Studies on the Effects of Calcium Bicarbonate Concentrations on the Biology of Biomphalaria pfeifferi (Krauss) (Gastropoda: Pulmonata)

by

A. D. Harrison,* N. V. Williams** & G. Greig

University College of Rhodesia, Salisbury

Williams (1970a), in field studies on aquatic snails in Rhodesia, was able to show that the concentration of dissolved calcium bicarbonate had a demonstrable effect on the distribution of some species, notably the planorbid Biomphalaria pfeifferi. This species was found to be restricted to waters with calcium concentrations of more than 5 mg/l Ca++ and bicarbonate concentrations of over 20 mg/l HCO₃⁻ as CaCO₃.

Williams (1970b) then, in a series of laboratory experiments using B. pfeifferi and another planorbid, Bulinus (Physopsis) globosus (Morelet), demonstrated that the maximum rate of population growth occurred in test waters with what he termed 'medium' calcium concentrations of 5 to 40 mg/l as Ca++, and bicarbonate concentrations of 20 to 200 mg/l as CaCO₃. He was able to relate his test water findings directly to the field distribution of these two species, using the biometric parameter rm, the intrinsic rate of natural increase as defined Andrewartha & Birch (1954), for each culture.

Williams' experiments on both species were carried out on snails bred from a fairly large sample taken from one local population, or deme. The 'medium' water in which they both gave their highest rm value happened to come from the natural habitat of their parental demes, Lake McIlwaine, a reservoir for the city of Salisbury.

The aim of this experiment was to determine if snails from different

---

* Present address: Department of Biology, University of Waterloo, Waterloo, Ontario, Canada.
** Present address: Department of Biology, University of Salford, Salford, Lancs, England.
Received January 22nd, 1970.
demes would give results similar to those obtained by Williams (1970b). It was decided to make this an intraspecific experiment and Biomphalaria pfeifferi was chosen as Williams had shown that it was more sensitive to chemical differences than the other species. Local populations were selected from catchments well separated from Lake McIlwaine and from one another. Use was also made of Williams' (1970a) extensive field survey to choose streams with markedly different calcium bicarbonate concentrations. Both had higher concentrations than Lake McIlwaine and Williams would have classified one of them as ‘hard’; his classification is given in Table I.

### Table I
Classification of culture water according to Williams (1970a and b)

<table>
<thead>
<tr>
<th></th>
<th>Calcium, mg/l as Ca++</th>
<th>Bicarbonates, mg/l as CaCO₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft</td>
<td>nil to 5</td>
<td>under 20</td>
</tr>
<tr>
<td>Medium</td>
<td>5 to 40</td>
<td>20 to 200</td>
</tr>
<tr>
<td>Hard</td>
<td>over 40</td>
<td>over 200</td>
</tr>
</tbody>
</table>

### Material and Methods

**Test Snails**

Breeding stocks were obtained from the following two field stations:

1. Stream on the farm ‘Little England’, about 50 kilometres north of Salisbury, 17°37'S, 30°35'E. This was Williams' (1970a) station 10. Annual range of bicarbonates: 51—190 mg/l as CaCO₃. Annual range of calcium: 6.5—32.4 mg/l as Ca++.  
2. Stream near Bindura, 158 kilometres north-east of Salisbury, 17°20'S, 31°31'E, Williams' (1970a) station 12. Annual range of bicarbonates: 37—469 mg/l as CaCO₃; annual range of calcium: 11—93 mg/l as Ca++. The low extremes given were produced by a flash flood and were transient; bicarbonates were usually near 300 mg/l and calcium near 50 mg/l.

**Culture Media**

The compositions of the following culture media are shown in Table II.

1. 'Soft' water from a stream in the Chindomora reserve, 17°35'S, 31°15'E, Williams' (1970a) station 1.
2. 'Medium' water, tap water from Lake McIlwaine, 17°52'S, 34°47'E, Williams' (1970a) station 8, and Williams' (1970b) test