trile extracts (A.D., unpublished results). Thus, an appropriate pH and an environment allowing initiation of polymerization, possibly involving lipid, can account for the formation of parasite haemozoin.

Bendrat *et al.* leave open the possibility that a haem polymerase enzyme may yet be found to exist in the parasite. We have previously postulated that protein(s) may serve as a structural focus about which the initiation of haem polymerization might occur[1]. However, we stress that there is no evidence yet for a haem polymerase enzyme as such, and that there is no need to invoke one to explain the currently available data.

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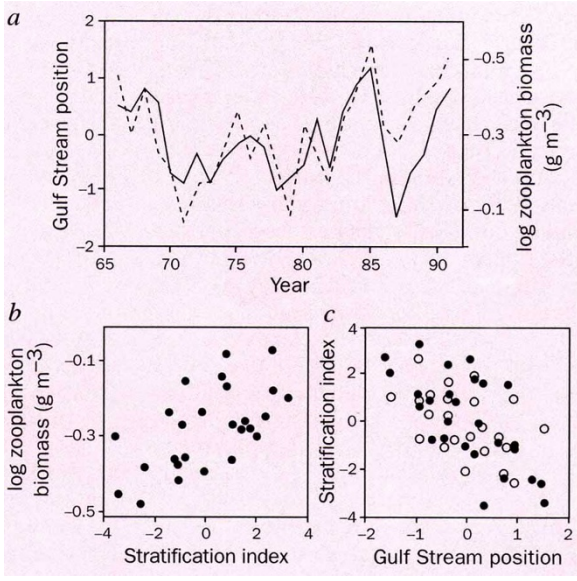
UK lake plankton and the Gulf Stream

SIR — Recent studies suggest that plankton succession in temperate lakes is strongly influenced by year-to-year variations in the weather[1]. Here we show that the interannual variations in the average summer biomass of zooplankton in Lake Windermere between 1966 and 1991 were closely correlated with north–south displacements of the Gulf Stream in the western Atlantic. The mediating factor seems to be subtle changes in the early summer weather which influence both the onset of thermal stratification and the growth of edible algae. Whereas similar responses can be seen in the seas around the European Shelf[2], Lake Windermere seems to be a particularly striking integrator of climatic events.

Lake Windermere is the largest lake in the English Lake District (54° 22′N, 2° 56′W), and is divided into two distinct basins by a large island. Temperature profiles have been recorded in the North Basin (area 8.05 km^2, mean depth 25 m, maximum depth 64 m) since 1935 and samples of crustacean zooplankton collected at fortnightly intervals since 1940. Monthly charts of the position of the north wall of the Gulf Stream have been published for the period 1966–91, based on data from surface, aircraft and satellite observations. An index of Gulf Stream latitude was constructed from these charts using principal components analysis[2].



a, Logarithm of the mean summer (May–September) biomass of zooplankton in the North Basin of Lake Windermere (inverted, solid line) compared with the latitude of the north wall of the Gulf Stream (broken line). A linear trend has been removed from the biomass data. *b*, Scatter plot relating zooplankton abundance in Lake Windermere to the index of stratification. The zooplankton samples were collected and analysed as in ref. 6. Correlation coefficient, *r*, 0.59. *c*, Scatter plot relating the index of stratification to the position of the north wall of the Gulf Stream. Closed circles show data from Lake Windermere, open circles those from Esthwaite Water. Calculations for Esthwaite Water used the 11° and 12° C isotherms. Values of *r* are 0.65 and 0.56, respectively, for Lake Windermere and Esthwaite Water. Each *r* value has $P<0.01$ after allowing for serial correlation (as in ref. 3).

Correlations between marine plankton abundance and the position of the Gulf Stream seem to be related to local variations in the intensity of thermal stratification[2,3], so similar effects might be anticipated in inland waters on the European Continental Shelf. There is a strong negative correlation between the summer biomass of zooplankton in the North Basin of Lake Windermere and the latitude of the Gulf Stream (see *a* in the figure). An important factor influencing the seasonal dynamics of zooplankton in Lake Windermere is the timing and intensity of thermal stratification[4]. When the lake becomes stratified in early summer, the growth of edible algae occurs before the zooplankton are able to lay their full complement of eggs, whereas if the lake becomes stratified later in the summer, the growth of edible algae is delayed and there is a better match between the zooplankton and their food.

These effects of early summer stratification can be illustrated by analysing the thermal characteristics of the lake at the beginning of June. A general index of onset of stratification was obtained by combining three measurements from early June profiles: the depth of the maximum temperature gradient, the rate of deepening of the 9° isotherm and the difference in depth of the 9° and 10° isotherms. These measurements were combined to form the index by subtracting the mean, dividing by the standard deviation, and then subtracting the last measurement (which decreases with intensity of stratification) from the sum of the first two (which increase with intensity of stratification).

The relationship between the biomass of zooplankton and this empirical index of stratification (*b* in the figure) shows that when the lake becomes thermally stratified in early summer, the biomass of zooplankton is much lower than when the lake becomes stratified later in the season. The year-to-year variations in thermal stratification of Lake Windermere are in turn closely correlated with the north–south movements of the Gulf Stream (part *c* in the figure). When the Gulf Stream is displaced northward, the early summer thermocline is shallower and better defined than when the Gulf Stream moves south. Similar relationships have been recorded in other thermally stratified water bodies. The stratification calculated for Esthwaite Water, a much smaller and shallower lake in the same area, is also shown in part *c* in the figure.

We believe that the results reported here and in the marine plankton demonstrate a hitherto unsuspected link between weather patterns around the United Kingdom and oceanic events at the other side of the Atlantic[3]. In agreement with this, long-term changes in the productivity of above-ground vegetation at Bibury, Gloucestershire, UK, have been shown to correlate with Gulf Stream northerliness[5]. In all these cases the signal appears more strongly in the biological data than local meteorological observations. The data from Lake Windermere have the advantage of indicating how weather variations can be integrated by physical and biological processes, and may provide a sensitive measure of regional climate change.

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