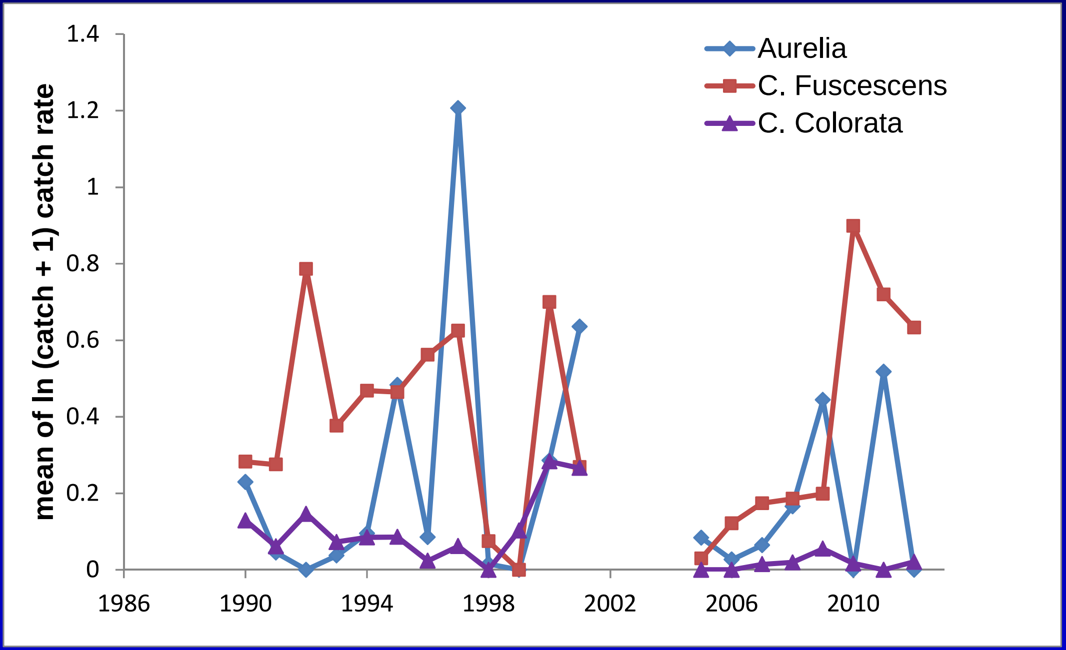


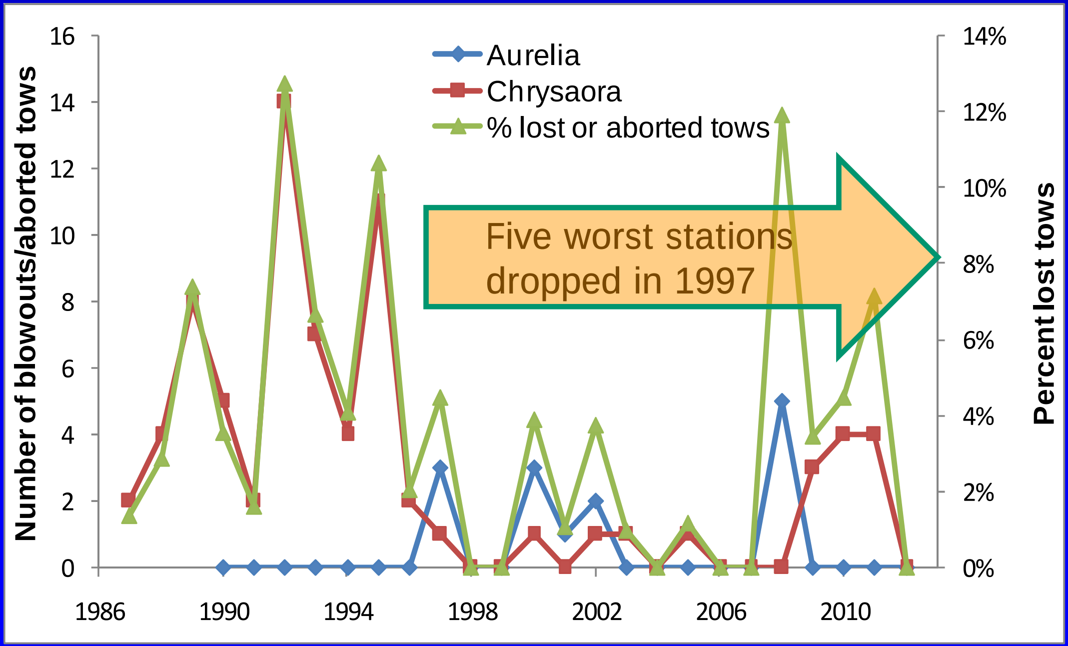




In a principal components analysis of the spatial abundance patterns (climatology), jellyfish loaded strongly (high spatial overlap) with juvenile salmon and the "coastal" krill species *Thysanoessa spinifera*.

The latter has been shown to covary with both seabird productivity (Sydeman et al. 2006) and California central valley chinook salmon production (Wells et al. 2012). Such overlap has been seen in other systems

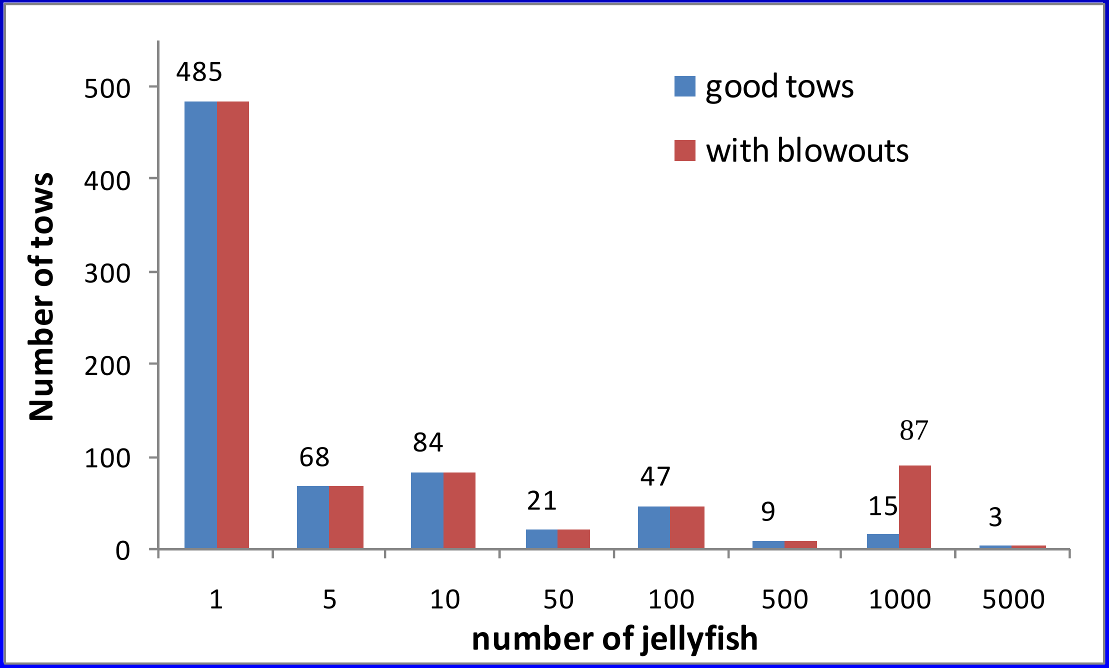




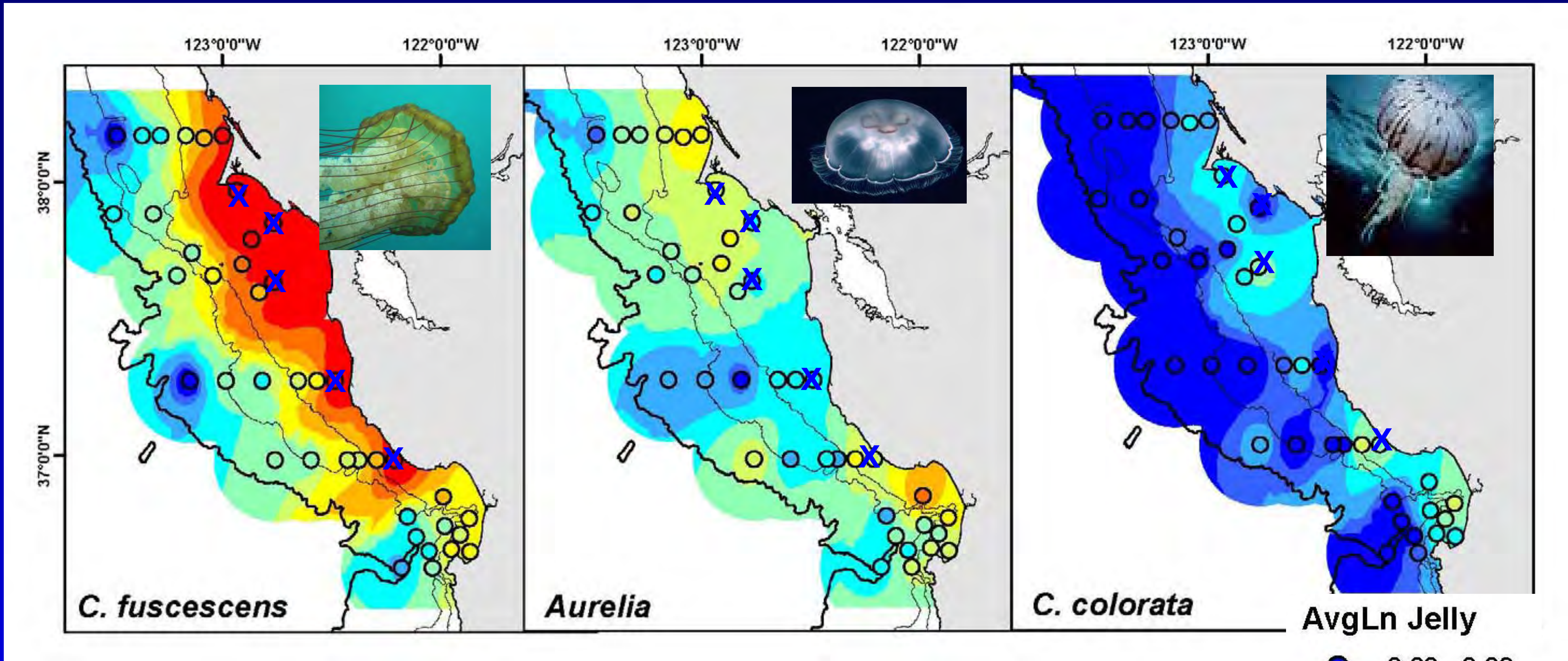
Scyphozoan abundance for three most frequently encountered species (*Chrysaora fuscescens, C. colorata and Aurelia aurita*- latter is likely non-native) was recorded reliably from 1990 through 2001, but dropped in 2002. Records re-started in 2005 but not keypunched and analyzed until very recently.

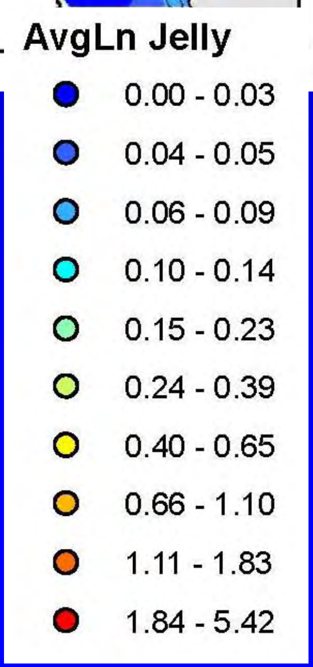
Relatively easy to estimate mean abundance based on our dataset. However, there is a bias due to net blowouts from high jelly abundance ("bad performance" hauls), as well as many instances in which hauls were abandoned due to high jellyfish abundance.

Although "jelly hauls" are not considered useful for most of the target taxon (rockfish, hake, squid), they are certainly important data for enumerating the abundance and distribution of jellyfish.



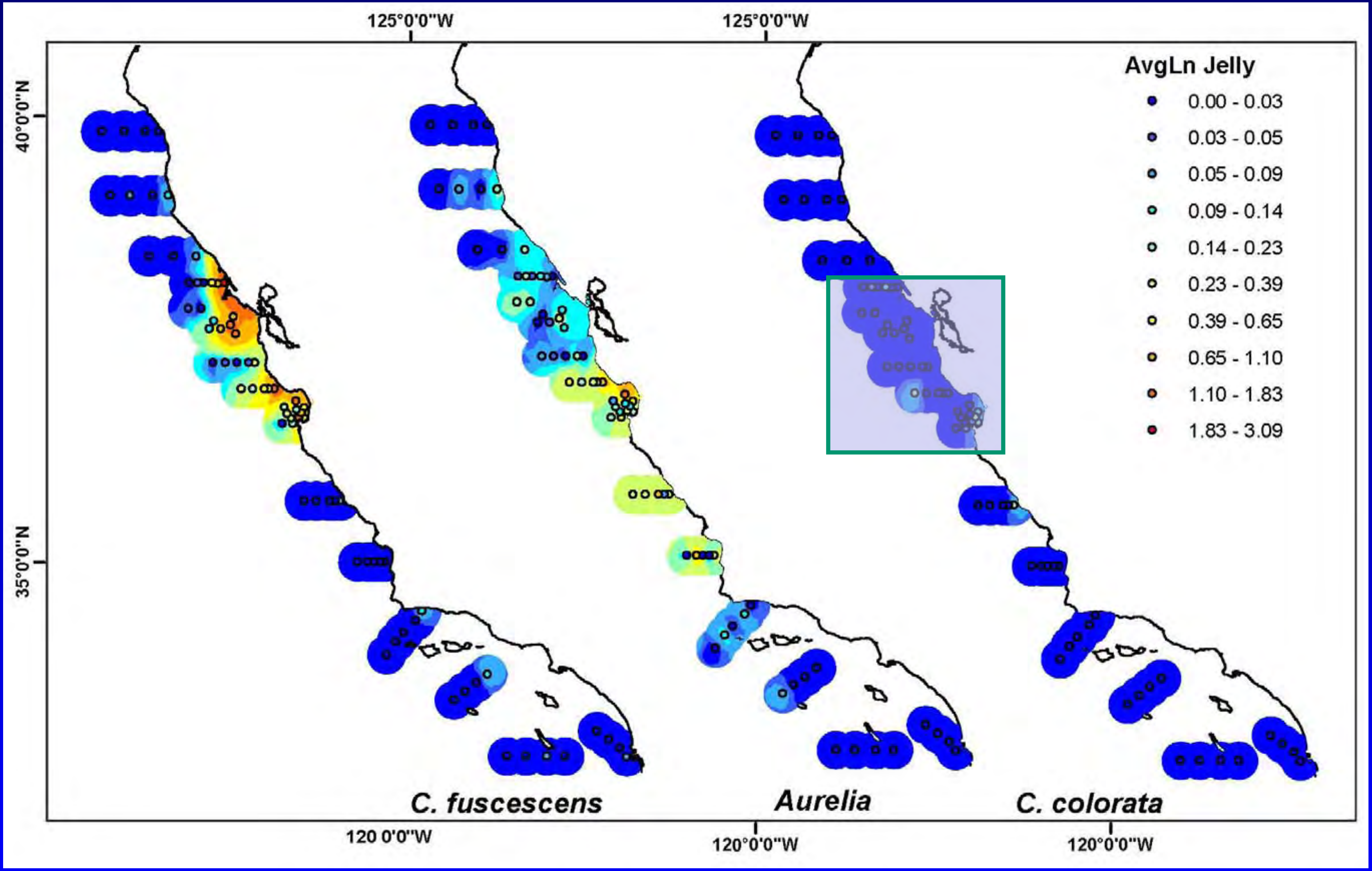
We used a pseudo-Windsorising approach and assigned a catch equal to the mean of the 99th percentile of observed catch (e.g., when the net did not rip and haul could be ennumerated), a value of ~ 4300 individuals (range 1300 to 8000)



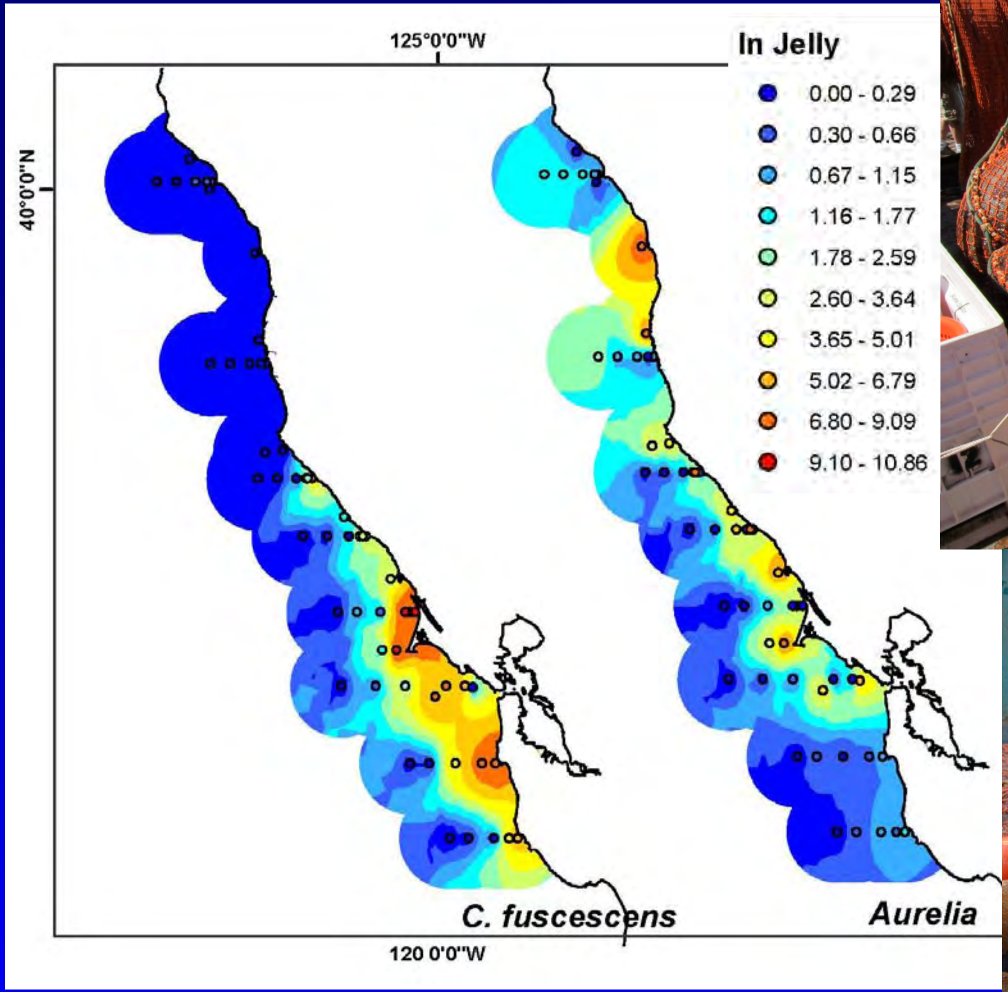


Based on this, we developed better species-specific distribution maps for the core area, including several stations abandoned in 1997 as a result of frequent net blowouts (X's represent dropped stations).

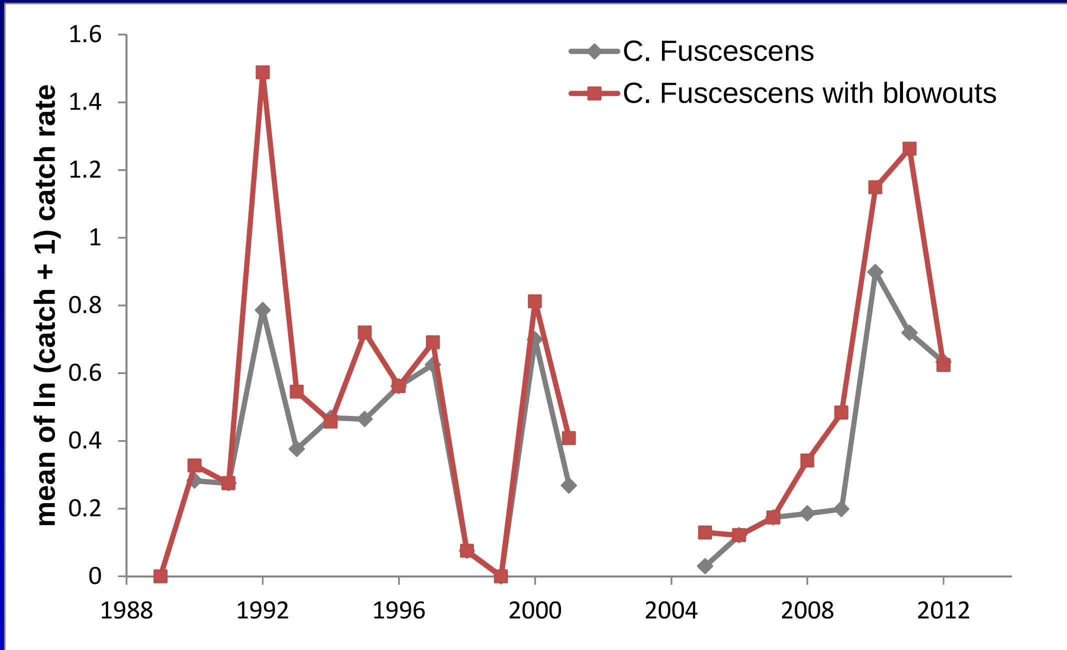
Results are consistent with a very shallow and coastal distribution for *C. fuscescens*, particularly south of major promontories (upwelling shadows, Graham and Largier 1997). *Aurelia* somewhat more widely distributed, *C. colorata* rare.

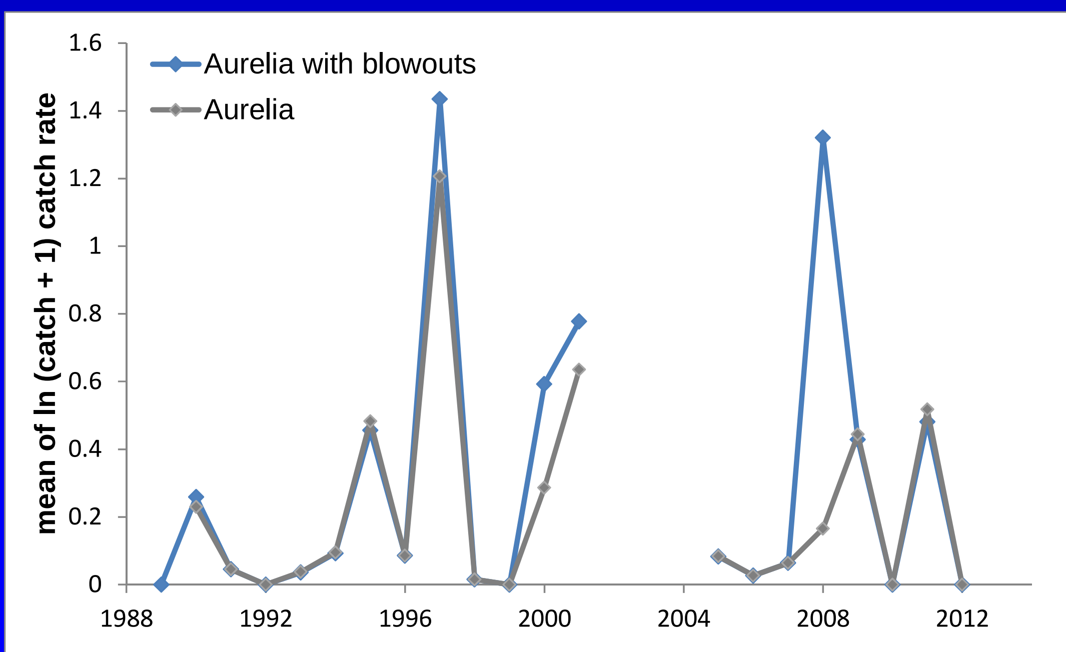


Broader survey range from 2005-present. Interestingly, the core central California sampling region seems to be the region of greatest abundance for all three of these species, although Aurelia is occassionally abundant off of the Big Sur coastline and in northern coastal waters




A different survey, similar result: salmon smolt survey (2005-2012) has larger net, fishes in daytime, generally later in summer. Here too, central CA is the core of the distribution for *C. fuscescens*, with *Aurelia* somewhat more widely distributed (J. Harding/Salmon Ocean Ecology Team data).

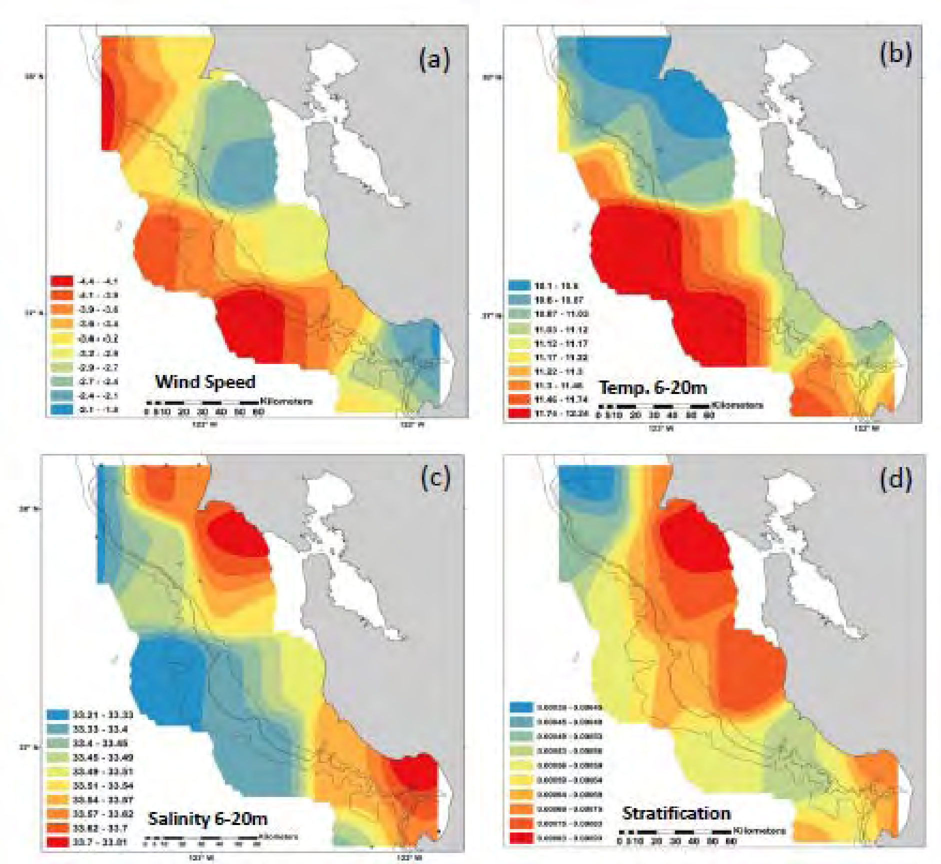


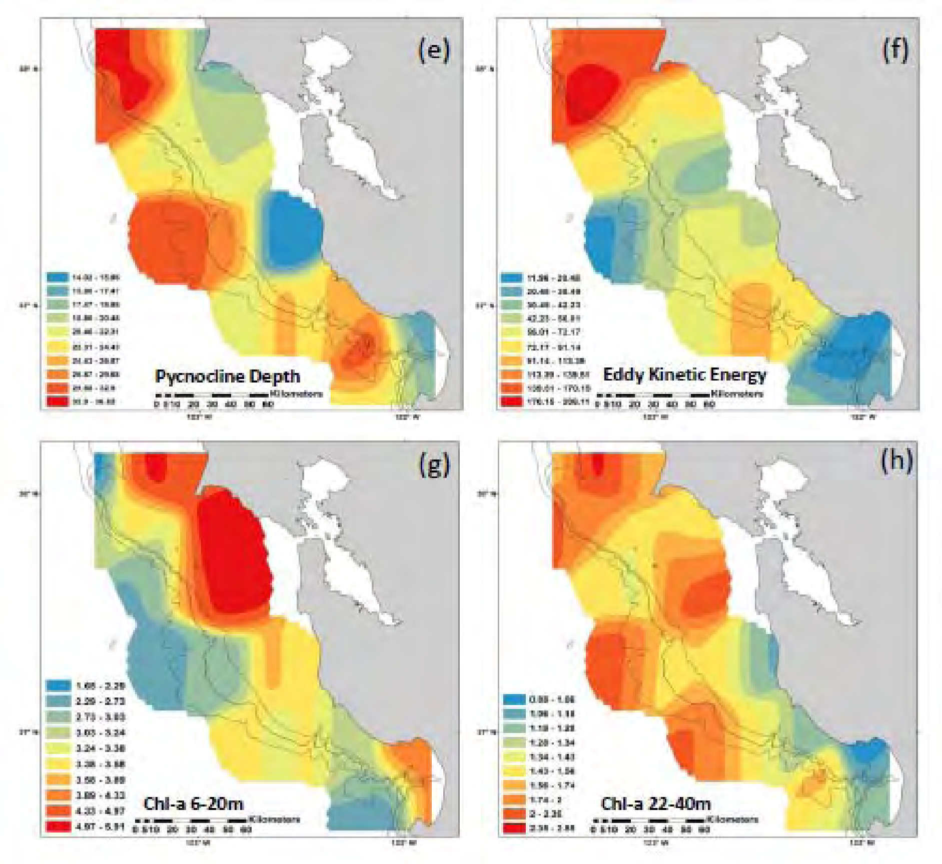


Temporal trends in core area

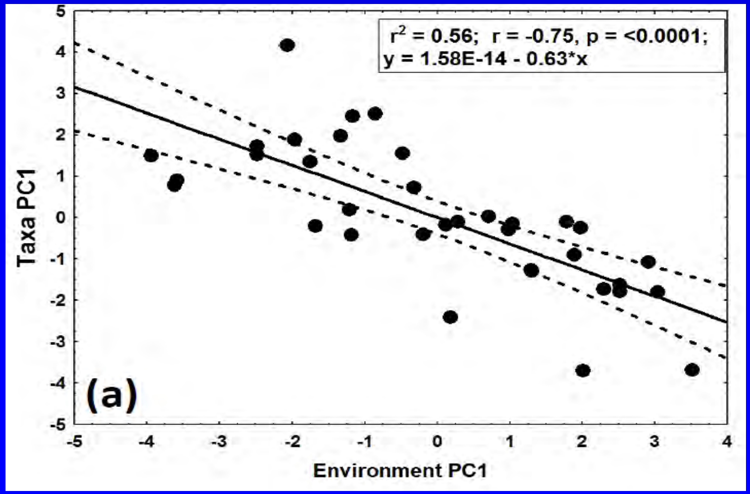
mean (ln(catch+1)) when "blowouts" are included results in a similar pattern, but scales upward from result when only "problem free" hauls are included. Treat this strictly as relative abundance index.

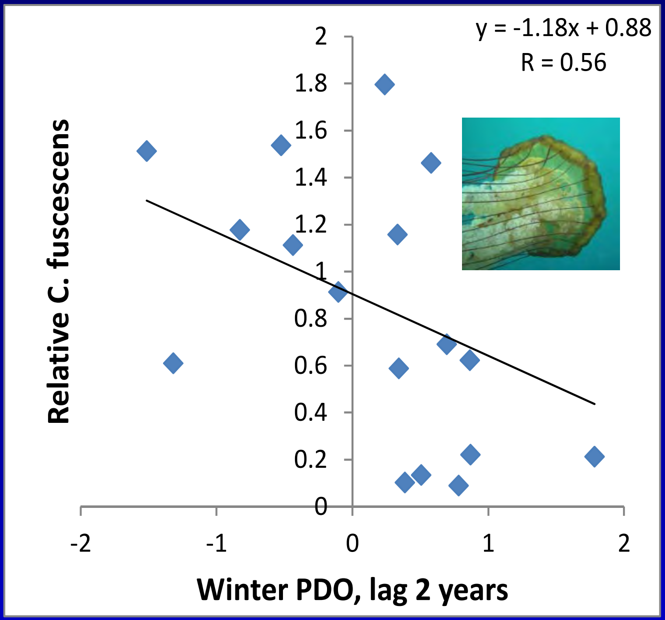
Note that for the temporal analysis, only data from the stations occupied consistently over time were used (e.g., dropped stations were not). We also explored delta-GLM with station effects, negative binomial GLMs, results consistent but models not stable.

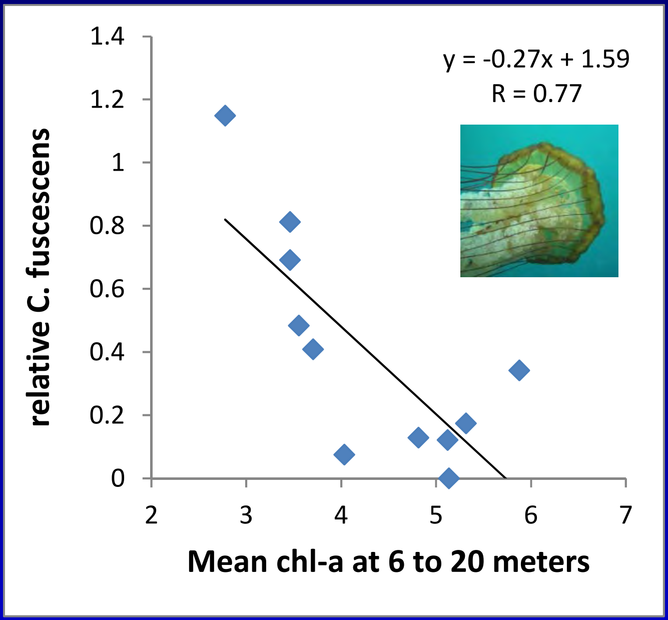




Santora et al also demonstrated covariation between the spatial structure of the micronekton assemblage and dominant physical characterstics in the core survey area. We are in the process of doing the same for temporal trends.



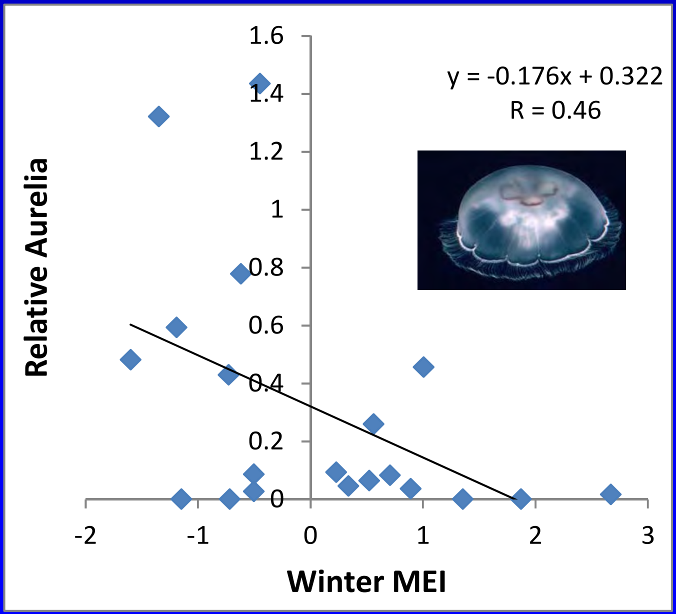


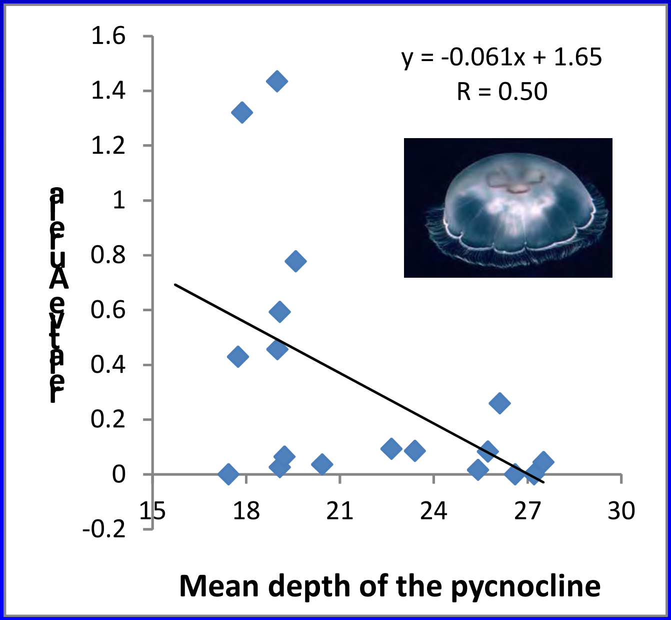


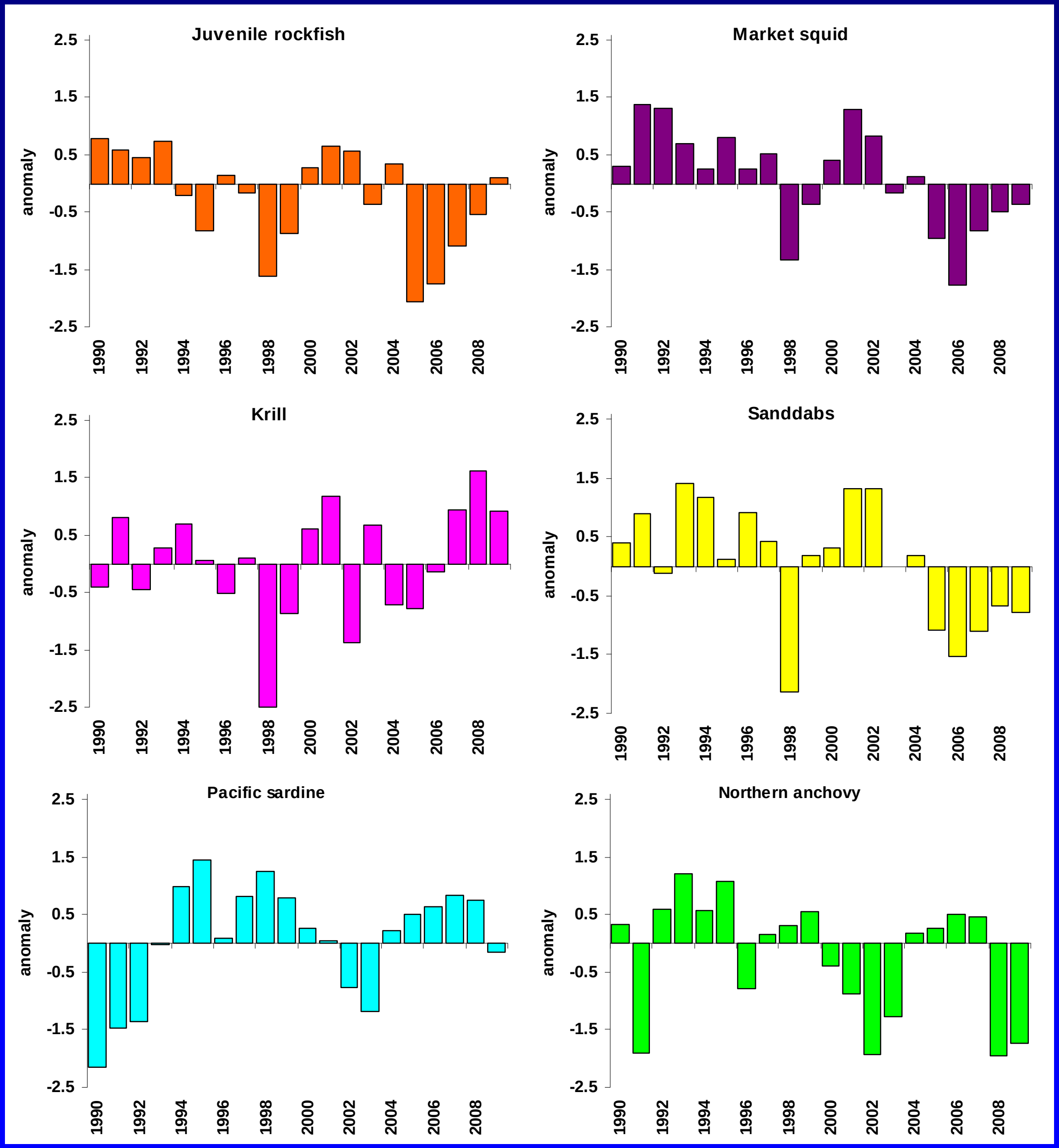
A range of respectable relationships to both basin-scale climate indices and the local physical indices.

Like most elements of the ecosystem, a suite of interacting factors likely drive abundance, but there may be a fair bit of predictability.

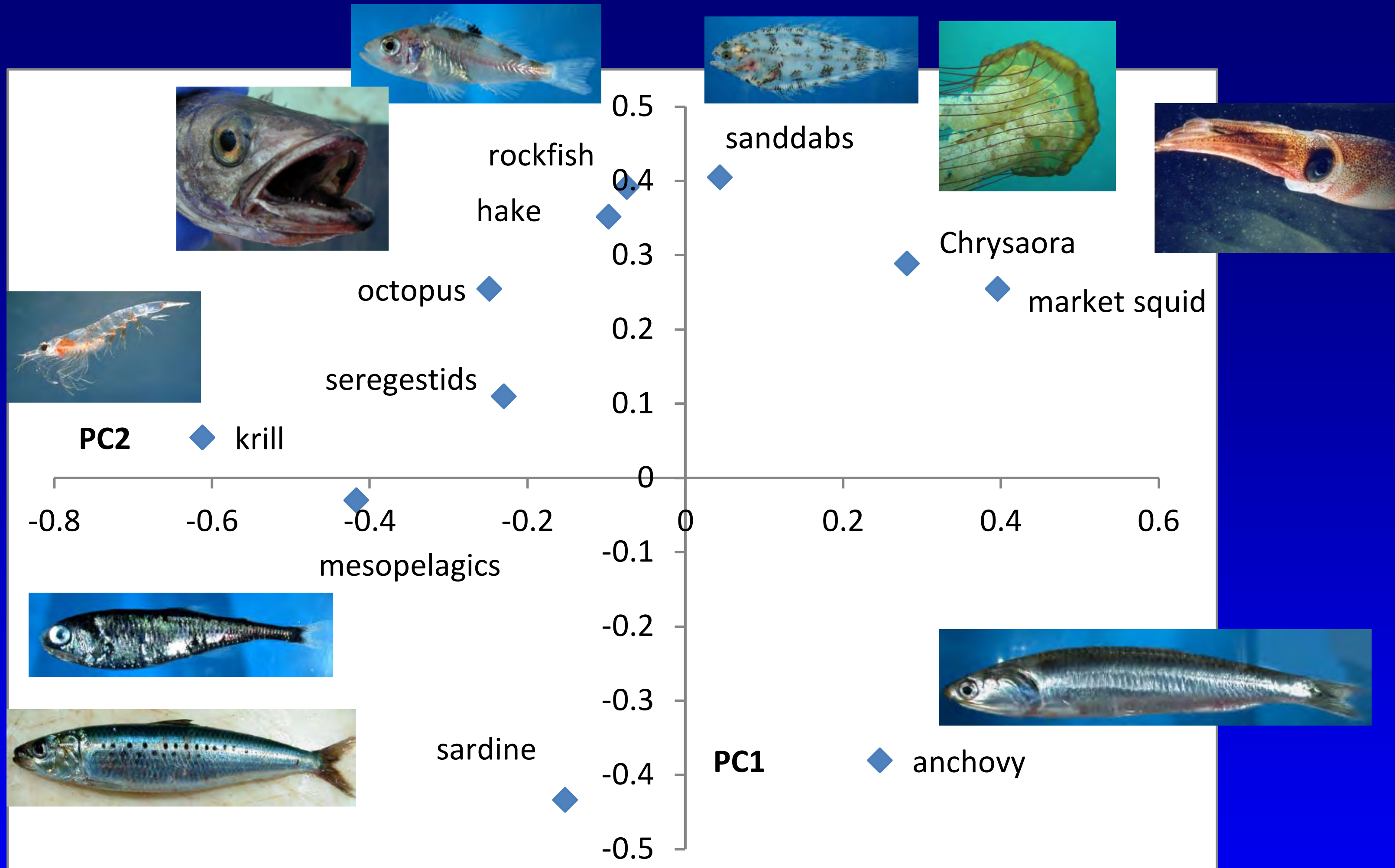
Future work will explore PATH models, SEMs, GAMs, PLS, other methods.







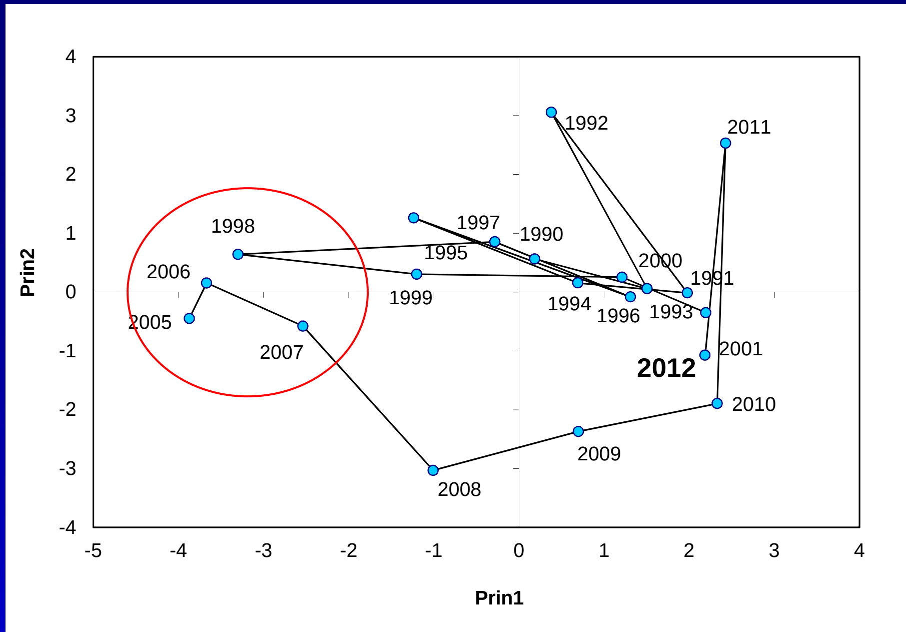
We have done some simple analysis of covariability within pelagic micronekton assemblage. Juvenile groundfish tend to covary in abundance with each other, and positively or negatively with most of the other micronekton that provide the forage base for the Central California ecosystem. Analysis has not historically included gelatinous zooplankton.

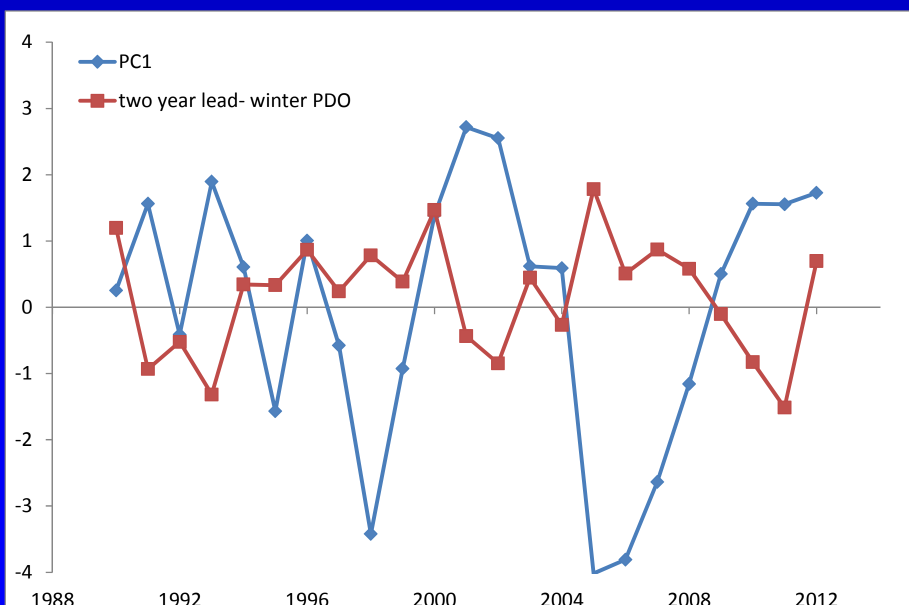


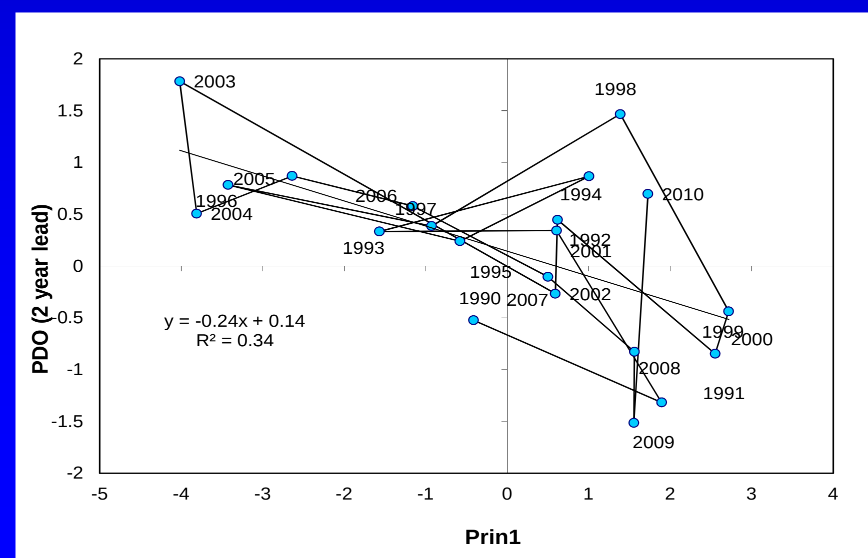
In an analysis of temporal covariability that included *Chrysaora fuscescens,* that species was associated with higher abundance of market squid (Doryteuthis) and YOY groundfish, and low abundance of sardine and anchovies. YOY groundfish and market squid tend to be associated with cool water, high upwelling, high transport conditions. Spatial and temporal associations are very different.

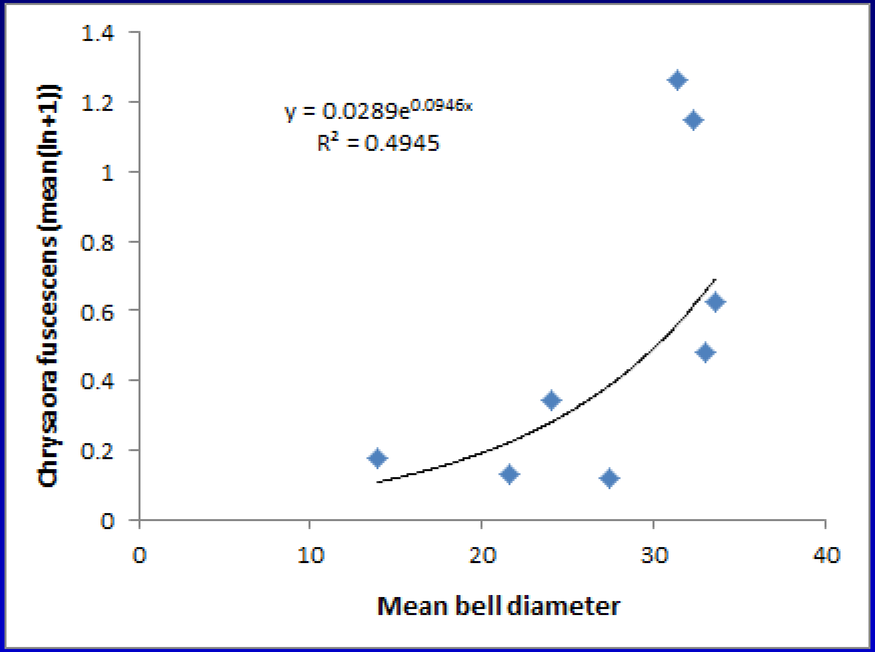
Principal component scores plotted in a phase graph for the forage community in the 1990-2012 period; 1998 and 2005-2007 stand out.

Correlation to basin-wide climate indices (MEI, PDO, NPGO) are strong only when lagged 1 to 2 year previous winter index (better to PDO, NPGO; R2 range ~0.2 to 0.35). Also, some suggestion of increasing variance over time. Index is a function of large-scale (source water) and mesoscale (transport, productivity) indices.

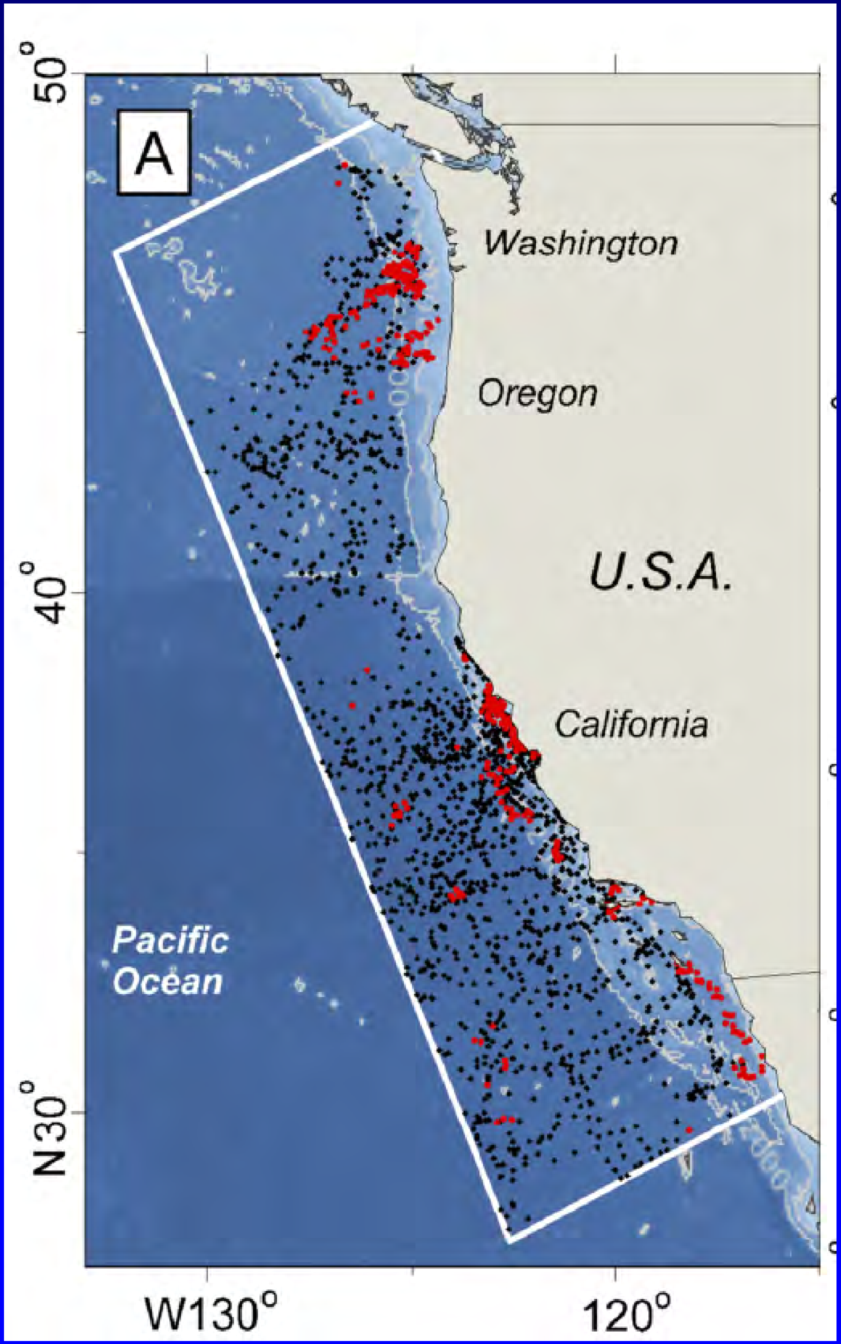




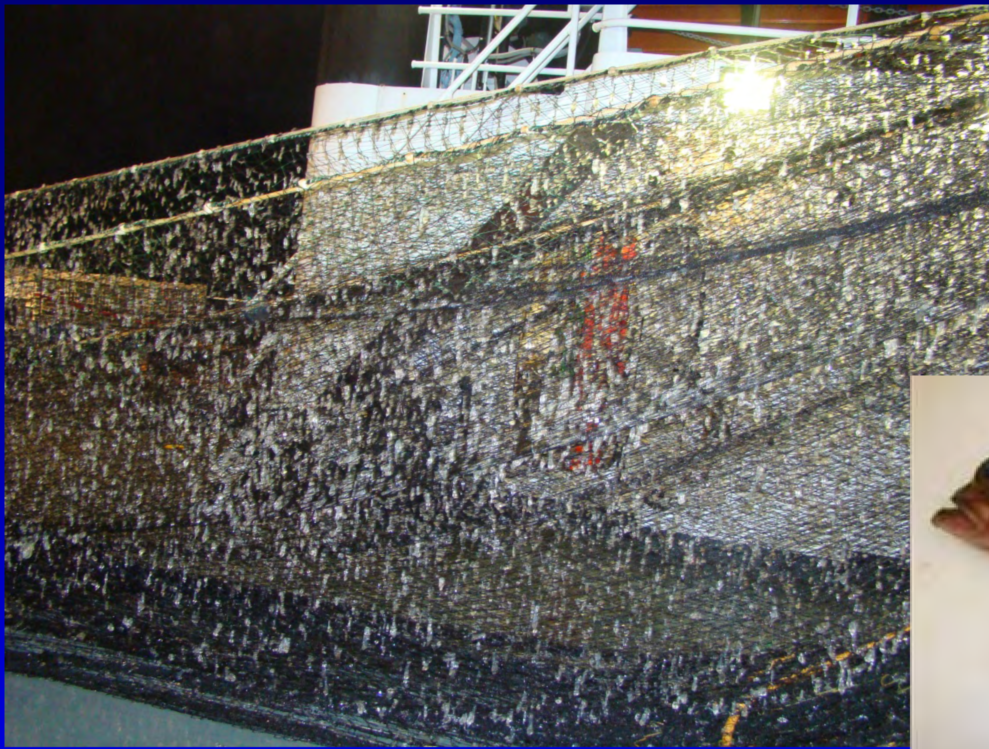




We have measured bell diameters since 2005; no terribly powerful results to report yet, although there does seem to be a nonlinear relationship between bell diameter and abundance (larger in high abundance years). Work in progress.

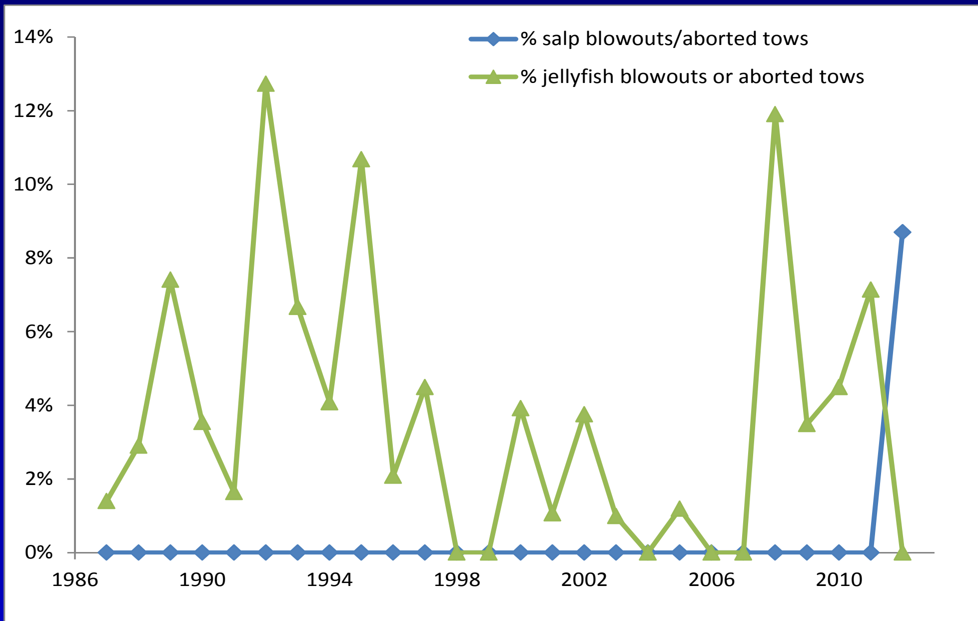


Scyphozoans are critical prey for leatherback sea turtles. Telemetry locations indicate areas of high habitat utilization (red is associated with area restricted search, ARS, behavior- indicating foraging, from Benson et al. 2011). Turtles eat a lot, 1000 tons per individual lifetime, perhaps 2 million tons/year throughout Pacific (Jones et al. in press). Central CA through OR are critical habitat for these species, major fisheries management issue.



Obviously, jellyfish are not the only gelatinous zooplankter out there

2012 was a low year for scyphozoans, but a huge year for thalacians, doliolids and heteropods, and was associated with huge difficulties for our survey (and for others)!



Diablo Canyon nuclear plant in California knocked offline by jellyfish-like creature called salp

By James Eng, NBC News

In Japan, it was a monstrous earthquake and tsunami that brought down the Fukushima nuclear plant. In California, it's a tiny, jellyfish-like sea creature called salp that's causing problems at the Diablo Canyon atomic plant.

An invasion of salp has prompted Pacific Gas and Electric Co. to temporarily shut down a nuclear reactor at Diablo Canyon, in Avila Beach, San Luisa Obispo County, on the central California coast.

A giant swarm of the transluscent barrel-shaped organisms this week clogged intake screens that are used to keep marine life out of the seawater that is used as a coolant for the nuclear plant.

On Wednesday, PG&E officials reduced power

Diablo Canyon Power Plant / AP

This photo provided by the Diablo Canyon Power Plant

Ocean Overrun With Gentle Gelatinous Salps

Post on Jul 03, 2012 by Danna Staaf from QUEST Northern California

Topics: Biology, Blog

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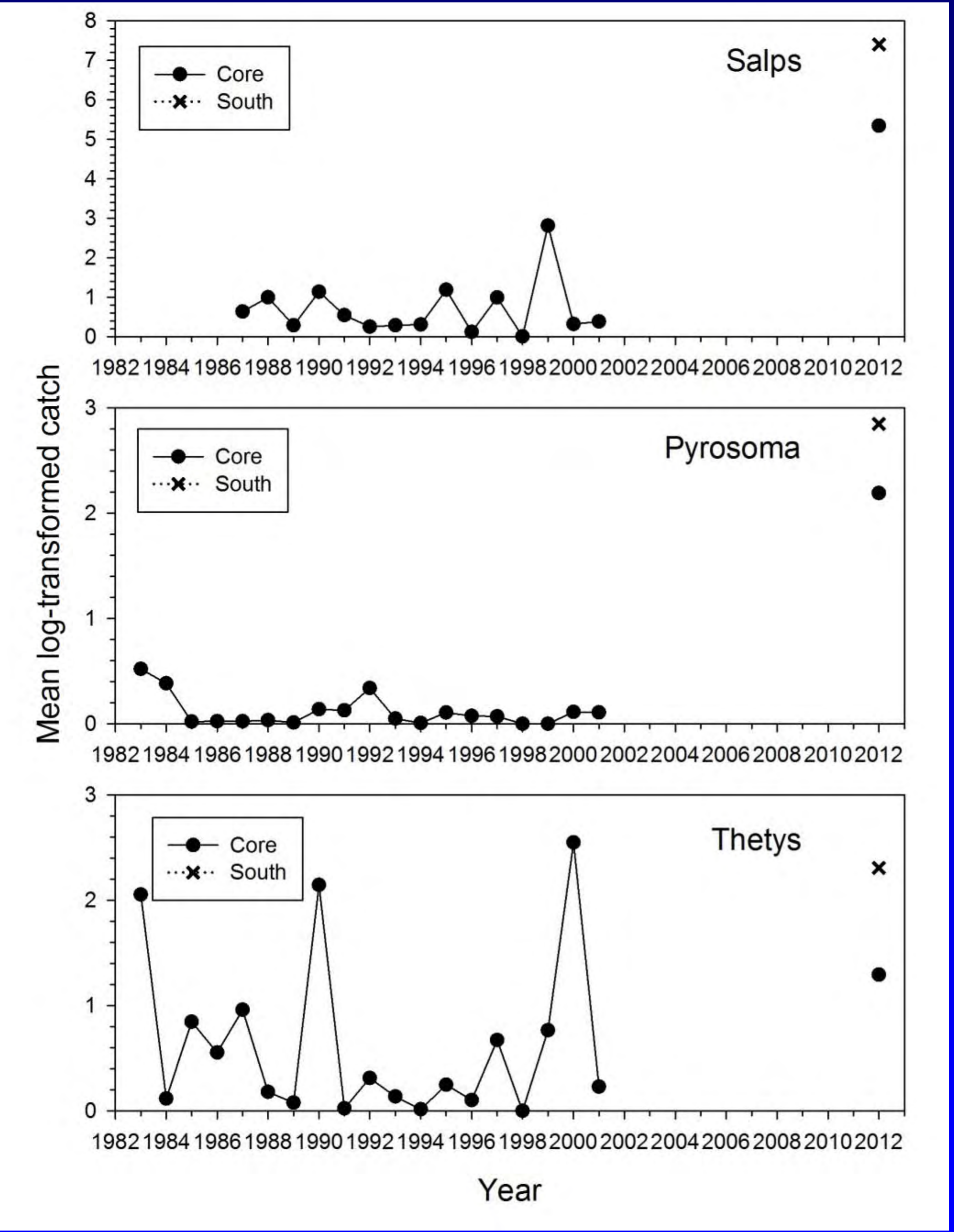
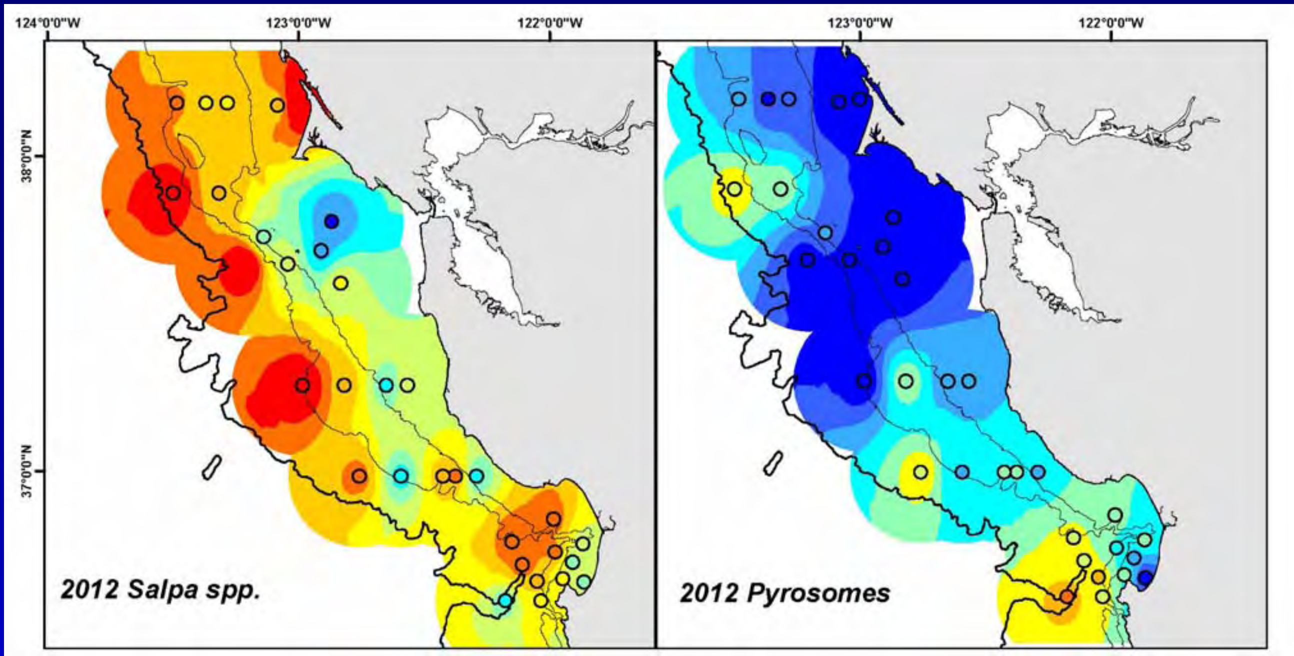
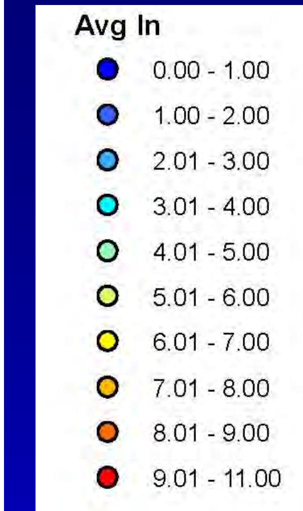
Similar to Scyphozoans, salps and pyrosomes were enumerated from the early years of the survey through 2001, but not from 2002 onward- until the anomalous event in 2012. We had never had a lost or aborted tow as a consequence of high salp abundance until 2012. In 2012 blew out two nets, twisted bridles to the point of loss, and aborted 7 hauls.

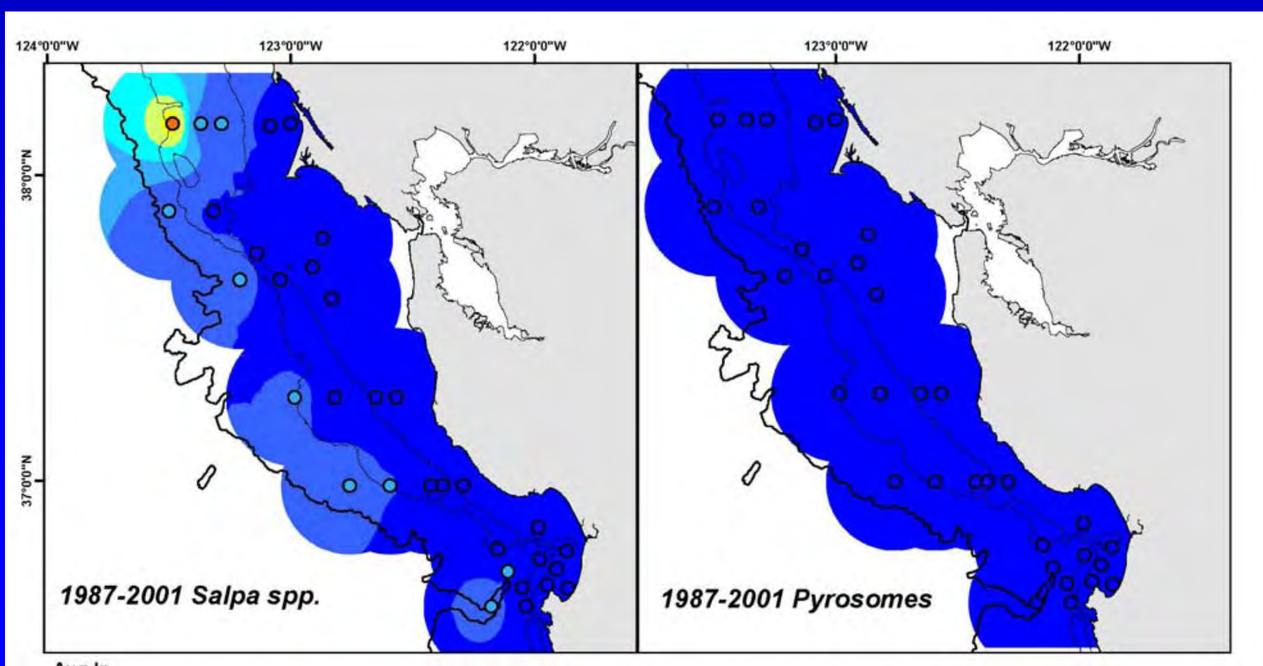


Similar to Scyphozoans, thalacians and pyrosomes were enumerated in the early years of the survey through 2001, but not from 2002 onward. We started again when we recognized the anomalous event early in 2012 (number preliminary and do not account for blowout tows).

Very high abundance of *Salpa fusiformes* was also noted in the Gulf of Alaska during 2011 (R. Hopcroft, UAF)







Very high abundance of Salpa fusiformes was also noted in the Gulf of Alaska during 2011

Conclusions

•Likely little here that is terribly new to Scyphozoan workers; characterization of spatial abundance patterns is consistent with those described previously. The Gulf of the Farallons and Monterey Bay seems to be significant hotspots for SCC which may have important implications for managing risk to sea turtles

•Spatial overlap with juvenile salmon and *Thysanoessa spinifera* is consistent with similar observations elsewhere (Cieciel et al. 2009, Brodeur et al.). Interesting that temporal overlap is greatest with cool water, high productivity species. No indication of increasing trends over time (but time series relatively short)

•There are certainly climate drivers that relate well to abundance, no silver bullet index, will take a GLM, PLS, PATH or other approach

•Future directions include food habits work to evaluate predation on krill, trophic overlap and other possible interactions with salmon