

RESEARCH COMMUNICATION

THE CONTROL OF SIMULIIDAE (DIPTERA, NEMATOCERA) IN SOUTH AFRICAN RIVERS BY MODIFICATION OF THE WATER FLOW VOLUME

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ABSTRACT

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It was found that the build-up of simuliid numbers subsequent to the construction of dams in the Vaal and Orange Rivers could be successfully prevented by periodic, artificially controlled reductions in the water-levels in these rivers.

Résumé

LE CONTROLE DES SIMULIIDAE (DIPTERA, NEMATOCERA) DANS LES FLEUVES D'AFRIQUE DU SUD PAR MODIFICATION DU VOLUME D'ÉCOULEMENT D'EAU

Il a été découvert que la prolifération des nombres de simuliides à la suite de la construction de barrages sur les fleuves Vaal et Orange pouvait fructueusement être empêchée par des réductions périodiques des niveaux d'eau de ces fleuves en les contrôlant artificiellement.

INTRODUCTION

Howell & Holmes (1969) reported on the use of DDT in the Vaal River to control various species of *Simulium* (chiefly *S. chutteri*) whose bites cause extreme irritation and have a debilitating effect on livestock in the vicinity of the river. Although DDT applied from the air was very effective, problems, possibly due to the hatching of diapause eggs, recurred after periods of floods. In the absence of such floods, however, slimy algal mats developed on the rocks after the application of DDT and made these sites unsuitable for the re-establishment of blackfly larval populations.

Following the construction of the H. F. Verwoerd and P. K. le Roux Dams along the Orange River and the resulting stabilization of the water flow, a *Simulium* problem developed in this river also, particularly in the area between the P. K. le Roux Dam and the Aughrabies Falls, some 600 km downstream. The flow rate of the Orange River is 34 times that of the Vaal River and, as its surface area is proportionately larger, far more insecticide would have to be used to control *Simulium* in this than in the Vaal River. In recent years the cost of insecticides and aerial spraying has increased enormously; a single series of 5 applications of a registered insecticide for blackfly control along both the Vaal and Orange Rivers would now cost well over R1,5 million. This programme would have to be repeated at least annually, since there is every likelihood that reinfestation would occur.

Besides the cost involved and the fact that past experience has shown that pesticides only temporarily alleviate the problem, these chemicals are extremely undesirable in potable waters. Another approach to this problem was therefore essential. Howell & Holmes (1969) originally dismissed the idea of flow manipulation as a means of controlling the eggs and larvae. However, since the sessile pupae are vulnerable to heat and desiccation, it was thought that the elimination of the pupal stage by water-level manipulation might control the problem.

THE WATER MANIPULATION TRIALS

Trials to reduce the numbers of Simuliidae by desiccating the immobile stages in the Vaal River below the Vaalharts irrigation weir (28° 06'S., 24° 56'E.) were carried out in 1977 by the Veterinary Research Institute, Onderstepoort, and the Department of Water Affairs. Similar trials in the Orange River below the P. K. le Roux (30° 00'S., 24° 47'E.) and Boegoeberg Dams (29° 05'S., 22° 13'E.) commenced in May 1978. Preliminary observations indicated that the Simuliidae in these rivers could be controlled by a weekly reduction of the water-level following a 60-hour closure in the Vaal (normal flow 10 cumec) and a 66-hour closure in the Orange (normal flow 340 cumec). A series of 3 consecutive stoppages of the flow in the Vaal and 6 in the Orange resulted in the reduction of simuliid numbers in these rivers for up to 30 km downstream from the Vaalharts weir, 370 km downstream from the P. K. le Roux Dam and 242 km downstream from the Boegoeberg Dam. During a series of 5 successive water flow reductions in the Orange River, which resulted in a drop in the water-level of between 28,8% and 72,8%, large areas in the river-bed were exposed to a fluctuating water level and were thus rendered unsuitable for the survival of a simuliid larval and pupal population.

In Fig. 1 an area 16,5 × 10 cm that was marked off by the drilling of 4 holes in the surface of a stone in the Orange River is shown (a) during its 1st exposure and (b) during its 4th exposure, 3 weeks after a weekly reduction of the water flow level in the period 11 April-13 May 1980. During the 1st exposure (Fig. 1a) approximately 1 800 pupae were counted in this small area alone, a figure that represents a population density of about 109 000 pupae per m². During the 4th exposure (Fig. 1b) only 20 live pupae were present in the same area, i.e. there had been an effective reduction of the population by 98,8%.

Irrigation canals in the Vaalharts complex as well as in the irrigation systems at Upington (28° 23'S., 21° 14'E.) fed by the Boegoeberg Dam proved to be important sources of blackfly breeding. Consequently, to achieve maximum control, the flow in these canals was completely stopped at suitable times to coincide with the shutdown in the rivers.

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The second author (G.J.B.) found eggs of a *Simulium* species, most probably *S. chatteri*, embedded in silt deposits in the bed of the Vaal River. These eggs, which were in diapause, were also killed by desiccation. The conclusion by Howell & Holmes (1969) that *Simulium* eggs resisted desiccation was probably based on a misidentification.

The decline in the *S. chatteri* population after modification of the water flow is therefore attributable mainly to the exposure and consequent desiccation of the sessile pupae and eggs under the arid conditions of the North-western Cape. Cloudy, humid conditions tended to reduce the efficacy of this control method. The larvae were probably also affected to some extent. Both the Vaal and Orange Rivers contain large pools of slow-moving water separated by

rapids. The disturbance in the usual habitat of the larvae as a result of reduced water-levels causes them to migrate into these pools where they have a minimal chance of survival.

The method of control briefly described above proved to be feasible as a standard procedure for reducing the build-up of pest populations of black-flies in the 2 largest South African rivers. The system is even more important as a substitute for the use of chemical pesticides for the control of Simuliidae in potable waters.

REFERENCE

- HOWELL, C. J. & HOLMES, G. W., 1969. The control of Simuliidae in the Vaalharts irrigation complex. *Journal of the South African Veterinary Medical Association*, 40, 59-67.

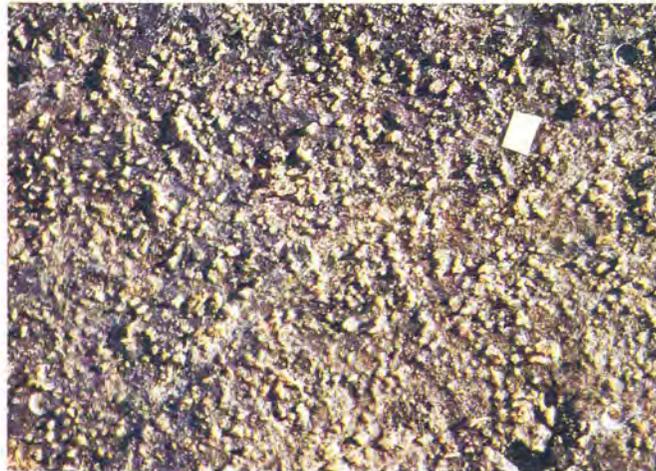


FIG. 1 Stone surface covered with *S. chatteri* pupae before (a) and after (b) a 4-week control campaign carried out in the Orange River