Ecosystem Fluctuations and Fisheries

From ocean-colour radiometric data collected by satellite, spatial fields of chlorophyll pigment (an index of the biomass of phytoplankton) can be produced on regional scales with resolution of one week and one kilometre. They can be used to characterise the seasonal dynamics of the phytoplankton in a given year at the same resolution. A striking application of such data comes from fisheries oceanography, where the significance of the dynamics is that many commercially-important fish species (including invertebrates) reproduce near the seasonal peak in phytoplankton abundance (the spring bloom). But the timing of the seasonal peak varies between years by as much as six to eight weeks. Do these ecosystem variations have any significance for the fishery? Remotely-sensed data allow us to document the inter-annual fluctuations in timing with great clarity. In an application on the Nova Scotia Shelf, the phytoplankton dynamics were studied for the entire available data series of ocean colour available until now. A parallel series, collected by sampling *in situ*, was also available for the larval survival of the haddock, an important commercial fish species. Comparison of these two independent series revealed that highly-successful year classes of haddock were associated with exceptionally early spring blooms of phytoplankton. This result was the first direct test of a long-standing hypothesis in the fisheries literature (the Cushing-Hjort hypothesis). It offers the possibility that the ecosystem-associated component of the variability in fish stocks might be separable from other components, such as exploitation by man or predation by seals. Note that serial data permit the extraction of value-added products, in this case the phase properties of the seasonal biological cycle.

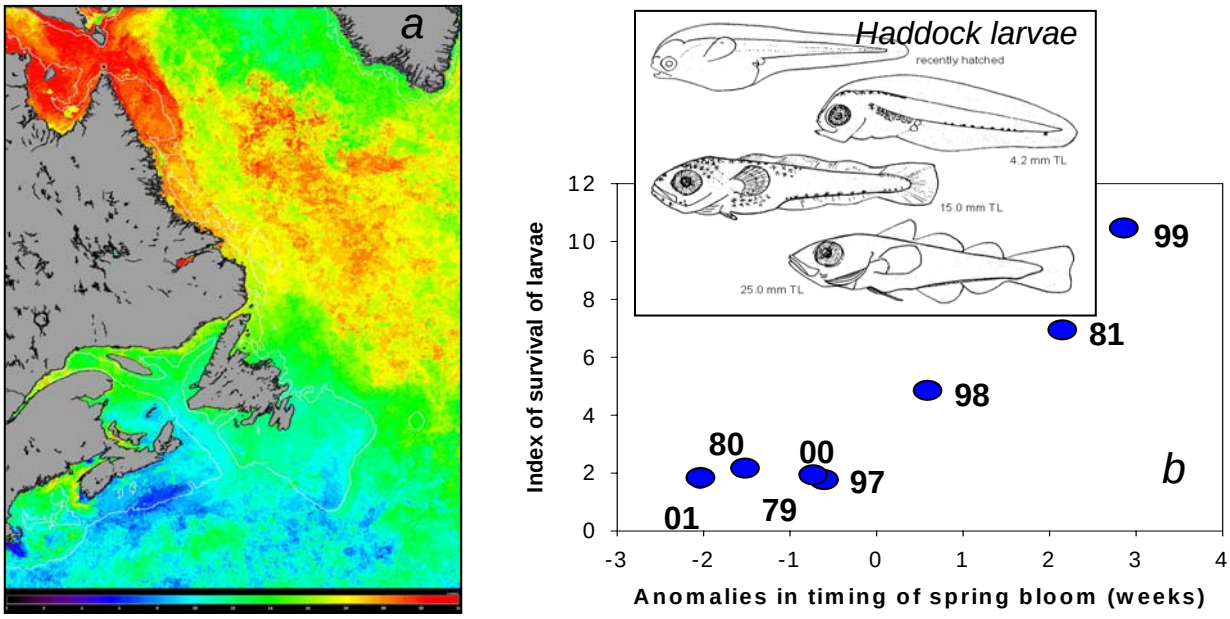

Figure (a) shows timing of the spring phytoplankton bloom peak in the Northwest Atlantic (derived from NASA SeaWiFS data). Colours change from blue indicating early (March) to red indicating late (July). (a) Relationship between survival index (normalized to recruitment) of haddock larvae and local anomalies in bloom timing. Data from the continental shelf east of Southern Nova Scotia (Canada) for the periods 1979 – 1981 and 1997 – 2001. Adapted from Platt *et al.*, Nature, 423: 398-399, 2003.