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Tidal variations in phytoplankton biomass and seston in a Northern Brittany estuary: "ebb-flood" asymmetry.

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In order to obtain a better understanding of the relationship between chlorophyll a, seston, salinity and tidal cycle in the Dourduff ria (Northern Brittany), the short-term variations on some biological and hydrological parameters were studied at a "fixed-point" during 22 consecutive hours in July 1980.

The sampling station was located in the upper part of the estuary where the tidal amplitude could reach 9 m at spring tides and changes in salinity range from 0–2 ‰ to 33–34 ‰. The water samples were collected with a 5 l horizontal water sampler every 15 or 30 minutes during both daytime and night on 2nd–3rd July 1980. Only the data concerning surface samples are considered here. Chlorophyll a (CHL) and

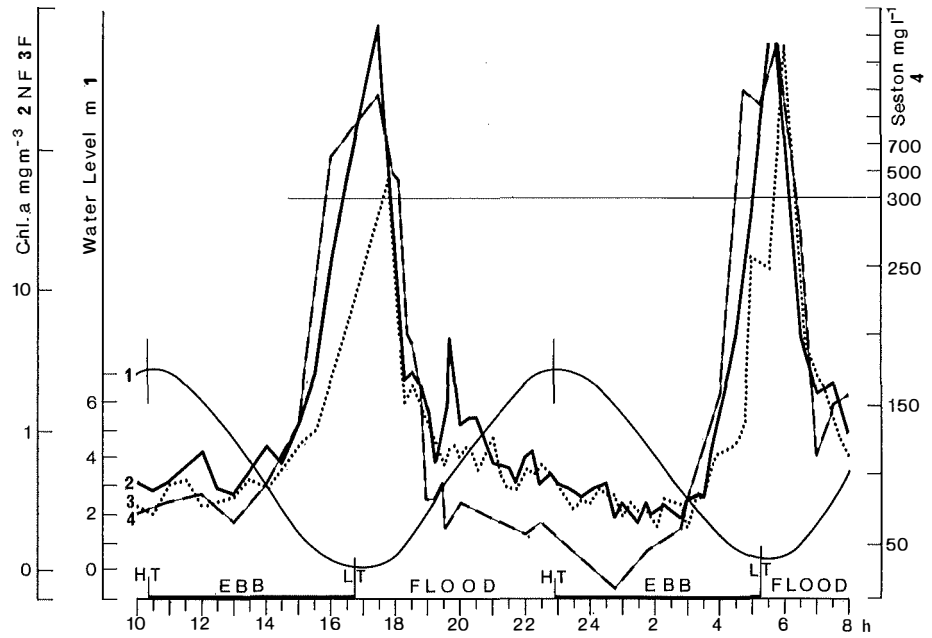

Figure 1

Tidal variations in phytoplankton biomass, seston and water level
CHL NF = Total phytoplankton biomass
CHL F = Nanophytoplankton biomass
H.T. = High tide
L.T. = Low tide

Phaeophytin a (PHAEO) of both net and nanoplankton, the latter separated by a 30 µm bolting silk, were measured according to the method of YENTSCH and MENZEL (1963) using a Turner 111 fluorimeter equipped with an R 136 phototube. Pigment concentrations were calculated using LORENZEN's (1966) equations. Seston was measured according to the method of BANSE et al. (1963). A thermosalinometer (courantometer Braystoke B.f.M. 0.10) was used to measure the salinity.

Very large variations occurred over a tidal cycle (Fig. 1). The level of the biological parameters increased sharply towards low tide. This phenomenon (GRALL 1972, RIAUX 1980) shows a secondary asymmetry between the ebb and the flood periods: both during daytime and at night the seston and CHL decrease more rapidly during the flood than they increase during the ebb. On the other hand, salinity and water level increase rapidly during the flood and decrease more gradually during the ebb (Fig. 1). This asymmetry can be accounted for by the dynamics of this estuary where the ebb lasts longer than the flood. The very high peaks of CHL and seston are linked to the salinity drop due to the river contribution and the high seston peak is more related to the ebb silt resuspension. Therefore, the CHL/Seston ratio decreases gradually during the ebb and increases rapidly during the flood (Fig. 2).

The CHL/PHAEO ratio followed the same trend as CHL/Seston, which indicates that silt resuspension transports high concentrations of degraded pigments. No significant difference was found in the tidal variations in nano- and microphytoplankton biomass.

The control of CHL and seston distribution by tidal cycle has been demonstrated in the St. Lawrence estuary (THERRIAULT and LACROIX 1976; DEMERS et al. 1979) where the cell dispersion is partly related to physical processes. In the Dourduff ria, where

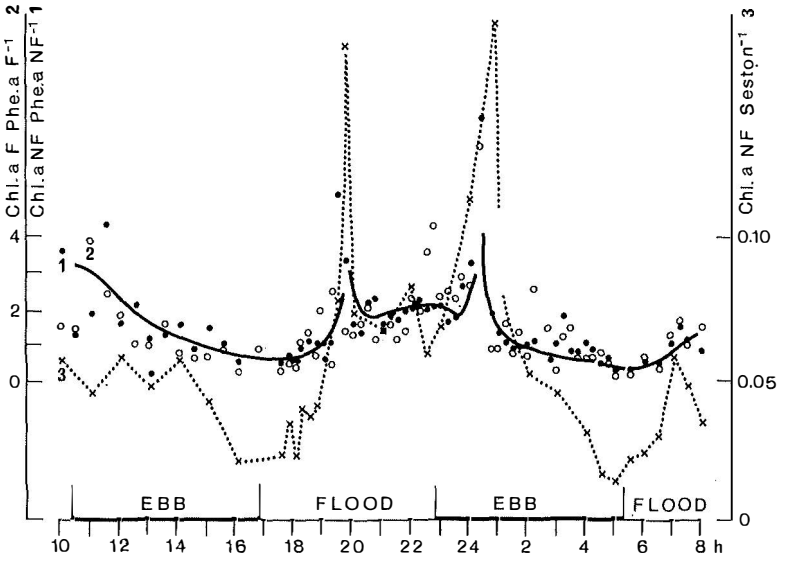

Figure 2

Tidal variations in CHL/Seston and CHL/PHAEO ratios
PHE NF = Total phytoplankton degraded pigments (Phaeophytin *a*)
PHE F = Nanophytoplankton degraded pigments (Phaeophytin *a*)
For explanation of other symbols see Fig. 1

the tidal amplitudes are very important and freshwater flow insignificant, the CHL maximum appears during the "late ebb" period (Fig. 3) and seems to be controlled by 2 factors:

– The first is the decelerating tidal phase that induces the maximum resuspension (GORDON 1975). BAILLIE and WELSH (1980) describe such a cyclic resuspension of epipelic algae in the Branford estuary, which is responsible for the very high CHL peaks.

– The other factor is that the river discharge (2 m^3/s), containing a high level of terrestrial nutrients, can highly favorise the euryhaline species growth in the brackish waters that flow out at low tide.

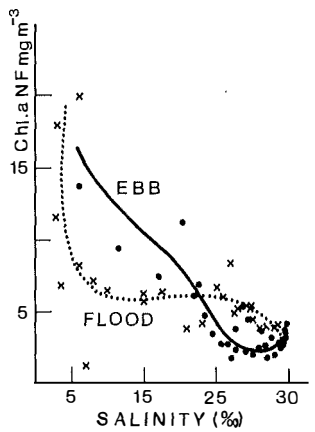

Figure 3
"Ebb-flood" variations in CHL *a* and salinity

A correspondence analysis performed on the collected data summarizes most of the above observations.

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