

Visualization of Lobster Larvae Migration in the Gulf of Maine

By: **Natasha Kellaway**
 Advisors: **Huijie Xue, Ph.D., Stephen Cousins**

Introduction

-Data has been collected for years on various aspects of lobster larvae development in the Gulf of Maine

-Prof. Huijie Xue, Danya Xu, and Stephen Cousins have created a model to simulate the development of lobster larvae in particular

-Visualization of this data could be a useful tool in seeing how currents affect lobster larvae movement and progression of lobster development over time

Simulation Model

The simulation model tracks the development of lobster larvae for a number of years. It is broken down into 60 day runs staggered by 10 days of each of the months of June, July, August and September. 262,170 tracers (larvae) are tracked at 5 different depths and develop based on conditions such as temperature at the location of the tracer for each time step as they drift with the currents in the Gulf of Maine.

Figure: a tracer file coupled with the table extracted by the new visualization program

Run	Date	Depth	Zone	Time
20050601	2005-06-01	5	Zone 1	00:00:00
20050611	2005-06-11	5	Zone 1	00:00:00
20050621	2005-06-21	5	Zone 1	00:00:00
20050631	2005-06-31	5	Zone 1	00:00:00
20050701	2005-07-01	5	Zone 1	00:00:00
20050711	2005-07-11	5	Zone 1	00:00:00
20050721	2005-07-21	5	Zone 1	00:00:00
20050731	2005-07-31	5	Zone 1	00:00:00
20050801	2005-08-01	5	Zone 1	00:00:00
20050811	2005-08-11	5	Zone 1	00:00:00
20050821	2005-08-21	5	Zone 1	00:00:00
20050831	2005-08-31	5	Zone 1	00:00:00
20050901	2005-09-01	5	Zone 1	00:00:00
20050911	2005-09-11	5	Zone 1	00:00:00
20050921	2005-09-21	5	Zone 1	00:00:00
20050931	2005-09-31	5	Zone 1	00:00:00

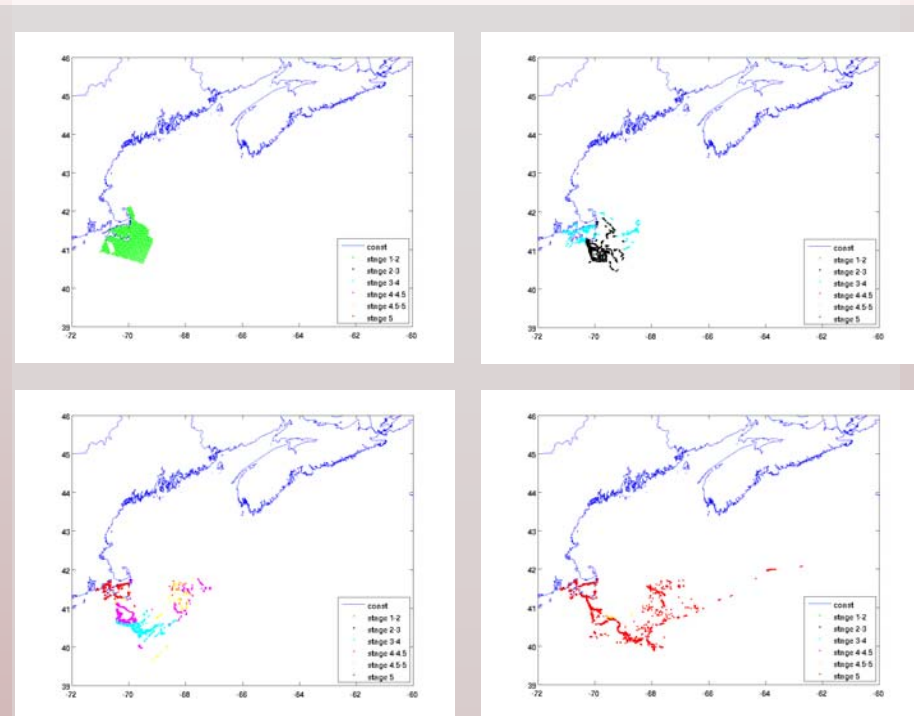
Creating an AVI MovieFile of Lobster Larvae Migration in the Gulf of Maine

A Perl script is used to go through the simulation data file and extract the necessary matrix

Matlab takes in the matrix, plots the tracers in a certain color based on development stage, and saves the figure as a movie frame

An AVI movie file is produced of lobster migration over 60 days

Figure: Various frames from a movie produced by this program



Future Work

-The Matlab program could be enhanced through speeding up its execution, from getting rid of hard-coded variables, and through adjusting the placement of the legend so it doesn't obscure tracer movement

-The GUI could be enhanced by making sure that drop-down menus are dynamically loaded

- The Google Earth portion of the project should be completed -- these images as a layer in Google Earth would allow visualization of lobster larvae migration along with other ocean products as

Conclusions

-Matlab can handle tens of thousands of tracers per movie frame, at the sacrifice of time

-This tool could be valuable for oceanographers – depth can be specified, development stages are easy to see, how currents affect lobster migration/development can be seen. If simulation data is provided in the same format, this tool can be used for any type of tracer movement

-This tool could become handy for oceanographers who want to use Google Earth with different layers of ocean

Related Work

The physical model is through GoMOOS (Gulf of Maine Ocean Observing Model), <http://www.gomoos.org/> [4]

The biophysical model was developed by Huijie Xue, Danya Xu, and Stephen Cousins [2]

References

- [1] Incze, L.S., R.A. Wahle, N. Wolff, C. Wilson, R. Steneck, E. Annis, P. Lawton, H. Xue, Y. Chen. 2006. Early Life History and a Modeling Framework for Lobster (*Homarus Americanus*) Populations in the Gulf of Maine.
- [2] Xu, Danya, H. Xue, S. Cousins. Numerical modeling and development and transport of lobster larvae (*Homarus americanus*) in the Coastal Gulf of Maine. [Online]. Available: http://rocky.umeoce.maine.edu/synthesis_lobster.html
- [3] Xue, Huijie, L. Shi, S. Cousins, N. Pettigrew. 2005. The GoMOOS nowcast/forecast system. doi:10.1016/j.csr.2005.04.014
- [4] Xue, Huijie, L. Incze, D. Xu, N. Wolff, N. Pettigrew. 2007. Connectivity of lobster populations in the coastal Gulf of Maine, *Ecol. Model.* doi:10.1016/j.ecolmodel.2007.07.024

Graphical User Interface

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