FRESHWATER BIOLOGICAL ASSOCIATION
River Laboratory, East Stoke, Wareham, Dorset BH20 6BB

Impact of watercress cultivation on river water quality

Progress report for the period January - December 1987

by

H. Casey & M. Ladle

Project Leader: H. Casey
Report Date: January 1988
Report to: Department of the Environment
Contract No: PECD/7/7/213
FBA Report Ref No: RL/149/1
FBA Project No: 149

The Freshwater Biological Association is part of the Terrestrial and Freshwater Sciences Directorate of the Natural Environment Research Council.

Objectives

The possible water quality implications of modern watercress growing practices need to be investigated. Chalk receiving watercourses are usually of high supply, amenity, game fishing and fish farming value. Any headwater pollution load, therefore, needs characterising and quantifying.

Timing of programme

1. Starting Date 1.10.86

Watercress growers in Dorset and Hampshire were contacted and a large number of sites examined. After discussions with watercress growers on the different management regimes involved, two sites were selected for more intensive study. The site in Dorset is managed in the traditional fashion, whilst the site in Hampshire is managed in a much more modern manner. Both sites have chalk streams upstream of and alongside the watercress beds.

2. 1986-87

Water, plant, sediment and invertebrate samples from upstream and downstream of the watercress beds, and from the watercress beds themselves, have been analysed.

At the Dorset site samples have been taken from inflows and outflows of a large number of beds over the season to try to obtain information on the variation between beds at one site. Similar sampling has been carried out at the Hampshire site but additional samples to demonstrate the level of variation over a given time have also been collected. Information on the different management practices has been obtained. Sampling at other watercress beds has taken place to supplement the information obtained from the two main sites.

Progress during 1987

Sampling at both the site in Hampshire and the site in Dorset has shown that the traditional type of management carried out in Dorset is completely different to the very intensive and much more scientific approach at the Hampshire site. In Dorset the fertilisers are applied by hand and the amount added depends on the persons concerned. In Hampshire all nutrients are added as a high concentrate solution, which is pumped into every watercress bed. The flow of every bed is calculated and the amount of nutrient being added is altered to give the maximum benefit to the growing cress. When growth is slow or when beds are being replanted the nutrient supplies are removed or cut down to save on costs. The solutions being added to the watercress beds contain very high concentrations and any error in calculating dilution factors could cause stream nutrient levels to be increased by a large amount.

E.g. Concentrations in nutrient inflows:-

Nitrate	36 mg l (NO N)
Soluble phosphate	103 mg l (PO P)
Potassium	624 mg l (K)

At Fobdown Farm there are 40 watercress beds and approximately 10,000 gallons of water per hour can be pumped for each bed. Therefore the

water leaving this site may amount to approximately 500 l/second. Stream discharge above the watercress bed in September 1988 was approximately 170 l/second. Thus any miscalculation of dilution factors or concentrated fertiliser solution composition will have a large effect on stream nutrient concentrations. This spray is normally only on during nine months of the year.

At the Hampshire site, in winter, zinc is also added to the watercress beds in the same way and the inflow spray can be as high as 346 mg l Zn. By the time it has been diluted at the top entrance to the bed it should be down to 1 mg l and normally at the outflow of the beds around 0.05 mg l.

Last winter these sprays were in use 24 hours per day. However, this year experiments are being carried out using a pulsing technique. A cooperative sampling exercise, using both FBA and watercress personnel from the Hampshire company, has been carried out on watercress beds both in Hampshire and in Dorset. Sampling was intensive in, and along, the beds whilst these zinc pulsing experiments were in operation. Results have been obtained on the movement of the zinc through the watercress beds and concentrations of zinc in the outflow water from the beds. In most cases this pulsing technique appeared to work quite well but in some experiments values of over 1 mg l^{-1} zinc were found. However, this method of zinc addition by pulsing could have one obvious advantage over the continuous addition method in that less zinc would be added in total.

The Hampshire Watercress Company has a full-time scientist and an analytical laboratory to try to manage its cress beds efficiently. No other company appears to operate on such an efficient scientific basis.

At the Dorset site and at many other sites the traditional method of using a concentrated zinc sulphate solution, drip feeding into the water inflow at the top of the watercress beds is normal. Higher levels of zinc have been found in sediments and plants growing in the stream below watercress beds than in samples taken from the stream above the outflow of the watercress beds. Sediment samples also show large variations in zinc concentration, the highest values being found just below the outflow of the beds, e.g. 2.4 mg/gm zinc in a silt sample.

The watercress industry in Dorset and Hampshire has had a further problem this year in that virus infection, similar to turnip mosaic virus, has been found in watercress beds in both counties. This is causing problems and again the only available cure for the industry is to keep the levels of zinc above 0.1 mg l. Dr J.M. Walsh is investigating this problem at the National Vegetable Research Station at Wellesbourne.

In both the streams examined flowing past the two main sites, there appears to be a healthy trout population living near the outflows of the watercress beds. However, at another site one side channel of a stream appears to be devoid of trout and of most other animals whilst the other channel has a normal population.

Invertebrate sampling on a different small chalk stream in Dorset has given some very interesting results. At the headwater of the stream there are Gammarus pulex present but lower down the stream below the major watercress beds there are no Gammarus present. Historical data from previous FBA work showed that in the 1960's Gammarus was abundant and this organism was often 10-20% of the gut content of trout in the stream.

Future plans

During the next six months a comprehensive invertebrate sampling programme is proposed at the site where there has been a change in the Gammarus populations during the next six months. This will involve taking samples at a series of sites above and below both small and large watercress beds and examining the invertebrate fauna present. Further cooperation involving intensive sampling on the pulsing of concentrated zinc solutions on other watercress beds is planned during the next three months. The amount of suspended material leaving the watercress beds when they are being cleaned out will be investigated.

Publicity

Mr Casey presented a talk at the Annual General Meeting of the Watercress Growers Association.