# Merging modeling and mapping to improve shellfish aquaculture site selection

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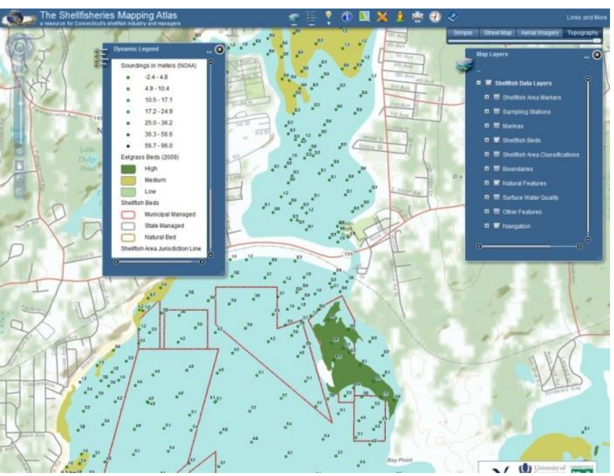
# Site selection and shellfish aquaculture

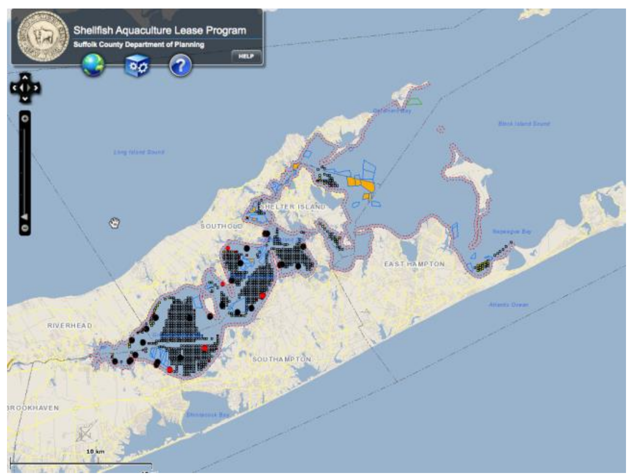
- Shellfish aquaculture industry experiencing growth in the US, interest in local sustainable seafood
- Most farms currently in the nearshore environment, many competing uses for limited space
- Improvements to siting new farms and expanding existing farms a recognized need at the federal, state, municipal level

# Mapping and site selection

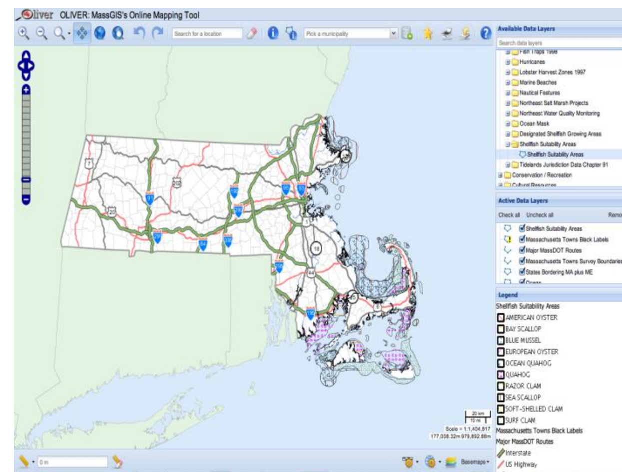
- GIS technology has given farmers and regulators the ability to visualize and minimize potential use conflicts
- Maps are becoming increasingly available in many states




Connecticut Aquaculture Mapping Atlas



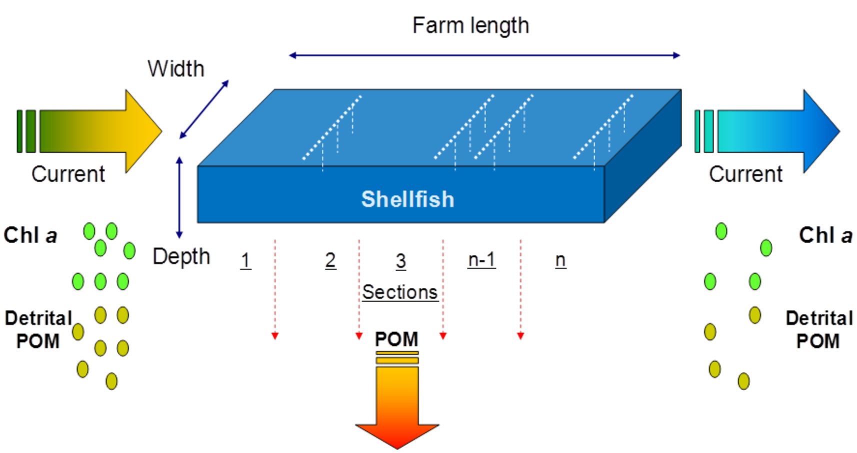

New York Shellfish iMap



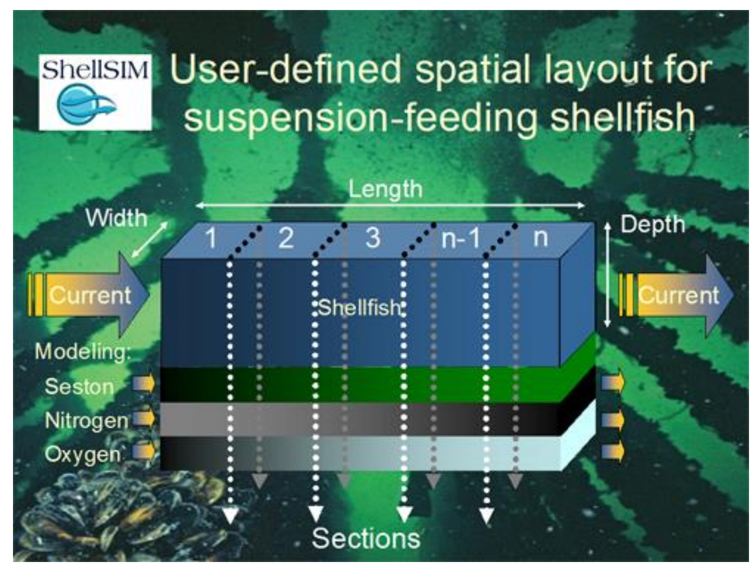

Massachusetts Online Data Viewer

# Modeling shellfish farm production

Several farm-scale models are commercially available to address biological production, ecological carrying capacity, and environmental impacts




Farm Aquaculture Resource Management Model




ShellSIM/ ShellGIS

# Benefits of a combined approach

- Mapping does not address production potential - will the target organism grow? At what rate in the system?
- Integrated, **mapping + modeling** allows users to simultaneously address social, environmental, economic factors towards an improved decision-making process
- **Responsible growth**: expand into areas without existing conflicts that are best suited for shellfish production

# Pilot Study – Connecticut waters of Long Island Sound


**Environmental Inputs**
Temperature, salinity, dissolved oxygen, chlorophyll, particulates, current speeds

**Sampling Details**
Milford: Monthly for a year
Westport & Mystic: May-September
Station 09 and H2: Long-term water quality monitoring stations; >15 years data

# Pilot Study – Connecticut waters of Long Island Sound




**Typical culture practices**

Collection of seed oysters (1-2 in) from restricted areas

Grow out to 3 in harvest size in conditional/approved leased areas

Days to harvest indicator of site suitability

## Thresholds for growth categories

High growth = <365 days

Moderate growth = 365 – 1095 days

Slow / low growth = 1095 – 1500 days

Not suitable for siting aquaculture = >1500 days

# Additional questions

- Spatial variability across an embayment
- Temporal variability – accuracy of a single year assessment
- Surface vs. bottom samples for food availability
- What to do with a limited data set?

# Spatial variability within an embayment

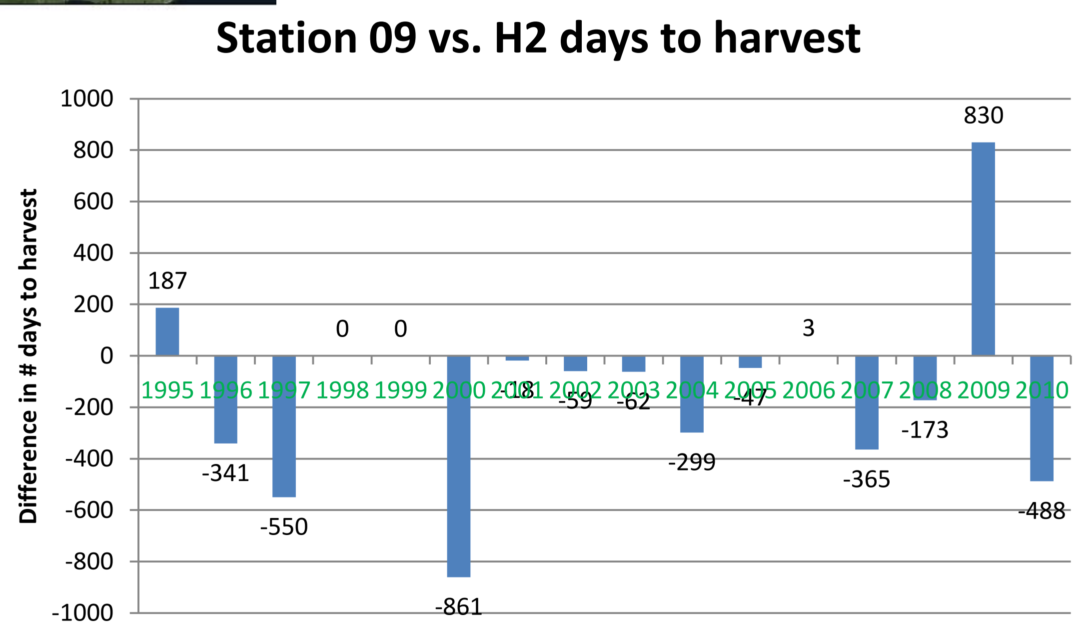

Embayment Range 301-364 days 333 average

Dock quite different 645 days to harvest

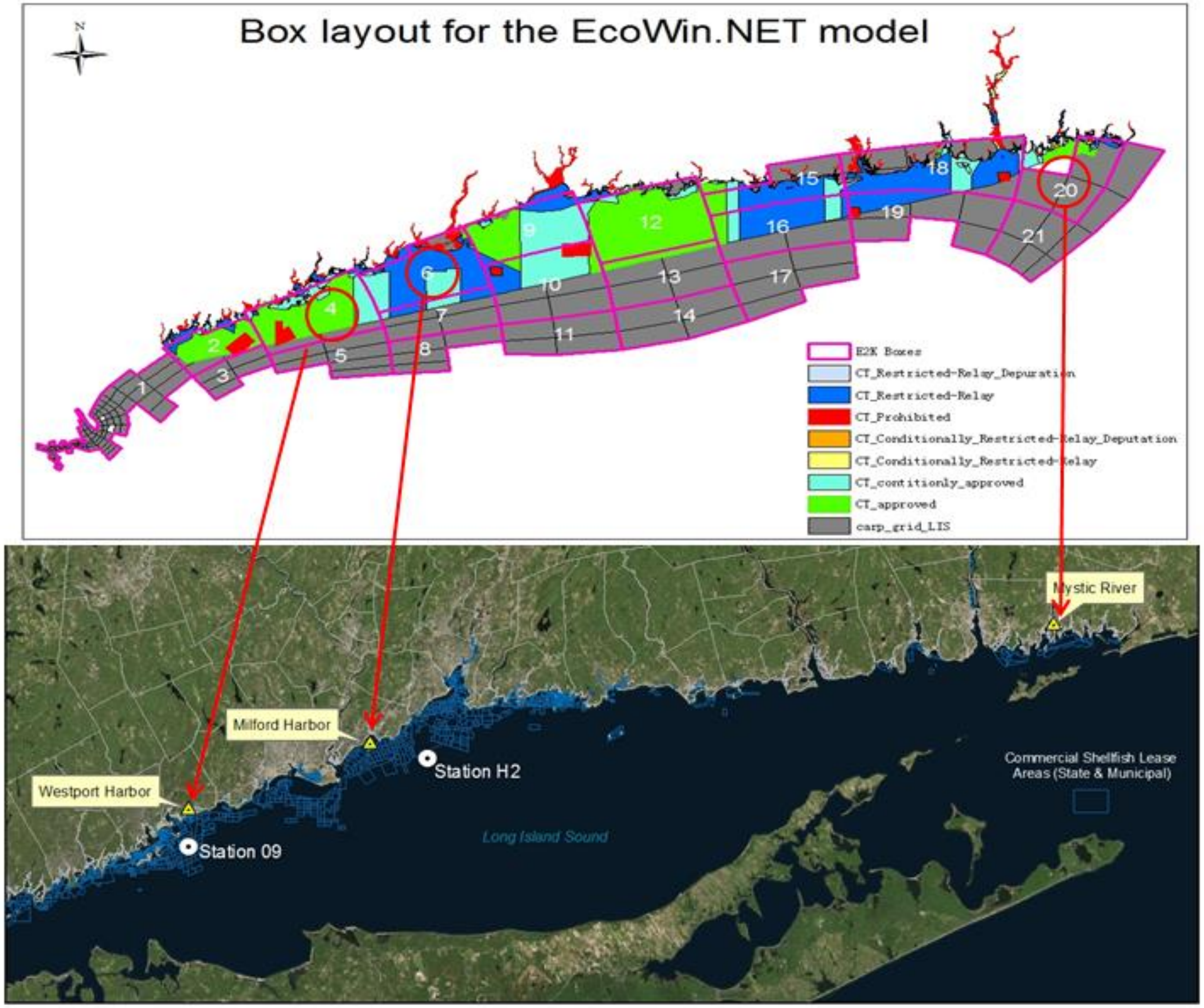
# Temporal variability in site predictions


Interannual variability high:
09: 341 to >1500 days to harvest
H2: 604 to >1500 days to harvest

BUT, consistency of prediction when same year of data used for comparison: 11 of 16 years Station 09 preferred



# Use model data for missing winter months




Citizen monitoring only conducted May-Sept; FARM needs full year

The EcoWin.NET ecosystem model was available for all of Long Island Sound

Milford stations were used to test this approach

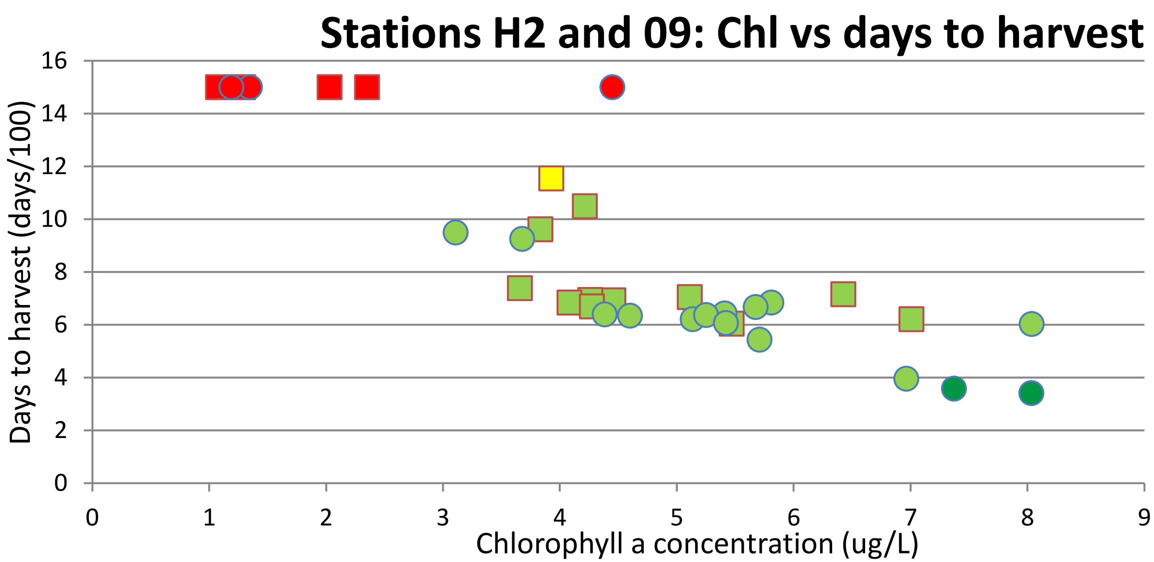
331 days to harvest based on all measured data

343 days to harvest with modeled + measured data

# Using surface samples to model bottom cultivation

- Surface water samples only – but CT industry is bottom cultivation
- LIS WQ monitoring samples full water column
- Compared FARM outputs with surface vs. bottom particulates at Stations H2 and 09
- No significant difference at Station 09; H2 had significantly faster growth using bottom POM, but growth category unchanged

# Using chlorophyll as a predictor of "good" or "bad" production years




Statistically significant differences in annual average chlorophyll between high/moderate vs. low/unsuitable growth categories

Annual average chlorophyll concentrations above 4.5 ug/L associated with high/moderate growth

# Conclusions

- All stations demonstrated Moderate/High growth
- Tool is likely most useful in locations with limited existing aquaculture or new industry
- Model data can be used for inputs of winter months
- High interannual variability indicates that site comparisons must be based on data from the same year

# Acknowledgments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