Further experiments in dispersal of phytoplankton by birds

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Introduction

In an attempt to see whether planktonic algae could be dispersed through transport in the gut of waterfowl, cells of the freshwater planktonic diatom *Asterionella formosa* Hass. were fed to Mallard *Anas platyrhynchos* (Atkinson 1970). No viable cells were found in the faeces. Traces of only a few *Asterionella* cells were found either in the droppings or in the cultures made from these droppings, although several thousand cells had been ingested. The diatoms have a complex poroid siliceous wall, so the cells have a characteristic shape and wall markings even after death. It had been expected that these silica 'shells' would be readily seen in the duck faeces, especially after acid cleaning with a mixture of nitric and sulphuric acids to remove organic debris. It did not seem likely that all the cells were being ground up in the gizzard (larger fragments of food grains were often found in the faeces) nor was it likely that the silica would be digested by the duck. However, it was possible that the *Asterionella* shells might have been eliminated before or after the time (4-20 hours later) at which the droppings were collected. A further set of experiments was therefore carried out to test this point.

The experiments

Four female Mallard were isolated in a closed room and fed on grain. The organisms to be tested were added to the drinking water, and observation was kept on the ducks until they had been seen to drink. The methods of collection and treatment of the droppings were as described previously (Atkinson 1970).

Preliminary observations were made by feeding Mallard with *Lycopodium* spores, which are easily detected in the faeces by microscopic examination and have been successfully used for this purpose in chickens (Harwood 1937). Many *Lycopodium* spores were seen in droppings collected 1-3 hours after the drinking water containing the spores had been removed from the duck. Many continued to be observed in droppings collected up to 25-27 hours later, a few even up to 51 hours. A repeat experiment carried out six days later gave similar results. It therefore appeared that droppings collected any time from 1-27 hours after the ducks had been fed with planktonic diatoms might be expected to contain diatoms or their silica 'shells'.

Pairs of a species of Cyanophyta and of five diatom species—all common planktonic algae—were fed to the four ducks, which were allowed access to the culture for one hour. The species used as test organisms were:

Cyanophyta
- *Oscillatoria* sp.

Bacillariophyta
- *Asterionella formosa*
- *Fragilaria crotonensis*
- *Melosira* sp.
- *Tabellaria flocculosa* (Roth) Kütz, var. *flocculosa* (*Tabellaria* A)
- *T. flocculosa* var. *asterionelloides* (Grun. in V.H.) Knud. (*Tabellaria* B)

The droppings were collected at times varying between 1-23 hours after withdrawal of the plankton. The results of the experiments are shown in Table I. By direct observation of a 3 ml. sample of the droppings, a very few cells were seen in only two of the seven samples examined. On acid cleaning half of the preserved faeces from each experiment, *Melosira* threads (usually 2-6 cells long) and single cells of *Asterionella* and *Tabellaria* were seen in all six samples examined. (*Oscillatoria* would be destroyed by acid cleaning as the cell walls are not silicified.)

In cultures of samples made from the droppings no sign of growth of any of the test species was directly observed, although in all the cultures *Chlorophyceae* were growing well. Acid cleaning of these cultures however, in every case, showed up cells of the different diatom test species and many of these cells were apparently undamaged externally. In the first two experiments the numbers of *Melosira* cells found on acid cleaning were considerable and suggest that there may have been growth of *Melosira* not seen by direct observation, at least in Experiment 1B. The numbers of *Asterionella, Fragilaria* and both *Tabellaria* spp. were small in each culture and there had probably not been any growth. *Asterionella* and *Tabellaria* were found only as

Table I. Results of experiments.

Expt. No.	*Food*	*Time after feeding (hours)*	*Droppings direct observation*	*Droppings acid cleaned*	*Culture (acid cleaned)*
1A	*Melosira* and *Oscillatoria*	1 - 3	*Melosira* 3 cells *Oscillatoria* (3 threads)	*Melosira* (20-50)	*Melosira* (20-50)
1B	idem	6 - 22	None	Not examined	*Melosira* (1000)
2A	*Asterionella* and *Fragilaria*	1 - 2½	None	*Melosira* (10-20)	*Melosira* (20-50) *Fragilaria* (20-50) *Asterionella* (<10)
2B	idem	4 - 6	*Melosira* (<10)	*Asterionella* (<10)	*Melosira* (60) *Fragilaria* (<10) *Asterionella* (<10)
3A	*Asterionella* and *Tabellaria* A	1½ - 4	None	None	*Asterionella* (10-20)
3B	idem	6½ - 22½	None	*Asterionella* (20-50) *Tabellaria* (<10)	*Asterionella* (<10)
4A	*Tabellaria* B and *Oscillatoria*	1½ - 3½	None	*Tabellaria* (10-20)	*Tabellaria* (20-50)
4B	idem	6 - 22½	Not examined	*Tabellaria* (<10)	*Tabellaria* (20-50) *Asterionella* (10-20)

single cells and not in colonies as is normal under natural conditions. It can be seen from the Table that cells of both *Melosira* and *Asterionella* were still to be found in the acid cleaned cultures or droppings on the day following the feeding of the diatom to the Mallard.

We conclude that while all the test species of phytoplankton were passed through the gut of the Mallard, often apparently undamaged, only *Melosira* had remained in a viable condition.

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Summary

Lycopodium spores fed to Mallard *Anas platyrhynchos* as a marker were found in the faeces from 1-51 hours after feeding. Five species of planktonic diatom and one Cyanophyte were fed to Mallard and their cells found in the faeces. Only *Melosira* sp., which was found in very large numbers in one culture, had passed through the gut in a viable condition.

References

ATKINSON, K. M. 1970. Dispersal of phytoplankton by ducks. *Wildfowl* 21 : 110-111.

HARWOOD, P. D. 1937. The frequency of change of cecal contents in fowls. *Proc. Helminth. Soc. Wash.* 4 : 38-39.

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