Case Study: **Uncertainty in quantification of weather, climate and biological influences on ocean productivity.**

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Topic:

***Can Genomic assays among plankton at the base of marine food chains compliment assessments of ‘productivity pulses’ of the ocean?***

Background:

Understanding how physical and biological components of the ocean and atmosphere interact and sum to various states of marine productivity remains a question that continues to challenge predictions for managers and other stakeholders associated with marine related economies. Research on the relationship between plankton community composition and the strength of salmon and other fishery indexes has provided promising associations (Peterson et al. 2014). We propose here to research an alternative approach that addresses an assessment of the actual physiological state of copepods through RNA-seq transcriptome profiling as a first step to determine how physical and biological forces orchestrate at the base of marine food webs. Copepods are more abundant than any other multicellular animal group (Ning et al. 2013), they thus from a key species at the base of marine food webs and comprise a pivotal food base for upper trophic levels. Information on gene expression response within plankton themselves interfaced with inference on concordant weather conditions such as short term up- or down-welling within the context of longer-term regional climatic indicators such as the PDO and ENSO, may provide indexes more tightly representative of alternate phases of ocean productivity. Success of this approach will be tested as a tool to inform and predict how changing environmental conditions affect biological components of ecosystems including economic considerations such as year-class fishery impacts. NOAA (OAR & NMFS) has an overarching interest in new scientific based approaches to integrate earth system processes and predictions (NOAA Strategic Research Guidance Memorandum August 2015).

In this case study we seek a group of students who work together to analyze incidence of successful and mismatch associations of large oceanographic, regional climate, copepod species composition and fisheries index data, combined with experimental applications of genomics and gene expression data from copepods to propose complementary approaches that improve performance of fishery index forecasts. Using advanced computing and programming skills; students will develop and test new fishery index calculation methods. By quantifying uncertainty inherent in performance, and relating this to individual components of the index derivation (oceanography, weather and climate variable, plankton gene expression), students will also assess the effectiveness and data needs for including species- or stock-environment considerations in management strategies.

Existing Data:

* 20 years of data from the Newport Hydrographic line and associated fishery index data

<http://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oeip/index.cfm>

<http://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oeip/g-forecast.cfm#TableSF-02>

* Current OOI information (temperature, chl, pH, etc.)

<http://oceanobservatories.org/>

* Historic real fishery performance

Data Needs:

Ongoing Newport Hydroline, associated weather and climate data, bioinformatics to enable specific species copepod gene expression analysis, actual near-real-time gene expression assays and findings.

Desired Area(s) of Expertise for Students:

This project will require expertise in weather, climate, fisheries and plankton ecology, oceanography, computer science, bioinformatics, genomics, molecular biology, math and statistics.