Fall 2010 Update: Annual Condition of the Northeast Shelf Ecosystem

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Fall 2010 Update: Summary of Conditions on the Northeast Shelf Large Marine Ecosystem

Summary

- Sea surface temperatures (SSTs) in the Northeast Shelf Large Marine Ecosystem during the first half of 2010 were moderate during winter, above average during spring, and exceptionally high in June.
- The 2010 spring phytoplankton bloom was a short duration, high intensity bloom occurring over most of the shelf waters. In recent years, an intense spring bloom usually occurred in the Massachusetts Bay/Nantucket Shoals area; however, this did not happen in 2010.
- Historically, the spring phytoplankton bloom on Georges Bank has started a week earlier than the bloom in the Gulf of Maine. However, in 2010, the spring phytoplankton bloom began first in the Gulf of Maine.
- Results of a recent analysis of the NEFSC food habits database indicate a decadal pattern in the consumption of red hake by Atlantic cod.
- Climate conditions in the Labrador Sea currently favor improved adult growth in Atlantic salmon. However, as long as climate continues to negatively affect survival during other parts of the salmon life cycle, salmon abundance will continue to decline.
- The abundance of larval Atlantic herring on Georges Bank continues to be low based on data collected during plankton surveys.

Data Sources

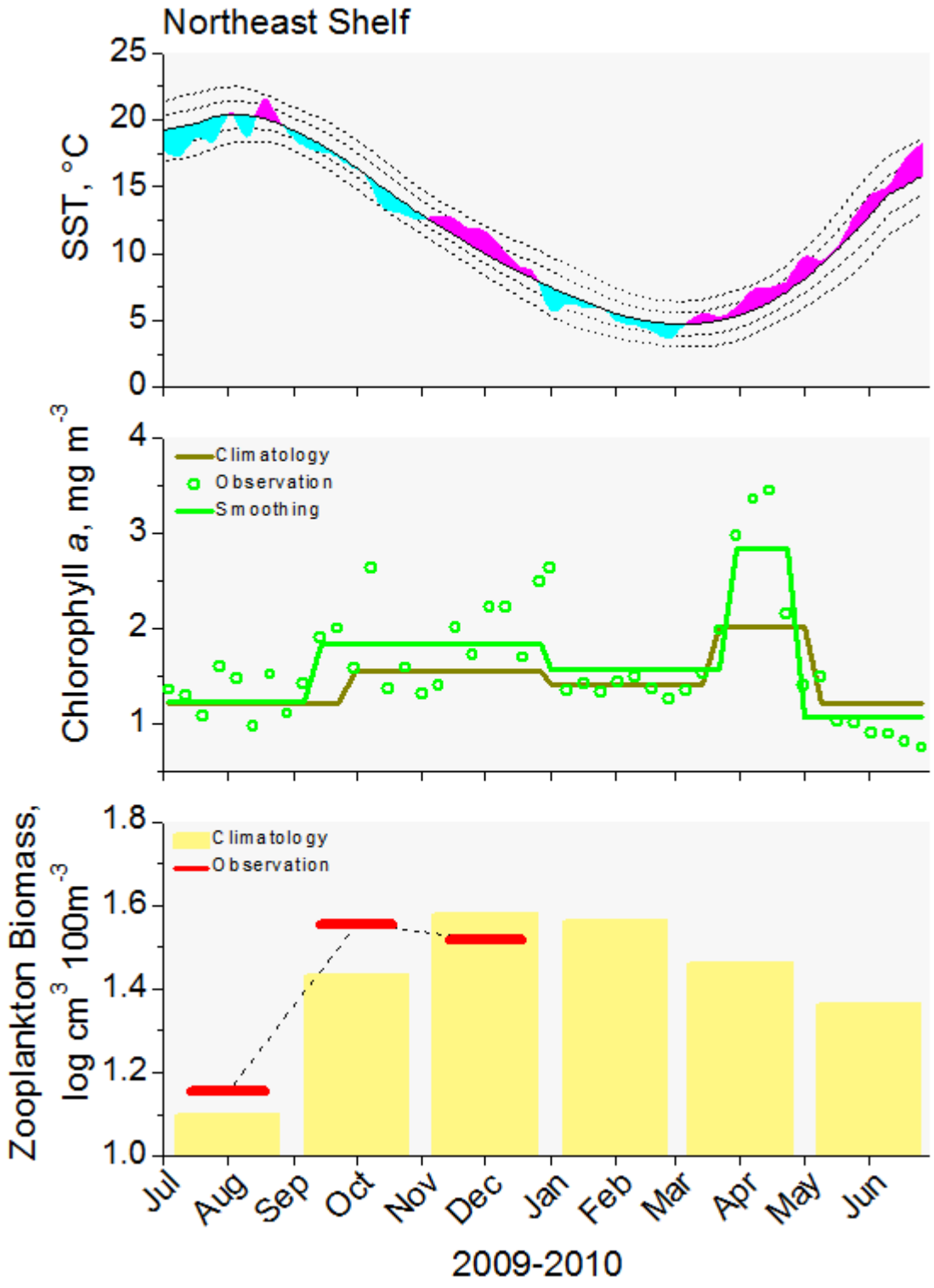
Sea Surface Temperatures (SSTs) were derived from three data sources: the Advanced Very-High Resolution Radiometer onboard the Polar Orbiting Environmental Satellite (AVHRR-POES); the MODIS Terra sensor; and the MODIS Aqua sensor. The SST data represent surface ocean temperatures, not the temperature of the entire water column.

Synoptic views of surface concentrations of chlorophyll a were derived from the Sea-viewing Wide Field of View Sensor (SeaWiFS) and the Moderate Resolution Imaging Spectroradiomater on the Aqua satellite (MODIS-Aqua). Data from these ocean color sensors were obtained from the NASA Ocean Biology Processing Group. These data sources were combined to characterize trends in chlorophyll a during 2008 and 2009; however, known discrepancies exist between the two sensors so the recent data should be considered provisional until an upcoming data reprocessing is completed. Chlorophyll a is considered a proxy for the phytoplankton biomass in the near-surface water.

Atlantic cod food habits data were obtained from the NEFSC's FHDBS (food habits) and SVDBS (fish surveys) databases. Consumption estimates represent the quantity (in weight) of red hake eaten by cod.

Indices of larval herring on Georges Bank are based on data collected from MARMAP and ECOMON plankton surveys for zooplankton and larval fish.

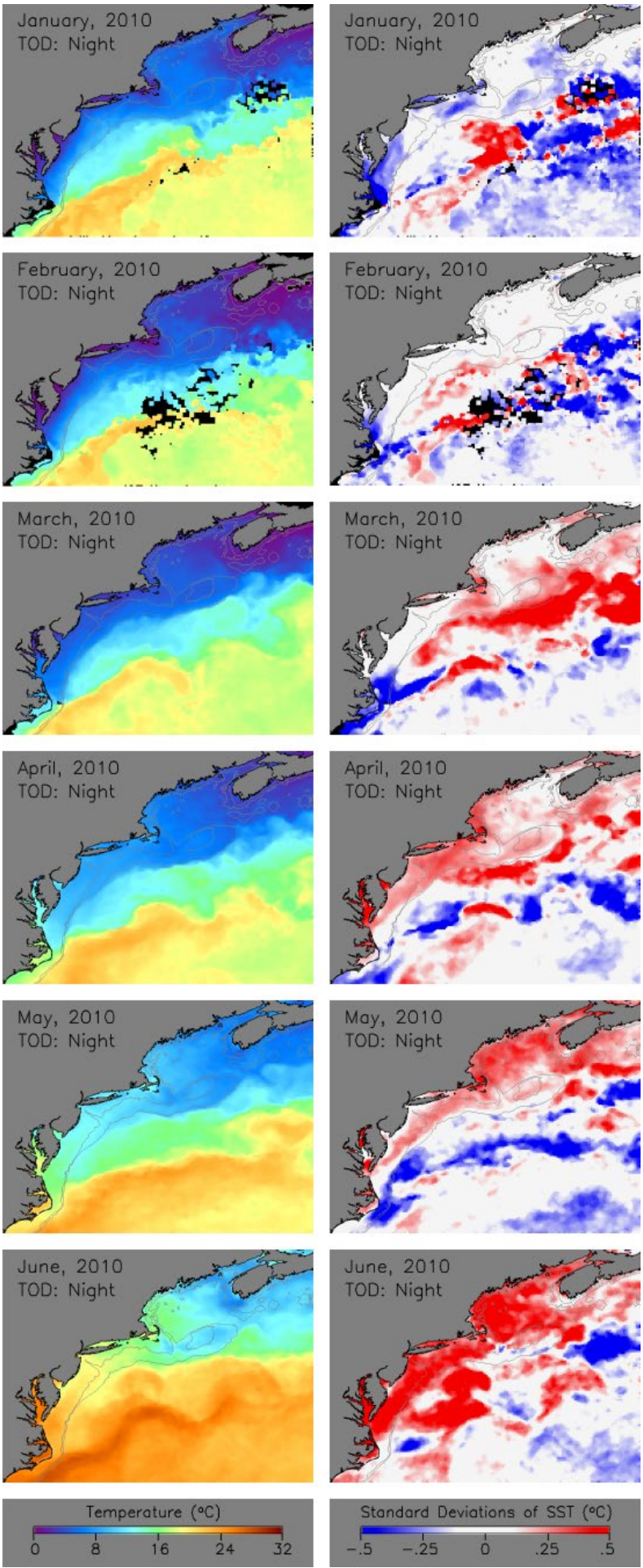
Spring Conditions



In the accompanying figure, surface temperature and chlorophyll biomass values are shown from July 2009 to June 2010.The Northeast Shelf Large Marine Ecosystem exhibited minor fluctuations in sea surface temperatures during the first half of the period. Consistently warm conditions occurred along the shelf during March through June 2010. The robust fall bloom of 2009 was followed by an exceptional spring bloom in 2010. The spring bloom in 2010 developed

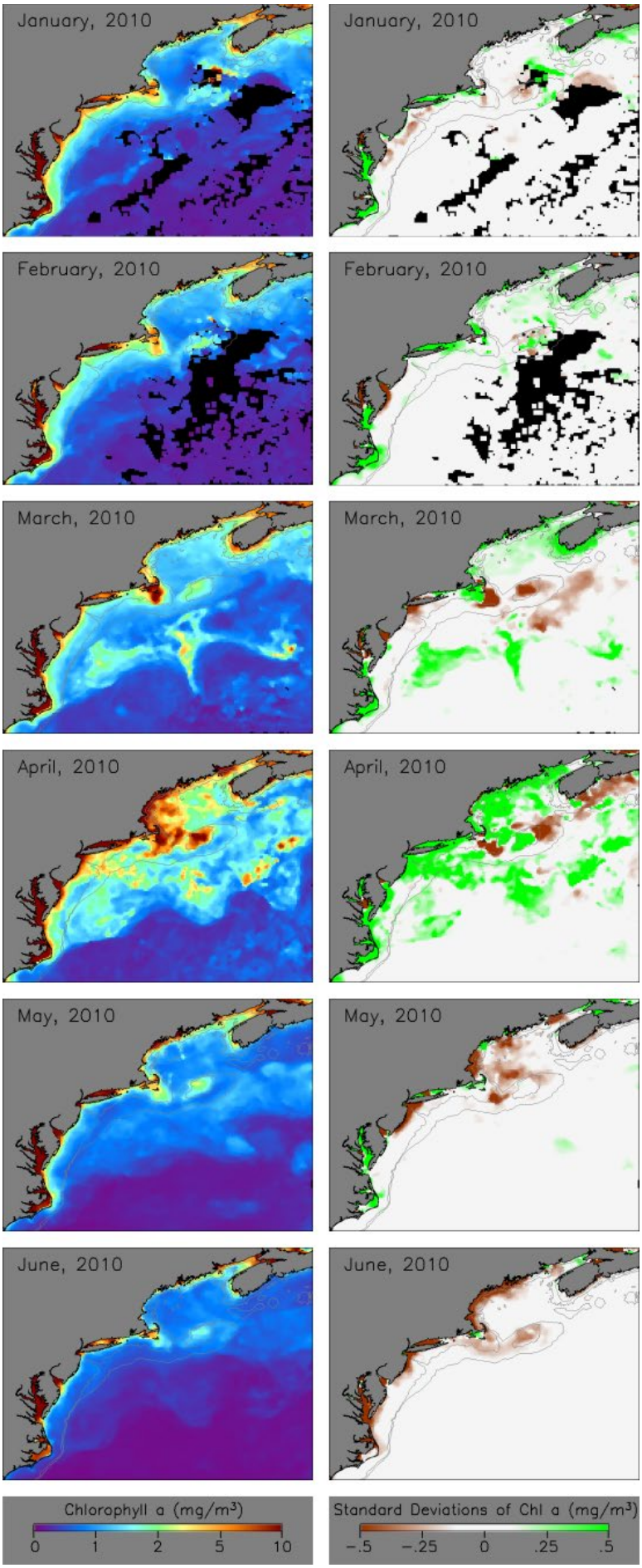
slightly later than usual and was of shorter duration than in previous years. Zooplankton biomass data were not available for this update.

Sea Surface Temperature Distributions


January, 2010
TOD: Night
January, 2010
TOD: Night
February, 2010
TOD: Night
February, 2010
TOD: Night
March, 2010
TOD: Night
March, 2010
TOD: Night
April, 2010
TOD: Night
April, 2010
TOD: Night
May, 2010
TOD: Night
May, 2010
TOD: Night
June, 2010
TOD: Night
June, 2010
TOD: Night
Temperature (°C)
0
8
16
24
32
Standard Deviations of SST (°C)
−.5
−.25
0
.25
.5

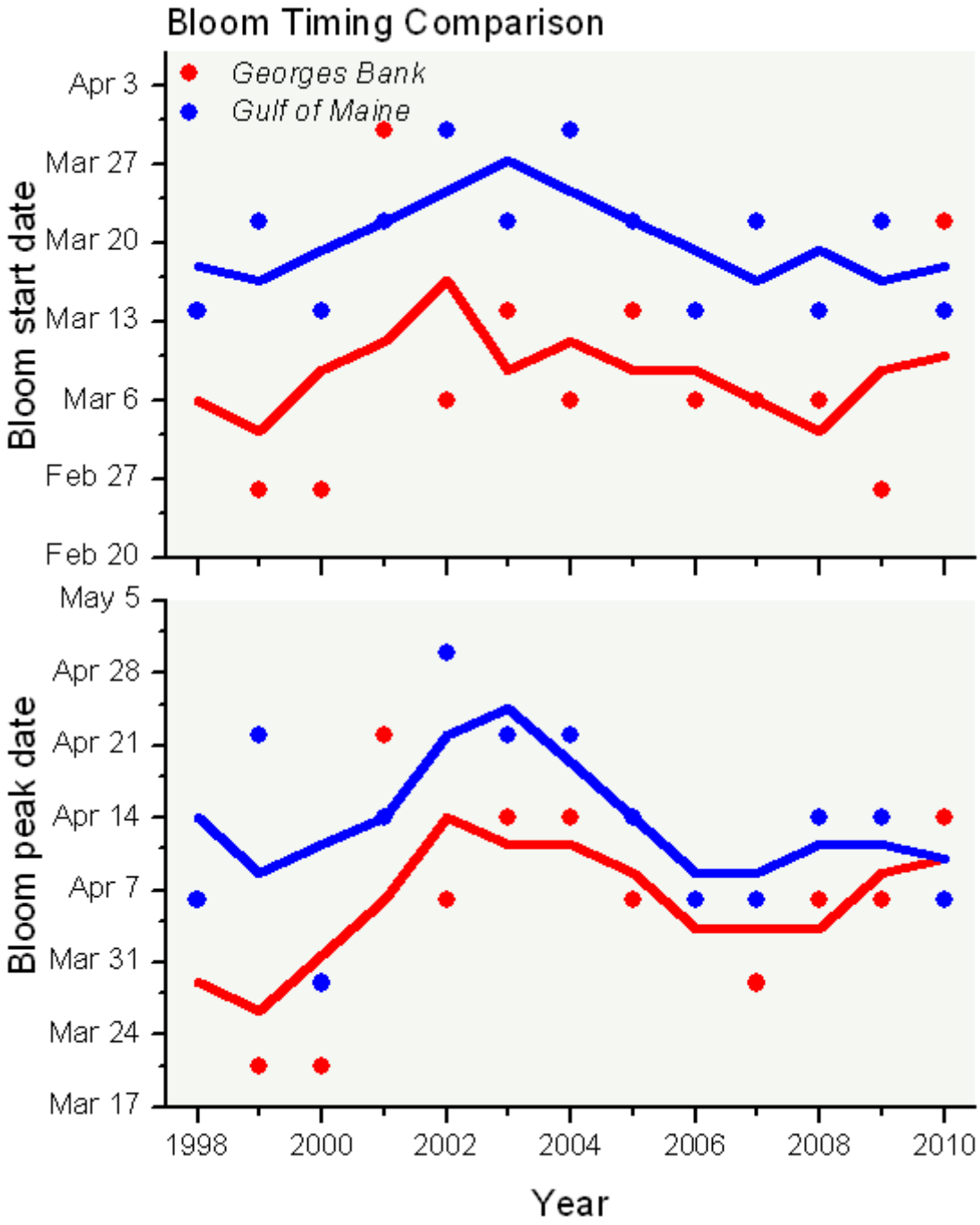
The progression of spring sea surface temperatures (SSTs) for the months of January through June 2010 are shown in the left hand set of panels. Higher SSTs appear as warm shades; low SSTs appear as cool shades. The right hand set of panels show exceptional anomalies of SST - those tending to exceed plus or minus one quarter of a standard deviation of the overall SST for the field. This type of anomaly highlights both high SSTs (the red shades) and low SSTs (the blue shades). The shelf was cooler than average in January, and exhibited average temperatures in February. But the spring warming in 2010 was exceptional, with above average temperatures over much of the shelf by April. By June, all the shelf waters were extremely warm at temperatures far above average.

Chlorophyll Distributions


January, 2010
January, 2010
February, 2010
February, 2010
March, 2010
March, 2010
April, 2010
April, 2010
May, 2010
May, 2010
June, 2010
June, 2010
Chlorophyll a (mg/m³)
0
1
2
5
10
Standard Deviations of Chl a (mg/m³)
−.5
−.25
0
.25
.5

The progression of spring chlorophyll concentrations for the months of January through June 2010 are shown in the left hand set of panels. Higher chlorophyll concentrations appear as warm shades; low concentrations appear as cool shades. The right hand set of panels show exceptional anomalies of chlorophyll concentration - those tending to exceed plus or minus one quarter of a standard deviation of the overall concentration for the field. This type of anomaly highlights both strong blooms (the green shades) and weak blooms (the brown shades). The exceptional spring phytoplankton bloom in the contiguous region of Massachusetts Bay and Nantucket Shoals observed in recent years did not occur in 2010. In 2010, the shelf phytoplankton biomass was about average through March, and slightly above average in April. After the spring bloom, phytoplankton biomass was average or below.

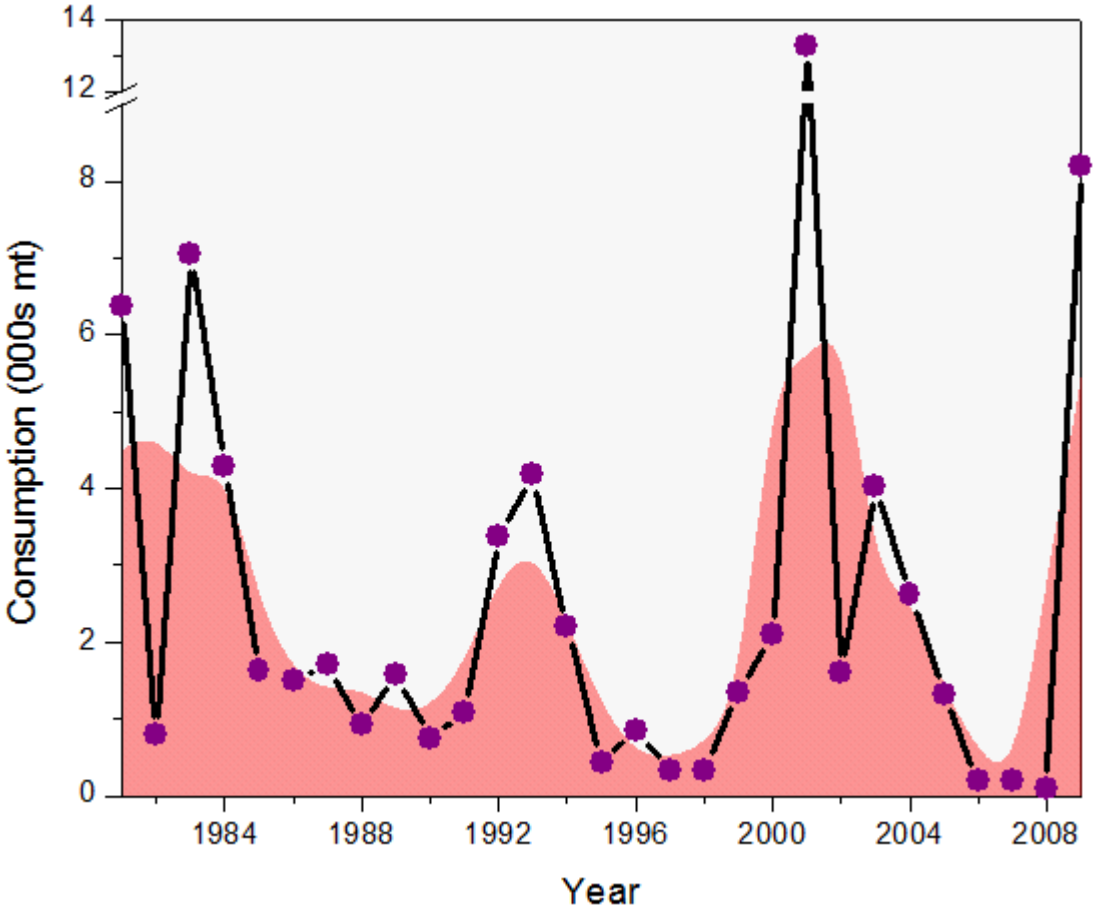
Phytoplankton Bloom Timing



In past advisories, spring bloom start and peak dates for the Gulf of Maine and George Bank areas were computed using a computer algorithm that analyzed daily chlorophyll data at fine spatial resolution. Problems with ocean color sensors this year have precluded the use of this approach in 2010. Hence, bloom start and peak dates were estimated by partitioning the production cycle based on examining 8-day chlorophyll data records. This approach yields comparable data to previous assessments and, in some cases, provides more accurate results. Historically, the Georges Bank bloom has begun a week earlier than that in the Gulf of Maine. However, in 2010, the Gulf of Maine bloom started earlier (March 14) than that on Georges

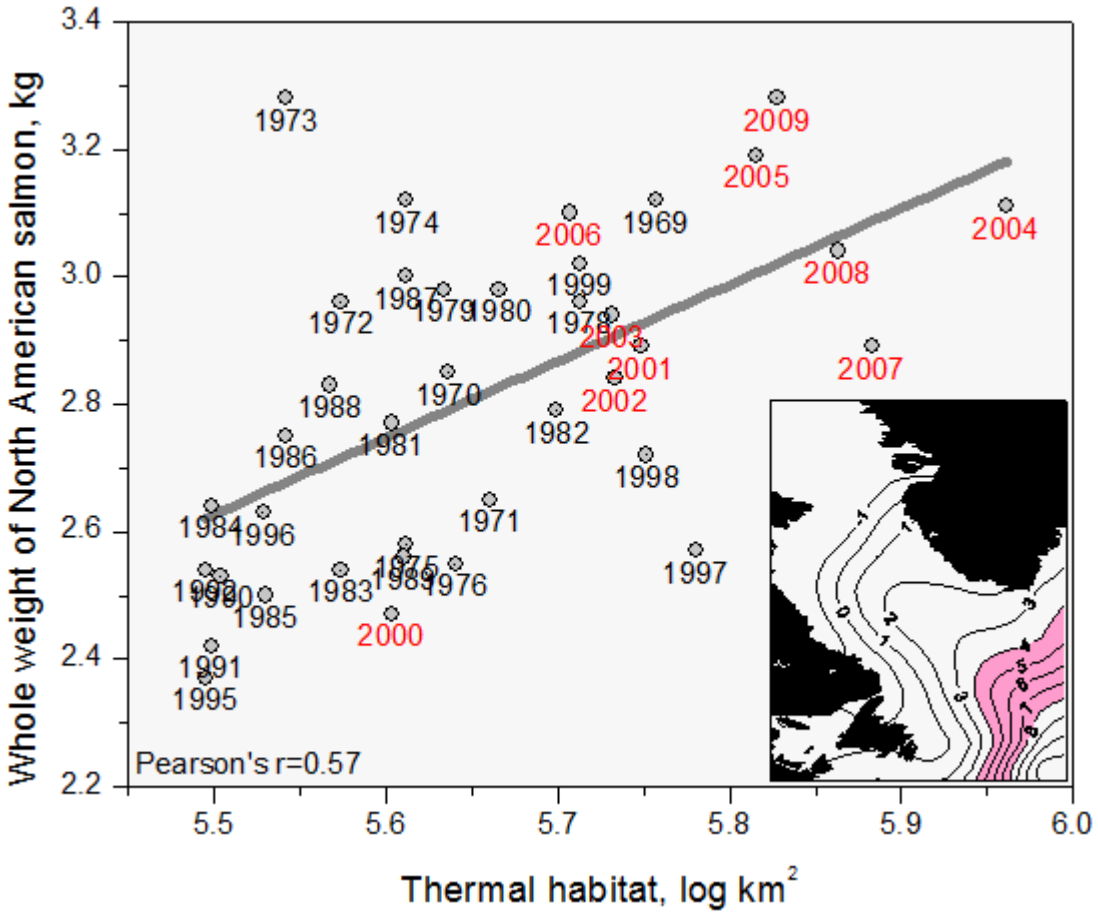
Bank (March 22). The bloom peak dates in 2010 followed the same pattern, earlier in the Gulf of Maine (April 6) than on Georges Bank (April 14).

Patterned Consumption of Red Hake by Atlantic Cod



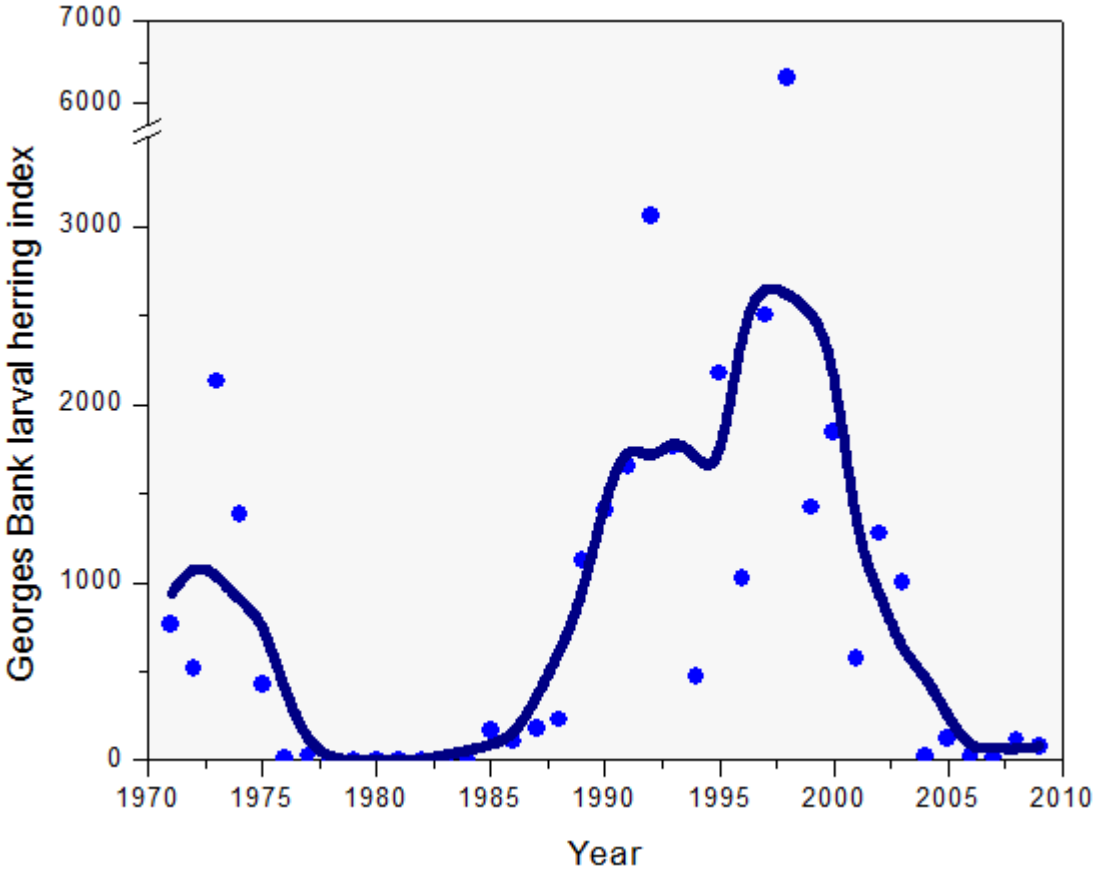
A highly patterned decadal periodicity in the consumption of red hake by Atlantic cod was revealed in a recent analysis of the NEFSC food habits database (See accompanying figure). The reason for this decadal oscillation are not yet known, but short period forcing occurs throughout nature and appears to be evident in this aspect of the Northeast Shelf LME.

Habitat in the Labrador Sea and North American-Origin Atlantic Salmon



Climate affects Atlantic salmon in many ways in both freshwater and oceanic environments. Despite poor marine survival of salmon in recent years, the size at age of salmon has been increasing. This increase in weight at age appears to be related to the amount of thermal habitat in the Labrador Sea during late winter and spring. This relationship is illustrated in the bivariate scatter between thermal habitat estimates and whole weight of North American fish captured at West Greenland (see figure). Thermal marine habitat for salmon is a measure of the variation in the surface area of the ocean between the 4°C and 8°C isotherms (see figure inset). The observed increase in salmon growth should translate into an increase in reproductive output. However, as long as climate continues to negatively affect survival during other parts of the salmon life cycle, salmon abundance will continue to decline.

Atlantic Herring Larval Index on Georges Bank Continues to Be Low



An index of larval Atlantic herring abundance on Georges Bank has remained low for a sixth consecutive year. The index is derived from plankton sampling from multiple ichthyoplankton monitoring programs, and only pertains to the Georges Bank spawning component of the herring population.