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ONCHOCERCIASIS CONTROL PROGRAMME IN WEST AFRICA
 PROGRAMME DE LUTTE CONTRE L'ONCHOCERCOSE EN AFRIQUE DE L'OUEST

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REPORT OF THE EIGHTH SESSION OF THE ECOLOGICAL GROUP
 BOUAKE, 23-27 MARCH 1987
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A. INTRODUCTION

1. The Ecological Group held its eighth session in Bouaké, Côte d'Ivoire from 23 to 27 March 1987.
2. The meeting was chaired by Professor K.W. Cummins and the list of participants is given in Annex 1.
3. Although Dr Ebrahim M. Samba, Programme Director, was unable to attend the meeting he had prepared an address which was read to the participants during the opening session and which is attached hereto as Annex 2.
4. During the morning of 27 March 1987 Ecological Group Members were pleased to have the opportunity to visit a stream (R. Kan) near Bouaké, for a demonstration of electrofishing equipment and to observe a number of invertebrate species. The Group expressed its appreciation to the Bouaké Sector Chief, other OCP staff and members of ORSTOM for the logistic support arrangements which had made the excursion so informative.

B. ADOPTION OF THE AGENDA

5. The following agenda was adopted:
 - Report on vector control operations
 - Report on hydrobiological monitoring activities
 - Independent analysis of aquatic monitoring data
 - Reports on environmental distribution and fate of pesticides
 - Research on new larvicides
 - Prioritization of hydrobiological monitoring activities
 - Work programme for 1987-88
 - Other matters
 - Arrangements for next meeting
 - Approval of report.

C. REPORT ON VECTOR CONTROL ACTIVITIES

(a) Activities during 1986 and early 1987

6. The Group was informed that during the last year considerable emphasis had been placed on preparations for the extension of vector control and evaluation activities to the south-east (Phase V zone) and to the west (Phase VI zone).
7. With regard to vector control operations in the original Programme area (Phase I-IV zones) it was noted that for the second successive year, rainfall during 1986 approached "normality" compared to values recorded during the early 1980's. Rainfall had been particularly heavy and well distributed in central and eastern savanna areas, where some rivers were observed to flow for the first time in many years. Elsewhere, rainfall had been below average.
8. During 1986/87, it was necessary to introduce a large-scale rotation of the five available larvicides, temephos, chlorphoxim, *Bacillus thuringiensis* H-14 (B.t. H-14) permethrin and carbosulfan. Although temephos was widely used in parts of the Phase I zone and in the east of the Programme area, its overall utilization had been significantly reduced; a trend which is expected to continue as a result of the spread of temephos resistance in savanna cytospecies.

9. For the first time, in early 1986, temephos resistance appeared in the Baoulé and Bagoé valleys of south-eastern Mali. After a clean-up operation with B.t. H-14 it was possible to reintroduce the use of temephos for most of the wet season but by the end of the rains temephos resistance had reappeared. This type of larvicide rotation can only be effectively implemented if entomological and insecticide susceptibility surveillances are very good.

10. The "Teknar" formulation of B.t. H-14, which required dilution with water prior to application, was used during the first 15 weeks of 1986. Thereafter, it had been replaced by the HPD formulation which was applied undiluted at a dosage of 1.2 mg/litre - 10min, instead of 1.6 mg/litre - 10min which had been the usual dosage of "Teknar". Later in the year the "Vectobac" formulation of B.t. H-14 was introduced in a large-scale field trial and found to be equal in efficiency to HPD. Apart from the technical benefit to the Programme of having two acceptable formulations of B.t. H-14 competition element could now be introduced for the future procurement of this larvicide.

11. HPD was used throughout the year for the treatment of the tributaries of the main rivers, and for this purpose it was almost able to compete with temephos. However, when the discharge rate of large rivers exceeded 75 m³/s, the continued use of HPD was prohibitively expensive and an alternative compound had to be introduced.

12. Chlorphoxim had been used extensively in 1986 as a replacement compound for temephos. However, the manufacturer of the formulation will terminate production in 1988. Accordingly, the use of this compound would be phased-out.

13. Both the "Talcord" and the "Coopex" formulations of permethrin had been used during the past year, but only under wet season conditions and when river discharge rates exceeded 75 m³/s. Although permethrin consumption in 1986 was appreciably higher than in 1985, it was never used continuously for more than 6-8 weeks, in order to reduce the risk of resistance developing. This was a very real threat to the continued use of this compound, considering the extensive agricultural use of synthetic pyrethroids in many parts of the Programme area.

14. Carbosulfan was the most toxic and the most expensive compound used during the last year. It was only used for short periods when rivers were in flood, and then as the final replacement for permethrin in the rotation sequence.

15. Details of larvicide dosages are presented in Table 1.

16. To counter the current temephos resistance problem the following larviciding tactics would be applied throughout 1987:

- (i) Year-round treatment of all tributaries with B.t. H-14.
- (ii) Rotation of B.t. H-14 and temephos on large rivers where the vector was susceptible to temephos.
- (iii) Rotation of B.t. H-14, chlorphoxim, permethrin and carbosulfan on rivers having known temephos resistant vector populations.

17. It was explained to the Group that many factors affect the weekly choice of the larvicide scenario implemented, notably:

- (i) Distribution of temephos resistance amongst the different cytospecies, determined by susceptibility levels and cytotoxic larval identification.

- (ii) The availability and deployment of the different larvicides. During the first half of 1986 many serious problems had been encountered. The loss of one batch of B.t. H-14 through fire and the mis-direction of another batch to Cairo, had caused serious logistical problems when it suddenly became necessary to make major redeployments of existing stocks and to draw upon alternative compounds.
- (iii) Characteristics of the larvicide formulations, especially with regard to their efficiency, selectivity and cost.
- (iv) Vector population dynamics, transmission potentials, and epidemiological patterns.

18. By May 1986, HPD was being extensively used (especially in the western part of the Programme area), with temephos being restricted to the Rivers Banifing (Mali), White Volta (Ghana) and Oti (Togo). Because of intolerable transmission rates by savanna flies, carbosulfan was introduced (chlorphoxim and permethrin stocks being too low), and carefully monitored by environmentalists of the Programme and from Côte d'Ivoire. This larviciding tactic was continued through June 1986, with the addition of B.t. H-14 treatments to R. Pru (Ghana) where temephos resistance in a savanna cytospecies had appeared in 1985.

19. Mid-July 1986 witnessed an appreciable increase in B.t. H-14 and temephos usage. Permethrin was also used to treat the R. Dion (eastern Guinea) when B.t. H-14 was discontinued for hydrological reasons.

20. In mid-August 1986 chlorphoxim was introduced for treatments of the Rivers Black Volta, Comoé (Côte d'Ivoire) and Sassandra (Côte d'Ivoire). Temephos replaced B.t. H-14 for the treatment of the Rivers Baoulé and Bagoé (Mali). Later in the month chlorphoxim was replaced by permethrin on the Black Volta. Also during late August, permethrin was introduced on the R. Marahoué and carbosulfan on the White Bandama (both in Côte d'Ivoire) to provide opportunities for detailed studies on the effects of these compounds on aquatic non-target organisms (EG.7 recommendation).

21. In September 1986, to prevent the spread of temephos resistance in the Black Volta basin, permethrin was introduced on R. Bougouriba (Burkina Faso). This compound was also introduced on the Rivers Comoé and lower Marahoué (both in Côte d'Ivoire).

22. During October 1986 it was possible to suspend treatments in several areas, e.g. Rivers Nzi and Comoé (Côte d'Ivoire). With the reappearance of resistance in the Niger tributaries of south-eastern Mali, B.t. H-14 was reintroduced on R. Baoulé and permethrin was introduced on R. Bagoé.

23. During the remaining weeks of 1986 B.t. H-14 progressively replaced the most toxic larvicides, except that carbosulfan was continued on the lower Black Volta and chlorphoxim on the Sassandra (Côte d'Ivoire). The appearance of temephos resistance at Tienfala on the main River Niger (near Bamako) required the introduction of permethrin.

24. In general terms, during January 1987, B.t. H-14 usage was confined to the River Black Volta and rivers to the west, while temephos was used to the east of the Black Volta. The exceptions were restricted treatments with chlorphoxim along the lower Black Volta, and restricted treatments with permethrin of the R. Niger around Tienfala.

25. By early March 1987 aerial permethrin treatments of the R. Niger (Tienfala) had been replaced by boat applications of chlorphoxim. Elsewhere, B.t. H-14 was the only larvicide in use; including resistance control operations along the Rivers White Volta, Pru (both in Ghana) and Oti (Togo), and reinvasion control operations in southern Togo.

26. The Group complimented the Programme on the very efficient way in which the five available larvicides had been rotationally used to combat an increased temephos resistance problem. It noted that Programme staff had rigidly adhered to Group recommendations concerning the limited use of permethrin and carbosulfan. The Group recognized that the sequential use of these larvicides on a large scale was now a routine vector control tactic and that this should be borne in mind when considering the prioritization of hydrobiological monitoring activities.

(b) Review of the revised control strategy for 1987

27. The Group noted that temephos resistance in savanna cytospecies was the most important factor determining control strategies and tactics for 1987 and for the subsequent years of the Third Financial Phase.

28. The gravity of the resistance problem was well illustrated by reference to the following list of resistance localities:

- Rivers Niger, Niandan and Milo in the upper Niger Basin of Guinea; not yet exposed to vector control operations,
- Rivers Sankarani and Dion in eastern Guinea; two years of vector control operations,
- Rivers Niger (at Tienfala and Markala), Baoulé and Bagoé in south western Mali,
- Rivers Sassandra and Bandama in Côte d'Ivoire,
- River Black Volta along the frontier between Ghana and Côte d'Ivoire/Burkina Faso,
- Rivers White Volta and Pru in Ghana,
- River Oti in Togo.

29. Although additional studies were required, it appeared that the westward movement of temephos resistance in Guinea could be attributed to fly movements in a NE to SW direction, assisted by the Harmattan wind; a type of reinvasion in reverse.

30. One of the most important consequences of the spread of temephos resistance was the extensive replacement of temephos by the more expensive B.t. H-14 formulations. See Table 2 for a comparison of costs. Furthermore, the use of B.t. H-14 required flight hours for treatment to be increased by 50 per cent; by the end of 1986 allocated flight hours had been exceeded by 30 per cent.

31. The increased complexity of larviciding operations made it necessary, on a weekly basis, to carefully evaluate all the taxonomic and susceptibility data and to formulate treatment tactics, river basin by river basin.

32. The Group recognized that the new and rapidly changing patterns of resistance and new treatment tactics required a very careful evaluation of all the hydrobiological sampling sites. This would have to be done without delay, to ensure that appropriate data would be collected to evaluate the effects of changes in pesticide use which would be necessitated by the resistance problem.

33. The vector control strategy approved for 1987 had made provision for the following:

- (i) Continuation of operations in the original Programme area (Phase I-IV), as required,
- (ii) Selective larviciding operations in the south-eastern extension area (Phase V),
- (iii) Year-round treatments in eastern Guinea (Phase VI-1) to protect that area and to prevent reinvasion into Côte d'Ivoire and Burkina Faso,
- (iv) Wet season treatments in western Mali (Phase VI-2),
- (v) Dry season and early wet season treatments in the upper Niger basin of Guinea (Phase VI-3) to prevent reinvasion of southern and western Mali.

34. The Group noted that this strategy would have to be revised to take account of:

- (i) The recent spread of temephos resistance and the risks of further spread,
- (ii) The continuing drop in the value of the US dollar,
- (iii) Budgetary constraints resulting from (i) and (ii).

35. It was thus acknowledged as being technically and financially unrealistic to consider attempting the original strategy which included extensions to the south-east and to the west. Even if an "ideal" formulation of B.t. H-14 became available to the Programme, the cost of its large-scale use would be prohibitive.

36. An alternative vector control strategy for the remaining part of 1987 had been formulated in order to maintain the present level of protection in the core area of the Programme and to make selective treatments to presumed sources of reinvasion (large breeding sites in the upper Niger basin of Guinea, some of the tributaries of Lake Volta in Ghana and Togo, and the R. Mono in southern Togo). There would therefore be no operational extensions as such.

37. Even to implement this revised strategy, additional larvicides and supplementary funding would be required in excess of the 1987 budget. Also a revised Plan of Operations for the remainder of the Third Financial Phase will be prepared to be presented to the JPC.8 in December.

(c) Considerations for a revised Plan of Operations

38. The Programme was confident that during the next 2-3 years the core area could be satisfactorily protected by vector control operations. By the end of that period onchocerciasis infection in man should have been brought down to levels at which vectors could be allowed back into the area without risking recrudescence of the disease. The primary objective of the Programme for the core area would then have been achieved.

39. In this regard with the registration of ivermectin in France anticipated before the end of 1987 plans were being accelerated to carry out large-scale operational trials of that drug in the OCP area.

40. If proven suitable for general distribution, this drug could supplement vector control in the core area of the Programme over the next two to three years, being used mainly for treating residual onchocerciasis and/or localized new outbreaks of the disease. In combination with vector control, ivermectin use could also be envisaged in the extension areas where vector control alone was no longer considered feasible.

(d) Comments by the Ecological Group

41. The Group was very encouraged to learn that there were good prospects for a phasing-down of vector control operations during the next few years, since there was optimism that the microfilaricide, ivermectin, would soon be available for the mass treatment of onchocerciasis. A reduction of vector control would result in a welcome release of insecticide pressure on the aquatic environment and with this in mind, the Group wished the Programme every success with the large-scale field trials of ivermectin scheduled to commence in 1987.

D. REPORT ON HYDROBIOLOGICAL MONITORING ACTIVITIES

(a) Hydrobiologists' Meeting

42. The annual meeting of the hydrobiologists in charge of the aquatic monitoring of the watercourses in the OCP area was held in Bamako from 6 to 9 January, 1987. The meeting was chaired by Ecological Group member, Dr C. Lévêque and attended by Dr C. Fairhurst, as observer.

43. Apart from Benin for which no national team report had been provided, there had been a general improvement in the quality of the monitoring data provided to the Programme during the Hydrobiologists' meeting.

44. As follow-up to a proposal made during the seventh session of the Ecological Group, participants in the Hydrobiologists' meeting were able to benefit from a one-day workshop. It was agreed that the workshop had been well worthwhile, especially in view for the good quality of scientific and technical discussions between the national participants and other specialists.

45. It was again noted that the preparation of annual reports by national teams was a continuing major problem. Data collection, sample analysis and report drafting were all very time-consuming activities. It was thus becoming more and more important that one of the Programme's hydrobiologists make regular visits to national teams to provide technical advice.

46. Attention should also be given to ways and means of making the national reports simpler and more standardized in format. Mr Yaméogo's efforts in this regard had already produced a marked improvement.

47. Now that the hydrobiology monitoring data base had been transferred from Geneva to Ouagadougou, the Programme was better placed to assist national teams with the analysis and presentation of their data, thus facilitating the preparation of reports. Obviously, maximum use of this facility could only be made if the national teams submitted their data to the Programme's hydrobiologists in a timely and regular manner.

48. With regard to monitoring schedules, it was noted that in general, the national teams tended to adhere to the established protocols. Delays had occurred in Guinea and especially in Mali, due to problems in the procurement of equipment and supplies.

49. To provide further assistance to national teams the Programme would provide an annual report on all the aquatic monitoring data which had been received and analysed.

(b) Recommendations to EG.8

50. The Group reviewed the six recommendations made to it in the report of the Hydrobiologists' meeting and provided appropriate responses which are presented in Annex 3.

(c) USAID Consultantship to OCP by Dr B.P. Hanson

51. Dr B.P. Hanson, of USAID stationed in Rwanda, completed a 60-day consultantship with OCP (December 1986 - February 1987) sponsored by USAID. The purpose of the consultantship was to participate in the hydrobiological monitoring procedures in the western extension area, and to work in the field alongside the Guinean hydrobiological team.

52. In addition, Dr Hanson was given direction by ORSTOM staff and Mr L. Yaméogo of OCP in preparing an initial listing of representative invertebrates according to their functional group (mode of feeding) and habitat preference. It was hoped that this approach could be continued, as referred to in the Hydrobiologists' report OCP/VCU/HYBIO/87.1, para.92. As a part of Dr Hanson's evaluation of stream invertebrates, he also conducted some field growth experiments which were designed to clarify some functional classifications. These experiments were somewhat curtailed because materials shipped from the United States did not arrive in Bamako in sufficient time to permit their use in the field.

53. Dr Hanson was able to participate in the annual meeting of the Hydrobiologists in Bamako (6-9 January 1987). He had prepared a report of his activities which would be forwarded to USAID and OCP and also to ORSTOM staff and members of the Group. The Chairman reported that Dr Hanson's evaluation was that the monitoring protocol was well designed for work in the western area (Phase VI). Dr Hanson had observed that the Guinean team should be able to conduct the monitoring procedures adequately providing some continued direction was afforded.

E. INDEPENDENT ANALYSIS OF AQUATIC MONITORING DATA

54. The Group reviewed the following two reports prepared by the University of Salford team:

- Aquatic surveillance - South-eastern extension.
Independent analysis of invertebrate catches.
(C.P. Fairhurst, P.J. Milligan, R.D. Baker and J. Hewett; February 1987).
- Aquatic surveillance - South-eastern extension.
Independent analysis of fish catches.
(C.P. Fairhurst, M.S. Curtis and J. Hewett; February 1987).

55. It was noted that the most comprehensive analysis results, for invertebrates, had been obtained from monitoring sites along the Rivers Mono and Amou in Togo. The least valuable data had been obtained from the River Ouémé in Benin.

56. For fish, the most valuable monitoring site in many respects was the one on the R. Pru. The Atchinedji station on the R. Mono was good, but it would soon be destroyed by the construction of a dam, which might also affect the Tototou station. The fish monitoring site on the R. Wawa was promising but had produced few fish per sample.

57. The main results and value ratings are given in Table 3. It should be noted that community identity was important because some stations, e.g. Tetetou and Atchinedji, may have similar populations of fish and both stations would not be necessary for future monitoring. Seasonal and long-term patterns were essential to an understanding of potential effects of pesticides.

58. The interpretation of much of the data had been made difficult because no large-scale maps giving basic descriptive information on the monitoring sites had been provided. It was hoped that within the framework of OCP's aerial operations, photographs could be taken of the monitoring sites, which could then be converted into appropriate maps. Each national team would then be able to provide a sketch map of each sampling site showing the location in the river section at which the actual samples were collected.

59. It was noted in some cases, that the aquatic monitoring data recorded by national teams and analysed by them and by ORSTOM, were not in complete agreement with regard to numbers of individuals. Nevertheless, many of the general patterns were very similar and by applying a wide range of analytical methods, the overall picture was always found to be the same.

60. The aquatic monitoring data from the south-eastern extension area was particularly useful because it provided pre-treatment information over a long period. Thus, it had been possible to clarify the situation concerning the fish Petrocephalus bovei, by comparing data from untreated and treated areas. It was now known that a drop in numbers of this species which had been recorded inside the treatment zone, could be attributed to natural causes because corresponding drops had been observed in the untreated zone. This finding indicated that monitoring personnel could take a less concerned view of earlier records of unexpected drops in numbers within the treatment zone.

F. REPORTS ON ENVIRONMENTAL DISTRIBUTION AND FATE OF PESTICIDES

(a) Chemical monitoring

61. The Group noted that the results of chemical analysis of river sediments were difficult to interpret, especially with regard to levels of chlorphoxim in samples taken from rivers which had not been treated with that chemical. In general, pesticide levels were low, often at the limit of detectability.

62. The high cost of having residue analysis conducted in Europe made it questionable as to whether additional samples should be collected and analysed.

63. With regard to the possibilities of having chemical analysis conducted in Africa, one Ecological Group member had explored the opportunities offered by the analytical centres established by UNEP/FAO within the framework of the Regional Sea Programme WACAF-2. His enquiries revealed that, if necessary, additional chemical analysis could be undertaken in one of the WACAF-2 Project laboratories.

(b) Environmental distribution and fate of permethrin

64. The Group received from one of its Members a literature review document on the environmental distribution and fate of permethrin which was based on data present in three recent reviews.

65. The review document stated that the possibilities of delayed toxic effects of permethrin and the bio-accumulation of that compound, were small. Thus, the evaluation of its potential hazard to aquatic systems should be made primarily on the basis of its high toxicity and on the stress caused on river biota at the time that treatments were made.

66. In fact, the rapid absorption of permethrin onto organic matter in suspended solids and sediments reduces its toxicity by several orders of magnitude. Moreover, it had been demonstrated that microbial degradation in sediments was the major pathway for the decomposition of the compound.

67. The level of persistence and the rate of decomposition could not be predicted with precision, because of wide variations caused by different environmental conditions. However, available field data and theoretical calculations indicated persistence in the aquatic environment of from a few days to some weeks.

68. Predicted bio-accumulation of permethrin was high, but, as synthetic pyrethroids were easily and quickly metabolized, it seemed unlikely that bio-accumulation hazards could occur.

69. These observations had been confirmed by residue analysis of water, sediments and biota, and by the literature reviewed.

70. After discussion of these factors, the Group concluded that the potential damage to important aquatic species could occur mainly at the time of permethrin treatment, or, as a consequence of the stress received by the ecosystem. Thus the research approach followed for other compounds was equally applicable to permethrin.

(c) Environmental distribution and fate of carbosulfan

71. Published information on carbosulfan was very scarce, to the extent that a meaningful evaluation of this compound could not be made. However, a theoretical model made on the basis of physico-chemical properties, indicated that the partition possibilities in environmental compartments were similar to those of permethrin.

72. Carbosulfan exhibited a great affinity for sediments and suspended solids and had a high bio-accumulation potential in biota. However, as little information was available on degradation and metabolism, it was impossible to draw any valid conclusions.

73. The Group therefore agreed that the carbosulfan molecule be studied as a matter of high priority, and recommended that searches of the literature be continued. In order to complete the hazard assessment process the Group also recommended that a critical review be prepared on the environmental distribution and fate of carbosulfan. This could be undertaken through cooperation with a member of the Group.

G. RESEARCH ON NEW LARVICIDES

74. The Group was informed that very few new larvicides were being made available to the Programme from the chemical industry. Consequently, an appreciable amount of the Programme's larvicide research activities were concerned with the evaluation of new formulations of existing compounds.

75. Large-scale field trials had confirmed that a third formulation of temephos was equal in efficacy to the Abate available from two sources and was no more toxic to aquatic non-target organisms.

76. A 50 per cent E.C. formulation of carbosulfan would be used operationally later in 1987. It was more cost-effective than the existing 25 per cent formulation and no more toxic to aquatic non-target organisms.

77. After testing many formulations of permethrin, a 25 per cent E.C. formulation from another company seemed to be somewhat more selective towards S. damnosum than the others. It would be used operationally during the 1987 wet season, with special environmental surveillance, to confirm if this improved selectivity occurred under field conditions.

78. Field trials had confirmed that the performance of the "Vectobac" formulation of B.t. H-14 was equal to that of HPD.

79. A new B.t. H-14 formulation from the HPD "6000" series had been shown to be three times more effective than HPD. The significance of this was that the dosage could be reduced from 1.2 to 0.4 mg/litre-10 min. For a large-scale field evaluation, 5000 litres of the new formulation had been ordered. If the field trial gave satisfactory results it was likely that the river discharge limit on B.t. H-14 use of 75 m³/s, could be increased to 200 m³/s. All of the new B.t. H-14 formulations had been tested against the non-target fauna, with acceptable results.

80. Research on new compounds had been concerned with organophosphates, synthetic pyrethroids and insect growth regulators (IGR's). Research on the organophosphate OMS-3036 was prematurely terminated because the compound was withdrawn by the manufacturer.

81. The organophosphate Phoxim was being examined as a possible replacement for chlorphoxim. As soon as samples were received work would commence on cross-resistance studies, dosage trials and assessment of environmental effects.

82. Within the pyrethroid group, work had been concentrated on the alpha-cyano group (alpha-methrin, cyfluthrin and others) since these compounds might be in a different cross-resistance group than permethrin. If one of these compounds was selected for operational trial (unlikely in 1987) the Group would be consulted.

83. Two juvenoid IGR's, OMS-3019 and fenoxycarb, were currently under study. OMS-3019 would soon be submitted to small-scale field evaluation. Fenoxycarb would be studied to define its minimal dosage. No operational trial of this type of compound was foreseen for 1987.

84. The Group commended the Programme on the efforts being made to identify new formulations and new compounds, which would have improved larvicide properties, but without having adverse effects on the aquatic environment. The results obtained so far with the HPD "6000" formulation of B.t. H-14 were most encouraging and seen as a means of reducing the use of more toxic compounds such as permethrin and carbosulfan.

H. PRIORITIZATION OF HYDROBIOLOGICAL MONITORING ACTIVITIES

85. The Group recalled that the Programme image had been very well accepted internationally, partly because of the Programme's great concern about the possible impact of anti-blackfly larvicides on the aquatic environment and partly because of the strict screening protocol for insecticides, designed to protect the non-target fauna. The OCP was one of the major vector control programmes in which the environmental dimension was really taken into consideration, and the Programme should be congratulated for taking that attitude.

86. The Group, while being well aware of the Programme's financial problems, was also concerned by the increasing use of alternative larvicides which were potentially more hazardous than temephos and B.t. H-14. Accordingly, the Group undertook a revision of the environmental monitoring protocol, based on the considerations stated above, in order to achieve a new protocol which was the minimum that could be considered as scientifically acceptable. It was stressed that any further reduction of the revised protocol would have adverse consequences on the quality of the environmental data required in support of the revised control strategy.

87. At the outset, the Group acknowledged that a complex array of considerations would be required to accomplish such a complete re-evaluation. The Group determined that their best course of action should be to provide the best scientific judgement possible as to the priorities of the hydrobiological monitoring, given the present situation of the Programme. The Group realized full-well that OCP, in the course of its determination of future action regarding the continuance of the most appropriate hydrobiological monitoring strategy, would have to take other factors into consideration. That is, in addition to the scientific evaluations that could be made by the Group and the consequences for environmental conservation, the matters of economic constraints for the Programme and the long-term benefits of participation by national teams in the hydrobiological monitoring, would certainly be involved in the overall evaluation by OCP.

88. As a basis for discussion the Group established an initial set of observations that it would use in its re-evaluation of the hydrobiological monitoring programme. These were as follows:

- (i) After 10 years of investigation, no drastic effects on non-target fauna had been demonstrated for rivers treated with Abate in the wet season and B.t. H-14 in the dry season. These results had been sufficiently well established that they were now appearing in the peer reviewed published scientific literature. This led to the conclusion that there were now sufficient data on such rivers that there was no longer a need to monitor them, until such time as they would be treated with permethrin and/or carbosulfan or any new pesticide.
- (ii) It was clear that the monitoring activities to determine the effects on non-target fauna must move from the original long-term strategy, which had been highly successful, to a short-term strategy (3-5 years) with primary emphasis on the effects of permethrin and/or carbosulfan treatments which would be used more extensively throughout the Programme area.
- (iii) Because the hydrobiological monitoring should now concentrate on the above mentioned short-term approach to the attack phase of permethrin and/or carbosulfan use, the Group felt that it should be possible to significantly reduce the effort spent on evaluating the effects of new larvicides on non-target fauna. This was compatible with the reduction in testing of new larvicides anticipated by VCU in the next two years.
- (iv) Considering the Programme to be in an attack phase with regard to the use of permethrin and carbosulfan, sampling strategies and data analysis must now be focused on the evaluation of the effects of these two compounds, used separately or in combination. In this context, it would be important to also consider those sites which could provide the best pretreatment data against which to compare the effects of permethrin and/or carbosulfan.

- (v) Thus, the basic task faced by the Group would be to recommend the most valid scientific approach for sampling strategies and the most appropriate sites to achieve the evaluation of the effects of permethrin and/or carbosulfan. This strategy should also include emphasis on special procedures critical for interpretation of data sets as detailed in EG.6, para.3 and EG.7, para 59, e.g. analysis of reproductive success of fish.
- (vi) Finally, given the recommended changes in hydrobiological monitoring strategy, it was imperative that the most efficient and reliable teams available (including those of OCP) be placed in the field for the collection of fish and invertebrate data. It was also critical that maximum support be provided to insure rapid processing of samples in the laboratory.

89. Given the above six general considerations for dealing with the new conditions faced by the Programme, the Group recommended three levels of priority for hydrobiological monitoring:

- (i) The first priority should be given to the monitoring of those river sites in the core area that had been treated with permethrin and/or carbosulfan, or for which treatment was anticipated in the next three years.
- (ii) The second priority should be given to obtaining hydrobiological monitoring data from sites in the south-eastern (Phase V) and western (Phase VI) portions of the Programme area. Particular attention should be focused on the likelihood that such sites could serve as sources of pretreatment data relative to applications of permethrin and/or carbosulfan.
- (iii) The third priority should be given to other sites for which there might be justification to continue monitoring activities for reasons other than their relevance to the present and anticipated application of permethrin and/or carbosulfan.

90. A complete evaluation of all monitoring sites within the entire Programme area is given in Annex 4 and referenced to Maps 1 and 2 which show all the monitoring sites. The detailed evaluation was made in consultation with Dr Fairhurst who had provided detailed statistical evaluations of the data from many of the sites.

91. The Group noted that these statistical analyses were not complete for the core area or the western extension (Phase VI). This had not been possible as the data for 1985 and 1986 for these areas were not held by the University of Salford team. The Group recommended that these data be supplied to Salford at once so that the analysis of all remaining data could be undertaken in the mode that had been applied to the south-east (Phase V).

92. After very extensive discussions within the Group and detailed consultation with OCP and ORSTOM staff, the Group made the specific recommendations for the sampling of fish and invertebrates given below. In the selection, the present and anticipated use of permethrin and/or carbosulfan was the major consideration.

(a) Monitoring of Invertebrates

93. The Group recommended the following strategy for hydrobiological monitoring of invertebrates:

- (i) Sampling only during the dry season. Twice per month in December and January; once per month in February, March and April. At any sites which do not flow during the dry season, the schedule would be twice per month in November and December and once per month in January.
- (ii) Surber and day drift samples only.
- (iii) Surber: at least 5 replicates taken with a 15 x 15 cm sampler where the range of current velocity is between 0.4 and 0.8m/sec and on rock substrates with Tristichia cover of 3 mm to 2 cm thick.
- (iv) Day drift: samples of 15 minutes durations with 20 x 20 cm nets; 6 replicate samples with nets of 200 u mesh and 6 replicate samples with nets of 500u mesh; samples to be taken at 13.00 and 14.00 hours. Current velocity to be measured at the mouth of each net. Weather conditions should be noted.
- (v) As recommended in the Hydrobiologists' meeting report (OCP/VCU/HYBIO/87.1 para.79, 96 and 110) the invertebrate families Baetidae, Hydropsychidae and Tricorythidae be identified to genus in all samples. Other taxonomic separations should follow the procedures already adopted under the standard protocol.

94. Table 4 provides a summary of sites recommended for hydrobiological monitoring and the evaluation criteria used in their selection. Care was taken to ensure that the sites were appropriate for evaluating the effects of permethrin and/or carbosulfan.

95. With regard to the data presented in Table 4, the objectives of the selection were as follows:

<u>River/Station</u>	<u>Objective</u>
R. Marahoué at Danangoro and Entomokro)	To focus on the effects of <u>carbosulfan</u>
R. Comoé at Gansé)	
R. Black Volta at Bamboi)	To focus on the effects of <u>permethrin</u> and <u>carbosulfan</u>
R. Niandan at Sassambaya)	
R. Niandan at Sassambaya)	To focus on the effects of <u>permethrin</u>
R. Bakoye at Kokofata)	Reference sites.
R. Amou at Amou-Oblo)	

(b) Monitoring of fish (see Tables 5A and 5B)

96. Sampling frequency

Every two months for Bandama, Comoé and/or Black Volta, Léraba and Oti. Quarterly for others, except Oti at Mango (once a year at the end of the flood).

97. Sampling techniques

Two batteries of gill nets per night for two nights at each sampling point. A battery would include a series of different mesh sizes: 12.5, 15, 17.5, 20, 22.5, 30 and 40mm (French measure). In order to improve the monitoring of juveniles, it was necessary to double the set of smaller mesh (12.5, 15 and 17.5mm).

98. Expected results

- catch per unit effort per mesh size,
- number of species caught,
- length frequency for most abundant species,
- coefficient of condition,
- gonadosomatic index for species selected by the Hydrobiologists' meeting,
- gut contents for invertebrate predators in 1 or 2 stations where carbosulfan is applied.

99. Electrofishing

For these stations on riffles already sampled by electrofishing it was requested to sample occasionally during the dry season for a better checking of fish fauna.

I. WORK PROGRAMME FOR 1987-1988

100. Because of the complete re-evaluation of the hydrobiological monitoring strategies conducted by the Group and the recommendations for very significant changes made by the Group, the monitoring work programme of OCP would likely require extensive revision in 1987-1988. The Group had made its recommendations in a prioritized fashion and felt that it was now necessary for OCP staff to evaluate the feasibility of rapid implementation of these recommendations in the light of the many constraints facing the Programme, other than the scientific evaluation given in this report. When a plan of action had been undertaken, the Group requested that the members be informed about the extent to which implementation of their recommendations had been possible.

J. OTHER MATTERS

101. The Group wished to encourage OCP staff to publish the results of their studies on the effects on non-target fauna of all pesticides used in the Programme. They should be published in the scientific literature as was now being done for data on temephos effects.

102. A member of the Group had been requested to conduct a literature review on the utility and feasibility of conducting enzymatic analyses, as an early warning to evaluate the effects of carbosulfan on fish.

103. Now that measures had been proposed for the reduction in the number of monitoring sites the Group urged that aerial photographs be taken of the retained sites so that large-scale sketch maps of each site could be prepared.

104. To facilitate the analysis and interpretation of raw hydrobiological data, the Group recommended that weekly small-scale treatment maps be sent to the University of Salford team, and that appropriate measures be taken to ensure that the national teams were fully aware that treatment data was always readily available to them, should they require such data for their own analysis.

105. The Group proposed that, considering the financial constraints of the Programme, additional funding for hydrobiological activities be sought from sources outside OCP, such as UNDP, UNEP, FAO and EEC as well as USAID on a bilateral basis.

106. The Chairman wished it to be recorded that English speaking members were most grateful for the great effort made by all participants to conduct the meeting in English, which was necessitated because it was not possible to provide simultaneous interpretation.

107. The Group was unanimous in expressing its sincerest appreciation to Mr L. Yaméogo, OCP Hydrobiologist, who, despite ill health, made a very commendable personal sacrifice to attend the meeting for the final sessions.

K. ARRANGEMENTS FOR NEXT MEETING

108. The ninth session of the Ecological Group would be held from 1 to 4 March 1988, at a venue to be determined.

109. The Group recommended that if required the 1988 Hydrobiologists' meeting be convened during the week prior to the Ecological Group meeting, with allowance being made for a 2-3 day overlap.

110. Dr C. Lévêque would represent the Ecological Group at the eighth sessions of the EAC (Ouagadougou, 15-19 June 1987) and the JPC (Rome, 30 November to 3 December 1987).

L. APPROVAL OF REPORT

111. The draft report was reviewed before the end of the meeting and the finalized version approved by the Chairman.

M. CLOSURE OF SESSION

112. The session was closed by the Chairman during the late afternoon of 27 March 1987. In his closing remarks the Chairman, on behalf of the Group, expressed sincerest thanks to the staff of Bouaké Sector for their kindness and excellent support to the eighth session of the Ecological Group. Special thanks were also given to Mrs F. Ba and Miss K. Nignan, conference secretaries.

TABLE 1: MINIMAL DOSAGES AND CARRY OF FIVE LARVICIDES
(DOSAGE SUFFICIENT TO OBTAIN 100 PER CENT KILL AT THE FIRST BREEDING SITE)

<u>Compound</u>	<u>Dosage</u>	<u>Carry (km)</u>	
	<u>mg/l-10 min</u>	<u>Dry season</u>	<u>Wet season</u>
Temephos	0.05 - 0.1	1-3	50
Chlorphoxim	0.05	1-3	15
Carbosulfan	0.05	3-6	10-15
Permethrin	0.015	1-3	15
<u>B.t. H-14</u>	1.2	1-2	10

TABLE 2: COMPARATIVE COST OF FOUR LARVICIDES BASED ON A RATING OF "1" FOR TEMEPHOS

<u>Compound</u>	<u>Dry season</u> (Approx. 10m ³ /s)	<u>Wet season</u> (Max. 500m ³ /s)
Chlorphoxim	0.7*	1.3
Carbosulfan	0.9*	2.3
Permethrin**	0.6*	0.7
<u>B.t. H-14</u>	1.4	4.3

* Utilization unacceptable because of high risk of ecological damage.

** High resistance risk due to extensive utilization of pyrethroids in agriculture.

TABLE 3: VALUE RATINGS FOR SAMPLING STATIONS, SOUTH-EASTERN EXTENSTON AREA

A - INVERTEBRATES

Site	<u>Asubende</u>	<u>Asukawkaw</u>	<u>Kati</u>	<u>Tetetou</u>	<u>Oblo</u>	<u>Beterou</u>
River	<u>Pru</u>	<u>Asukawkaw</u>	<u>Sio</u>	<u>Mono</u>	<u>Amou</u>	<u>Queme</u>
Method	DD ND S	DD ND S	DD ND S	DD ND S	DD ND S	DD ND S
No. of collections	++/++/+	++/++/+	+/+/+	+/+/+	+/+/+	-/-/-
No. of animals/Replacate	-/-/-	-/-/+	+/+/-	+/+/-	++/++/+	-/-/++
Community separation		+/+/+		+/+/	+/+/+	
Seasonal pattern	-/+/	-/ /+	/+/	++/++/+	++/++/	/ /+
Overall Rating	+2	+8	+5	+12	+15	-2

B - FISH

Site	<u>Asubende</u>	<u>D.Papasse</u>	<u>Atchinedji</u>	<u>Tetetou</u>	<u>M'beta</u>	<u>Beterou</u>
River	<u>Pru</u>	<u>Wawa</u>	<u>Mono</u>	<u>Mono</u>	<u>Queme</u>	<u>Queme</u>
No. of collections	++	+		+	-	-
No. of fish/collection	+	-	++	+	+	-
No. species	++	+				-
No. fish/species	-	--	++			-
Community identity	++	++	++	+	-	-
Seasonality	++				-	-
Overall Rating	+10	+1	+6	+3	-2	-6

Key

- ++ Indicates "very good"
- + Indicates "better than average"
- Indicates "worse than average"
- Space indicates "no comment".

ND = Night drift
DD = Day drift
S = Surber

TABLE 4: LIST OF INVERTEBRATES MONITORING STATIONS¹
(A = Abate, C = Chlorphoxim, B = B.t. H-14, Ca = Carbosulfan, P = Permethrin)

1) Central zone	Danangoro Marahoué	- 3 years pretreatment data - Good results - Treated with A, C, B, Ca and P. - Will be treated 1987: - Dry season with B - Rainy season with Ca only
and		
2) Central zone	Entomokro Marahoué	- 1.5 years pretreatment data - Good results - Treated with A, B, C, Ca and P. - Will be treated 1987: - Dry season with B - Rainy season Ca only
and		
3) Central zone	Gansé Comoé	- No pretreatment data - Results not very good - Treated with A, B, C, P and Ca - Will be treated in 1987 - Dry season with B. - Rainy season with P and Ca
and/or		
4) Central zone	Bamboi Black Volta	- No pretreatment data - Results not very good - Treated with A, B, C, P and Ca - Will be treated: - Dry season with B - Rainy season with P and Ca.
5) South-Eastern zone	Amou-Oblo Amou	- 6 years of pretreatment data - Very good results - Never treated - Will be treated with B
6) Western zone	Sassambaya Niandan	- 2.5 years pretreatment data - Very good results - Never treated - Will be treated - Dry season with B - Rainy season with P only
and		
7) Western zone	Kokofata Bakoye	- 2.5 years pretreatment data - Very good results - Never treated - Will not be immediately treated

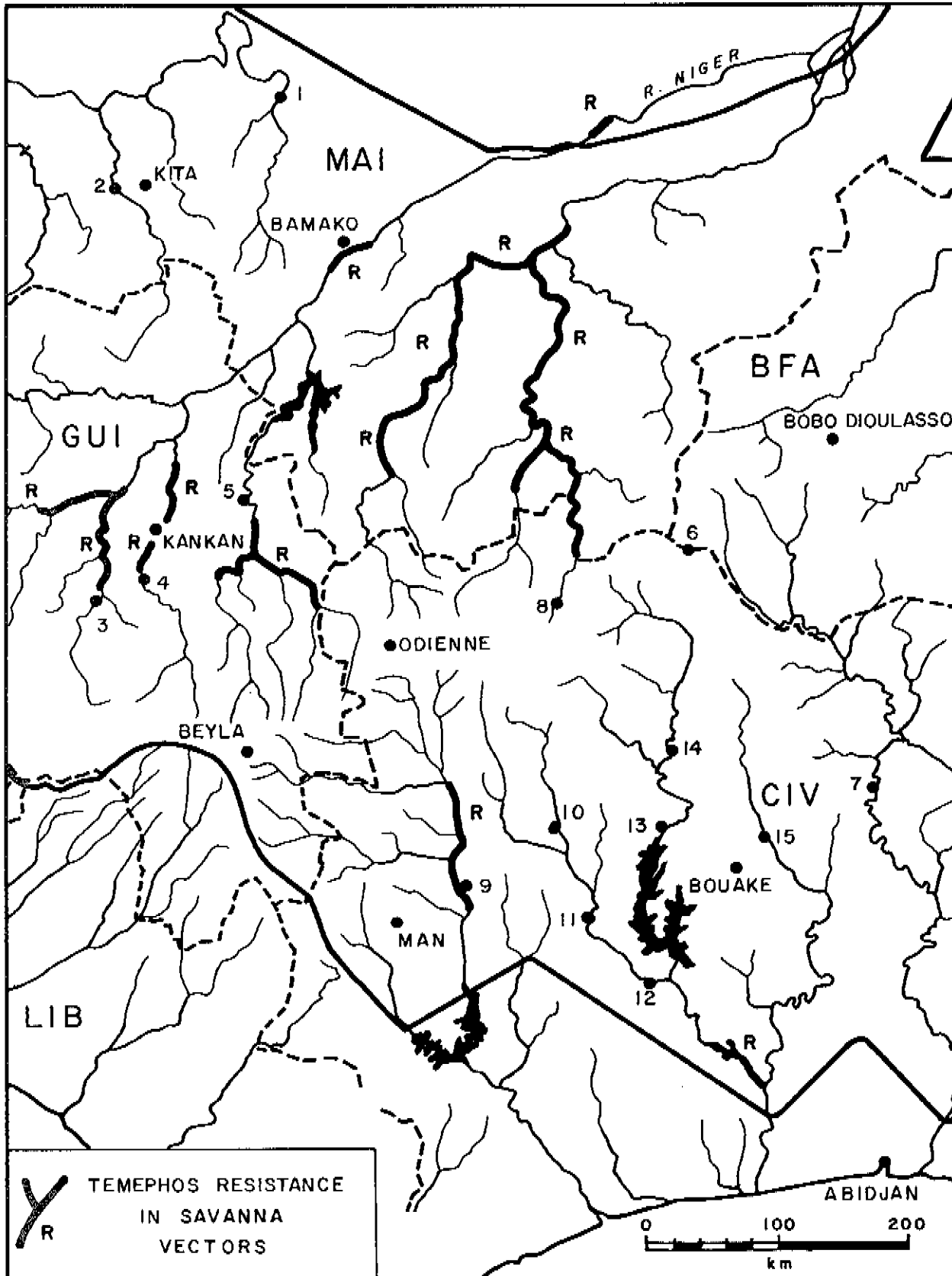
¹ Further details are given in Annex 4 and Maps 1 and 2.

TABLE 5A: LIST OF FISH STATIONS
(Further details are given in Annex 4 and Maps 1 and 2)

	<u>Zone</u>	<u>Station and River</u>	<u>Comments</u>
FIRST PRIORITY	Central	Nianka on Bandama	Very good results with long-term patterns; description in 10 years publication; has been treated with A, B, C and Ca; good numbers of <u>Alestes</u> and <u>Eutropius</u> .
	"	Ganse on Comoé	Good results; good numbers of <u>Alestes</u> , <u>Petrocephalus</u> , <u>Eutropius</u> ; needs reactivation.
	"	Pont Frontiere on Léraba	Good results; long-term patterns; good numbers of <u>Schilbe</u> and <u>Alestes</u> ; good station to check with Comoé.
	"	Sabari on Oti	Very good results with long term patterns; description in 10 years publication generally low numbers but good for <u>Eutropius</u> .
	Eastern	Asubende on Pru	Very good results; best of Eastern Stations; good numbers of <u>Schilbe</u> , <u>Alestes</u> , <u>Polypterus</u> ; best pretreatment.
	Western	Missira on Baoulé	Pretreatment; well known station, monthly sampled; temporary river.
SECOND PRIORITY	Central	Bamboi on Black Volta	Interruption of monitoring to be reassessed.
	Eastern	Mango on Oti	High diversity; check with Oti (Sabari)
	Western	Mandiana on Sankarani	Pretreatment data.

TABLE 5B: PRIORITY OF CHOICE FOR FISH MONITORING SITES
(Further details are given in Annex 4 and in Maps 1 and 2)

<u>River and Site</u>	<u>Control</u>	<u>B.t.H-14</u>	<u>Perme- thrin</u>	<u>Carbo- sulfan</u>	<u>Carbo/Perm</u>	<u>Frequency</u>
FIRST PRIORITY:						
Bandama (Niaka)				X		Every 2 months
Comoé (Ganse)					X	Every 2 months
Léraba (Pt frontière)					X	Every 2 months
Oti (Sabari)					X	Every 2 months
Pru (Asubende)		X				Quarterly
Baoulé (Missira)	X					Quarterly
SECOND PRIORITY:						
Sankarani (Mandiana)			X			Quarterly
Oti (Mango)					X	Once a year
Black Volta (Bamboi)					X	Quarterly



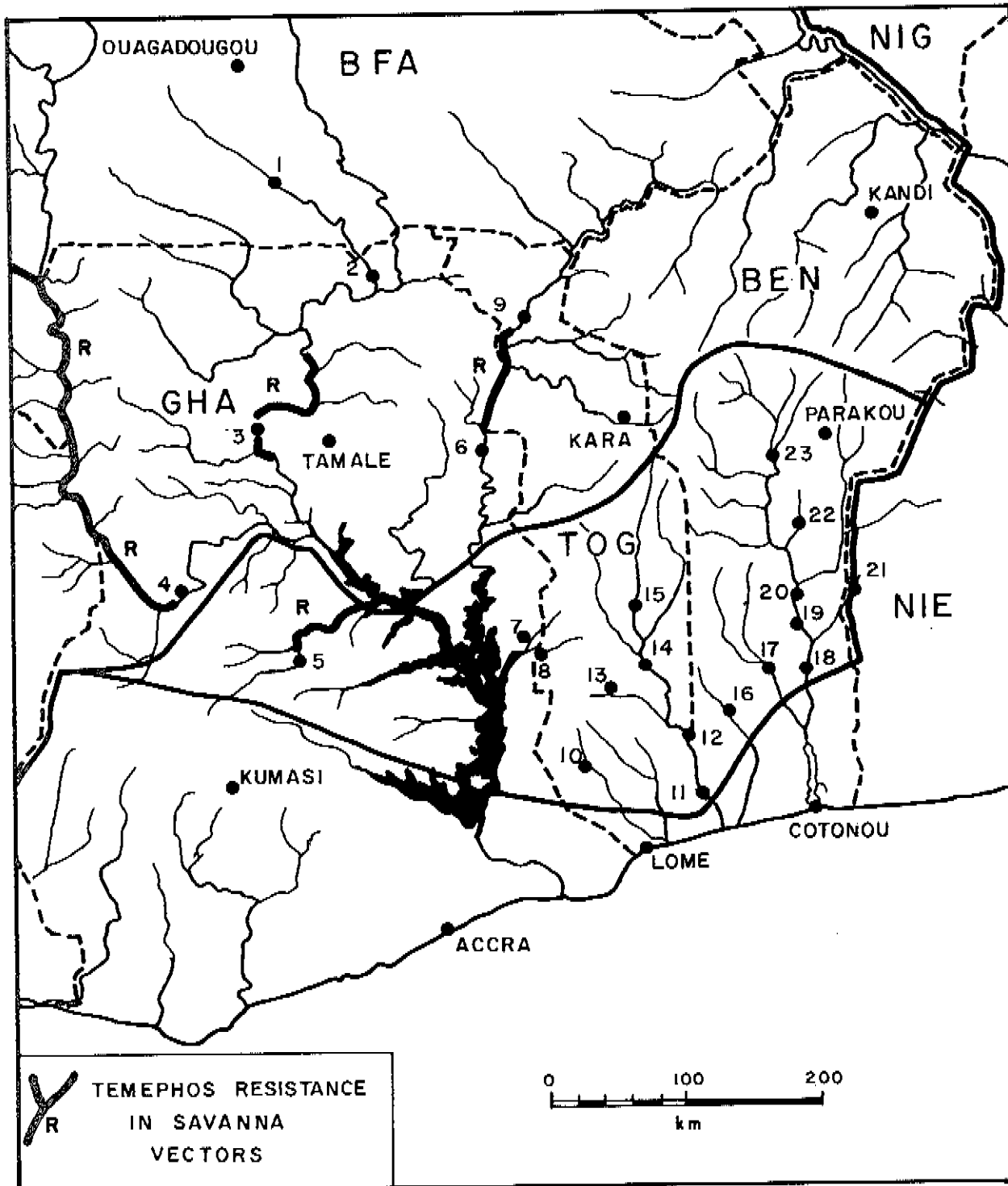
MONITORING STATIONS IN THE WESTERN
OPERATIONAL AREA

LEGEND TO MAP 1

Number	Station	River	Country	Category ¹
1	Missira	Baoulé	Mali	IF
2	Kokofata	Bakoye	Mali	IF
3	Sassambaya	Niandan	Guinea	I
4	Boussonke	Milo	Guinea	IF
5	Mandiana	Sankarani	Guinea	F
6	Pont Routier	Léraba	Burkina Faso/ Côte d'Ivoire	IF
7	Gansé	Comoé	Côte d'Ivoire	IF
8	Kouto	Bagoé	" "	IF
9	Pont Sémien	Sassandra	" "	IF
10	Mankono	Marahoué	" "	F
11	Danangoro	Marahoué	" "	I
12	Entomokro	Marahoué	" "	I
13	Marabadiassa	Bandama	" "	F
14	Niaka	Bandama	" "	F
15	Route Dabakala	Nzi	" "	IF

¹I = Invertebrates
F = Fish

MAP 2



MONITORING STATIONS IN THE EASTERN
OPERATIONAL AREA

LEGEND TO MAP 2

Number	Station	River	Country	Category ¹
1	Pont P6	Nazinon	Burkina Faso	I
2	Nangodi	Red Volta	Ghana	I
3	Daboya	White Volta	Ghana	IF
4	Bamboi	Black Volta	"	IF
5	Asubende	Pru	"	IF
6	Sabari	Oti	"	IF
7	Asukawkaw	Asukawkaw	"	I
8	Dodi Papasse	Wawa	"	F
9	Mango	Oti	Togo	F
10	Kati	Sio	"	I
11	Agome	Mono	"	F
12	Tetetou	Mono	"	IF
13	Oblo	Amou	"	IF
14	Atchinedji	Mono	"	F
15	Kpessi	Mono	"	F
16	Lanta	Koufto	Benin	I
17	Atcherigbe	Zou	"	F
18	Zagnanodo	Oueme	"	F
19	M'betekoukou	Oueme	"	F
20	Atchakpa	Oueme	"	IF
21	Kaboua	Okpara	"	F
22	Vossa	Baffa	"	F
23	Beterou	Oueme	"	IF

¹I = Invertebrates
F = Fish

ANNEX 1

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PRESENTATION BY DIRECTOR OCP TO ECOLOGICAL GROUP
Bouaké, 24-27 March 1987

Dear Members of the Ecological Group,

I wish to express my regret to you at not being able to attend this session of the Ecological Group and address you personally. The Programme is currently going through an exceptionally critical period because of the continuing slide in the value of the dollar and the now rapidly spreading problem of resistance. This has resulted in an in-depth review of all the Programme activities and I am under considerable pressure to collate all the facts to attend a meeting of the Committee of Sponsoring Agencies in Rome next week. Your full appreciation of the situation will be critical to your deliberations and I would have preferred to brief you personally rather than by letter but, as managers yourself, I am sure you will understand.

As you are aware the Joint Programme Committee at its fifth session in December 1985 approved the Plan of Operations for the third Financial Phase (1986-1991) at a cost of US \$133 million. Since the financial ceiling was fixed when the Long-Term Strategy was approved the previous year the US dollar has devalued by over 40%. At the last JPC the donors agreed that the Programme should be compensated for dollar fluctuation but you will agree that decline, which is continuing even today, is more substantial than was ever anticipated. As a result, last December in Accra the donors indicated that additional support would be conditional on savings being realized in certain Programme areas.

Dr Philippon will be briefing you on the vector control operations and will definitely highlight the spread in temephos resistance in the vector not only in rivers under treatment by the Programme for both long and short periods but also in rivers in the Western Extension area where larviciding has not even started. This is forcing upon the Programme a radical change in the implementation of the strategy as described in the Plan of Operations mainly because of the need to replace temephos with B.t. H-14 for the greater part of the year. The need for this change has only become evident in the past few weeks and subsequent to the JPC. Because B.t. H-14 is a less efficient larvicide than temephos, greater quantities are required so increasing the logistical support and the number of flight hours required to obtain the same result. As a consequence, there is no way in which the same area previewed to be covered in 1987 can now be brought under control within the budget approved by the JPC. Even to maintain the success in the original Programme area and prevent recrudescence at a time when the objective is within reach, and push far enough into the extension areas to limit the impact of reinvasion, will be possible within the budget only if radical cuts in less-essential, non-operational activities are implemented. To this end it has been incumbent upon me to insist that the different units review their activities and retain only those activities which are of top priority. Posts have been frozen, consultants greatly reduced, research contracts not renewed or not implemented, the vehicle fleet not replaced, travel cut back and non-essential services curtailed. With regard to the latter you will be aware that no simultaneous interpretation is being provided for this session of the Ecological Group to save money and I would appreciate your sympathetic understanding and patience to ensure that all participants understand what is being said. Further, we have just had a financial management meeting of all senior staff of the Programme in Ouagadougou to analyse together the various Programme activities, to sensitize them to the situation we are facing and to determine how the cost-effectiveness of the Programme can be improved.

ANNEX 2

Both Drs Philippon and Baldry will enlarge on those matters for you and answer your questions. This is an extremely serious situation that is being faced by the Programme and the savings incurred are being used to purchase the larger quantities of B.t. H-14 necessary to ensure the control effort can continue. Without the larvicide and the aircraft to apply it effectively, the Programme is finished. The situation is as critical as that. I am not trying to dramatize the situation in any way - this is not necessary as the facts are available for all to see.

During the first two financial phases the funds available were more than adequate. As we entered the third phase we knew that funding was tight but thought we would survive with careful management. However, the unexpectedly rapid spread in resistance coupled with the equally rapid fall in the US dollar (the World Bank allowed for approximately 20% devaluation over the six years) has required this urgent change in approach. A revised strategy will have to be prepared to be presented to the donors in Washington in November and to the JPC in December. If the new medicament, ivermectin, is proven to be as successful in community trials as it has been in small clinical trials (only 1200 people having been treated to date) then by mid-1988 or 1989, the Programme could have an additional, if not an alternative tool, to help it achieve its objective and so possibly alleviate the tremendous pressure on the vector control operations.

With this background, I would urge you to look very critically at what is currently being done in collecting hydrobiological data. The long-term analysis which has been undertaken I hope will help you to reassess the situation and advise what activities - and in view of the scarcity of funds I would plead for the minimum of activities - that must be undertaken to provide you, the Ecological Group, with the information you require to ensure that the larvicides applied are not having any deleterious effects on the environment. In view of the very extensive use of the very selective B.t. H-14, and the limited use envisaged of the more toxic chlorphoxim, permethrin and carbosulfan, could the collection of data be restricted to a few sites on a restricted number of rivers? Also, in view of the slower progress into the western extension area, can the collection of additional data from there be deferred? I must also recommend only activities which have importance and relevance to the operations and that you give a priority rating to all the activities you propose. Any ideas as to how these hydrobiological activities might be financed other than out of the Programme funds would also be appreciated.

I am very sorry to present you with such a bleak picture and have you carry out such an onerous task during your three-day meeting. I am confident, however, that you will rise to the challenge so that together we may continue to go forward to the JPC with ideas that will be acceptable to all its participants, showing them that, as we strive together to make every part of the Programme more cost-effective, the money the donors provide is being wisely used. I look forward to receiving your report in this respect.

I am sorry Douglas Marr is also unable to attend but is involved in the review of the Onchocerciasis Chemotherapy Project called for by the JPC but I am sure David Baldry, whom you all know, will be a very efficient secretary to the Ecological Group and provide all the support you require.

Again please accept my apologies for being unable to be with you and I wish you a very successful meeting and an enjoyable stay in Bouaké.

RECOMMENDATIONS OF THE 1987 HYDROBIOLOGISTS' MEETING
TO THE ECOLOGICAL GROUP AND ECOLOGICAL GROUP RESPONSES

Rec. 128.: Considering that the aquatic fauna of the Guinean zone differs considerably from that of the sudano-sahelian watercourses, the hydrobiologists are wondering about the extent of taxonomic knowledge of this fauna and the steps taken to carry out monitoring in that zone.

EG Response: In view of the need for the Programme to revise its strategy for the Third Financial Phase (1986-1991), especially with regard to the extent of vector control activities in the western and south-eastern extensions, this issue will be addressed during the ninth session of the Ecological Group.

Rec. 129.: The hydrobiologists would like to have the views of the Ecological Group on the additional research proposals.

EG Response: The Group reaffirmed its recommendation that special attention continue to be given to the collection of data on spawning patterns and gut analysis of important fish species and continued efforts be made to provide the best possible taxonomic treatment of the samples collected. In addition, the Group was enthusiastic about the possibility of conducting additional intensive drift studies of the type reported by J.M. Elouard of ORSTOM.

Rec. 130: The wish was expressed that a final version of the results of the analysis of the ten years of monitoring be distributed to the teams.

EG Response: Final versions of reports on fish and on invertebrates are almost ready for release.

Rec. 131: The hydrobiologists would like to have the views of the Ecological Group on the possibility of continuing studies on the accumulation of pesticides in Tristichia and possibly, in view, notably, of the use of new pesticides.

EG Response: The Group concluded that, as in the case of sediment, further collection and analysis was not warranted at this time. However, it noted that the dried samples of Tristichia had proved to be suitable material for analysis. The absence of basic studies on this subject made the interpretation of the results difficult. Moreover, the molecules utilized by the Programme can decompose rapidly, making delayed detection unlikely.

Rec. 132: It was suggested that now that the monitoring data are entered in Ouagadougou, OCP should publish, every year, a directory of basic data collected by the different teams in the Programme area.

EG Response: The Group confirmed that this will be done.

Rec. 133: The Atchinedji station on the Mono (Togo) will very soon be drowned by a dam lake. It was therefore requested that it be removed from the list of monitoring stations and that the Tetetou station be sampled every two months.

EG Response: The request that Atchinedji station be discontinued as a monitoring station was accepted by the Group. The consideration of the Tetetou station has been included in the Group's general recommendations on all monitoring stations (Section H). Change in water quality due to the dam will make this site also unsuitable as a monitoring station.

ANNEX 4A

A - APPRAISAL OF FISH MONITORING STATIONS
(SEE ALSO MAPS 1 AND 2)

Phase and Country	River and Station	Monitoring		Treatments	Possible '87 treatment		Continuation Category	Comments
		Start-Finish	Start-Type	Low water	High water			
III - Côte d'Ivoire	Léraba	74	87	75 ABCCa	B	CP	G	Good results
"	Comoé	74	87	75 ABCCaP	B	CP	G?	Some inconsistencies.
"	Bandama/Niaka	74	87	75 ABCCa	B	CP/Ca	G	Very good results
"	Bandama/Marab.	75	82	75 ABCCa	B	CP/Ca	X	Kossou Lake effects
"	Nzi	76	85	75 ABC	B	EP/Ca	X	Irrigation dam
I - Ghana	Black Volta	77	87	75 ABCPCa	B	CP/Ca	G?	Bridge construction
II - Ghana	White Volta	76	87	76 A	B	C	G?	Bridge damage
III - Côte d'Ivoire	Bagoé	75	84	77AB	B	AB	G?	Resistance downstream
IIIE - Ghana	Oti/Sabari	75	87	77 A	B	B/A/C?	G	Very good results.
IV - Côte d'Ivoire	Marahoué	78	87	78 ABCP	B	CP/Ca	G?	Good. No pre-treatment data
"	Sassandra	78	87	78 ABCP	?	?	X	Inconsistent results and pollution
V - Ghana	Pru	78	87	85 AB	B	B	G	Very good results
"	Wawa	81	87	- -	B	-	G?	Modification of protocol?
V - Togo	Mono/Tetoutou	81	87	- -	B	A	G	Good results
"	Mono/Atchinadji	82	87	- -	B	A	X	Good. Destroyed by dam
"	Mono/Kpessi	81	87	- -	B	A	G	Supplementary station
"	Agome	85	?	- -	B	A	X?	Supplementary station
"	Oti/Mango	82	87	- -	B	BC	?	Assists Sabari treatment
V - Benin	Oueme/Beterou	81	87?	- -	-	A?	X	Poor data and reports
"	Oueme/M'beta	81	87?	- -	-	A?	X	Poor data and reports
"	Oueme/Atchakpa	81	87?	- -	-	A?	X	"
"	Oueme/Zagnan.	81	87?	- -	-	A?	X	"
"	Okpara	81	?	- -	-	-	X	"
"	Beffa	81	?	- -	-	-	X	"
"	Zou	?	?	- -	-	-	X	"
VI - Guinea	Milo	85	87	- -	B	AP	?	
"	Niandan	85	87	- -	B	AP	?	
"	Sankarani	85	87	- -	B	AP	?	
VI - Mali	Reoulé	84	87	- -	-	-	G	Well known station
"	Bakoye	85	87	- -	-	-	?	

ANNEX 4A (Cont.)

¹A = Abate; B = B.t. H-14; C = Chlorphosim; P = Permethrin; Ca = Carbosulfan

²Continuation categories: G = Good, could be maintained : 6 : 5 chosen for operational reasons
G?) : 6 : 2 chosen for operational reasons
?) Should be re-evaluated : 6 : 1 chosen for operational reasons
X?) with 1985 and 1986 data : 1 : -
X Could be eliminated : 11 : -

TOTAL 30

NB. Other stations have been sampled at various times.

ANNEX 4 B

B - APPROVAL OF INVERTEBRATE MONITORING STATIONS
(SEE ALSO MAPS 1 AND 2)

Phase and Country	River and Station	Monitoring		Treatments	Possible '87 treatment		Continuation Category ¹	Comments
		Start-Finish	Start-Type ¹	Low water	High water			
I - Côte d'Ivoire	Léraba	75	85	75 ABCCa	B	CP	X	Inconsistent results
"	Comoé	75	85	75 ABCCaP	B	CP	?	Difficult access
"	Bandama	75	85	75 ABCCa	B	CP/Ca	X	Bridge construction
"	Nzi	75	87	75 ABC	B	EP/Ca	G	Good results-seasonal river
I - Ghana	Black Volta	75	87	75 ABCPCa	B	CP/Ca	?	Bridge construction
II - Ghana	White Volta	75	87	76 A	B	C	?	Bridge damage
"	Red Volta/ Nangodi	75	87	76 A	B	C	?	Difficult to interpret
II - Burkina	Red Volta/ PS	75	87	76 A	B	A	G?	Difficult to interpret
IIW - Côte d'Ivoire	Bagoé	75	84	77 AB	B	AB	X?	Bridge reconstruction
IIIE - Ghana	Oti	75	87	77 A	B	B/A/C?	G	Some pretreatment data. Long monitoring
IV - Côte d'Ivoire	Marahoué/ Ehton.	78	87	79 ABCP	B	C/P/Ca	G	Very good results + pretreatment data
"	Marahoué/ Danari.	75	87	79 ABCP	B	C/P/Ca	G	"
"	Sassandra	78	87	78 ABCP	B	C/P/Ca	X	Inconsistent data + pollution
V - Ghana	Pru	79	87	85 AB	B	B	G	Long pretreatment data
"	Asukawkaw	80	87	- -	B	-	G	Good results
V - Togo	Sio	81	87	- -	B	A	G	Good results and access seasonal
"	Mono	81	87	- -	B	A	G	Very good results
"	Amou Amou	81	87	- -	B	-	G	Very good results

ANNEX 4B (Cont.)

Phase and Country	River and Station	Monitoring		Treatments		Possible '87 treatment		Continuation Category ²	Comments
		Start-Finish	Start-Type ¹	Low water	High water	Low water	High water		
V - Benin	Oueme/Bete-rou	82	87?	-	-	-	A	X	Few records - no report
"	Oueme/Atchakpa	87	87?	-	-	-	A?	X	Few records - no report
"	Kouffo	?	87?	-	-	-	B	X	Few record - no report
VI - Guinea	Milo	84	87	-	-	B	AP	G?	Possible pollution
"	Niandan	84	87	-	-	B	AP	G	Appears good
VI - Mali	Baculé	84	87	-	-	-	-	X?	Poor results
"	Bakoye	84	87	-	-	-	-	G	Appears good.

¹A = Abate; B = B.t. H-14; C = Chlorphoxim; P = Permethrin; Ca = Carbosulfan

²Continuation categories: G = Good, could be maintained : 11 : 5 chosen for operational reasons
 G?) : 2 -
 ?) Could be re-evaluated : 4 : 2 chosen for operational reasons
) with 1985 and 1986 data
 X?) : 2 -
 X Could be eliminated : 6 -

TOTAL 25

NB. Frequency of monitoring may change in different sites.

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