1.II-2. FEASIBILITY OF SMALL-SCALE VECTOR CONTROL

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INTRODUCTION

The good results of the WHO-Onchocerciasis Control Programme in West-Africa show that transmission of onchocerciasis can be reduced to very low or even zero levels by treating all *S. damnosum s.l.* breeding sites at weekly intervals in an area large enough to minimize the risk of reinvading infected flies from outside the controlled area. In Cameroon, the high costs of such an approach, together with logistical problems likely to be encountered in the neighbouring countries Nigeria, Tchad, Central Africa, into which the onchocerciasis foci extend from Cameroon, prevent, at the actual state, the set-up of a similar programme in this area (WHO & OCEAC, 1985). Nevertheless, localized small scale vector control (BAKER et al. 1984) might still be a valuable and cheap alternative in those areas, where ivermectin will not be given. At these sites where the drug will be given, it could additionally help to reduce the incidene of new infections.

Starting September 1987 the village populations along the river Vina du Nord will receive treatment by ivermectin at annual intervals. These treatments will greatly reduce the transmission, but will not reduce it to zero. If there was no more transmission going on and if ivermectin was given every year, it would take more than 10 years, until all adults worms have died and the parasite reservoir has disappeared from the human population. Any ongoing transmission during this period would jeopardize this result. It might thus be interesting to evaluate the costs and benefits of an additional small scale *Simulium* larvicide control programme, which, together with other means to reduce man-fly contact (chapter 1.II.1), could help to interrupt transmission.

In order to judge the feasability and possible beneficial effects of such a local vector control, sufficient data should be available on the dynamics of transmission of onchocerciasis, on the distribution and accessibility of the *Simulium* breeding sites and the efficacy and carry of the insecticide under the local conditions.

Two trials were conducted, one in the rain-forest river Meme near Kumba (Fig. 12) and one in the Sudan savanna river Vina du Nord near Touboro (Fig. 13) to collect base-line data for a possible small-scale vector control.

The trial in the rain forest near Kumba was also designed to provide information on the dispersal and movements of the three prevailing *Simulium* vector populations (*S. sqamosum/yahense, S. damnosum s.s.* and *S. mengense*) river up- and downstream from their breeding sites.

Details of these studies are given in the reports of BARTHELMESS 1986 and RUTSCHKE, DESCHLE 1987.

MATERIAL AND METHODS

Trials at the river Meme in the rain-forest Fig. 14)

Two stretches of rapids including two large waterfalls (Ndjanga and Bai falls) were treated at 1 ppm in the river Meme, and in the tributaries Beke and Foe BT-H14 was given at 5 ppm.

4 Fly-catching sites along the river Meme were used to monitore the adult fly-populations.

Baseline data on the dynamics of the vector population and dynamics of onchocerciasis transmission at the river Meme near Ngongo stem from ENYONG (in press).

Trials at the river Vina du Nord in the Sudan savanna (Fig. 13)

The only major *Simulium* breeding site in the area of Soramboum, the disused causeway near the Campement, was treated treated three times using 1, 0.1 and 0.5 ppm. .

The adult fly-populations along the river Vina du Nord were monitored at 4 stations. Flies were also marked and released at three of the stations around the Campement in order to study the dispersal of the fly-population (see also chapter 1.III.1)

Baseline data on the dynamics of the vector fly-populations were available for up to 5 years at different sites in the Sudan savana (RENZ & WENK 19987, RENZ 1986, 1987).

Larvicide used and laboratory susceptibility tests

A newly developed formulation of BT-H14 (TEKNAR® HPD) was used in these trials.

A bio-assey apparatus, developed at the Institute of Tropical Medicine in Tübingen (DESCHLE, in prep.) was used for testing the suceptibility of *Simulium* larvae against different formulations of insecticides, in order to find the best concentration to apply.

RESULTS

IN THE RAIN-FOREST AT THE RIVER MEME AND TRIBUTARIES

Bacillus thuringiensis H-14 larvicide was applied at 1 ppm in the river Meme and 5 ppm in the tributaries three times at weekly intervals. Despite of a high efficacy of the larvicide, the reduction in the man-biting density was low at the control fly-catching site Ngongo, 30 % of the pre-treatment density at most, but was more obvious after the treatments at Njanga and Bai Falls (Fig. 13). Immigration of flies from untreated tributaries downstream or from breeding sites river upstream, failure of the insecticide application, or a combination of all these factors is discussed in order to explain this observation.

Examination of the morphology of the flies caught along the river Meme showed that *S. damnosum s.s.* almost completely disappeared after then treatments, but the breeding sites of *S. squamosum* and *S. mengense*, which were mainly in the small affluents of the river Meme, were less affected (Fig. ~ and Progress Report Barthelmess 1986).

IN THE SUDAN SAVANNA AT THE RIVER VINA DU NORD

The good larvicidal action of the B.t. treatments were also reflected by the decreasing biting rates on the control-collectors along the river Vina du Nord (Fig. 14).

One treatment at 1 ppm Teknar was found to be effective for up to 20 km riverdownstream (see Table 8). Hence at least 5 treatment sites would be necessary to cover the stretch of the river Vina du Nord at its lower reaches from Sora Mboum to the border with the Tchad, where a string of villages heavily affected by onchocerciasis lies along the road to the Tchad (see Fig. 3).

From these results, the amount and costs of larvicide (BT H-14, Teknar HPD, 1 ppm for 10 min, approx. costs 15 US $/ltr) needed for weekly applications at 5 sites along the river is calculated in Tab. 8.

It has been shown that two third of the annual transmission of onchocerciasis takes place during the dry season (Tab. 18). If the treatments were limited to the dry season (Nov. to May), when the river is easily accessible and the water discharge is low, the costs for the insecticide (27,000 $) would be around 1 US $ per head of population protected along the river. During the five months of rainy season the costs per head would amount 7 US $. Also, *Simulium* breeding sites were productive in seasonally flowing affluents which cannot be reached from the ground.

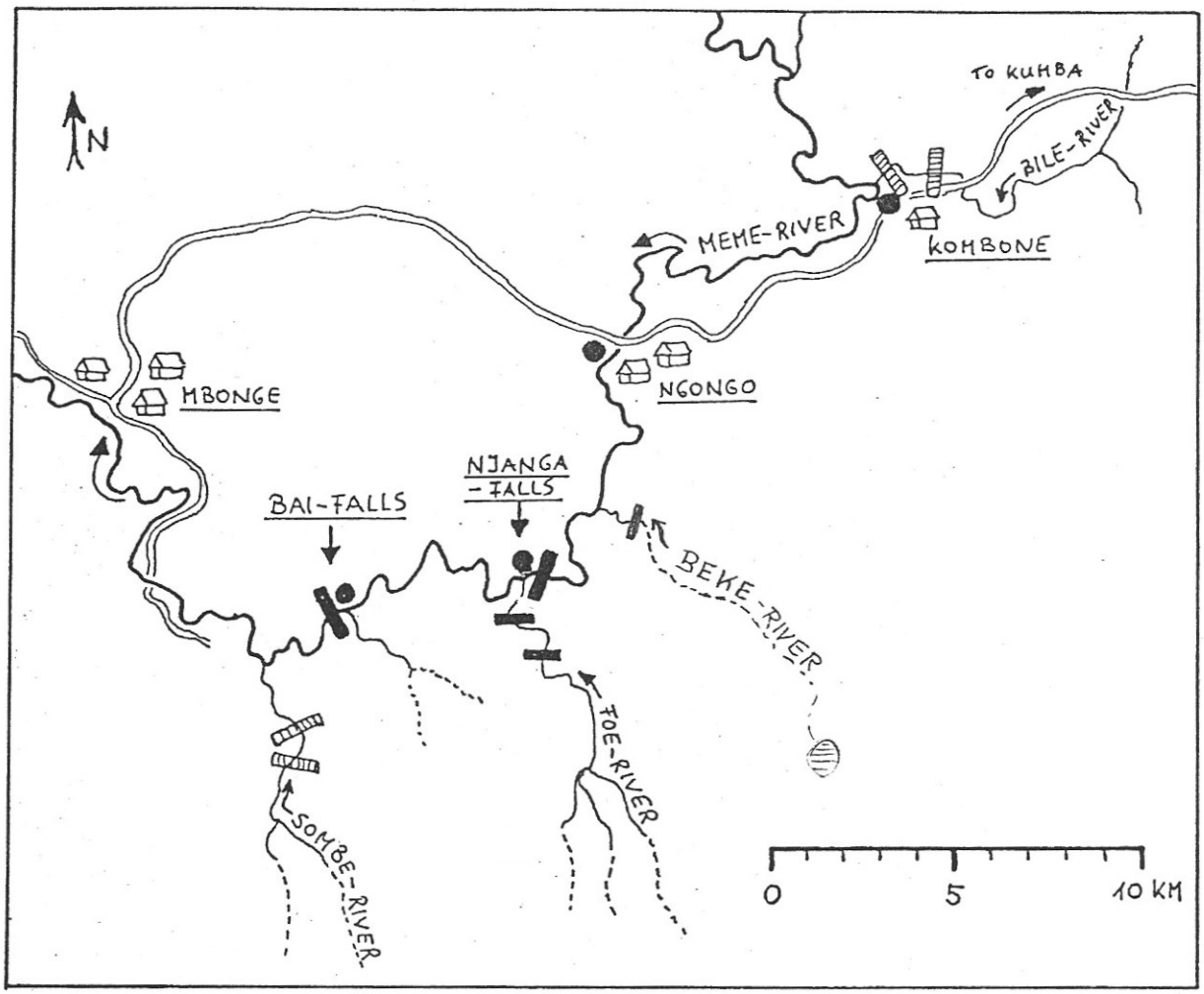


Fig.: 12 Experimental treatment of S.damnosum s.l. -breeding-sites with BT H-14 (Teknar HP -D)

- ▌ treated breeding sites
- ▌ untreated breeding sites
- ● fly-catching sites

Insecticide doses (calculated for a stream discharge of 10 minutes):

Bai-Falls	1 ppm
Njanga-Falls	1 ppm
Meme near Kombone	1 ppm
Foe-river	5 ppm
Beke-river	5 ppm

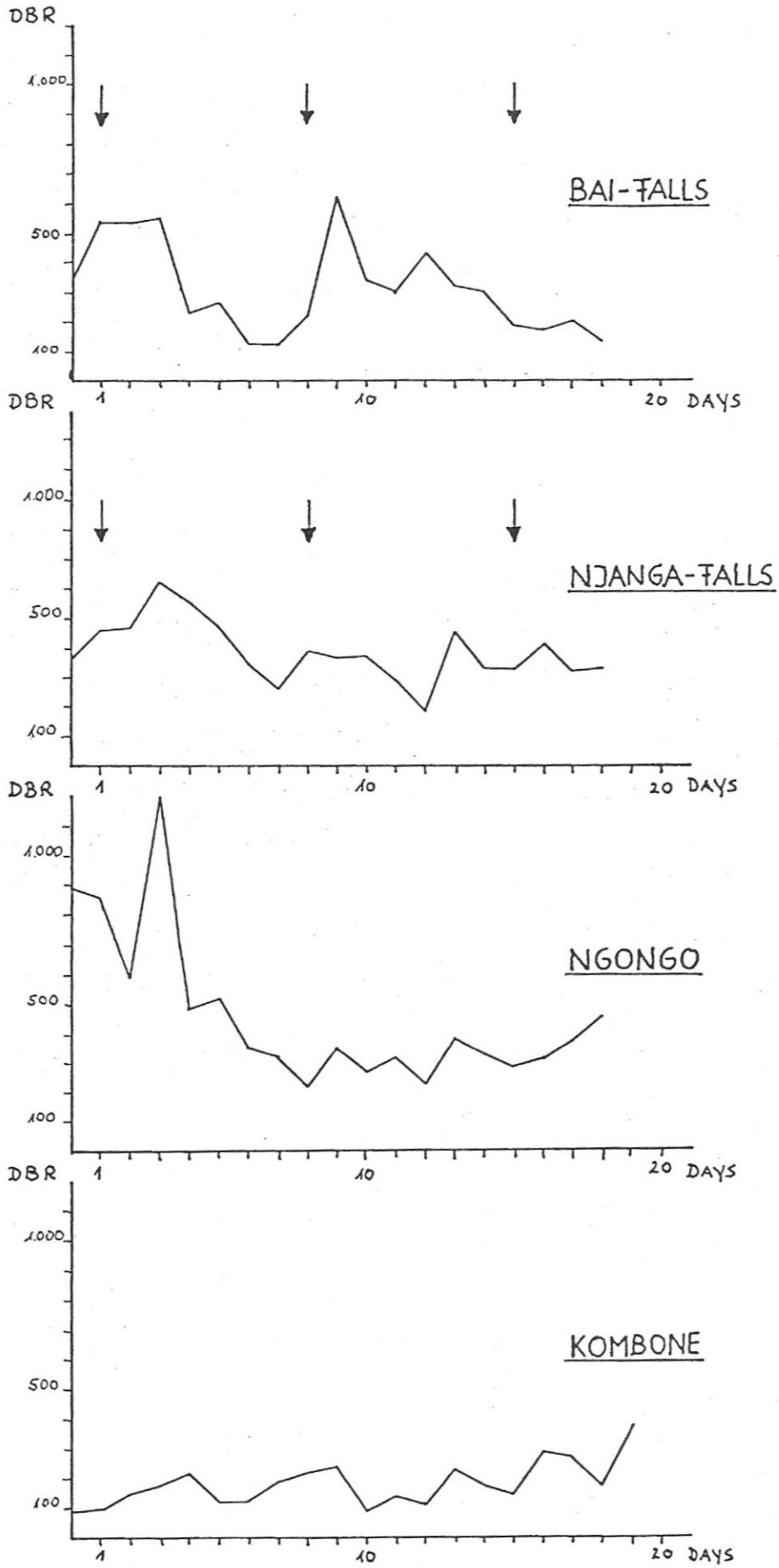
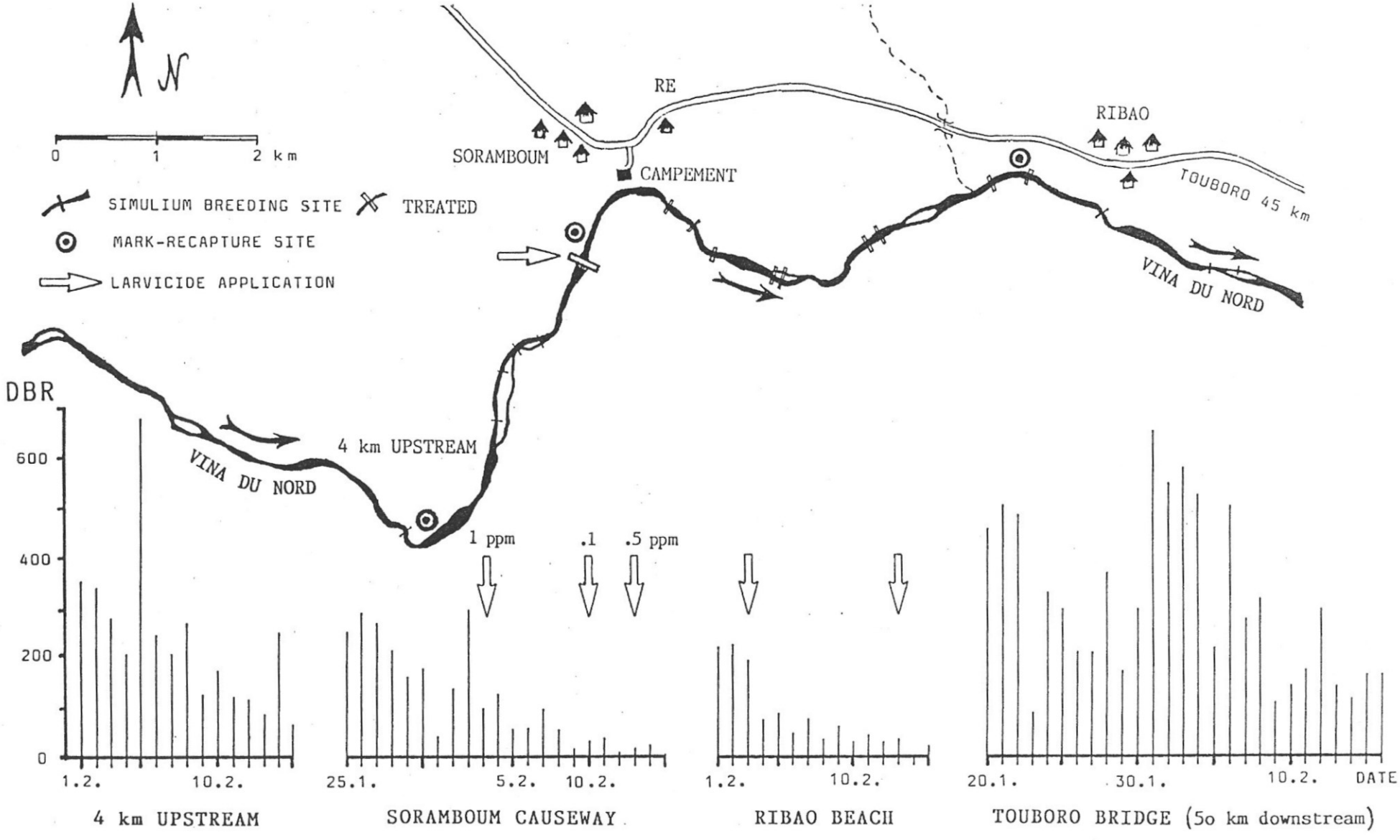


Fig. 13: Biting-rates (DBR) at fly-catching sites along the river Meme before and after treatment (↓) with BT H-14 (24.2.-15.3.86).

Fig. 14: SIMULIUM DAMNOSUM S.L. BITING RATES (DBR) AT FLY-CATCHING SITES RIVER UP- AND DOWNSTREAM FROM THE TREATED SITES BEFORE AND AFTER APPLICATION OF B.T. H-14.



TAB. 8:

FEASIBILTY OF SMALL-SCALE VECTOR CONTROL AT RIVER VINA DU NORD
AMOUNT OF INSECTICIDE NEEDED

(Weekly applications at 5 treatment points)

MONTH	water discharge m^3/sec	dosage larvicide ltr/appl.	amount larvicide ltr/month	costs BT H-14 US$/month	
Nov.	30	18	360	5,400	
Dec.	18	10.8	216	3,240	
Jan.	12	7.2	144	2,160	DRY SEASON
Feb.	8	4.8	96	1,440	Σ 1.8 m^3 larvicide
Mar.	7	4.2	84	1,260	27,000 US $
Apr.	35	21	420	6,300	
May	40	24	480	7,200	
June	130	78	1.560	23,400	
July	310	186	3.720	55,800	RAINY SEASON
Aug.	400	240	4.800	72,000	Σ 13.2 m^3 larvicide
Sept.	200	120	2.400	36,000	198,000 US $
Oct.	60	36	720	10,800	
Σ			15.000		

1 ltr of BT-H14 at 15 $

The down-stream efficacy of Teknar HP-D at the Vina du Nord (North-Province) with different doses, calculated for a stream-discharge of 10 min.

DATE OF APPL.	DOSE (VOLUME PPM)	DOWN-STREAM FROM THE APPLICATION POINT 0,2*	1,2	1,7	2,0	4,6	7,0	9,7	18,0 km	
3.2.86	1	100					98,5	92,5	27,7	% Mort.
10.2.86	0,1 ca	90	21,4	8,1						% Mort.
13.2.86	0,5	100			87,8	69,6				% Mort.

* Breeding site "Radier"

A persisting effect of the experimental treatment of the river Vina du Nord during the dry-season ?

After the application of BT H-14 larvicide (Teknar HP-D, Sandoz) on the 3rd, 10th and 13th of February (1.0, 0.1 and 0.5 ppm/10 min resp.), the Daily Biting Rates (DBR) went down quickly, even at the catching site Touboro, 55 km river-downstream from the application site. The DBR there fell from an average number of 282 flies/man/day before the 15th to only 54 flies/man/day afterwards, and remained below 30 flies/man/day throughout the dry season (Tab. 9). Comparing the DBR during this season in 1986 with the biting rates recorded in previous years, it is obvious, that the biting rates were at their lowest levels ever recorded, though the biting rates at the beginning of the dry season had been very high. This might be due to circumstantial evidence only, and should therefore be supported by more data, especially from the corresponding water-level data of the river Vina. If it could be confirmed, it would mean, that the biting rates can be kept at low levels during the dry season by a few larvicide applications at rather far distances.

	Daily S. damnosum s.l. Biting Rate			
Y E A R	JAN	FEB	MARCH	APRIL
1976	-	69	138	-
1977	180	64	47	-
1985	-	- before/after treatment	-	157
1986	274	282 54	24	28
1987	151	98	38	19
1988	537	103	36	54

Tab. 9 : S. damnosum s.l. biting rates at the catching site 'Touboro Vina bridge' after a localized application of BT H-14 larvicide some 55 km river-upstream on the 3rd, 10th and 13th of February 1986.

DISCUSSION

In the rain forest, the effects of the larvicide applications were poor, in the small tributaries as well as in the large waterfalls. Good results were only obtained when each small branch of the large rapids and waterfalls was treated individually by pouring the insecticide right after the stagnant stretches into the fast flowing branches of the river obtained. This was then also visible in the reduction of the adult fly biting density at control points along the river (Fig. 13).

In the savanna, the results were much more encouraging. At least during the dry season, localized *Simulium* control would be feasable and could help to reduce much onchocerciasis transmission.

B.T.-H14 (Teknar HPD), produced by a non-spore-forming variant of the *Bacillus thuringiensis* has already prouved to be highly effective against palearctic and African Simulium larvae, and is not affecting the non-target organisms, exept the larvae of Culicidae and Chironomidae (Diptera). Furthermore, development of resistence has up-to-now not yet been reported though B.t. has been intensively used as a pesticide in agriculture for some decades of years. This would be very important, since local control will be particularily at risk of inducing resistence as it has to be continued for an undefinitive period, at least until a save and effective macrofilaricide will be available.

Insecticides are intensively used in the cotton fields in the savanna and in the coffee/cacao plantations in the forest. The distribution and regular treatments in these regions are assured by governmental organizations (SODECOTON in the North and the SOWEFACO in the forest). The villagers are therefore very well acquainted with dosage and regular applications of insecticides, as well as they are aware of the possible danger of improper use. They could therefore do small scale vector control by themselves, if the good results of these treatments would be evident for them.

Efficacy of four Bacillus thuringiensis H-14 (B.t.H-14) formulations against penultimate and ultimate instars of Simulium damnosum s.l. larvae from the savanna and rain forest under laboratory conditions.

Formulation	LC 50 value savanna (in ppb)	LC 50 value rain forest (in ppb)
BACTIMOS FC	436	385
TEKNAR WDC	281	173
TEKNAR HP-D	37	83
IPS 82	*	30

LC 50: letal concentration 50%
ppb : parts per billion (weight/volume)
* : not investigated