ITS proposal 2015 – *research activities*

Scientific analysis	Long-term goals	Near-term science objectives (2015)
Data synthesis	Identify key parameters and condense the time series information	(1) Separately synthesize surface, midwater and benthic time series into a manageable number of representative data sets
Synchronous variability	Identify cause/effect relationships between the time series	(2) Compare the time series from (1) with each other and with climate indices to identify similar variability at the seasonal and interannual scale
Prediction	Predict key parameters in the future, a few years ahead and under climate change	(3) Identify lagged-relationships based on (2) and identify species for which those are robust enough to enable prediction
State of the ecosystem	Define and share proxies related to ecosystem health	(4) Investigate calculations of biodiversity indices
Outside datasets	Enlarge the above studies to the California Current	*- none for 2015 -*
Carbon budget	Quantify carbon fluxes from surface to bottom and harvest	(5) Start combining midwater animal counts with biomass and respiration numbers

working on it
next steps
not going to happen this year?

Past/current work

(1) Separately synthesize surface, midwater and benthic time series into a manageable number of representative data sets
(4) Investigate calculations of biodiversity indices

Objective (1): *Monitoring a biodiverse ecosystem results in tracking a large number of species and variables. This is especially striking in the midwater time series, which consist of several hundred species monitored over 50 to 1000 m depth. Statistical techniques to reduce the time series to a manageable number of representative data sets will be investigated, such as clustering or Empirical Orthogonal Functions (EOFs).*

Objective (4): *A number of biodiversity indices have been published; they will be applied to the integrated time series to evaluate changes over time, in relation to environmental parameters.*

focus on biology

Work to date:

- data harmonization & preprocessing for BOG / MidW
- investigation of biodiversity indices and PCA for MidW

Future work:

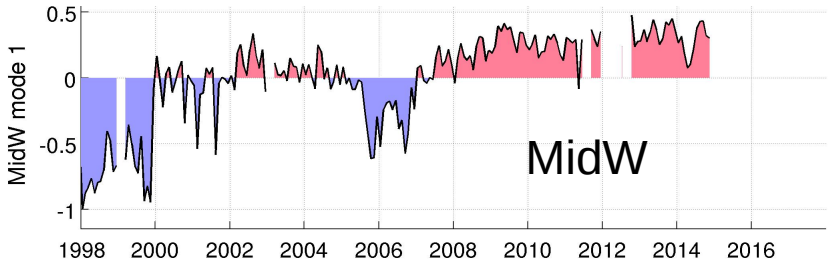
- investigate benthic time series – 10 species
- apply same methods (PCA / biodiversity) to BOG/benthic
- investigate & buy matlab clustering toolbox *– see how animals/plankton cluster and choose key species*
- add physical datasets (ROV temp/O2, benthic?)
- **choose a set of representative indices for each** (PCA, key species, biodiversity)

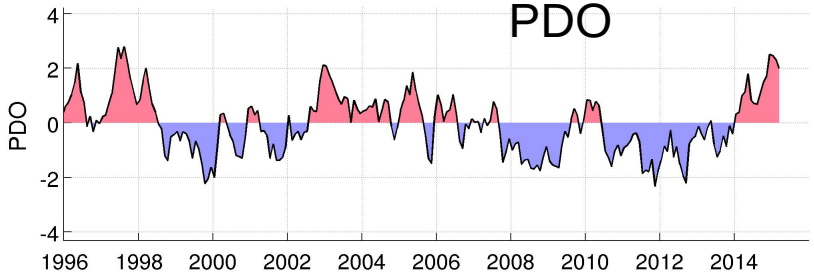
Next steps

(2) Compare the time series from (1) with each other and with climate indices to identify similar variability at the seasonal and interannual scale
(3) Identify lagged-relationships based on (2) and identify species for which those are robust enough to enable prediction

<u>Objective (2):</u> The reduced number of key species/parameters obtained from Objective (1) can then be compared with each other and with environmental forcing at the seasonal and interannual scales to identify climate-driven variability across trophic levels. Techniques could be as simple as lagged correlations or more complex since relationships are likely to be non-linear. In addition to ocean physical parameters measured as part of the time series, environmental forcing could be assessed from satellite data and climate indices such as the Pacific Decadal Oscillation (PDO).

<u>Objective (3):</u> Studies conducted within Objective (2) are likely to identify lagged relationships between trophic levels, as a change in the environment propagates up the food chain (bottom-up control) or a change in predation may have a delayed impact on lower trophic levels (top-down control). Those relationships, when robust, can be used to predict the abundance of certain species. The method can be tested by comparing predicted vs. real time series in hindcast.



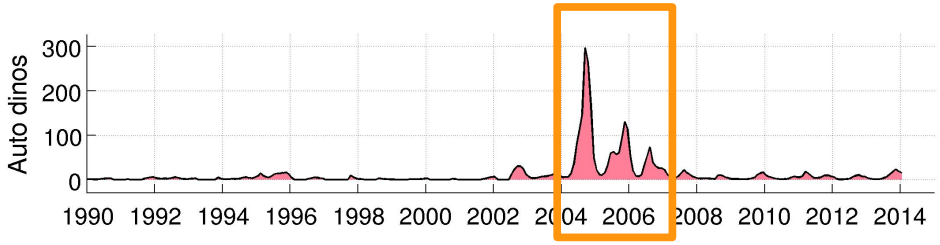


1- Compare time series with each other (next slide)
2- Compare time series with climate indices.

e.g. possible lagged 2-year relationship between MidW and PDO.
Or regime shift in late 90s visible in phytoplankton.

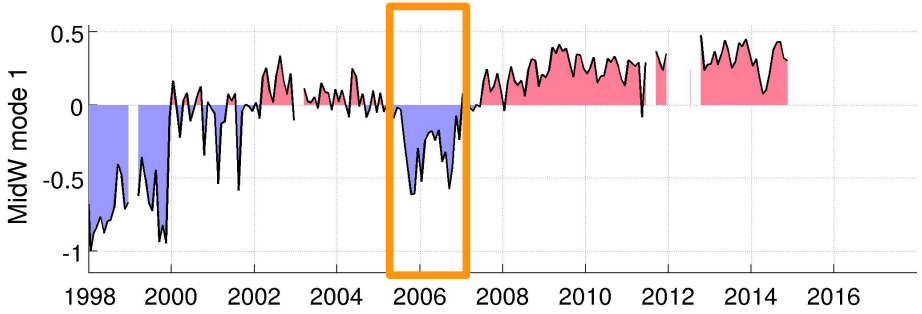
Inter-time series

Surface – autotrophic dinos



2006-2006

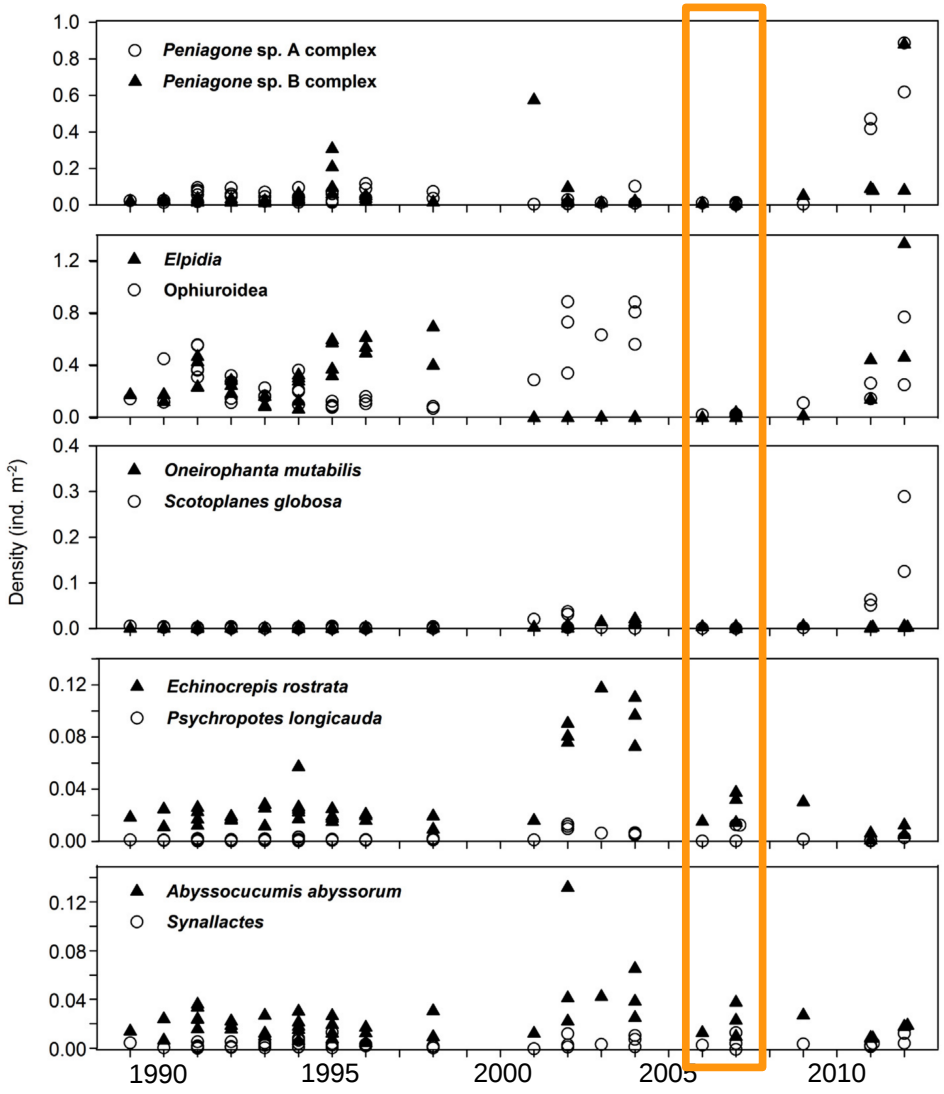
Midwater - PCA1



2005-2006

Benthic – 10 species

2006-2007



Kuhnz et al., 2014

Next year?

(5) Start combining midwater animal counts with biomass and respiration numbers

<u>Objective (5):</u> As part of the Midwater Ecology project (901220), carbon biomass and respiration rates are being measured for dominant species. While precise temporal assessments are not currently possible due to lack of information regarding animal size, those values can be combined with animal counts (averages or at the seasonal cycle) to start working towards a carbon budget.

Future years

(2) Scientific data integration: Based on the input of the group meetings, iteratively develop data synthesis and analysis to effectively elucidate understanding of the combined data-set as well as prototype analysis and visualization techniques to be developed in the data management effort. More specifically, scientific analyses that can be tackled during the 5-year project are:

2015
- **Synthesize** the information contained in the three time series, in order to identify key variables and reduce the number of parameters being compared to each other to a manageable number

2015
- Identify **synchronous and lagged patterns of variability** in the environment and across trophic levels, at the seasonal and interannual scales


- Develop **predictive capabilities** by identifying lags (e.g. animals responding to climate variability with some time delay) and processes (e.g. features observed in situations likely to become more common with climate change, such as strong upwelling or low oxygen)


- Develop **proxies related to the state of the ecosystem**, and in particular to biodiversity, productivity and ecosystem health. Study how those crucial parameters have been evolving with time and how they might be influenced by the environment or anthropogenic stressors.

later? (MBON)
- Compare the MBARI time series to **external datasets**, either in Monterey Bay (related to parameters not currently measured such as zooplankton or top predators) or in the California Current (e.g. CalCOFI)


- Work toward a **carbon budget** by quantifying carbon fluxes from the surface to the ocean floor and to harvested species (where possible), looking at pathways such as grazing, respiration and carbon export.

ITS proposal 2015 “Proposed work”