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Many aspects of the high latitude North Atlantic circulation and seaice are apparently related to the NAO (North Atlantic Oscillation). To identify the mechanisms of long term NAO-related variability response experiments are carried out with a coupled ocean-sea ice model of the North Atlantic.

We concentrate on the effect of long term changes in the forcing on the large scale oceanic circulation in the periods before and after 1970, especially on the sudden drop and the following recovery of the NAO index in the mid-nineties.

Experiments with "NAO+" and "NAO-" forcing show a clear response in the Arctic Ocean and the subpolar North Atlantic. There is a direct connection between the wind stress forcing and the sea ice cover and a subsequent reaction of the SSS and SST fields. To distinguish the influence of NAO-related wind stress and temperature changes, we vary each forcing component individually.

OS12Q HC: 316 A Monday 1330h

Coral Reef Habitats: New Insights From Integrated Coastal Science II

Presiding: **M Field,** University of California, Santa Cruz**; P Jokiel,** University of Hawaii at Manoa

OS12Q-01 1330h

Advective Linking of Shelf and Back Reef Ecosystems by Wind-influenced Tidal Transport

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Surface drogue trajectories in a tidal channel in the Exuma Cays, Bahamas, are combined with tidal predictions and wind stress calculations to describe the physical linking of shelf waters of Exuma Sound with back reef environments on Great Bahama Bank. Five flood-tide excursions under varying tide and wind conditions are used in a multiple linear regression analysis to obtain an empirical equation that estimates 705 wind-influenced flood-tide excursions over a one-year time period. Results define back reef regions that are chronically hypersaline due to their isolation from the regular arrival of shelf water. The regression equation suggests that tidal forcing alone produces flood-tide excursions of 3-9 km. Predominantly landward wind stress is more effective in extending flood-tide excursions than in shortening them. Wind forcing has the greatest influence on the flood-tide excursion when the wind direction is 10^o counterclockwise of a directly across-shelf heading. Correlation is highest (r = 0.868) when wind stress is vector-averaged from one hour before the flood through the end of the flood tide. With both tidal and wind forcing, 90% of the flood-tide excursions are longer than 5.6 km, but only 10% are longer than 9.1 km. Juvenile queen conch are absent from otherwise suitable seagrass habitat beyond approximately 6 km from the mouth of the tidal channel. This provides evidence that the infrequent arrival of shelf water impacts the back reef ecosystem by making regions beyond the normal reach of Exuma Sound water hydrographically distinct.

OS12Q-02 1345h

Mapping Bathymetry and Percent Living Coral with Multi-spectral Data; Kailua Bay, Oahu, Hawaii

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The purpose of this study was to determine how effective a tool airborne multi-spectral sensor data was for mapping and studying coral reef geology and ecology. We successfully predicted depth and bottom-type using a simple formula based on the difference in radiance measured in two multi-spectral bands. Our study area was in Kailua Bay, Oahu, Hawaii, which is a typical fringing reef marine environment. The airborne multi-spectral data used was collected when weather and ocean conditions were calm.

Two of the three visible wavelengths measured in this study were suitable to work with. These wavelengths were at 488 nm and 551 nm with a 10 nm full width half maximum. Our results indicate that our two-band method can improve the predictive results (accuracy and detail) when applied to multiple two-band combinations with hyperspectral sensors. Furthermore, we will be able to map change in bathymetry and percent living coral cover by applying these methods to data collected at different times.

We achieved 77% accuracy for seven 'percent living coral' categories derived by unsupervised classification of our multi-spectral predicted bottom-type map. Forty-four 30 m line-intercept transects (Harney, 2000) were used as ground truth and provided detail of the make-up of each percent living coral category. Furthermore, the area covered by each percent living coral category was calculated.

From our multi-spectral depth predictions (80% accuracy), we generated a map of slope for Kailua Bay and found the relationship among slope and the percent living coral categories. With the smallest slopes found in the greatest and the least percent living coral habitats and the greatest slopes in the middle percent living coral categories, we present two hypotheses for this observed relationship. The first hypothesis is that slope is the inhibiting factor to coral growth. In the second hypothesis, the observed relationship results from the topography generated by the various extents of coral cover.

OS12Q-03 1400h

Reefal carbonate facies off Dubai, Arabian Gulf: remote-sensing with Ikonos satellite images and ground-truthing by vessel-based video survey

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Satellite-based remote-sensing is a rapid and cost-efficient way to obtain large-scale data of seafloor types or organismal assemblages. Misclassifications can reduce accuracy and rigorous ground-truthing is necessary. We compared results from a vessel-based video-survey recording footage along parallel survey lines from the surface (Riegl et al., 2001, Bull. Mar. Sci. 68) and classification from an Ikonos image with 1m pixel resolution - two data-sets with 100 percent space cover. Video data were obtained in 1995/6, the Ikonos image in 2001. Facies distribution was not expected to be identical since in the five intervening years a coral mass mortality had killed most of the corals and breakdown of the skeletons had started. Also seagrass and algae beds exhibit high spatial dynamics and were not expected to be identical in the two surveys. The remotely-sensed distribution of habitats nevertheless was highly compatible with that observed by the video survey. Some differences were found in the distribution of algae and seagrass beds, but these could largely be attributed to the five-year time-lag between the surveys. The classification obtained from the satellite image suggests that the video-survey missed some areas of coral-growth. Conversely, some areas mapped as having corals in the video survey did not show in the image classification which suggests breakdown after the 1996 mass mortality. Several small coral areas surrounded by seagrass areas and dense areas of algal growth were only picked-up by the video-survey - since most dead corals were covered by algae, their pixel values on the satellite image were similar to those of algae. Also, in depths greater 10m the spectral values did not allow clear classification. Overall, for areas in less than 10m depth, the results of the satellite-remote sensing and the vessel-based video-survey compared very well. Images courtesy NASA Scientific Data Purchasing Program and F. Muller-Karger at USF.

OS12Q-04 1415h

Drowned Reefs and antecedent Karst Topography, Au'au Channel, S.E. Hawaiian Islands

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During the last glacial maximum *LGM*, about 21,000 years ago, the Hawaiian Islands of Maui, Lanai and Molokai were inter-connected by limestone bridges creating a super-island known as Maui-Nui. Approximately 120 meters of sea-level rise during the Holocene Transgression flooded, and then drowned, these bridges separating the islands by inter-island channels. A new multibeam high-resolution bathymetric survey of the channels between the islands, coupled with observations and video-transects utilizing DeepWorker-2000 submersibles, have revealed the existence of numerous drowned reef features including concentric solution basins, solution ridges (rims), sand and sediment plains, and conical shaped reef pinnacles. The concentric basins contain flat lagoon-like bottoms that are rimmed by steep sided limestone walls. Undercut notches rim the basins at several depths marking either sea-level still stands or paleo-lake levels. All of the solution basins shallower than 120 m were sub-aerial at the LGM, and at one stage or another, may have been shallow shoreline lakes. Today, about 70 drowned reef pinnacles are scattered across the Maui-Lanai underwater bridge and all are situated in wave-sheltered positions. Most drowned during the interval between 14-10,000 years ago when sea-level rise averaged 15 mm/yr. Virtually all of the surficial topography in the Auau Channel today is a product of karst processes accentuated by marginal reef growth during the Holocene. Both the submerged basins and the drowned reefs represent an archive of sea-level and climate history in Hawaii during the late Quaternary.

Key words: Drowned reefs, Holocene Transgression, sea level, karst topography, reef growth, Hawaii

OS12Q-05 1430h INVITED

Large Scale Assessments of Reef Condition in the Atlantic Province, a Role Model for Other Reef Areas

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Large-scale surveys of reefs throughout the Western Atlantic Province provide a regional context for understanding spatial patterns in reef health. By examining multiple indicators of reef condition (corals, fishes, and algae), across multiple spatial scales, it is possible to develop norms for each indicator. These norms allow for comparative analysis of reef condition. It is also possible to infer potential causes (local versus regional) and processes (herbivory, mortality, recruitment), which allow for a more complete understanding of the present states and future trajectories of these complex systems.

During the past 3 years, scientists and managers from throughout the region have applied a standardized rapid assessment methodology to over 500 reef sites in 23 countries as part of the Atlantic and Gulf Rapid Reef Assessment (AGRRA) Program. This baseline dataset establishes the present state of the region's reefs and lays the foundation for future repetitive assessments. Highlights of the AGRRA Program, to be discussed include: 1.Development of a practicable method for rapidly assessing key indicators of reef condition with small teams of divers. 2.Establishment of a sampling approach for characterizing large areas (hundreds to thousands of km). 3.Applying the method to a large number of reef areas, particularly remote areas not previously examined. 4.Establishment of scales for various indicators of reef condition (e.g. partial mortality, biomass of target fishes, abundance of fleshy algae). 5.Distinguishing large-scale vs. local impacts to reefs.

URL: http://coral.aoml.noaa.gov/agra/

OS12Q-06 1505h

δ^{15}N and δ^{13}C Measurements of Trophic Structure on Coral Reef Systems Within the Northwestern Gulf of Mexico

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Measurements of δ^{13}C and δ^{15}N for variety of organisms on four reef systems within northwestern Gulf of Mexico were used to determine ultimate carbon sources and basic trophic structure within each system. Sampling occurred within Flower Garden Banks National Marine Sanctuary and Sonnier Bank on four seasonal cruises. δ^{13}C values ranged from -32.2 ppt. (Rhodophyte *Wrightiella blodgettii*) to -11.8 ppt (snail *Cerithium litteratum*). δ^{15}N signals spanned 0.3 ppt (Cyanobacteria) to 11.1 ppt (planktivorous fish *Paranthias furcifer*). Herbivorous invertebrates (*i.e. C. litteratum*) exhibited the lowest δ^{15}N values (2.3 ppt), while highest δ^{15}N values (> 7.3 ppt) were noted in fishes. Macroalgae contributed a substantial percentage of carbon to herbivore diets (> 75%). Herbivore δ^{15}N values ranged from 2.3 to 10.2 ppt, compared to 1.4 to 4.8 ppt for macroalgae. δ^{15}N signals of anthozoans (3.8 to 4.7 ppt) corresponded to their consumers (6.4 to 8.5 ppt), while suspension feeders (4.3 to 8.9 ppt) were measurably enriched relative to particulate organic matter (3.0 to 4.3 ppt). In general, there appeared to be a 3.3 ppt enrichment in δ^{15}N between successive trophic levels. Significant differences ($p < 0.05$) in δ^{15}N values occurred between mid-shelf banks (Stetson and Sonnier) and outer shelf banks (East and West Flower Gardens). The data demonstrated that carbon and nitrogen isotopes can be used to construct accurate food webs and identify dominant sources of primary production within coral reef systems in the Gulf of Mexico.

OS12Q-07 1520h

Scales Of Damage And Recovery From Destructive Fishing On Coral Reefs

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A study was conducted in Indonesia to examine the impact of blast fishing and the process of coral recovery at different scales. A single blast from a typical soda bottle bomb leaves craters approximately 2 m in diameter, while extensive blasting over a number of years results in vast, shifting fields of dead coral rubble. We tracked two bomb fishermen in North Sulawesi and have monitored single blast sites over two years. The diameter of single craters amidst the topographically complex reef decreased an average of 20 cm/year. However, these edge effects were absent in the large rubble fields, which are basically featureless and often swept by strong currents. Coral recruitment in both the single craters of known age and large rubble fields of unknown age was assessed. Patterns of coral recruitment and recovery differ at the two scales, with little natural recovery in the large rubble fields. Rubble fields that have sufficient larval supply and good water quality are potential candidates for reef rehabilitation efforts, which must incorporate stable structures to resist scattering by currents and burial by shifting rubble. Low cost, locally available substrate stabilization methods were tested (netting, cement slabs, and rocks piled onto rubble). On the basis of these pilot studies, larger rock piles, the most successful method, were installed and are being monitored. Studies of the immediate impacts of and long-term recovery from destructive fishing are valuable as we assess the global threats to reefs on a variety of spatial and temporal scales.

OS12Q-08 1535h

Coastal Eutrophication: Using Radium Isotopes to Determine the Cause

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Anthropogenic nutrient enrichment is one of the major contributors to coral reef deterioration. Such is the case for the northern Gulf of Aqaba (Eilat, Israel), a 180 km long 10-15 km wide branch of the Red Sea, where decline of the reef has been observed and attributed to eutrophication. Possible sources of nutrient enrichment to this area include fish pens located about 250 m offshore, groundwater leachate from a Jordanian sewage treatment plant, run-off from local agriculture and land-based aquaculture, sporadic hotel waste effluent, and other smaller point and non-point sources. In order to elucidate the dominant source of the nutrients, water was sampled for radium isotopes, nitrate, phosphate and salinity. Naturally occurring radium isotopes have been shown to be powerful indicators for the presence of groundwater in coastal regions. These isotopes (^{223}Ra and ^{224}Ra) form the basis for exploring the influence of groundwater input in this system. The study area encompassed the northwest corner of the gulf: from the western shore to the Israel-Jordan border about 3 km to the east. Transects were conducted perpendicular to shore at four locations. ^{223}Ra (half-life 11.4 days) and uncorrected ^{224}Ra (half-life 3.7 days) activities suggest substantial groundwater discharge near the border with radium activities reaching 34.49 dpm/100 L (^{223}Ra) and 672.77 dpm/100 L (^{224}Ra) near shore. The offshore activities were 0.11 dpm/100 L (^{223}Ra) and 3.69 dpm/100 L (^{224}Ra). The nitrate and phosphate concentrations were slightly elevated along the border transect, but the highest values occurred several hundred meters to the west along a transect conducted near the mouth of a saline river. Here the values were approximately an order of magnitude larger with nitrate concentrations of 11.15 μM. Offshore concentrations were 0.10 μM. Salinity values did not vary more than 0.44 for all transects. The preliminary results suggest that the nutrient enrichment is decoupled from the major subterranean groundwater input. The discharge of the saline river appears to be a significant nutrient contributor and work is in progress to determine the suppliers associated with this source.

OS12Q-09 1550h

Effect of Eutriphication on the Relationship between Zooxanthella and Corals.

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Coral reefs are found in oligotrophic waters poor in nutrients such as nitrogen and phosphates. They thrive in oligotrophic conditions because of the symbiotic relationship between corals and dinoflagellate algae (zooxanthellae) embedded in the coral tissue. In their mutualistic symbiosis, the photosynthetic capability of the zooxanthellae is used as a basis for the metabolic energy of the whole association, and, eventually, a great part of the entire reef ecosystem. The relationship between CO2, Ca2+ exchange and photosynthesis by corals was studied with microelectrodes for Ca2+, O2, pH and CO2. The uptake of Ca2+ at the polyp surface is not an indirect effect of increased CaCO3 precipitation at the skeleton, but that Ca2+ uptake is directly regulated by photosynthesis. There are three major ways in which increased nutrient supply may adversely affect corals and entire reefs. 1) Phytoplankton population increase in the water surrounding the reef results in a decrease of the light availability to the underlying corals. 2). Seaweed growth increase by overgrown macro-algae eventually causes the death of corals. 3) Nutrient increase may affect the relationship between the zooxanthellae and the coral. The population density of algae is controlled by nitrogen and carbon limitation. The coral host keeps the algal growth far from their maximal growth rate. As a result of nutrient enrichment there is an increase of algae densities; the algae become CO2 limited and probably compete with the animal for use of carbon for calcification. Photosynthetic rates, on a per cell basis, were inversely correlated with algal densities, indicating possible competition among the algae for CO2. Coral growth decreases due to eutriphication.

OS12Q-10 1605h

Depth-Related Skeletogenesis in *Porites* spp.: Stable Isotope Fractionation and Density Band Formation

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Annual skeletal density variations and stable isotope composition of stony corals have been used to reconstruct environmental conditions in contemporary and ancient communities. It is well established that both the environment and the organisms physiology control oxygen and carbon isotopic composition of coral skeletal material. However the effect of water depth, on density banding and isotopic compositions of the skeletal material is not fully understood.

To resolve this, colonies of *Porites* spp. from Eilat (northern tip of the Gulf of Aqaba) were transplanted in 1991 from a depth of 6 to 40 m. Before transplantation, the corals were stained using a vital calcification indicator,Alizarin Red-S, demarcating the two phases of growth. Here we report results from the first colony retrieved 10 years later. A slice was cut from the colony along the major growth axis and X-rayed to reveal the annual growth bands. Stable isotope composition and skeletal density were measured along a profile parallel to the growth direction yielding a monthly resolution.

Results reveal clear differences between the two growth phases at 6 and 40m. The annual growth rate decreased from 5.7±0.5 mm/year at 6m to 3.0±0.4 mm/year at 40m. Mean seasonal δ^{18}O amplitude in shallow-water formed skeleton is $1.2\pm0.1^{o}/_{oo}$, significantly lower than the seasonal amplitude of δ^{18}O in the deep-water formed skeleton, which is $1.6\pm0.2^{o}/_{oo}$. The average seasonal temperature amplitude in surface water at Eilat, ca.6^{o}C, was in good agreement with the mean seasonal δ^{18}O amplitude value found in the shallow-water skeleton. Temperature amplitude was expected to be slightly lower at 40 than at 6 m. However, the results showed that δ^{18}O amplitude was significantly higher in the deep-water skeleton. The major difference in δ^{18}O values between shallow and deep-water skeleton occurred during the winter months, being three-fold higher than during summer. Temperature alone cannot explain the higher δ^{18}O amplitude in deep water when compared to shallow water. It seems that two other factors may influence δ^{18}O composition in coral skeleton formed during winter in deep water: The first is that deep water mixing imposes an enriched water ^{18}O signal at 40 m. The second is that slower growth and calcification rates result in enriched δ^{18}O composition through the kinetic effect. δ^{13}C maxima preceded the δ^{18}O maxima in the skeleton secreted at 6 m. A maximal correlation is observed when δ^{18}O time series lagged 3 months behind the δ^{13}C series. This reflects the time lag between light intensity and seawater temperature in Eilat. Following transplantation, this phase shift was absent. It is thus possible that in deep water, kinetic effect plays a stronger role in shaping the δ^{13}C signal than photosynthesis. Interestingly, correlation between skeletal density and δ^{18}O composition in the two parts of the skeleton revealed that the timing of density band formation remained the same regardless of depth. Low-density skeleton was formed during the summer and high-density skeleton during the winter. This may imply that the timing of banding patterns is intrinsically controlled. We therefore suggest for a further study the question; weather the timing of density band formation is genetically or environmentally controlled?

OS12Q-11 1620h

Biogeochemical Controls on the Stable C and N Isotopic Composition of Marine Sponges Along Natural Environmental Gradients in Florida Keys Reef and Sea Grass Habitats

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Systematic trends are observed in the stable carbon and nitrogen isotopic compositions of eight sponge species collected at a series of stations in Key Largo, FL, ranging from the Florida Bay side out to the outer reef tract. These trends appear to be related to gradients in organic matter sources as well as in situ biogeochemical processes associated with microbial symbionts hosted within sponge tissues. The observed δ^{13}C trend features a continuous C-13 depletion going from nearshore, shallow waters out to the outer reef. This δ^{13}C trend could result from a greater abundance of seagrass-derived carbon in the < 5m-sized particulate organic carbon filtered by sponges from shallow, nearshore waters. However, individual sponge species exhibited systematic differences in their absolute range of δ^{13}C values at a given station suggesting that carbon sources or biogeochemical processes may differ significantly among species. Significant shifts in δ^{13}C values could be expected to result from increased contributions of microbial photosymbionts to sponge nutrition over inshore to outer reef gradients in nutrition mode described by previous researchers. Isotopic gradients can be hypothesized to result from shifts in CO2 concentration gradients and transport rates to symbionts in phototrophic sponges. Symbiotic algae, including cyanobacteria, have a demonstrated ability to actively pump bicarbonate as an alternate C source under the CO2 -limiting conditions expected for the symbiont, thereby generating extremely enriched δ^{13}C values through dramatically reducing isotopic fractionation. Observed δ^{15}N values exhibited no systematic spatial variability. However, δ^{15}N values in all *Ircinia spp.* were systematically depleted (N-15 depleted) from typical oceanic values relative to six other sponge species. This depletion appears to result from N2 fixation by microbial symbionts *Ircinia spp.* are known to host. N2 fixation appears not to occur at appreciable rates, or the results of it are obscured, in the other sponge species studied given their heavier δ^{15}N values typical of marine particulate organic matter.

OS12R HC: 323 C Monday 1330h

Zooplankton: Feeding, Growth, and Distribution II

Presiding: **N H Marcus,** Florida State University**; R S Lampitt,** Southampton Oceanography Centre

OS12R-01 1330h

Interactions Between Meso- and Micro-Plankton: Deductions From Fine Scale Distributions in Three Dimensions Obtained Using In Situ Holography.

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Interactions between mesozooplankton and their detrital or microplankton prey are not controlled by the average concentrations of these entities in the water column. For many years it has been known that distributions are invariably patchy but the relationships between the patches in the real world have been very hard to deduce. It is these relationships that determine the interactions between an organisms and its food and in order to obtain a deeper understanding of such interactions, observations must be carried out on the appropriate spatial scales. Using a novel in situ holographic camera, we present data from a Scottish Sea loch on the fine scale three dimensional distributions of particles and organisms on a range of spatial scales. We describe the distribution of potential food particles in the cubic centimetre around mesozooplankton and compare this to control volumes outside their swimming range. This enables us to calculate the effects of patchiness on the encounter rates that would be expected in the real ocean.

OS12R-02 1345h

ZOOVIS: A New High-Resolution Digital Still Camera System for Quantifying Zooplankton Distributions and Abundances.

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The zooplankton visualization and imaging system (ZOOVIS) consists of a high-resolution (4.19 megapixel) monochrome digital still camera and strobed light-sheet coupled to a CTD package and connected to a surface computer via an electro-optical cable and winch. ZOOVIS was designed to be a zooplankton CTD a vertical profiling instrument capable of quantifying the distribution and abundance of meso- and macro-zooplankton with concurrent environmental data on comparable spatial and temporal scales. This paper will provide an overview of the system architecture and operation. During the fall of 2001, ZOOVIS was deployed in Knight Inlet, a fjord along the coast of British Columbia, Canada to provide sea-truth for concurrent high-frequency acoustic studies of zooplankton distributions in the vicinity of the fjord sill. Preliminary results from the ZOOVIS deployments during that cruise will be presented.

URL: http://zooplankton.lsu.edu/zoovis.htm

OS12R-03 1400h

Food Limitation of Temperate Marine Copepods: Naupliar and Copepodite Responses to Primary Productivity

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Copepods are the most abundant metazoan grazers in the oceans, yet the response of their growth rates to various environmental factors remains unclear. Part of the uncertainty is due to the differences in response of the developmental stages, since both body size and shape differ significantly between nauplii and copepodites. In order to determine the influences of food and body size on naupliar and copepodite growth rates, artificial cohort analyses were performed on *Acartia* and *Eurytemora* species in the Bay of Fundy during the summer of 2000 under a natural range of chlorophyll a concentrations. Observed growth rates were compared to maximum growth rates published in the literature in order to assess whether the observed rates were at or near maximum, and the relationship between chlorophyll a concentration and growth rates was determined via multiple regression analyses. Over half of the observed growth rates were higher than the maximum values at similar temperatures in the literature, indicating 1) that the published literature does not represent maximum growth, 2) that there are discrepancies between various methods of measuring growth rates of copepods or 3) growth rates vary among populations within species. Copepodite growth rates were positively related to chl a concentration in the >20μm size fraction (r^2 = .45, p=.0005), but not related to body size, while the naupliar growth rates were only related to body size (r^2 = 0.68, p<0.0001), and were not related to chl a concentration in any size fraction (0.2 - 2.0 μm, 2-20μm, >20μm particle size). This indicates either that nauplii do not experience food limitation under natural conditions, or that they are feeding on other food sources which are not measured by chlorophyll analyses. These results suggest that the different life stages of copepods respond differently to varying food concentrations, or that the diets differ significantly among developmental stages. This has important implications for future food web trophodynamic studies in marine systems.

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Effects of Hypoxia on the Survival and Life History Traits of Acartia tonsa

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Concern for the increasing occurrence of coastal zone hypoxia has generally focused on the direct, short-term impact of reduced dissolved oxygen (DO) levels, on the survival of commercially important species. Copepods, especially the naupliar stages, are important food web components yet only a few studies have considered the effect of reduced DO levels on their survival and behavior. This study considered the impact of sub-lethal oxygen concentrations on copepods. Acartia tonsa were reared at 25 oC at saturating DO (control), and reduced DO concentrations of 1.5 or 0.7 ml/L. Oxygen concentrations were maintained in replicate flasks, by bubbling with air (control), or mixtures of nitrogen and oxygen. Egg production, but not survival was significantly different between the controls and 1.5 ml/L treatment. Survival and egg production were significantly lower at 0.7 ml/L compared to the control. Growth and development rates are also being compared. The results suggest that sub-lethal as well as lethal effects may have important repercussions on population and community dynamics.

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Copepod Hatching Success Rate in Ecosystems With High Diatom Concentrations the Paradox of Diatom-Copepod Interactions Revisited

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Diatoms dominate phytoplankton assemblages during the spring bloom and in upwelling areas. Copepods are usually the main component of the zooplankton in those areas and prey of most larval fish.

Some recent laboratory studies have suggested that diatoms may have a deleterious effect on the hatching success rate of copepod eggs. This challenges the classic view of the diatom-copepod interactions. Conceptual models of the areas and periods of high productivity in the marine environment, upwelling areas and spring blooms, are based on the energy flowing from diatoms to fish through copepods. If a deleterious effect of diatoms occurs in situ, secondary production by copepods could in fact be limited by their diatom prey. Therefore, our understanding of the energy transfer from primary production to fisheries in some of the most productive and economically most relevant marine ecosystems could be seriously flawed.

As part of a series of field experiments, we have measured diatom concentration and copepod egg hatching success rate in a range of areas representative of those high productivity ecosystems: Gulf of Alaska, Iceland basin, Labrador Sea, Scotian shelf, Gulf of St. Lawrence, Georges Bank, English Channel, Long Island Sound, Oregon and Namibia upwelling areas and South Georgia (Antarctica). Experiments were performed with 16 species of copepods and diatom concentrations ranging from 0.06 to 700 mg C m-3 or from