Identifying linkages between zooplankton dynamics, fishery resources and climate change in the Northern Gulf of Mexico

NGI Plankton Group

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Southeast Area Monitoring and Assessment Program: SEAMAP

- Ongoing state-federal cooperative, fisheries-oceanographic, sampling program
- Generated over 40,000 plankton samples from over ~250 stations in northern GOM Large Marine Ecosystem over the past 30 years
- Resulted in an extensive database on the early life stages of fishes
Key Goals

1) Improve use of existing collections for resource management
   Data needs for *Ecosystem-Based Management*
   Expand from finfish to managed *invertebrates*

2) Assemble long-term datasets and relate to climate variability

3) Protect samples for future use
   Needs change!
   Hurricanes happen 😞
It’s not just fish...
Ecosystem-based Management

Barausse et al. 2009

Fish
Fish food
Things that eat fish
Things that eat the food that fish eat
Things that prefer to live where fish live
### Analysis of the invertebrate zooplankton component of SEAMAP plankton samples

Andrew Millett (NOAA/NMFS/IAP World Services), Joanne Lyczkowski-Shultz (NOAA NMFS), and Wanda Kandalayk (MIR/ZSIOP)

<table>
<thead>
<tr>
<th>General Zooplankton</th>
<th>Decapod Crustacean Larvae</th>
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<tbody>
<tr>
<td>Calanoid copepods</td>
<td>Phyllosoma</td>
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<tr>
<td>Cyclopoid copepods</td>
<td>Penaeid postlarvae</td>
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<td>Harpacticoid copepods</td>
<td>Portunidae megalopae</td>
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<tr>
<td>Ostracods</td>
<td>Sicyoniidae postlarvae</td>
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<td>Mysid shrimp</td>
<td>Menippe megalopae</td>
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<tr>
<td>Cladocerans</td>
<td>Geryonidae megalopae</td>
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<tr>
<td>Amphipods</td>
<td>Penaeidae larvae</td>
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<tr>
<td>Euphausiids (all life stages)</td>
<td>Portunidae zoeae</td>
</tr>
<tr>
<td>Isopods</td>
<td>Sicyoniidae larvae</td>
</tr>
<tr>
<td>Barnacles (all life stages)</td>
<td>Geryonidae zoeae</td>
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<tr>
<td>Stomatopod larvae</td>
<td>Menippe zoeae</td>
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<td>Chaetognaths</td>
<td>Sergestidae</td>
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<tr>
<td>Hydromedusae</td>
<td>Lucifer spp.</td>
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<tr>
<td>Siphonophores (Calycophora)</td>
<td>Solenoceridae</td>
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<tr>
<td>Ctenophore larvae</td>
<td>Misc. Decapods</td>
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<tr>
<td>Polychaetes (all life stages)</td>
<td>Other Decapods</td>
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<tr>
<td>Pteropods</td>
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<tr>
<td>Heteropods</td>
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<td>Gastropod larvae</td>
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<td>Bivalve larvae</td>
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<tr>
<td>Cephalopods</td>
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<td>Salps</td>
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<td>Doliolids</td>
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<td>Larvaceans</td>
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<td>Lophophores</td>
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<td>Echinoderms (all life stages)</td>
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<tr>
<td>Other zooplankton</td>
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</table>
Using Zooplankton Community Distribution to Identify Large Marine Ecosystem Sub-Units within the Northern Gulf of Mexico

WM Graham¹, FJ Hernandez¹, Jr, AF Millett², L Carassou ¹, G Zapfe², KL Robinson¹,³, MA Bogeberg¹, A Hunter¹, J Lyczkowski-Shultz⁴

¹Dauphin Island Sea Lab, Dauphin Island, Alabama ²NOAA NMFS IAP World Services, Pascagoula, Mississippi ³University of South Alabama Department of Marine Sciences, Mobile, Alabama ⁴NOAA/NMFS/SEFCS Mississippi Laboratories, Pascagoula, Mississippi.
Expanding data collection for gelatinous zooplankton during SEAMAP plankton surveys

Andrew Millett (NOAA NMFS IAP World Services), William M. Graham (DISL), and Glenn A. Zapfe (NOAA NMFS)

Jellyfish sampling protocols were implemented in 2009 and have been conducted on the following SEAMAP Plankton Surveys:

- Winter 2009: 4 Feb – 16 Mar
- Spring 2009: 29 Mar – 1 Jun
- Fall 2009: 25 Aug – 30 Sept
- Spring 2010: 3 Apr – 23 May
- Fall 2010: 24 Aug – 30 Sept

Jellyfish collected during bongo, neuston, or MOCNESS plankton tows are removed from samples for identification, counts and measurement.
Quantification of Hydromedusae Predation on Fish Eggs in the Northern Gulf of Mexico

Renee Collini, MSc Thesis, USA/DISL

- Temporal/Spatial overlap of predator & prey
- Up to 14% of fish eggs consumed by hydromedusae each day
NGI Product

Diversity and Distribution of Portunid Crab Megalopae from SEAMAP Plankton Samples – Preliminary Results.

Carley Knight (USM GCRL), (MS thesis project)
Sara E. LeCroy (USM GCRL), Chet F. Rakocinski (USM GCRL)
and Joanne Lyczkowski-Shultz (NOAA NMFS)

Identification of portunid megalopae undertaken first

Tentative key to genera created for portunid megalopae

Reference set of portunid megalopae established to provide to LSU team for creation of training sets for image recognition software development

Preliminary density and distribution data examined
Guillermo Sanchez-Rubio (USM/GCRL/CFRD), Harriet M. Perry (USM/GCRL/CFRD), and Joanne Lyczkowski-Shultz (NOAA NMFS)

- Atlantic Multidecadal Oscillation (AMO), North Atlantic Oscillation (NAO), and El Nino Southern Oscillation (ENSO) have been found to influence the climatology of the northern GOM during the winter months.

- In 1982, the combination of AMO cold, NAO positive, and ENSO warm phases produced wet winter conditions.
- In 1999, the opposite phases of these modes of variability produced dry winter conditions.

More focused comparisons and analysis of biological responses to the shift in climate-related hydrological regimes are forthcoming.
Project Objectives: USM/GCRL/SIPAC and NMFS

Inventory SEAMAP samples lost to Katrina and those recovered at SEAMAP Invertebrate Archiving Center (SIPAC) at USM/GCRL
Physical samples are fragile...

Gulf Coast Research Lab,
SEAMAP sample repository
Hurricane Katrina, 2005
Bottlenecks in Analysis:
Time series like SEAMAP produce a lot of samples...
SIPAC project goals are two-fold

1. Post-Katrina recovery and management of unsorted plankton and identified invertebrate samples:
   - 4900 unsorted plankton samples recovered (54%)
   - 3921 identified invertebrate samples recovered (55%); mostly decapods
   - 1404 invertebrate zooplankton samples received from NMFS Pascagoula (includes 387 portunid, 7 menippid, 285 penaeid and 130 sicyonid lots)
   - 649 unsorted plankton samples (1982-84) sent to LSU for scanning
Advantages of Semi-automated Software

Error rates between humans and software are comparable in systems that classify objects in up to 30 categories

Untrained taxonomists can operate the software and complete the majority of classifications

The work can be checked by more experienced taxonomists and corrections and more difficult classifications can be made

Analyses are completed faster and cheaper

Quality control and assurance is easier to do

Significance of the NGI Partnership

Zooplankton ecologist colleagues at USM, DISL and LSU joined NOAA/NMFS researchers to initiate analyses of various invertebrate zooplankton components of SEAMAP plankton samples.

Our project brings together regional plankton and fisheries expertise along with new technologies and methodologies to expand the SEAMAP database to include information on invertebrate zooplankton.

Training of four graduate students directly related to NGI plankton efforts has also resulted in two NOAA/NMFS hires (Knight and Millett).

Expertise and resources continues to be extensively utilized in ongoing Natural Resources Damage Assessment following the Deepwater Horizon oil spill.
Any questions?