ONCHOCERCIASIS CONTROL PROGRAMME
IN THE VOLTA RIVER BASIN AREA

REPORT OF THE THIRD SESSION OF THE ECOLOGICAL GROUP

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INTRODUCTION

1. The Ecological Group held its third session at the Agricultural University, Wageningen, the Netherlands, from 22 to 24 March 1982.

2. Professor Dr Jan Koeman was elected chairman. The list of members, secretariat and advisers who attended is attached to this report.

ADOPTION OF THE AGENDA

3. The following agenda was adopted by the Group:
   1. Review of recent OCP operational activities
   2. Review of aquatic monitoring
   3. Report of ecological effects of chlorphoxim
   4. Report of Insecticide Meeting, Geneva
   5. Report on untreated waters in OCP area providing potential refugia
   6. Consideration of cholinesterase and pesticide residue studies
   7. Data handling programme
   8. Any other Business
   9. Approval of Report

REVIEW OF RECENT OPERATIONAL ACTIVITIES

4. WHO provided the Ecological Group with relevant background information on the operational activities focussing particularly on the problem of insecticide resistance. Resistance to temephos had appeared at Chutes Gauthier, a particularly difficult site to treat, in May 1980, only one year after treatment had started. This resistance, limited to the Simulium soubrense/sanctipauli cytospecies pair, had spread to all known habitats of these cytospecies in Ivory Coast by January 1982. It was very stable even after seven months interruption of treatment and had had epidemiological consequences.
5. As approved by the Group at its second meeting, temephos was replaced by chlorphoxim in those already treated areas where resistance was confirmed, and no extension of operations into new areas had been undertaken. There was an interruption from August to October 1980 in the use of chlorphoxim. Treatments in the October 1980 to January 1981 period were effective, but a subsequent batch of chlorphoxim applied from May to August 1981 proved much less effective. After 15 to 18 months in all sites other than at Bui on the Black Volta, double resistance to chlorphoxim appeared. Cross-resistance to other organophosphorus compounds under consideration had also been demonstrated experimentally.

6. For dry season treatments it had proved possible to replace chlorphoxim most effectively with *Bacillus thuringiensis* H-14, which seemed to have no ecologically unacceptable properties. As yet, no fully satisfactory formulation existed commercially, especially for rainy season application but several more concentrated formulations of B.t. H-14 had been prepared and were being tested. It was hoped that a suitable formulation would be available for general use in 1983.

7. The White Bandama had been repopulated with forest species of *Simulium* which seemed not to be anthropophilic. Some repopulation with savanna species has also been observed recently, but these would be susceptible to temephos treatment.

REVIEW OF AQUATIC MONITORING

8. The Ecological Group was informed of the main points arising from the meeting of hydrobiologists which met in Ouagadougou in March 1982.

9. The hydrobiologists, in reviewing the overall activities in the Programme area, considered, in particular, the results of three years of pre-treatment data collected on the river Pru, Ghana, which included lists of economic fish species present and calculation of the catch per unit effort. The true interpretation of this information was difficult, due to the considerable influence of local fishing on the composition of the fish population, such influence being impossible to assess with any degree of accuracy.

10. The hydrobiologists had recommended the following:

   (a) the inclusion of systematic Surber sampling by pairs of samples from downstream to upstream;

   (b) the continued use of the ORSTOM-gutter and various artificial substrates;

   (c) the use of electric fishing equipment to facilitate the inventory of riverine fish;
the installation of a micro-computer to handle the collected data;

(e) the publication of the catalogue of aquatic insects from Ivory Coast, and

(f) the preparation of a similar catalogue of fish.

11. The hydrobiologists also requested that relevant portions of the Ecological Group report influencing the monitoring programme be communicated to them without delay for information and appropriate action.

12. The joint report of the ichthyologists was likewise presented to the Group. This report had the following conclusions:

(a) No impact of the temephos treatments on the fish population had been observed;

(b) no change had been noted generally over a period of five years in the catch per unit effort;

(c) factorial analysis of the catch per unit effort showed no significant medium-term change in fish communities; the coefficient of condition showed no significant variation;

(d) the studies did provide evidence of significant changes related to hydrological conditions and of natural population variations since observations began.

13. The Ecological Group, recalling its recommendation for the establishment of an OCP hydrobiologist position, welcomed the appointment of the incumbent. However, it considered it extremely critical that the scope of activities associated with this position should be clearly defined. It recognized that the hydrobiologist would need to act as coordinator with particular reference to quality control in the collection and recording of monitoring data, in pesticide screening and in specific research results.

14. Routine hydrobiological monitoring would require different emphasis in different areas according to the need to improve and standardise the overall quality of data and to fill gaps in the Programme. In Ivory Coast and Ghana where operational teams exist the hydrobiologist would provide the necessary overall supervision of invertebrate and fish surveys during one visit to each team per year. In Togo, where there was currently a lack of an ichthyologist in the teams, and in Benin the OCP hydrobiologist would cooperate in monitoring the fish populations four times per year. In all cases he would give attention to the training of personnel in the field techniques including periodic updating if procedures were modified in some way.

15. Data handling in the Programme headquarters would gain importance with the proposed introduction of a micro-computer. The hydrobiologist would have to coordinate the receipt of all field data and its entry into this computer (see para. 39).
16. The Group felt that the testing of new insecticides and determination of their potential environmental impact was of such importance that this activity should be separated from routine monitoring and research activities. However, the OCP hydrobiologist should act as coordinator of appropriate ecological assessments to the relevant phases of screening.

17. The Group considered that the hydrobiologist should be actively involved in the coordination and, where possible, the undertaking of existing research activities as well as evaluating and developing new research efforts. It recommended in particular that electrofishing studies of raffle fish be undertaken once per year in Ghana and Ivory Coast, and feeding habits and fecundity studies also be conducted annually at selected sites.

18. It was evident that the programme of work was too heavy for one person and the Group recommended that he should have the support of an assistant entomologist/hydrobiologist to help with the screening of new insecticides, a data-processing clerk to check the data and consultants, as necessary, to help with the other activities.

19. The Ecological Group expressed satisfaction at the report of the ichthyologists. It recommended caution, however, in interpreting apparent short-term changes in the fish-species mix. It noted that some variability in the data was related to changes in personnel, and in the collection of methods, as well as in the choice of monitoring sites. Local fishing, pollution or natural disturbances also affected the catches.

20. The Ecological Group was, in fact, very concerned with the effect of fishing with chemicals, which had become more and more evident in many West African rivers and, especially, with any misunderstanding that this might provoke in using Simulium larvicides in the same rivers. It considered that a case study of the reported use of Lindane to catch fish along a 30km stretch of river might provide a vivid illustration to the governments of the OCP area of the ecological dangers involved in such indiscriminate practices.

21. The proposal to add three smaller mesh sizes to the standard battery of gill nets to enhance the study of younger and smaller fish was endorsed by the Group.

REPORT ON ECOLOGICAL EFFECTS OF CHLORPHOXIM

22. The last field information to complete this report was received and analysed only one week prior to the meeting so the Ecological Group could not examine all aspects in detail. The chlorphoxim treatments had covered about 4000 km of river during its peak period of utilization. During the time of study approximately 60 000 litres of formulated product had been applied. Variation in the effectiveness of different batches of chlorphoxim had been noted. The impact on the drift of non-target organisms in the 48 hours sequence one month and five months after the start of treatment was studied and, in all cases, a strong night drift had been recorded. Studies carried out in the rate of colonization of artificial floating substrates had showed this to be strongly affected by the treatments and the relation between colonization intensity and current speed had been distinctly different from normal. After treatment a general increase in drift had occurred affecting the majority of invertebrate groups; some which normally drift in small quantities had become frequent in fish stomach contents.
23. Season appeared to be significant. In the dry season there was a high mortality after drift related to the occurrence of a low reinstallation potential on long stretches where water was nearly stagnant. In the wet season high mortality occurred only near the point of application; during that season good reinstallation facilities existed all along the downstream river section.

24. The overall impact of chlorphoxim treatment on invertebrate fauna was found to be insignificant. It was generally lower than expected and even if high for some groups could not be considered as "catastrophic". The systems appeared to be very resilient and the immediate impact did not have too much meaning. Monitoring should concentrate, therefore, on longer term comparative effects.

25. The Ecological Group, taking into account the apparently acceptable impact of chlorphoxim treatments done during the rainy season was disposed towards the possibility of allowing the utilization of other chemicals also known to provoke a high drift of invertebrates. Such use would be restricted to the rainy season and treatments would have to be applied with a maximum of caution. This possibility would depend on an alternative such as B.t. H-14 being used in the dry season.

REPORT OF INSECTICIDE MEETING

26. The Group was informed that an ad hoc working group had been constituted recently in Geneva to consider an accelerated programme for the development of alternative insecticides. The Ecological Group Chairman who attended the meeting gave a résumé of the discussions and conclusions. Such was the importance of the subject to the Group that it requested that copies of the working documents and final report be sent to all members for their review and comment.

27. The Ecological Group stressed the need to make a preliminary hazard assessment of promising new larvicides and new formulations of known compounds. The Group insisted on being kept informed of events as soon as they happened, especially regarding possible ecological effects of larvicides under test.
The Ecological Group supported the recommendation of the working group that initial bioassays should be carried out in the laboratory (phase 1), preferably in Africa, on non-target insect species which occur in the OCP area such as Neoperla spio (Plecoptera), Cheumatopsyche digitata (Trichoptera), Tricornychus sp. (Ephemeroptera), Cricotopus sp. (Diptera) and Zygonyx torrida (Odonata). Other non-target organisms which might be used include Macrourichius (Decapoda), and the fish Aletes, Tilapia, Barbus and Labeo parvus. The test used should be in accordance with the international methodology, for example like that developed by the FAO Expert Consultation on Environmental Criteria for Registration of Pesticides. The short-term or acute toxicity of a compound could be evaluated by use of a special in situ gutter system (phase 2) which would provide information about the general level of toxicity, in comparison with temephos.

A candidate larvicide showing promise in phase 2 would then pass on to a test of its efficiency against temephos-resistant larvae and its effects on non-target organisms in small river tests (phase 3). The Group emphasized that these tests must be accompanied by adequate hydrobiological investigations.

The Ecological Group recommended that it be consulted at the end of the small river tests (phase 3) and its agreement obtained before proceeding to the restricted use of a candidate larvicide for two years in a large river test in a restricted area. Only after clearing this final test satisfactorily could a larvicide be introduced to operational use in the Programme.

Having regard to the double resistance exhibited by the S.soubrense-sanctipauli cytospecies pair and the cross-resistance to other organophosphorous compounds, the Group emphasized its earlier recommendation that the extension of control operations to new geographical areas should await the availability of at least two operationally usable larvicides additional to temephos. In this respect the Group noted with some concern the plans to carry out large-scale control of S.damnosum s.l. in Nigeria in close proximity to the OCP area using temephos alone.

REPORT OF UNTREATED WATERS IN OCP AREA PROVIDING POTENTIAL REFUGIA

The Group welcomed the report on "The Untreated Component of River Systems in the OCP Area and its Environmental Implications" produced in response to its earlier request. However, an assessment based on the percentage of river lengths covered by insecticide treatment was only a first step in the determination of overall environmental impact.

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33. In agreement with the Report of the 1982 Hydrobiologists Meeting, the Group felt that some further assessment should be made of the biological potential of various riverine zones as reservoirs for aquatic insect and fish species. It recommended, therefore, that a pilot study be carried out in the Bandama River Basin, using the data already available, to determine whether different types of zones could be identified. For such a study further field data might have to be collected in order to provide the basis for a balanced judgement. It was hoped that a preliminary report could be submitted by October 1982. If results proved promising, the method could be extended to the Black Volta River Basin but this would certainly involve the collection of additional data especially from the rarely treated zones.

34. The technique should be considered for use in the pre-control assessment of the proposed western extension area. Such studies might allow the selection of treatment tactics designed to reduce the overall environmental impact of the larviciding campaign, in the event that the temporal and spatial alternation of larvicides become feasible.

**CONSIDERATION OF CHOLINESTERASE AND PESTICIDE RESIDUE STUDIES**

35. During their annual meeting the hydrobiologists had suggested that chemical residue analysis of temephos in fish tissue would provide "the establishment of the mortality rate in relation to the quantity of temephos present in the organism. It would also be possible to discover particular levels corresponding to visible traumatisation of the species." The Ecological Group noted that, in the case of acute and sub-acute exposure of fish to pesticides and other chemicals, there was generally no direct correlation between the level of the residue in tissue and organs and the degree of toxicity as there were no steady-state distributions of the chemical over the various tissues and body liquids; a steady-state equilibrium might exist after longer-term exposure of fish to the chemical. Even so, there were no known toxic effects to which these levels could be correlated. Therefore the levels measured could lead only to a qualitative conclusion that the fish have been exposed to temephos.

36. The Ecological Group recommended that, for the time being, some continued field testing of cholinesterase activity in fish brain in river sections repeatedly treated should be undertaken to confirm the results obtained in the preliminary studies. It was important to retain the competence in cholinesterase analysis in the event that new candidate larvicides include organophosphorous and/or carbamate compounds.

37. With regard to the eventual introduction of other larvicides, the Ecological Group emphasized the need for chemical measurements to be made in order to establish their presence in the water, their possible accumulation in the biota and their environmental distribution. This should form an integral part of the larvicide screening programme.
38. The Group also noted that there is no simple method for the analysis of a wide spectrum of pesticide which might originate from other sources such as agriculture and the abusive use of pesticides for fishing. A meaningful analysis could only be undertaken if there were circumstantial evidence that specific compounds were involved. It should also be recognized that some of these pesticides might exist in the water, but did not show up as residues in the biota. The Ecological Group endorsed the view of the hydrobiologists that, in order to assess any interference, information on the occurrence of other pesticides should be obtained preferably through enquiry to the authorities than through fish tissue analysis.

DATA HANDLING

39. The Ecological Group considered the short-term and long-term handling of hydrobiological data in OCP. It strongly recommended that the proposed micro-computer be installed in Ouagadougou as soon as possible, to record, sort and clean up the data before it is sent to Geneva for storage. Routine analysis of the data should be undertaken in Ouagadougou to provide immediate warning of hydrobiological change. As mentioned in paragraph 18, a data processing clerk would be needed to assist the hydrobiologist directly with these tasks.

40. The independent evaluation of the data handling, analysis and interpretation was considered relevant and very essential. The Ecological Group recommended, therefore, that this evaluation, developed and provided to date by the Salford University Group, should continue to be provided to it on a biennial basis by an independent group.

OTHER BUSINESS

Laboratory culturing of S.damnosum sp.

41. Referring to its previous report, the Ecological Group was pleased to note that progress had been made in laboratory culturing of a species of the S.damnosum complex both at Akosombo, Ghana, and at Amhurst University, USA. The need to support these and similar research studies in laboratories in Africa and elsewhere was stressed.

Proposed Western Extension (Senegambia project)

42. In view of the studies being undertaken in relation to extending the OCP operations to the Senegambia area, the Ecological Group recommended that preliminary hydrobiological studies be implemented as soon as possible to provide necessary base-line data. In this respect it considered that it would be preferable to have three well-investigated sites rather than a blanket survey by many national teams and proposed that maximum effort should be concentrated in the following regions:
(a) Middle Course of the Gambia river by the Senegal team.

(b) Kankan region of Guinea (upper Niger River tributaries) by the Guinea team.

(c) Manantali region of Mali (site of Manantali Dam), by the Mali team.

43. All sites should be investigated for a minimum, two-year, pre-treatment period. Details of the proposed investigations agreed to are provided in Annex 1.

Structure and Meetings

44. Informed of the recognition by the Joint Programme Committee at its second session that the introduction of any new insecticides to the OCP operations would be subject to the approval of the Ecological Group, the members considered that the Group's present, rather loose, structure and mode of working would not permit the necessary close rapport with the Programme or with each other. Accordingly, to ensure a rapid response to results for the accelerated insecticide development programme, the Group recommended that its chairman be maintained as the focal point for direct contact with OCP and that he, in turn, dialogue directly with the other group members to obtain a consensus of opinion. While accepting that the fourth meeting of the Ecological Group be scheduled for September 1983 to have close liaison with the EAC, the Group retained the privilege to request OCP to convene an intermediate meeting should developments important to the operations so demand.

45. As the technical basis of the vector control operations is in a state of change resulting from the appearance of resistance and the introduction of alternative insecticides, the Group expressed the desire to be kept informed of such changes as might occur, whether these emanate from the routine monitoring studies on non-target organisms, or the development of new larvicides or formulations, etc.

46. The Group insisted that the monitoring procedures should be maintained and no modifications introduced without it being consulted beforehand and giving its prior approval. Similar prior consultation and approval must be a prerequisite to any new insecticide being introduced to phase 3 large river tests (see paragraph 30).

47. The Group further stressed the need for it to be strongly represented during this important period at the EAC and JPC meetings preferably by two members, and the following participation was suggested:
48. The draft report of the third session of the Ecological Group was approved.

49. Prior to the closure of the meeting by the Chairman, thanks were expressed to him for so willingly and efficiently hosting the meeting in the Department of Toxicology, Agricultural University, Wageningen.
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Details of the proposed investigations

1. The Gambia Site

(a) Invertebrates. Monthly investigations at one site to establish community composition, seasonality, etc. Twice-yearly survey of the whole system to check validity of the data from the main site, zonal differences, etc.

(b) Fish. Three-monthly investigations at 3-4 fixed sites. A general river survey once per year over the whole system using 4-5 additional sites.

(c) Related projects. Fish biology, migration, etc. Duration of life cycles of the most important species of invertebrates. Estimation of the ecological value of the untreated versus the treated portions of the river (as established by OCP).

2. The Kankan Region

(a) Invertebrates. Monthly investigations at one site on the Dion River - routine monitoring. General survey of the rivers of the whole upper basin once a year.

(b) Fish. Four sites to be sampled every three months. These sites will be situated in the high basin region of the Niger River. A twice-yearly more extensive survey involving five to six further sites. This will provide data mainly from downstream of the main sites. This will need the help of external expertise or a consultant.

3. The Manantali Region

Only fish studies to be carried out here using the same programme as at the Gambia site - routine monitoring and general survey of the upper basin once per year.