Abstract

The Strait of Georgia is a highly productive, semi-enclosed, marine ecosystem lying between Vancouver Island and mainland British Columbia. The Strait receives large quantities of fresh water from the Fraser River with peak values occurring almost simultaneously with the start of the Fraser River freshet. In 2002 and 2003 blooms occurred when the Fraser River freshet was delayed. The predominant winds are weaker than those in the Strait of Juan de Fuca, has show that the 2002 and 2003 blooms occurred before the start of the freshet. A review of late 1990’s data suggest a similar timing. We will present the evidence for a revision of the model and suggest an updated one.

Observations of the Timing of the Spring Bloom

The figure shows, for six years, the Fraser River outflow as a line, the peak of the bloom (marked *) in the southern Strait of Georgia and the time at which the outflow from the Fraser River reaches twice its winter average value (marked with an arrow).

In each year the peak of the bloom occurs before the freshest state (it is close in 2003). So the stratification provided by the Fraser River outflow is needed to start the spring bloom. The timing of the spring bloom must be independent of the timing of the freshet.

Discussion

The black line on the 2002 data figure light panel is the light intensity required at the surface in order for the average mixed layer illumination to equal the saturation value for Thalassiosira. Thalassiosira is the first diatom species to bloom in the spring. This data would suggest that Thalassiosira should bloom much earlier.

The figure shows irradiance (per and density (significance of light in January 2003). The saturation intensity for Thalassiosira is 14 W m^-2 and the compensation point is 4 W m^-2. The combination gives a Scheffer depth of 20 m.

Thus in a simple system one would expect a spring bloom could occur in January in the Strait of Georgia. We believe the the missing pieces are advective and turbulent loss of phytoplankton from the upper layer, and temperature effects on growth. The Strait of Georgia system is stratified by the Fraser River outflow (even at low water values) and mixed by episodic wind events. Thus the mixed layer is highly variable, less than 1 m during calm periods and 5 to 10 m during mixing. Secondly the surface circulation leads to a loss of surface water from the system. Thirdly, January sea surface temperatures are low and so diatom growth rates will be reduced.

Conclusions

1. The spring bloom occurs before the beginning of the Fraser River freshet and thus the timing of the freshet is not linked to the timing of the bloom.

Hypothesis

The spring bloom is suppressed in January due to:

• Temperature limitations on growth

• Integrated effect of rapid variations in light intensity

• Detrainment from the rapidly varying mixed layer

• Advection loss due to estuarine flow

References


