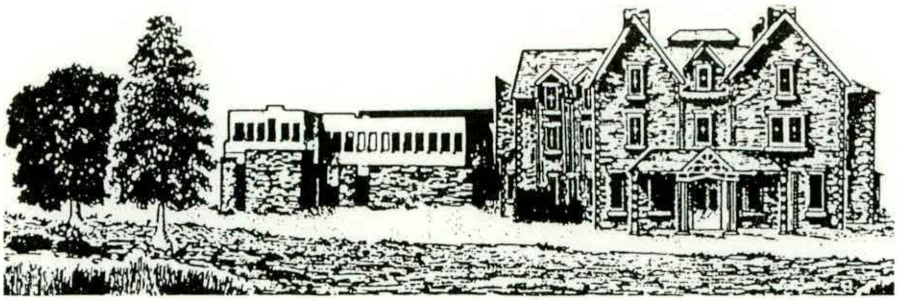
FRESHWATER
BIOLOGICAL
ASSOCIATION



The **Freshwater Biological Association** is the leading scientific research organisation for the freshwater environment in the United Kingdom. It was founded in 1929 as an independent organisation to pursue fundamental research into all aspects of freshwater biology and chemistry. The FBA has two main laboratories. The headquarters is at Windermere in the Lake District and the River Laboratory is in the south of England. A small unit has recently been established near Huntingdon to study slow-flowing eastern rivers.

The FBA's primary source of funding is the Natural Environment Research Council but, in addition, the Association receives substantial support from the Department of the Environment and the Ministry of Agriculture, Fisheries and Food who commission research projects relevant to their interests and responsibilities. It also carries out contracts for consulting engineers, water authorities, private industry, conservation bodies, local government and international agencies.

The staff includes scientists who are acknowledged experts in all the major disciplines. They regularly attend international meetings and visit laboratories in other countries to extend their experience and keep up to date with new developments. Their own knowledge is backed by a library housing an unrivalled collection of books and periodicals on freshwater science and with access to computerized information retrieval services. A range of experimental facilities is available to carry out trials under controlled conditions. These resources can be made available to help solve many types of practical problems. Moreover, as a member of the Terrestrial and Freshwater Sciences Directorate of the Natural Environment Research Council, the FBA is able to link up with other institutes to provide a wider range of environmental expertise as the occasion demands. Thus, the FBA is in a unique position to bring relevant expertise together for problems involving several disciplines.

Recent contracts have involved a wide variety of topics including biological monitoring, environmental impact assessment, fisheries problems, salmon counting, ecological effects of reservoirs and other engineering works, control of water weeds, control of insect pests and effects of chemicals on plants and animals.

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Turbidity and plant growth in large slow-flowing lowland rivers.

Progress Report: March 1989
Dr A.F.H. Marker

The Institute of Freshwater Ecology is part of the Terrestrial and Freshwater Sciences Directorate of the Natural Environment Research Council.

1. SUMMARY

The period covered by this first report has been used to develop specific methodology and instrumentation for measuring turbidity, suspended solids and underwater irradiance for conditions found in the middle abd lower reaches of the River Great Ouse. Sampling strategies have been developed and an extensive sampling programme is now underway covering phytoplankton, suspended solids and turbidity in relation to algal epiphyte growth on underwater macrophytes. Preliminary data are presented relating light levels on the river bed to the river bed profile, turbidity levels and phytoplankton chlorophyll a concentrations. Studies are underway concerning the extent of macrophyte cover and periphyton densities.

2. INTRODUCTION

The River Great Ouse is a highly managed large lowland river in eastern England. It drains rich arable land in the Midlands and Eastern England and over the years nutrient concentrations have increased and there is a general perception that the clarity of the water has decreased. The main river channels have been dredged a number of times partly for flood control reasons but also for recreational boating and navigation activities. The purpose of the contract is to investigate the seasonal variations and causes of turbidity and their effects on aquatic plants and the associated periphytic organisms. Particular attention is being paid to the distribution of macrophytes and the seasonal variation of periphytic organisms in relation to channel size and structure.

3. METHODS

3.1. Electronic data logging and recording.

Two electronic data loggers have been built in the workshop at IFE Windermere, the first just before the programme started and the second has just been completed. The instruments may be used for remote logging or the instantaneous recording of field data with the operator present. "Intelligence" is provided by an all-weather Husky Hunter or Microscribe microcomputer. They are capable of simultaneously recording turbidity, light, dissolved oxygen, water depth and temperature. The sensors described below are all used with these loggers.

3.1.1. Irradiance measurements have been made with two Skye quantum sensors. Vertical extinction coefficients have been recorded at least weekly and often more frequently. A multiple sensor has recently been constructed in the IFE Windermere workshop and will be used extensively in the coming year. Essentially in-coming light is estimated from the output of four photodiodes after restriction by broad-band interference filters of nominal 40nm bandwidth. The points of maximum light transmission of these filters is 400, 450, 550 and 650nm. Use is also being made of a much older manually operated Isco spectroradiometer.

3.1.2. Turbidity is being measured much more extensively using Partech sensors, also fitted to the data recorder. Good calibrations have been derived relating turbidity to the vertical extinction coefficients (Fig 1). Considerable effort has been placed on accurate calibration and extensive information has been derived on the causes of baseline drift.

3.1.3. Temperature is measured by Grant thermisters.

3.1.4. Dissolved oxygen is measued by either Phox or LTH electrodes.

4. FIELD SAMPLING, RESULTS AND DISCUSSION

4.1. Phytoplankton. Sampling for phytoplankton has initially been concentrated on three reaches of the River Great Ouse between Offord (Nat. Grid Ref. TL217672) and Needingworth (Nat. Grid Ref. TL361713). Maximum phytoplankton chlorophyll a concentrations were observed in May 1988 but, apart from minor fluctuations in the later summer, concentrations gradually dropped from then on to reach a minimum in late autumn and early winter. Minor increases in the winter were during periods of high turbidity (Fig 3) following rain with the consequent wash out of sediment. Seasonal variations were remarkably similar at the three sites but in the late summer and autumn concentrations were lowest at the most downstream site (Needingworth).

4.2 Turbidity. Throughout this study we have used the twin beam sensors made by Partech. They are more accurately described as suspended solids monitors rather than turbidity sensors which measure light scattered at right angles to the main beam. In this study Partech sensors have been used as a quick method of measuring the clarity of the water since changes can occur very rapidly in rivers. Fig 3 shows the the seasonal changes in turbidity over a nine month period. From mid-summer turbidity gradually dropped and by autumn the water was perceptibly clearer at all sites. The extent of the drop in the late autumn and early winter was in part due to lack of rain in the catchment area in 1988.

4.3 Channel morphology. The cross sectional morphology of the river was estimated at three sites in the main navigation channel and at three sites in adjacent side channels. The presence of emergent marginal and submerged macrophytes were also noted as well as their depth penetration. Estimates of turbidity and the vertical extinction coefficient were then used in conjunction with these depth profiles to estimate light transmission at the river bed. Data for one site have been collated and are shown in Figs 4 and 5 for the nine months between July 1988 and March

1989. The increase in light transmission can be clearly seen between July and November, but even during the period of maximum light tansmission (November) most of the river bed receives less than 20% of the subsurface illumination. In mid-summer light transmissions were generally below 10%.

4.4 Periphyton and macrophyte growth. Due to the requirements of land drainage and recreational navigation (boating) the main channels have been dredged and the river bed slopes steeply away from the banks, and is mostly over 1.5 metres deep. Average depth is about two metres. The banks are typically fringed by _Phragmites_, _Glyceria_, _Scirpus_ and overhanging trees but there are also extensive unfringed banks with exposed clay showing. Submerged macrophytes (eg _Nuphar_ and _Sparganium_) do not appear to grow below 1.5 metres and hence are generally confined to a narrow area just beyond the fringing emergent macrophytes. Preliminary studies on epiphytic algal densities have been made on the fringing emergent macrophytes, _Scirpus_ and _Phragmites_. Limited data are shown in Table 1.

Table 1

Densities of epiphytic algae on Scirpus and Phragmites stems, expressed as µg chl. a. cm^{-2} .

Site	Host	Date	mean	95% conf. limits upper	lower
Lees Brook	Scirpus	November	9.66	12.24	7.62
side channel	Scirpus	December	4.50	8.83	2.50
	Scirpus	January	2.89	5.42	1.55
Great Ouse	Scirpus	October	3.76	4.79	2.95
main river	Scirpus	November	12.16	17.18	8.61
	Scirpus	December	8.71	17.13	4.43
	Scirpus	January	3.53	5.97	2.08
	Phragmites	January	4.64	6.06	3.56

5. Research programme for 1989-90

5.1 Two loggers will be installed on the bank of the Ouse, the first in the main navigation channel, the second in a smaller side channel. Turbidity dissolved oxygen, temperature and water depth will be monitored.

5.2 Investigations into the transmission of light to the bed of the river and its side channels will continue and be related to the distribution of macrophytes and the morphology of the river bed. More specific information on light transmission will be obtained from a spectroradiometer and a new submersible sensor fitted with broad band interference filters (transmission maxima at 400, 450, 550 and 650nm).

5.3 Turbidity and phytoplankton densities will be measured weekly at nine sites between St Neots and Earith.

5.4 The growth and seasonality of epiphytic algae will be studied at two sites.

5.5 Chemical data from Anglian Water will be collated from the Offord and Clapham intakes.

Fig 1. Relationship between turbidity and the vertical extinction coefficient,

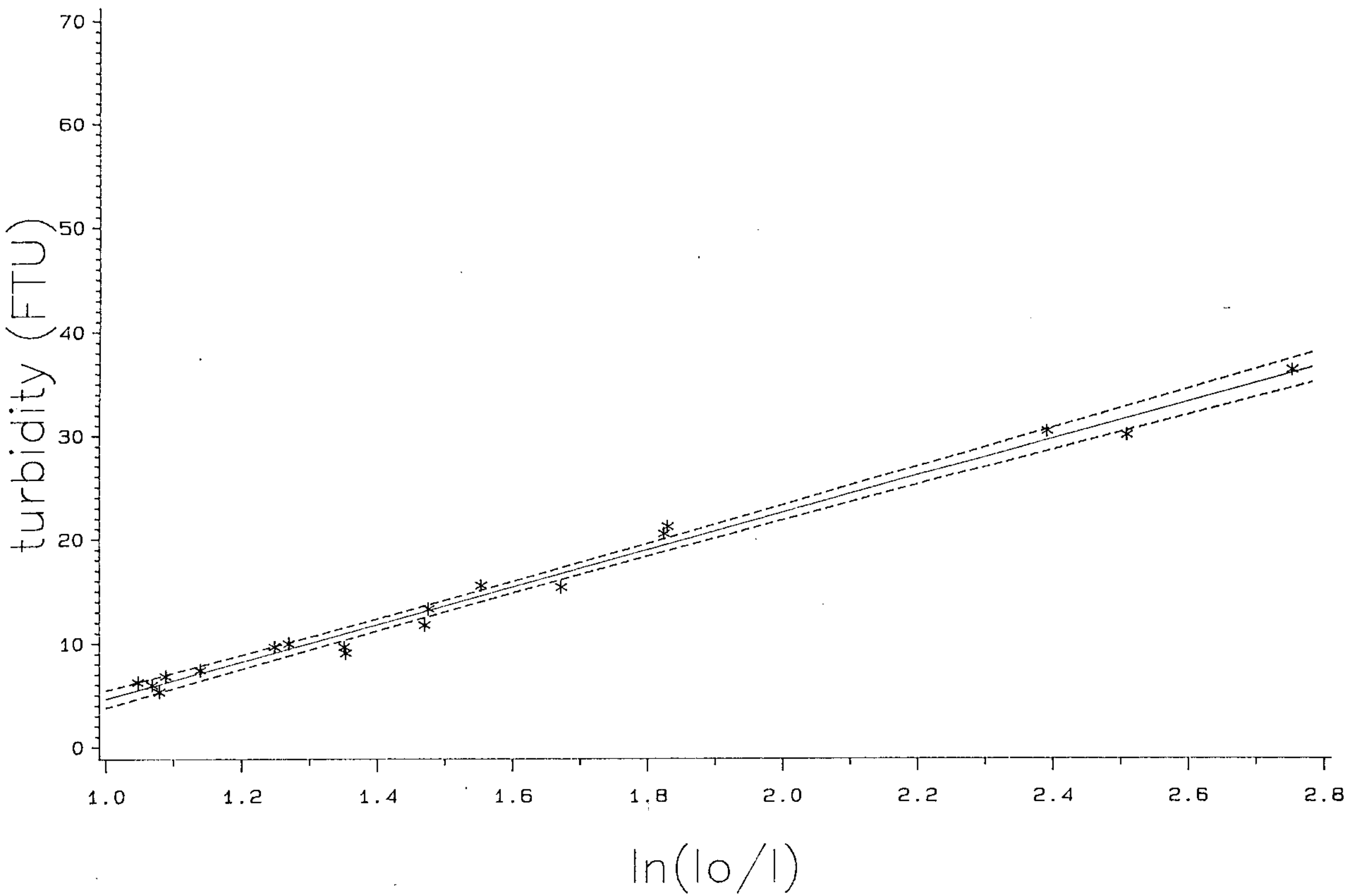


Fig 2. Seasonal variation in the Great Ouse phytoplankton chlorophyll—a

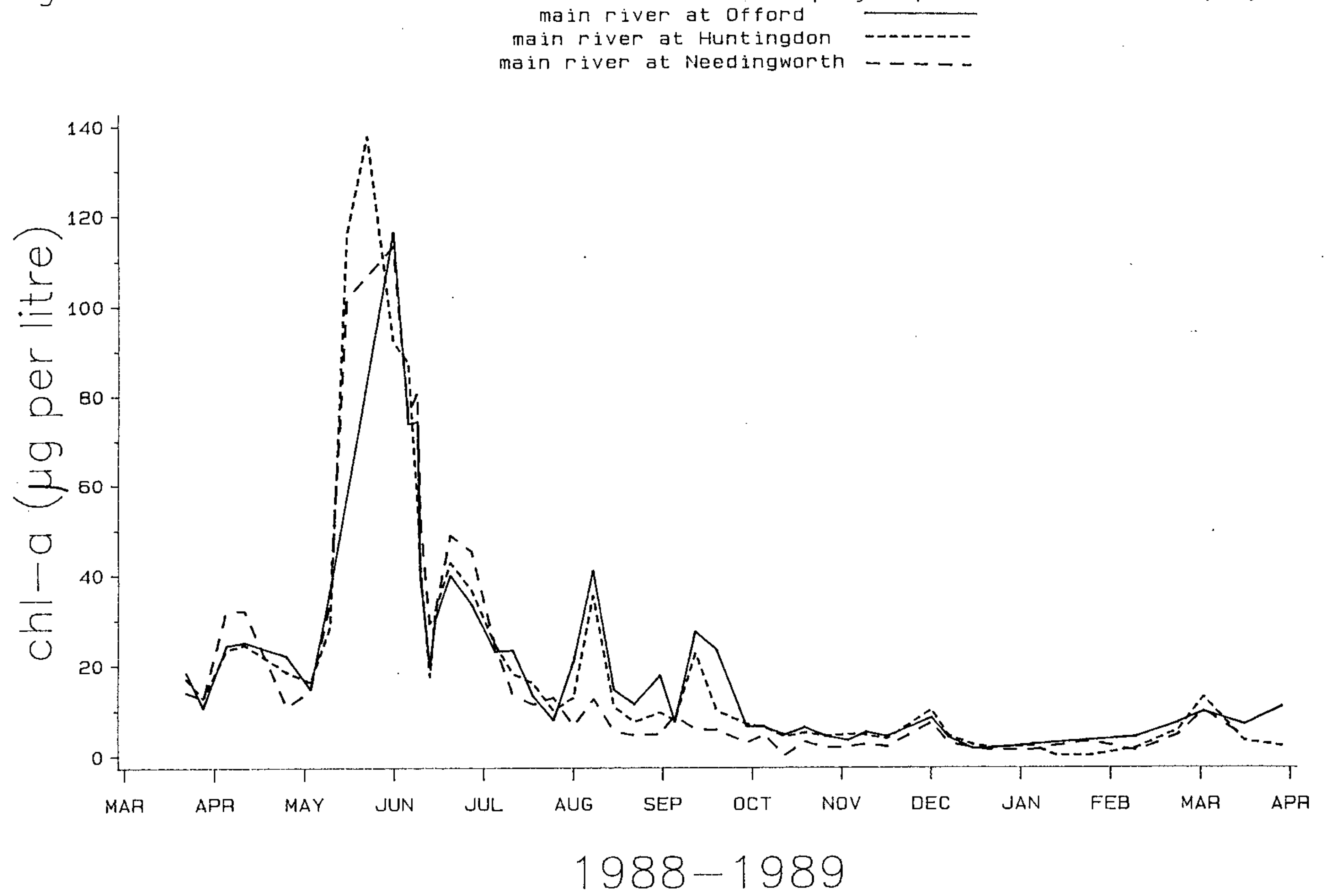


Fig 3. Seasonal variation in the turbidity of the Great Ouse

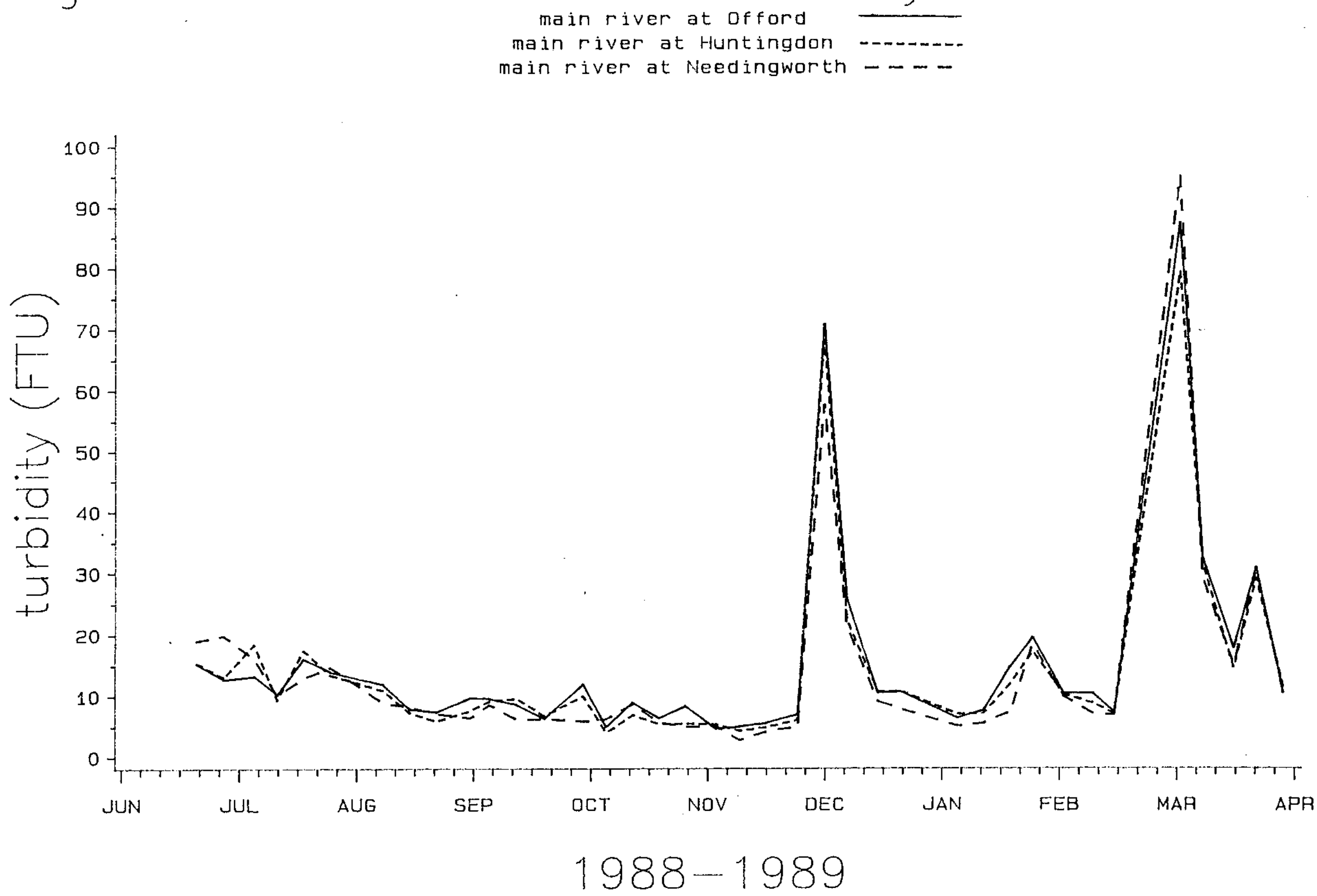


Fig 4. Irradiance levels on the river bed of the Great Ouse in 1988

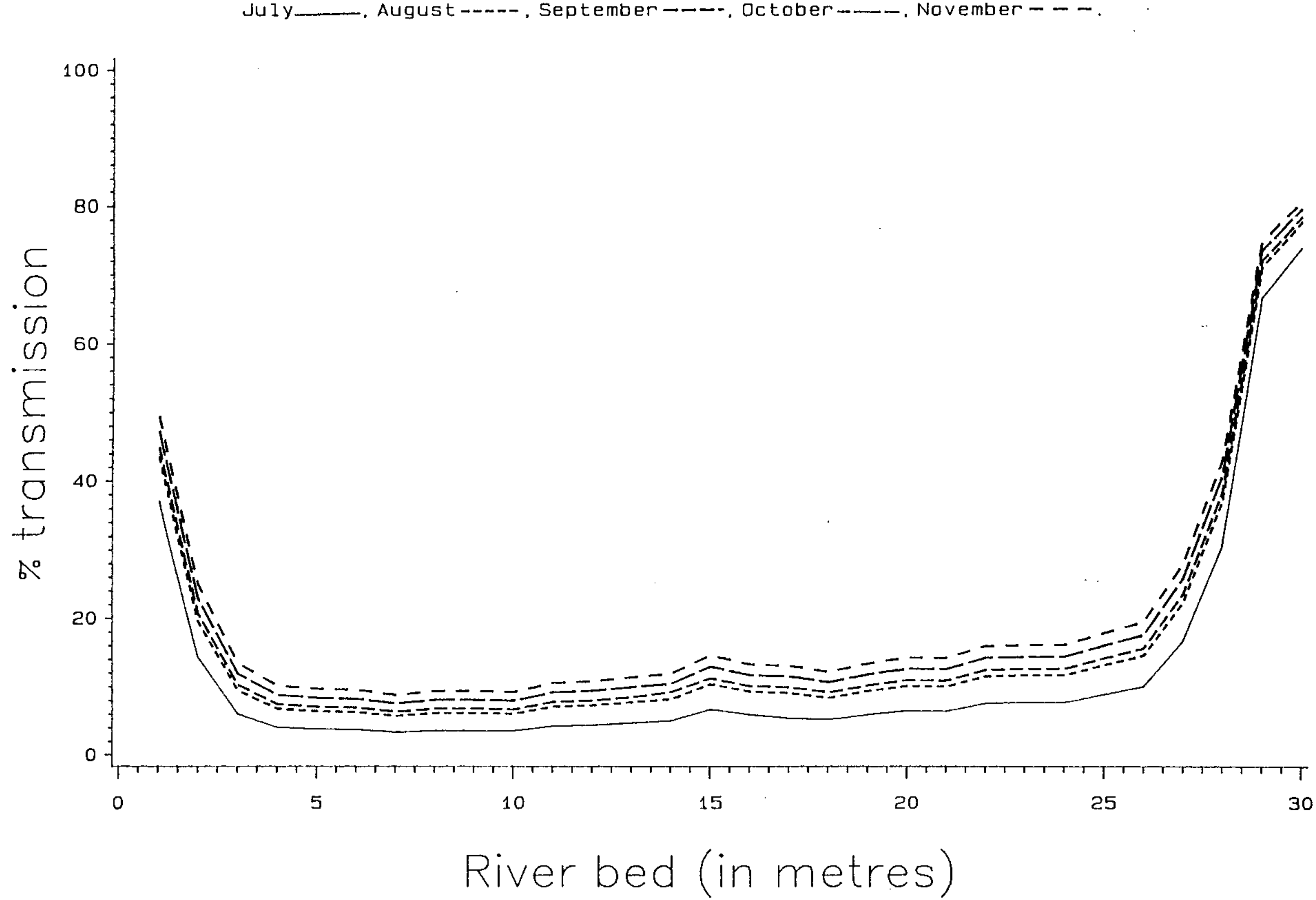
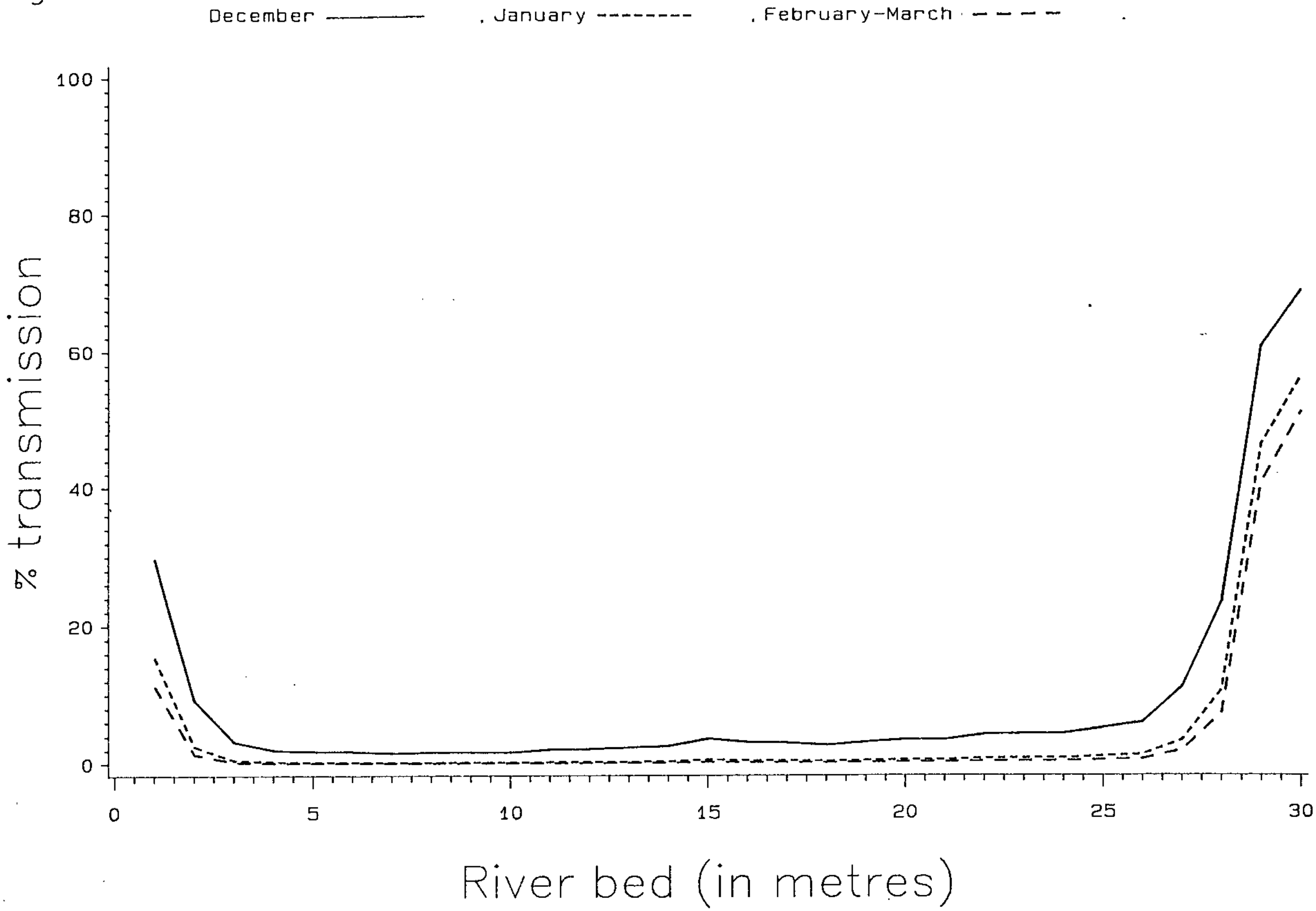


Fig 5. Irradiance levels on the river bed of the Great Ouse in 1988–89



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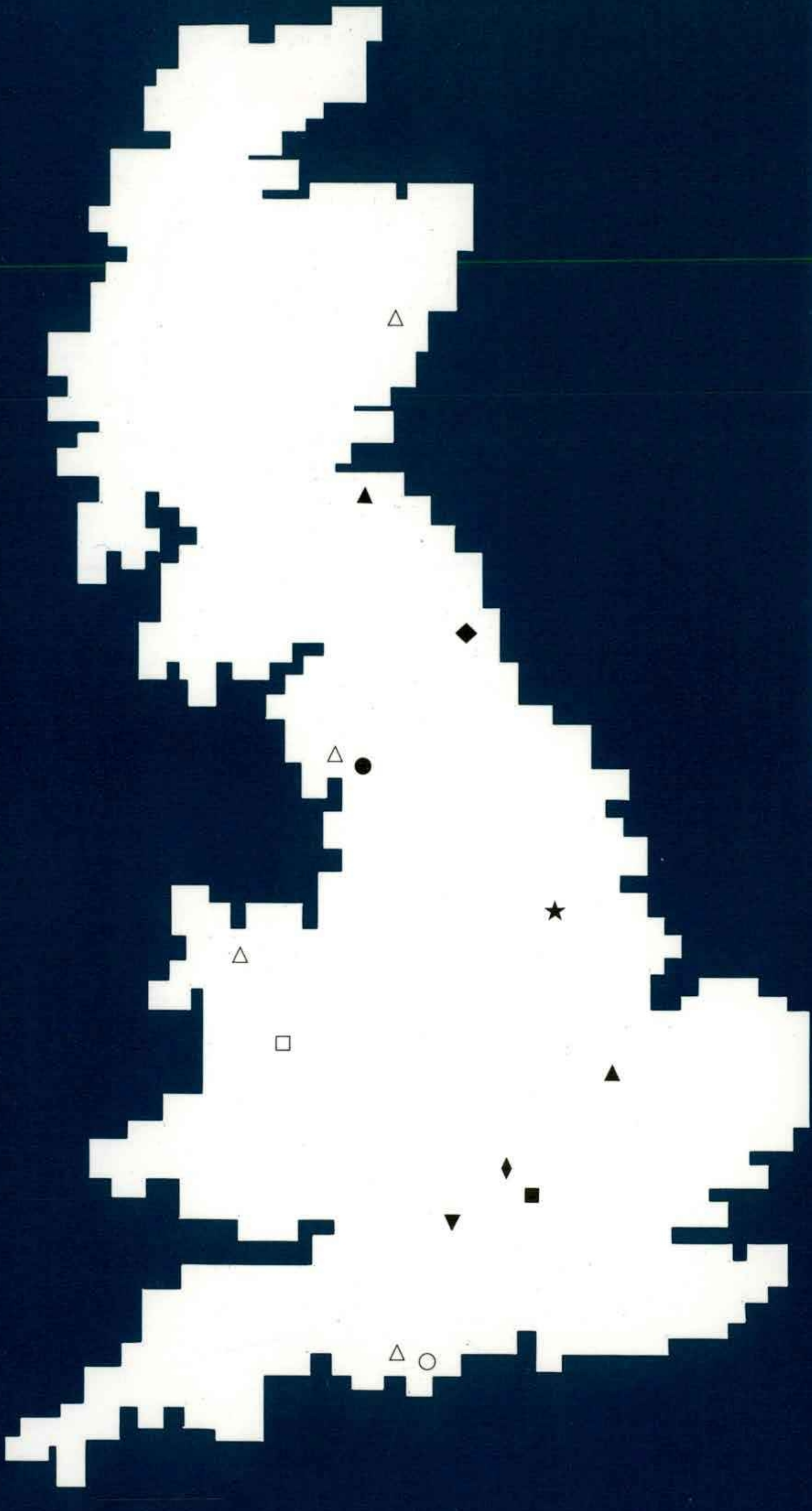

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