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ORGANISATION MONDIALE DE LA SANTE

ONCHOCERCIASIS CONTROL PROGRAMME IN WEST AFRICA  
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REPORT OF THE FOURTEENTH SESSION OF THE ECOLOGICAL GROUP  
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## SUMMARY OF RECOMMENDATIONS

Summaries of the Ecological Group's **recommendations** are presented below:

### Operations and entomological situation

1. Spot evaluation of the impact of permethrin on the non-target insects on the Niger river and to put at the disposal of the Ecological Group any document concerning the **Sanaga** river survey in Cameroon (para. 27).

### Search for new larvicides

2. Continuation of the research activities on *B.t.* W-14 toxins active against blackflies as well as the evaluation of other potential biological agents (para. 40).
3. Continuation of the screening of **OMS** 3002 on both non-target fauna and blackflies and if the results are positive then to get a quantity of the insecticide (marketed formulation) sufficient for treatment on an operational scale (para. 41).
4. The group congratulated the Insecticide Research Unit in Bouake (**IRU/Bouake**) on the work it had done with a view to improving the efficacy of the larvicides and recommended that the team's effort and facilities should be **maintained**.

### Aquatic monitoring

5. To cancel 14h00 drift sampling (para. 48).
6. Use of the theoretical **index** proposed by **Elouard** and Sirnier in 1990 to classify any new insecticide submitted for evaluation (para. 48).
7. To continue with and strengthen the training sessions for the hydrobiologists (para. 57.b)
8. To make available to the hydrobiologists a larger assortment of material with respect to water quality analyses (Nitrate, Phosphate, **COD**, Turbidity, etc.) (para. 57.c).
9. Annual visit by the hydrobiologists to the Programme headquarters in Ouagadougou in order to familiarize themselves with the processing of their data (para. 57.6).
10. Spot evaluations, by the hydrobiologists, of the presence of *Caridina africana* on the watercourses under monitoring (para. 9).

### Complementary research, training and data publication

11. To provide logistic support to the hydrobiologists to help them in the **preparation** of joint publications (para. 57.e).
12. To support the participation of one or two hydrobiologists (preferably an anglophone and a francophone) in the international symposium which will be held in **Dakar**, in November 1993, on the biodiversity of freshwater and brackish **water** fish in Africa, to enable them to present the results of the ichthyological monitoring within **OCP** (para. 57.f).
13. To support the participation of one or two hydrobiologists in a training course on "Environmental Impact Assessment" to be held in August 1993 at Maroua, Cameroon.
14. To carry out susceptibility tests on non-target aquatic insects, for example *Cheumatopsyche copiosa* which is widespread in the Programme area (para. 33).

15. The hydrobiologists to superpose the treatment sequences and the monitoring results in order to facilitate the interpretation of the data (para. 57. f).
16. To facilitate and encourage the training of the **hydrobiologists** in order to ensure their capability to evaluate the impact of human activities on aquatic ecosystems in the context of devolution (para. 66).
17. Participation of some assistant **hydrobiologists** in the next meeting of hydrobiologists (para. 67).
18. To wait for the results of the pilot environmental study project before resuming the search for funds for complementary research (para. 72).

#### Economics and environment

19. A specialist in the field of economics and environment to be invited to the next meeting of the Group to discuss the feasibility of an economic evaluation of the environmental values as a direct result of the monitoring programme. It would be desirable also if the World Bank could ensure the participation of one of its representatives in this meeting (para. 76).

#### **A. INTRODUCTION**

1. The Ecological Group held its fourteenth session from 18 to 22 January 1993 in Cotonou, **Benin**, under the chairmanship of Professor D. Calamari. Lists of participants and of working documents are presented in appendices 1 and 2 respectively.

##### Opening session

2. **Dr D. Quillévére**, Chief of the Vector Control Unit, welcomed the members of the Ecological Group, on behalf of the Programme Director, and extended to them the Programme's best wishes for the New Year. He emphasized the important role played by the Ecological Group in the excellent results recorded by the hydrobiologists and the Programme in the field of aquatic monitoring and informed the participants of the discussions of **JPC13** on the possible environmental impact of resettlement in the fertile onchocerciasis-freed valleys.

3. The Chairman of the Ecological Group drew the attention of the other members to three agenda items which he would like to see dealt with carefully: evaluation of new larvicides, aquatic monitoring and **environmental** issues raised during **JPC13**. He wished the participants every success in their deliberations and informed them of the retirement of **Dr D. Baldry** who, for many years, had been in charge of the secretariat of the Group's meetings. He then proposed that **Mr L. Yaméogo** should be responsible for the secretariat of the fourteenth session of the Ecological Group.

4. The Ecological Group thanked **Dr D. Baldry** for and congratulated him on the excellent secretariat work he had done for many years and wished him all the best during his retirement.

##### Field visits

5. Members of the Ecological Group, hydrobiologists of the national teams and OCP staff attending the meeting visited **Adjarala**, on the Mono, on **16** January and **Ganvie** on **17** January 1993. The Adjarala site is located below the Nangbeto dam and the Tetetou (**Togo**) hydrobiological monitoring station which were initially planned to be visited but which could not come on because of constraints beyond the Programme's control.

6. The participants expressed their gratitude to the Programme for the organization of such field visits which made it possible to assess the state of the treated watercourses and which constituted an important support to working documents distributed to them.

#### Communications

7. On 15 January, Mr F.M. **Gibon, ORSTOM\***, presented to the hydrobiologists a communication on "Factors determining geographical distribution of lotic insects. Consequences on the zonation of rivers and the theory of refugia". Dr M. **Yasuno** also presented to the hydrobiologists the results of tests conducted with many herbicides on **macrocrustacea** in **Japan**.

8. The series of communications continued on 18 January with the presentations of **Dr H. de Longh** on taxonomy, biology and susceptibility of shrimps to insecticides, and that of Professor **K.W. Cummins** on aquatic insect functional **groups**. Dr **C. Lévêque** gave an overview of the principal conclusions of the Rio de Janeiro meeting on **biodiversity** and the main research lines that emerged from this meeting's theme.

9. The communications were well received by the participants. They thanked the speakers and expressed the wish for such training sessions to be maintained and strengthened. It was recommended that the invertebrate biologists should collect benthic fauna samples and bring them to the next meeting for practical functional group classification sessions under the supervision of Prof. **K.W. Cummins**. Spot evaluations of the presence of *Caridina africana* should also be made on the watercourses under monitoring.

#### **R. ADOPTION OF THE AGENDA**

10. The agenda, as presented in the contents list of this **report** was adopted.

#### **C. REPORT ON VECTOR CONTROL OPERATIONS**

##### Operations and entomological situation

11. The Chief of the Vector Control Unit (VCU) reviewed vector control operations and the entomological results obtained over the past year. He **was** supported in that by the chiefs of the Programme's two operational areas (eastern and western).

12. The presentations indicated that in the dry season only *B.t.* B-14 **was** usually employed in the **larviciding** operation. But in 1992, because of the problems concerning the efficacy of the batches supplied, the operational dose had to be doubled. Therefore, as soon as the river discharge exceeded **15 m<sup>3</sup>/s**, other insecticides had to be used, the maximum limit of the helicopter reservoirs having been reached. During the 1992 dry season, the entomological results were excellent since only four infective females (on 140 catching points), with eight infective larvae, were caught, in the 18th week (April ending -early May).

13. In the rainy season, the usual spraying strategy was used, viz., permanent rotation of the different insecticides available. However, in 1992, because of the low efficacy of the batches of *B.t.* H-14, it was used only in the low-discharge tributaries. Just as in the dry season, the entomological results were excellent since only four infective females, with eight infective larvae, were caught at the 260 entomological evaluation points, during the 40th **week (September ending - early October)**.

14. Because of these good entomological results, the annual transmission potentials (ATPs) were very low in both the dry and rainy seasons. However, considering all the blackfly species, transmission was still above the acceptable threshold (100 infective larvae per man per year) on 41 (most in the extension zones) out of the 260 catching points. But this transmission was mainly due to the forest species. In fact, if only the transmission due to savanna species was taken into account, not more than 12 points (i.e., about 5% of the total number of catching points) would be counted where the ATP was above the threshold of 100 (southern Côte d'Ivoire and eastern extension). The poor performance of the B.I. H-14 formulation used in 1992 could be the principal cause of this residual transmission.

15. The widespread distribution of ivermectin to the populations combined with the usual larviciding had quite obviously led to an appreciable improvement in the interruption of transmission. Previously, using larviciding alone, it took eight to nine years for the number of infective females and infective larvae to decrease below the acceptable threshold of 100. Since the start of the combined use of the two forms of treatment, the same result had now been obtained after only two years, in Guinea for example. However, it was still necessary to be cautious and avoid concluding hastily that the combined use of ivermectin and larvicides would enable the duration of larviciding to be reduced since there was still no proof to suggest that this drug reduced the lifespan of adult worms.

16. In March 1992, the Programme set up a laboratory in Bouake, which became operational in June, for the making of DNA analyses aimed, on the one hand, at differentiating between human *Onchocerca* (*Onchocerca volvulus*) and animal *Onchocerca* (*O. ochengi*) and, on the other hand, at distinguishing, within the *O. volvulus* complex, the savanna blinding strain from the forest one which was far less blinding. Additional information on this new technique for OCP is given below (para. 28).

17. As regards the post-control checkpoints, the results were quite satisfactory since almost all the points had less than 1<sup>o</sup>/∞ infective females in relation to the parous females (calculated threshold, below which there is theoretically no risk of recrudescence of transmission). In the whole area under control, only three points seemed to pose some problems. But in one case there was a considerable presence of migrant fishermen from outside the OCP area (Zongoiri rapids area, for example) and in another case there was a significant prevalence of animal *Onchocerca* (Porga area, for example). On the Banifing IV, all the infective larvae identified during the post-control period belonged to the *O. ochengi* species.

18. In the eastern zone, the 1992 rainfall, which was similar to that of 1990, was far less than that of 1991. Moreover, as regards maximum spate discharges, those of 1991 were the highest in the past fifty years. While this discharge difference led to a different insecticide use strategy, it did not change the number and total length of rivers treated. Concerning the insecticides employed, there was an increase in treatments with pyraclofos (22 840 litres instead of 12 745) and B.t. H-14, due, for the latter product, to the obligation to use it at double dose and to the more prolonged low water levels (137 672 litres instead of 71 341), a decrease in treatments with permethrin (7 927 litres instead of 24 960) and Abate (21 767 litres instead of 31 838) and a stable use of phoxim (11 976 litres instead of 14 317).

19. Insecticides, like permethrin and carbosulfan, that were the least selective with regard to the non-target fauna, were used according to the recommendations of the Ecological Group. These two insecticides were employed on the Bandama, the White Volta and the Black Volta but not on the Oti/Pendjari basin. Larviciding was interrupted on the main Oti basin right from the second quarter because of the good epidemiological results. As a precaution, permethrin was still not being used on the Mono because of the use of agricultural pyrethroids. On the Oueme, while there was no carbosulfan spraying, there were, nevertheless, four consecutive cycles of permethrin. In conclusion, each formulation was used in a different quantity compared to 1991 but, on the whole, the quantity used (including all the insecticides) was almost the same, even though some savings, in terms of cost, were made. In 1993, larvicide coverage should be more or

less the same. The Chairman of the Ecological Group expressed his satisfaction with that since the reduced use of permethrin and carbosulfan did not seem to have affected the entomological results.

20. In the western **zone**, the 1992 hydrological situation **was** practically the same **as** in 1991, except in Sierra Leone where the rains were more abundant in 1992. Ivermectin coverage was now quite **appreciable** and this could in future influence, for example in terms of suspensions, the future **larviciding** strategy because of the positive and beneficial effect of this drug on transmission. Thus, in some problem areas on the **Sassandra** and the Marahoue, the **ivermectin** distribution, which was currently being carried out, would be particularly appreciated as a support to larviciding.

21. Classically, only *B.t.* H-14 is used in the dry season and when the entomological situation allows it **larvicide applications** are completely suspended. When the rivers start flowing again, between **15** and  $70 \text{ m}^3/\text{s}$ , the organophosphorus compounds, particularly pyraclofos, replace *B.t.* H-14. At high water, carbosulfan and permethrin are used preferably in rotation with Abate or short periods of suspension. During the flood-subsidence periods, the organophosphorus compounds are used again up to the threshold of  $15 \text{ m}^3/\text{s}$  below which *B.t.* H-14 is employed.

22. In relation to this theoretical chronology, **phoxim** would not be used in 1993 for, by making judicious rotations, the other five insecticides should be sufficient. In 1992, apart from a few reaches of River Niger where there were great discharges during a good part of the year, there had rarely been more than six cycles of **permethrin/carbosulfan**. However, when the number of cycles had been exceeded, it always involved only limited reaches of 30-40 km and on high-discharge rivers. As regards permethrin, its use **was** limited to 48 reaches out of a total of 337 treated, and the exceeding of six cycles concerned only four reaches (two on the Niger, one on the lower **Rokel** and one on the lower Kaba). Carbosulfan was used on 32 reaches, mainly in Sierra Leone, and only one was subjected to seven cycles.

23. For the whole of the western zone, **11 320** kilometres of river were treated with **84 500** litres of insecticides, which was slightly more than in 1991.

The following were significant facts in the western zone:

- In Mali: relatively great use of permethrin (Niger);
- **Côte d'Ivoire**: Abate not used much (resistance);
- Guinea: no particular restriction (classic pattern);
- Sierra Leone: great quantity of carbosulfan (high discharges for many weeks).

In terms of cost, US \$40 per kilometre of river treated (cost of the insecticide, transport to the caches, application by helicopter) seemed to be a realistic limit that should not be exceeded. In this context, the limits for the use of the different insecticides were:

- Abate, up to  $400 \text{ m}^3/\text{s}$ ;
- **Pyraclofos**, between  $15$  (toxicity threshold) and  $250 \text{ m}^3/\text{s}$  (and even 300);
- Permethrin, above  $70 \text{ m}^3/\text{s}$  without discharge restriction;
- Carbosulfan, between  $70$  (toxicity threshold) and  $100 \text{ m}^3/\text{s}$ ;
- Vectron, up to  $350 \text{ m}^3/\text{s}$  (therefore promising **if** its toxicity on the non-target fauna was acceptable, para. 38).

24. The Ecological Group congratulated the Programme on the excellent results obtained by implementing an insecticide rotation strategy that took into account the impact of each of them on the aquatic fauna and which reduced the risks of resistance development in the blackflies. It noted, however, that the great discharges at Tienfala on the Niger (at least  $200 \text{ m}^3/\text{s}$  for many months) had forced VCU to treat this reach with permethrin for more than the six cycles recommended.

25. Following the concerns expressed by the Ecological Group on these prolonged permethrin sequences, it was given information on an experiment that was currently being conducted on River Sanaga in **Cameroon** where a reach of some 40 km was being treated with permethrin each week almost without interruption, for more than three years now; the discharge of the river was between 300 and 8,000 m<sup>3</sup>/s.

26. A sampling of the saxicolous fauna made in both the treated area and an untreated area, more than two years after the start of the **larviciding**, showed lower **faunal** densities in the treated area as well as the absence of Tricorythidae. On the contrary, the Baetidae and **Hydropsychidae** seemed not to have been affected. Besides, a detailed study on the adult Trichoptera showed a species richness hardly less than that of the untreated upstream reaches.

27. While expressing **its** satisfaction with the encouraging results of this experiment, the Ecological Group recommended that a spot evaluation of the impact of permethrin on the **non-target** insects be made in River **Niger** and that any existing document on the monitoring conducted on River Sanaga be put at its disposal.

#### D. OPERATIONAL RESEARCH AND NEW LARVICIDES

##### Research on Onchocerca

28. As had been reported (para. 16), a DNA-probe laboratory had been set up in Bouake and many and interesting results had already been obtained. Two main objectives justified the use of this advanced technique:

- To make it possible to check that the parasites that had been subsisting in the treated areas for a long time now were *O. ochengi*. This was particularly useful during post-control studies on the blackflies.
- To make it possible to check that at the southern limit of the zone, all that concerned savanna onchocerciasis had been really covered. In this case, the analyses were made from blackflies, and also from nodules or skin snips, and this allowed forest *Onchocerca* to be differentiated from the savanna ones.

This laboratory had been cited as an example of successful transfer of technology. It seemed that it was the first laboratory in a tropical zone in a position to apply the DNA-probe technique on a large-scale and with an immediate operational objective.

29. Considerable progress had been made in the development of **immunodiagnostic tests** and field trials would probably be carried out in 1993. Such a type of test would be a more effective alternative and better accepted by the populations than the traditional skin snip.

##### Resistancg

30. The flies (*S. sanctipauli*) in the limited area of the lower Comoe and lower **Bandama** still showed resistance to temephos and, to a lesser extent, **phoxim**. As regards the resistance of *S. sirbanum* to temephos, the situation seemed to have improved. However, since the control of the vector was very effective in 1992, it had been difficult to monitor the susceptibility because of the lack of rivers colonized by the larvae.

31. Concerning the other insecticides, there were still technical difficulties in a reliable testing of the susceptibility to carbosulfan and permethrin. There were no special comments on the susceptibility to the other organophosphorus compounds and the situation could on the whole be considered good.

32. The Ecological Group **was** informed about the work the OCP hydrobiologist had undertaken with the national teams to evaluate the reliability of the studies on the levels of susceptibility/resistance of the **non-target** organisms to the insecticides. It showed the possibility for the national hydrobiologists to identify, up to the larval stage, a number of organisms including the Trichoptera of the genus *Cheumatopsyche* which were abundant in most of the Programme's watercourses. What then remained to be found was an appropriate technique for the carrying out of the tests.

33. The Ecological Group appreciated the measures taken and recommended the use of *Cheumatopsyche copiosa*, for example, for shaker-technique tests or in distilled water, both in treated and in untreated areas.

#### Insecticide **quality** control and **improvement** of **formulations**

34. Particular attention was paid to two formulations with a view to improving them: carbosulfan and pyraclofos - the first because of its low effective carry, and the second because it was heavy and tended to sink towards the river bottom at the spraying point before dispersing correctly subsequently.

35. Regarding the quality of the products, in 1992, the poor quality of the **remaining** *B.t.* H-14 batches supplied considerably impeded the larviciding logistics. The 1991 *B.t.* H-14 was acceptable at the time it was received, and then there **was** a rapid degradation leading to a decrease in activity. The 1992 *B.t.* H-14 did not have a sufficient efficacy right from the beginning. However, the last batches supplied as a replacement proved to be acceptable. In order to try to facilitate the control of the quality of *B.t.* H-14, **IRU/Bouake** had developed a new protocol based on the use of a shaker rather than minigutters. This new system allowed the testing of 80 flasks per day and would now be used routinely.

36. Research had been conducted in collaboration with Institute **Pasteur** in an attempt to identify the *B.t.* H-14 **toxin(s)** effective on the blackflies. The first tests carried out by IRU had already shown that the toxins that killed mosquitoes or blackflies were not the same. This certainly explained why, despite the tests made (on mosquitoes), the industry supplied *B.t.* H-14 batches having a variable efficacy on blackflies. Identification of the toxin effective against the blackflies would open new prospects for the improvement of the quality of the operational batches and possibly the production of *B.t.* formulations more effective against the blackflies. It had been planned to conduct preliminary tests with other potential biological agents (*Clostridium bifementans*) in 1993.

#### Search for new insecticides

37. For 15-70 m<sup>3</sup>/s, only three organophosphorus compounds could be used for quite long cycles, *B.t.* H-14 being too costly and carbosulfan and **permethrin** too toxic. In the field of research, the priority was therefore to find a non-organophosphorus insecticide not toxic to the non-target fauna and effective on the blackflies between 15 and 70 m<sup>3</sup>/s.

38. The pseudopyrethroids or organosilanes seemed to meet these different criteria because they were effective against the blackflies and not very toxic to **fish**. Among the molecules of this group tested, **OMS 3002** (Trebon in agriculture or Vectron in public health) appeared to be the most interesting. One of its advantages was that it had already been marketed. Three types of tests had been carried out on this product:

- susceptibility tests;
- trough tests;
- small-scale river tests (effective dose and carry).

39. The susceptibility tests did not show any relationship between resistance to temephos and resistance to **OMS 3002**. This formulation was effective (**97-99%** mortality) at a concentration of **18 mg/l/s** (0.06 litres of formulation in 30% EC per **m<sup>3</sup>/s**). The carry seemed to be of the same order as that of permethrin. But its advantage was that its toxicity was 200 times less than that of permethrin against fish.

40. The Ecological Group congratulated the Programme on its attempts to identify the **B.t.** H-14 toxin effective against *S. damnosum* and on the prospections made with a view to finding bacteriae for possible replacement of B.r H-14 (for example, *Clostridium bifementans*). The Group encouraged **OCP** to continue with the research in this field.

41. Besides, considering the efficacy of **OMS 3002** (Vectron) on *S. damnosum* at the dose of **18 mg/l/s**, its great degradability and low toxicity on both mammals and fish, the Group authorized the Programme to undertake pilot operational larviciding after an evaluation of the impact of the product on the non-target insects in gutter and tests on shrimps had been carried out.

#### **E. ANALYSIS OF BENTHIC INSECTS MONITORING DATA**

42. In order to meet the different recommendations of the Ecological Group, in collaboration with a consultant, Miss M. **Simier**, the Programme undertook an analysis of the gutter-test data and monitoring data (drift and **Surber**) with a view to a more in-depth evaluation of the impact of the larvicides. To that end, it was necessary:

- to see whether the gutter-test data allowed a clear classification of the different insecticides;
- to determine behavioural-drift and accidental-drift taxa;
- to underscore any effect of the larvicides on richness, abundance and relative composition of the communities in the drift.

43. The insecticide classification made on the basis of the analysis of the multiple gutter tests confirmed existing knowledge of the toxicity of the different chemical insecticides. This classification gave, from the control, a distance between 20 and 90 for temephos, 100 and 150 for pyraclofos and **150** and 170 for **chlorphoxim**. Regarding the drift in river, the differentiation between behavioural-drift and accidental-drift taxa was complicated by the variability related to the hydrological season. Nevertheless, the Leptophlebiidae and Caenidae presented a nocturnal drift almost 200 times that of the daytime. They could be considered as behavioural drifters contrary to the Orthocladiinae and Pylalidae which practically showed no difference between the day and night drifts.

44. With regard to the long-term trend of the night-time **drift/daytime** drift (**ND/DD**) ratio of the different taxa, it almost always showed a decrease after the start of larviciding. On the other hand, the proportion of taxa in the drift had changed only very little, indicating a low impact of the larvicides on the drift of the **benthic** fauna. Concerning the **discharge/drift** relationship, some taxa (Tanytarsini, Elmidae, Polycentropodidae) presented a good positive correlation of their day drift index with the discharge. The correlation was negative for the Caenidae and Chironomini. For the night drift, most of the taxa showed a negative correlation with the discharge.

45. Comparison between the **14h00** drift and that of **17h00** showed that they were quite similar. The differences concerned mainly the **Hemiptera** and *Neoperla* sp.

46. The application of the index developed by Elouard and Simier in 1990 to the Danangoro pyraclofos data gave an index of 4.7 while the value predicted from the gutter-test data was 4. The fact that these two values were comparable confirmed the suitability of the index for the prediction, on the basis of multiple-gutter test results, of changes that an insecticide could bring about on the saxicolous fauna.

47. In regard to the **drift/Surber** relationship, the monitoring data did not allow a clear relationship to be established between these sampling methods.

48. The Ecological Group noted the extent of the work done by Miss **Simier** and considered the information presented interesting. However, the Group expressed the wish that in future the analysis of the drift data should above all take into account **taxa** present in the Surber samples. It also took note of the similarity of the **14h00** and **17h00** drifts and **recommended** the cancellation of the sampling made at **14h00** and the maintenance of that of **17h00** for which more complete historical data existed. Besides, the Group recommend& that the theoretical index developed by Elouard and Simier in 1990 be used for the classification of any new insecticide tested in multiple gutters.

#### F. AQUATIC MONITORING ACTIVITIES

49. The Annual Meeting of Hydrobiologists was held from 12 to **18** January 1993 in Cotonou under the chairmanship of Professor D. **Calamari**, Chairman of the Ecological Group. **Dr E.K. Abban** and Mr J. Tapsoba were elected rapporteurs while Dr D. Paugy **was** in charge of the meeting's secretariat. All the monitoring teams were represented in the meeting. The main results are presented below:

##### Entomofauna

50. In **Côte d'Ivoire**, at Entomokro, the densities of the organisms had decreased considerably. The analysis of the data showed a marked contrast between the pre- and **post-larviciding** collections as soon as chlorphoxim was introduced (a contrast that seemed to be related to the densities of the Tricorythidae). On the other hand, the use of carbosulfan and **permethrin** did not appear to have changed significantly the **structure** of the communities. In fact, everything was going on as if a situation of equilibrium now existed between the use of less selective **larvicides** at high water and the **recolonizations** which could take place at low water. This **recolonization** was more difficult at Danangoro because the use of poisons during traditional fishing interfered in this station in the dry season. The continuation of the recolonization studies on the Leraba and the **Nazinon** had not shown any notable change in the situation compared to that presented in 1992.

51. According to the recommendations of the Ecological **Group**, the monitoring in Ghana covered only River **Pru**. It **was** interesting to note that while the densities of the organisms seemed to be affected when phoxim was used, they got to normal values **as soon** as *B.t.* H-14 cycles were returned to. Consideration of the dry-season collections showed that, in 1992, there **was** an improvement compared to what had been observed in previous years.

52. Despite the use of the available six insecticides on the rivers in Guinea, the total fauna appeared not to have been affected. In these rivers, the densities of the Tricorythidae, considered as indicator species, were stable, which suggested that there had not been too serious impacts in them.

53. The monitoring in Sierra Leone was started only a very short time ago so conclusions could not be drawn from it. However, it seemed that the first treatments had passably affected the initial fauna.

### Fish fauna

54. During the 1991-1992 campaign, the fish monitoring activities went on normally in all the countries (**Côte d'Ivoire**, Ghana, Guinea and Sierra Leone) according to the protocol and frequencies established beforehand. In addition to the **parameters** usually collected for the monitoring (catch per unit effort : **CPUE**; and coefficient of condition: **K**), some data on species biology (reproduction, feeding habits ...) were also provided by the different teams.

55. On the whole, no change which could be attributed to the insecticide sprayings was detected in the composition of the fish fauna. Quantitatively, a contrast was still observed between the collections (CPUE) according to the hydrological seasons during which they were made. In this connection, the variations observed concerned both the rivers treated and those not treated in 1991-92. Likewise, no marked change in **K** was observed, which seemed to mean that the environment responsible for the condition of the fish had not been disrupted significantly.

56. The studies on the reproduction of the principal species showed that the parameters that characterized the different strategies were quite normal. However, in some rivers, hydrological changes appeared to have affected the recruitment of some species. Nevertheless, the length frequency distributions observed during this period appeared, on the whole, to be similar to what they had been in previous years. The complementary studies the teams had conducted in order to better understand the biological cycles of the species were starting to bear fruit and should now be published. This would, in the near future, facilitate the interpretation of observations made during routine monitoring. In the coming years, it was suggested that the ichthyologists involved in the monitoring should reflect to see if it was possible, on the basis of results obtained as part of the monitoring, to prepare a Biotic Integrity Index, taking as an example the model established in the United States.

### Recommendations of the hydrobiologists

57. The Ecological Group congratulated all the hydrobiologists on the quality of the reports presented and on the excellent results. The Group encouraged them to continue with the research in order to facilitate interpretation of the monitoring results. Besides, the Group noted with satisfaction that the Programme **was** continuing to implement a treatment policy that minimized the impact of the larvicides on the non-target aquatic fauna. The recommendations of the hydrobiologists were then reviewed by the Group which gave the following suggestions and replies:

- (a) The proposed work programme for **1993/1994** was endorsed by the Group which considered, however, that there were no special reasons for the selection of a station on the Kaba, the Mongo or the Kolonte, but recommended spot investigations on request.
- (b) The Ecological Group recognized the importance, to the **hydrobiologists**, of the communications presented by its members and invited experts and supported the recommendation of the hydrobiologists that these training sessions be maintained and strengthened.
- (c) The Group recommended that a larger assortment of material with respect to water quality analyses (Nitrate, Phosphate, COD, Turbidity, etc.) be made available to the hydrobiologists.
- (d) The Group recommended that the hydrobiologists be provided with the possibility to pay an annual visit to Ouagadougou in order to familiarize themselves with the processing of their data.
- (e) In order to enhance the value of the data collected in the aquatic monitoring, the Group recommended that the hydrobiologists be given logistic support for the preparation of joint publications.

- (f) The **Group recommended** that the Programme support the participation of one or two persons (preferably an anglophone and a francophone) in the international symposium which would be held in **Dakar**, in November 1993, on the **biodiversity** of fresh water and brackish water fish in Africa, to enable them to present a communication on ichthyological monitoring within OCP. It also **recommended** that one or two **hydrobiologists** participate in a training course on "Environmental Impact Assessment" to be held for two weeks, in August 1993, in Maroua, Cameroon, under the coordination of the Environment and Development Centre.

In conclusion, the Ecological Group **recommended** that the **hydrobiologists** superpose the treatment sequences and the monitoring results in order to facilitate the interpretation of the data.

#### G. ENVIRONMENTAL ISSUES ARISING FROM JPC13

58. The Ecological Group endorsed the "Draft Proposal for a Pilot Project on Environmental Impact Assessment in the OCP area", presented by the Committee of Sponsoring Agencies, in relation to the methodological approach and the purpose of the study. However, members of the Group expressed some concern about the restricted budget, the availability of manpower and the limited timetable.

59. Besides, the Ecological Group would have welcomed the participation of a representative of the Committee of Sponsoring Agencies at the discussions concerning the evaluation of the environmental problems that would certainly result from the resettlement in the **onchocerciasis**-freed valleys.

#### H. AQUATIC MONITORING AND DEVOLUTION

60. **The** Ecological Group discussed at length the prospects and implications of devolution of the aquatic monitoring. The Group would like to point out that it was of the opinion that it had fulfilled its moral contract by favouring the emergence of national scientific teams. Devolution was not a **new** problem to the hydrobiologists. The level of competence was quite satisfactory at present.

61. The future of the hydrobiology teams would depend, to a large extent, on the priority the countries concerned would give to environmental issues. To maintain efficient and competent teams, it was necessary to retain qualified scientists by offering them attractive salaries and working tools which would allow them to continue **with** research. These questions were outside the mandate of the Ecological Group but it felt concerned because it would not like the long work of training and information that it had undertaken to be completely lost.

62. The hydrobiology teams that had been set up under the auspices of OCP would have to be involved also in other activities apart from aquatic monitoring. The existing scientific expertise was certainly available to OCP but would also be at the disposal of other objectives in the context of devolution.

63. Another way of tackling the question of devolution was to consider it in the context of the discussions that took place during the Rio **de** Janeiro Conference. The protection of the environment and biodiversity was a common concern of mankind. **A** close collaboration between the countries was needed so as to face the environmental problems resulting from human activities. While the sovereignty of the states was reaffirmed in the selection of development, they were nevertheless responsible for the preservation of their environment.

64. Considering the technical and financial implications, it was strongly suggested that northern countries should help developing countries to mobilize human, material and financial

resources with a view to ensuring a sustainable development that reconciled respect for the environment with the exigencies of development. What was to be done now **was** to apply those principles and reflect rapidly on the way in which the United Nations or some countries, in their bilateral aid, could help to maintain, including through salary subsidies, competent teams on environmental problems.

**65.** Some countries were thinking about the putting in place of foundations to encourage research in developing countries. It would be at that price that the devolution of the monitoring of the aquatic environment within OCP could be envisaged calmly.

**66.** The Ecological Group recognized the complexity of the concept of devolution, especially in the present context of general economic crisis, but expressed the wish for the Programme to facilitate and encourage further training of the **hydrobiologists** so that they would be in a position to undertake an evaluation of the impact of human activities on the aquatic ecosystems.

**67.** Besides, having noted the greater and greater involvement of monitoring team leaders in administrative duties, the Ecological Group expressed the wish for steps to be taken to maintain the quality of the work of the teams. The Group therefore **recommended** that the present leaders report to it on measures taken to impart the knowledge acquired to their collaborators and that the Programme authorize some of these assistants to attend the next meeting of hydrobiologists.

#### I. FOLLOW-UP OF EG13 RECOMMENDATIONS

**68.** The Ecological Group expressed its satisfaction with the implementation of almost all the recommendations made during its last session. However, the Group would like some activities to be either redone or continued:

- Study on susceptibility levels in aquatic non-target insects (recommendation **No.5**)
- Surveys to assess the presence or absence of macrocrustaceans on the watercourses monitored (recommendation **No.6**).
- Analysis of fish data, taking into account hydrological parameters and details of the types of insecticide used (recommendation **No.10**).

#### J. WORK PROGRAMME FOR 1993/1994

**69.** The Ecological Group endorsed the work programme proposed by the hydrobiologists for 1993/1994, which **was** essentially the same as that of 1992/1993.

**70.** Furthermore, the Group suggested that communications should be presented to the **hydrobiologists** in 1994 by some of its members on the following subjects:

- (a) "Biological bases for the evaluation of **water** quality (or use of the concept of biodiversity for the evaluation of water quality)". (Dr C. **Lévéque**).
- (b) "Chironomidae as biological indicators of the state of the aquatic environment." (Dr M. **Yasuno**).
- (c) "Role of simple physico-chemical parameters in the evaluation of water quality." (Prof. D. Calamari).

Dr C. Back **was** also asked to prepare a presentation on the theme "how to write a **scientific** article".

## K. OTHER MATTERS

### (a) Project for complementary research

71. Participants were reminded that the Ecological Group had suggested that the project for the study of refugia, prepared by one of its members in 1992, be refined for presentation to the EEC in order to secure funding.

72. The refined project presented to the Ecological Group **was** considered scientifically acceptable but, unfortunately, did not take **into** account the EEC standards for the funding of projects. Because of the difficulties encountered, the Ecological Group recommended that the results of the pilot environmental study project be awaited before resuming the investigations.

### (b) Exchange of experience by national teams

73. The Ecological Group was informed of the Programme Director's decision to allow the hydrobiologists to undertake missions in the other OCP countries and then to visit Ouagadougou to discuss how the mission went on and analyse their data in collaboration with Programme staff.

74. The Ecological Group thanked the Programme Director for this laudable initiative and expressed the wish for concrete steps to be taken in the course of the year.

### (c) Economics and environment

75. Economic studies on the environment and **biodiversity** were currently becoming considerably important, notably as part of cost-benefit-analyses which were necessary for the defining of strategic choices in the field of economic development. The value related to a direct use of biological resources (for example, fish), the value related to an indirect use (role of humid zones in the refilling of underground water) and the value related to the consent to pay in order to preserve a resource or system could be distinguished in a simplified manner.

76. In adevolution perspective, and also to demonstrate to some donors and administrators that research on the preservation of biological diversity and natural resources had economic consequences, the Ecological Group would contact competent teams in the field of economics of natural environments. A specialist could be invited to the next meeting of the Ecological Group with a view to discussing a feasibility study of a work which could be carried out in OCP.

## L. ARRANGEMENTS FOR THE NEXT SESSION

77. The Ecological Group suggested that its fifteenth session be held from 1 to 4 February 1994 in Bouake with a visit to the **Soubre** station at the end of the session. **A** joint meeting of the Ecological Group and the **hydrobiologists** could be organized on 31 January, just after that of the hydrobiologists scheduled for 27 to 30 January.

78. The Group expressed the wish also for the Programme to arrange for it to **overfly** an onchocerciasis-freed zone in **Côte d'Ivoire** during its next session.

## M. READING AND APPROVAL OF REPORT AND RECOMMENDATIONS

79. The report in French and the recommendations in English were read and approved **by participants** in the fourteenth session of the Ecological Group before the closure of the meeting.

## N. CLOSURE OF THE SESSION

80. Before bringing the session to a close, with regard to the fifteenth session, the Chairman of the Ecological Group expressed the wish for all the members to plan to arrive in Bouake by 30 January 1994 and return to **Abidjan** on 5 February 1994.

APPENDIX I

**LIST OF PARTICIPANTS**

Members

Professor D. Calamari (President), Institute of Agricultural Entomology, Faculty of Agriculture, University of Milan, via Celoria 2, **I-20133 Milan, Italy**

Professor K.W. Cummins, Director, **Pymatuning** Laboratory of Ecology, Department of Biology Sciences, University of Pittsburgh, **Pittsburgh, Pennsylvania 15260, USA.**

**Dr H. de Iongh**, Centre for Environmental Studies, University of Leiden, P.O. Box **9518, 2300 RA Leiden**, Netherlands

**Dr C. Lévêque**, Département des Eaux Continentales, ORSTOM, 213 rue La Fayette, **75480 Paris Cedex 10, France.**

Dr M. Yasuno, Director, Environmental Biology Division, National Institute for Environmental Studies, 16-2 Onogawa, **Tsukuba**, Ibaraki **305** Japan

Other participants

Dr D. Paugy, ORSTOM, Museum national d'Histoire naturelle, **Laboratoire d'Ichtyologie, 43** rue du Cuvier, **75231 Paris Cedex 05**, France

Secretariat

Dr C. Back, VCU/OCP, B.P. 1474, **Bouaké, Côte d'Ivoire**

Dr J.M. Hougard, VCU/OCP, B.P. 2279, **Bamako, Mali**

M. M. Kassambara, VCU/OCP, B.P. 160, **Parakou, Benin**

Dr D. Quillevere, VCU/OCP, B.P. 549, **Ouagadougou, Burkina Faso**

M. E.J. Senghor, INF/OCP, B.P. 549, **Ouagadougou, Burkina Faso**

M. J.M. Tapsoba, VCU/OCP, B.P. 549, **Ouaadouaou, Burkina Faso**

M. L. Yameogo, VCU/OCP, B.P. 549, **Ouagadougou Burkina Faso**

M, D.G. Zerbo, VCU/OCP, B.P. 36, **Kara, Togo**

APPENDIX 2

## LIST OF DOCUMENTS

- OCP/VCU/HYBIO/93.1 - Further training of fish monitoring team of Sierra Leone and preparation of a document on Sierra Leone's fish fauna (**J.F. Guégan**)
- OCP/VCU/HYBIO/93.2 - Short-term impact of 30% Trebon (**OMS 3002**) on non-target aquatic fauna (Summary)
- OCP/VCU/HYBIO/93.3 - Summary of the annual report for **1991/1992** (Guinea). **II. Invertebrate Biology** (F. Konde and K. Nabe)
- OCP/VCU/HYBIO/93.4 - Summary of analysis of benthic fauna monitoring data.
- OCP/VCU/HYBIO/93.5 - **1991/1992** OCP Invertebrate monitoring report, Ghana. (**J. Samman**)
- OCP/VCU/HYBIO/93.6 - OCP fish monitoring report **1991/92**, Ghana (**E.K. Abban, P.K. Ofori-Danson, F.Y. Amevenku**)
- OCP/VCU/HYBIO/93.7 - Summary of annual report on fish monitoring in Guinea (**M.E. Diop**)
- OCP/VCU/HYBIO/93.8 - Monitoring of entomofauna of treated rivers in **Côte d'Ivoire** and untreated rivers in Burkina **Faso** (Summary)
- OCP/VCU/HYBIO/93.9 - Summary of fish monitoring report, Sierra-Leone (G. Ganda)
- OCP/VCU/HYBIO/93.10 - Summary of Invertebrate monitoring report, Sierra Leone (**D. Tholley**)
- OCP/VCU/HYBIO/92.9 - Analyses complémentaires des données de la surveillance aquatique. **I. Tests en gouttikres** (M. Simier)
- OCP/VCU/HYBIO/92.10 - Analyses **complémentaires** des données de la surveillance aquatique. **II. Dérive** (M. Simier)
- OCP/VCU/HYBIO/92.11 - Analyses complémentaires des données de la surveillance aquatique. **III. Surber** (M. Simier)
- OCP/VCU/HYBIO/92.13 - Surveillance de la faune entomique non-cible de **cours** d'eau traités en **Côte d'Ivoire** et de **cours** d'eau non traités au Burkina **Faso** (Rapport).