

1937

Kenya

No. 38299

SUBJECT.

C0533/485

Tsetse Fly control

Grant from C. D. F.

Previous

18307/32.

Subsequent S. P. 1.

Report by Mr C. B. Lynch  
and Mr. R. T. Vance.

C.I.  
C.D.F.  
MEDICAL.  
Nominal.

1. ACTING GOV. KENYA..... 50..... 20.1.37 2  
Trs. report by Dr. E.A. Lewis on experiments on control  
of Glossina pallidipes and comments thereon forwarding  
application for a free grant of £5,700 from C.D.F.  
to enable the work to be continued.

2. ACTING COL. SEC..... 3 PNs..... 25.1.37  
Trs. twenty additional copies of report by Dr. E.A. Lewis

R 297

DESTROYED UNDER STATUTE

I have spoken to Dr. *Brien*  
and he considers that while the proposal is not  
unattractive, it should in the first instance be  
referred to the Tsetse Fly Sub-Committee for their  
consideration. The original proposal was referred  
to the committee in 1932, and, in their recent report,  
the East Africa Sub-Committee, in commenting upon the  
recommendations of the Governors' Conference,  
expressed the view (paragraph 5 of their report of  
the 8th February, No. EAC/TF 463) that their attitude  
towards the continuation of the work would depend  
largely upon its future character, since if it was  
to be mainly an investigation of the 'ecology' of  
pallidipes, they would be doubtful as to the usefulness  
of doing research work of this kind in addition to  
the similar work being done in Tanganyika. They  
therefore did not feel able to form any definite  
opinion in the lack of fuller information.

46542/2/37

From the application put up in this Despatch  
it would appear that Kenya wants to continue this  
research work in various directions. The first  
main direction under (a) is undoubtedly nothing but  
an investigation into the 'ecology' of the pest.  
The other proposals, however, isolating blocks of  
bush, maintaining corridors, continuing clearing,  
extending trapping and devising good baits are not  
subject to the reproach that they would overlap

*Kenya-Tanganyika's work.*

The whole of the expense will go to providing  
the

the necessary labour with one overseer at  
£360 a year.

Draft herewith.

J. E. A. Howard

2.3.37.

A. J. Rowland  
33/37

his proposals to see later

To E.A.C. (inc. and separate report) cons. 15 MAR 1937

Mem for Memo to  
boab

DESTROYED UNDER STATUTE

E.A.C. (616) 18.3.37  
Clerks (3) and promises a further reply as soon as  
they obtain their Taster Fly Committee's observations.

The next C.A.C. meeting is  
provisionally fixed for the  
28<sup>th</sup> April - applications  
to be in by the 16<sup>th</sup> April.

? Rfn in a fortnight, to ask  
Mr Hemming if there is a chance  
of the Taster Fly Committee's Board  
being available in time for the  
C.A.C. meeting on the 28<sup>th</sup> April.

A. J. Rowland  
23/3

5. E.A.C. (T.F.) 465.....22.3.37. 3  
6. E.A.C. (T.F.) 466.....25.3.37.

I understand that Mr Rickard has  
arranged to call a meeting of  
the Taster Fly Committee early  
next week at which No 5  
will be considered. He is away  
until the 6<sup>th</sup> April.

? Rfn on the 10<sup>th</sup> April if  
we haven't heard from the E.A.C.  
before then

A. J. Rowland  
24/37

J. E. A. Howard  
11+

His can wait a little  
longer. A meeting of the  
Taster Fly Committee is being  
arranged & we have been in due course  
what is recommended in regard to the  
Scheme proposed in No 1.

In the meantime his T. Stokdale says  
like to see the M. A. J. Rowland  
9/4

A meeting of the Taster Fly Committee was held  
today & it was decided to recommend the  
scheme submitted to the C.A.C. with certain  
reservations - emphasis will be laid on  
the importance of the applied part of the  
scheme & of the necessity of securing  
collaboration with the Department & the F.A.C.  
does not expl. in J.F. in respect of the  
research programme submitted. A reply  
from the Committee should be in the office

within a few days.

*For final date*  
9/4

*[Handwritten mark]*

- 7. E.A.C. (T.F.) 6.4.37.  
Agendum for thirty-second meeting of Tsetse Fly Committee.
- 8. ECONOMIC ADVISORY COUNCIL.....10.4.37.  
Trs. Tsetse Fly Committee's obs'ns and recommendations on Govt. of Kenya's application for further grant from C.D.F.
- 9. ACTING GOV. KENYA.....161.....12.3.37.  
Trs. report by Mr. C.B. Symes and Mr. R.T. Vane on the experiments carried out in connection with the eradication of G. palpalis in Kaniadoto area of S. Kavirondo District.
- 10. ACTING CBL. SEC.....3PN.....12.3.37.  
Trs. 20 additional copies of the Report by Messrs. C.B. Symes and R.T. Vane, for transmission to the Tsetse Fly Committee of the Economic Adv. Committee.

No 7. Publy

No 8. *Substantive!* I submit draft memorandum for the C.A.C., a letter of thanks to the E.A.C., & a note from Sir F. Stokdale to Sir Guy Marshall asking him to attend the C.A.C. meeting on the 26<sup>th</sup> April.

*no record of this*

No 9+10. Draft letters to C.A.C. Committee.

*Dr O'Brien to see later*

*J. F. G. Smith*  
15/4/37

No. Comemo.

No. C.A.C. 2162 → 17<sup>th</sup> April 37

11 To E.A.C. (8 ansd) (encl) 19 APR 1937

19/5

12 To E.A.C. (Copy 9 encl). 19.4.37

DESTROYED UNDER STATUTE

*Dr O'Brien to see*

12A To Sir Guy A.K. Marshall 20.4.37

13 To Cooper. w/comp 15 copies 4<sup>th</sup> report (encl to 9) 22.4.37

DESTROYED UNDER STATUTE

14 ECONOMIC ADVISORY COUNCIL (E.A.C./616).....20.4.37.  
Acks (12) and states that a further communication will be sent when they are in possession of the views of their Tsetse Fly Committee.

DESTROYED UNDER STATUTE  
15 ECONOMIC ADVISORY COUNCIL (E.A.C./616).....20.4.37.  
Acks (11) with comments.

DESTROYED UNDER STATUTE  
16. Sir G. Marshall 21/4/37

*Will attend the C.A.C. meeting on the 26<sup>th</sup> April.*

No. 14 & 15 Publy

No 16. *Publy Smith.*

*May I have a list of the pp to send to Sir G. Marshall in due course, & can you suggest what time we should ask him to be available.*

*Sir F. Stokdale will also be available to attend.*

*J. F. G. Smith*  
22/4

*Dr O'Brien*

DESTROYED UNDER STATUTE

17 To Sir G. Marshall so (ansd) (encl) 26/4/37

19. C.D.A.C. (C.D.A.C. 2166) 1.5.37.

Recommended further grants of £1,700 p.a. for 3 years for continuance of work of tsetse fly control in Lambre Valley. Similar letter being sent to Treasury.

Draft to Treasury herewith.

C.R. Brown  
2/5/37

20 To Treasury 7/6 cons 6.5.37.

COPY SENT TO ACCOUNTS DEPARTMENT.

D.O. Inspector

R. 20. 1/6

R. 20. 1/6

114 I see thank you and then 8/5/37

21. TREASURY (S. 32609/0244) 20.5.37

Sanctions proposed grants from C.D.F.

I submit Draft despatch to Gov. Kenya, for Caon

C.R. Brown  
21/5

AIR MAIL 25/5

22 To Kenya - 419 - (9010<sup>B</sup> + 19) (1 Annul) (9ackya) 25.5.37

114

23. Imperial Bureau of Animal Health  
DESTROYED UNDER STATUTE

23.7.37

Requires whether they may have a copy of "The Evaluation of 6 Palpalis from River Areas by the 'Block' Method" by C.B. Soper & R.T. Vane.

I annex a spare copy of the report which, unless E.A. Dept. see any objection, might be sent to the Bureau of Animal Health.

114 26/1/37

99 Brown 28/1 above

24 To I.B.A.H. (23 and) (if send as per draft) 3.8.37  
DESTROYED UNDER STATUTE

114 25/5

CD 308

C. O.

Mr. Grossmith 21/5/37

Mr. Pashin 21/5

Mr. P. Stoddart 24/5 (re: [unclear] from [unclear])

Sir C. Parkinson.

Sir G. Tomlinson.

Sir C. Bottomley

Sir J. Shuckburgh.

Perms. U.S. of S.

Parly. U.S. of S.

Secretary of State.

AIR MAIL.

Downing Street,

28 May, 1937.

G.D.  
R 24 MAY  
D 25

Sir

I have etc. to acknowledge the

DRAFT. for comm

(1) receipt of Mr. Wade's despatch No.50 of the 20th of January regarding an application for further assistance from the Colonial Development Fund to enable investigational work on Tsetse Fly control to be continued

KENYA.

NO. 419

GOVERNOR.

and to inform you that the application was referred in the first instance to the Tsetse Fly Committee of the Economic Advisory Council.

CDAC. 2162 (10B on the file)  
from CDAC 1/5/37. (No. 19)

The Colonial Development Advisory Centre, to which is annexed a copy of a letter from

I enclose a copy of the a memorandum prepared for submission to the recommendations of the Tsetse Fly Committee.

I and invite your ~~particular~~ attention to

the recommendation that arrangements should be made to secure the collaboration

of Mr. C.F.M. Swynnerton, Director of Tsetse Research, Tanganyika Territory, in that part of the programme concerned with

FURTHER ACTION.

research work of a fundamental character,  
namely the studies of the bionomics of  
Glossina pallidipes.

3. The application was considered by  
the C.D.A.C. at a meeting on the 28th of  
April when they recommended further grants  
of £1,900 a year for three years for the  
continuance of the work of Tsetse Fly control  
in the Lambwe Valley, South Kavirondo District.  
A copy of a letter from the Committee containing  
their recommendations is enclosed. On the  
Committee's recommendation the Lords Commissioners  
of the Treasury have sanctioned the payment of the  
grants recommended.

4. I take this opportunity to acknowledge  
the receipt of Mr. Wade's despatch No. 161 of the 12th  
of March and to inform you that the contents have  
been communicated to the Tsetse Fly Committee  
together with the report by Mr. C.V. Symes and Mr. R.T.  
Vane on the experiments carried out in connection  
with the eradication of G. palpalis in the Kaniadoto  
area of the S. Kavirondo District.

9

I have, etc.

W. ORMSEY

21.7

Any reply to this letter should be addressed to--  
THE SECRETARY,



TREASURY CHAMBERS.



TREASURY,  
WHITEHALL, LONDON, S.W.1.

and the following number quoted:

20 May, 1957.

S. 34609/0244.

RECEIVED  
20 MAY 1957  
C. O. REGY

Sir,

I have laid before the Lords Commissioners of His Majesty's Treasury Mr. Flood's letter of the 6th instant, (38299/37), signifying Mr. Ormsby Gore's concurrence in the recommendation of the Colonial Development Advisory Committee, conveyed in the Secretary's letter of the 1st May that further grants of £1,900 a year for three years should be made from the Colonial Development Fund to the Government of Kenya for the purpose of financing the continuance of the campaign to eradicate Tsetse fly in the Lambwe Valley of the South Kavirondo District.

I am now to request you to inform the Secretary of State that My Lords sanction the proposed grants from the Colonial Development Fund in accordance with the recommendation of the Committee.

A copy

The Under Secretary of State,  
Colonial Office.

COPY SENT TO ACCOUNTS DEPARTMENT. 20.

A copy of this letter has been sent to  
the Secretary of the Colonial Development Advisory  
Committee.

I am,

Sir,

Your obedient Servant,

*F Phillips*

38299/37

20

G. O.

Mr. *Stromwith* 3/5-  
Mr. *Parkin* 5/5 f.

*And (21)*

*53*

- Mr.
- Sir C. Parkinson.
- Sir G. Tomlinson.
- Sir C. Bottomley
- Sir J. Shuckburgh.
- Permt. U.S. of S.
- Parly. U.S. of S.
- Secretary of State.

CD  
R 5-MAY  
D 15 4

6 May, 1957

DRAFT.

*The Secretary,  
Treasury* (19)

*I am to refer to the letter from the Colonial Development Advisory Committee of the 7th of May (CDAC 205) recommending further grants of £1900 a year for three years to the Government of Kenya for the purpose of financing the continuance of the campaign to eradicate tsetse fly in the South Kavirondo, and to request that the Lords Commissioners of the Treasury may be moved to sanction the payment of the grants in question from the Colonial Development Fund.*

FURTHER ACTION.

*Stromwith*

Communications on this subject  
should be addressed to—

THE SECRETARY.

Telephone: WHITEHALL 9191.

COLONIAL DEVELOPMENT ADVISORY COMMITTEE

COLONIAL OFFICE,

DOWNING STREET,

S.W.1.

C.D.A.C. 2166.

RECEIVED

3 MAY 1937

REGY

1st May, 1937.

3c

Sir,

I am directed by the Colonial Development Advisory Committee to request you to inform Mr. Secretary Ormsby Gore that, at their 97th meeting on the 28th of April, they had before them an application (C.D.A.C.2162) from the Government of Kenya for further grants of £1,900 per annum for three years for the continuance of experiments in Tsetse Fly control. The Committee had the advantage of receiving evidence during their consideration of this application from Sir Guy Marshall, C.M.G., D.Sc., F.R.S., Director of the Imperial Institute of Entomology, and from Sir Frank Stockdale, K.C.M.G., C.B.E., F.L.S., Agricultural Adviser to the Secretary of State.

2. In view of the many schemes relating to Tsetse Fly Research now being undertaken in various parts of Africa, the Committee enquired whether

effective

THE UNDER SECRETARY OF STATE,

COLONIAL OFFICE.

Apr 6 Kenya (22)

effective co-ordination and supervision were being maintained to prevent overlapping. It appears that the work being carried on throughout Africa can be divided into two parts; the first dealing with research and observations on the bionomics of tsetse fly, and the second dealing with measures for the eradication of the fly from particular areas. The Committee are satisfied that steps have been, and are being, taken for the effective co-ordination of this work both by the Tsetse Fly Committee of the Economic Advisory Council, and by the Director of the Imperial Institute of Entomology. The particular application before the Committee falls within the second of the two classes of work referred to above. The assistance is desired to continue the work of clearing and control in the Lambwe Valley with the object of opening up further areas for pasturage. Densely populated areas lie on either side of this valley and it is becoming increasingly urgent that additional pasturage should be afforded to permit of a diffusion of the population. The effective eradication of the fly

from

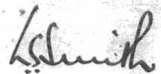
from this area is therefore essential before any such movement of population can take place. The Committee recommend further grants of £1,900 per annum for three years for the continuance of the work of tsetse fly control in the Lambwe Valley.

5. A similar letter is being sent to the Treasury.

I am,

Sir,

Your obedient servant,



Assistant Secretary to the Committee.

CONFIDENTIAL.

E.A.C.(T.F.)  
32nd meeting.

Copy no. 17

ECONOMIC ADVISORY COUNCIL.

TSSETSE FLY COMMITTEE.

CONCLUSIONS of the thirty-second meeting of the committee, held in Conference Room "A", 2, Whitehall Gardens, S.W.1, on Friday, 9th April, 1937 at 3 p.m.

P R E S E N T :

The Right Hon. The Earl De La Warr,  
Parliamentary Under Secretary of State  
for the Colonies. (In the Chair.)

Major E.E. Austen, D.S.O.,  
late Keeper, Department of  
Entomology, British Museum  
(Natural History).

Sir Arthur G. Bagshawe, C.M.G.,  
M.B., late Director, Bureau of  
Hygiene and Tropical Diseases.

Sir Guy A.K. Marshall, C. .G.,  
D.Sc., F.R.S., Director,  
Imperial Institute of  
Entomology.

Mr. H.D. Riley,  
Keeper, Department of  
Entomology, British Museum  
(Natural History).

Sir F.A. Stockdale, M.C.M.G.,  
C.B.E., Agricultural Adviser  
to the Secretary of State  
for the Colonies.

Dr. C.H. Wenyon, C.M.G., C.B.E.,  
F.R.S., Director-in-Chief,  
Wellcome Bureau of Scientific  
Research.

Mr.D.H.F. Rickett ..... Acting Joint Secretary  
to the committee.

The committee had before them the following  
paper -

Continuance of campaign for eradicating  
tsetse flies in the south Kavirondo  
district, Kenya Colony.

Copy of letter no. 38299/37, dated  
15th March, 1937, from the Under  
Secretary of State, Colonial Office,  
to the Secretary, Economic Advisory  
Council, covering an application from  
the Governor of Kenya for a further  
grant of £1,900 a year for three  
years from the Colonial Development  
Fund.

(Paper E.A.C.(T.F.) 465.)

In the course of the discussion, SIR GUY  
MARSHALL observed that there were certain aspects  
of the report prepared by Mr. Lewis which seemed  
to him to be open to criticism. He himself would  
like to see arrangements made for some form of  
supervision by Mr. Swynnerton, the Director of  
Tsetse Research in Tanganyika, of the work to  
be carried out under this scheme in the south  
Kavirondo.

SIR FRANK STODDALE said that he fully agreed  
with Sir Guy Marshall's suggestion insofar as  
concerned research work of a fundamental  
character. He thought that in this field  
Mr. Swynnerton should be recognised as the leading  
authority. An important part of the programme  
of work proposed, however, had as its object  
the provision of additional pasturage in certain  
areas in the Lambwe Valley, where overcrowding  
was serious. He thought that where measures  
of this kind were concerned they should be left  
under the control of the officers of the Kenya  
Government.

THE CHAIRMAN commented on the fact that the scheme, which was in course of execution, was not apparently regarded as the ideal scheme which would be possible, given the necessary resources.

MAJOR AUSTEN raised the question why experiments should be required to devise traps more attractive to fly and capable of effecting consistent heavy catches. He thought that this was remarkable in view of the fact that Glossina pallidipes had always been regarded as the most suitable species of fly for attack by trapping.

SIR FRANK STODDALE suggested that this might be due to variation in the density of fly. Mr. Swymerton had shown that traps are only effective where the density of the fly was comparatively high. He (Sir Frank) also laid emphasis on the necessity for confining attacks against the fly to a scale on which any advances made could be maintained by settlement.

SIR GUY MARSHALL expressed his agreement with this view.

At the conclusion of their discussion, the committee agreed:-

- (a) To recommend that the Economic Advisory Council should inform the Secretary of State for the Colonies that the Tsetse Fly Committee were of opinion -
  - (i) that the continuance of the campaign for eradicating tsetse flies, undertaken by the Kenya Government in the south Kavirondo district, would be likely to prove of great benefit to that territory, and that they therefore recommended that support should be given by the Secretary of State for the Colonies to the application made by the Government of Kenya for a further grant of \$1,900 a year for three years, to be made from the Colonial Development Fund for the purpose of financing this work;

- (ii) that as regards that part of the programme which was concerned with research work of a fundamental character (namely the studies of the bionomics of Glossina pallidipes referred to in paragraph 2a of the memorandum forming enclosure 2 to the letter from the Colonial Office under consideration) it was desirable that arrangements should be made for this side of the work to be carried out under the supervision of Mr. C.F.H. Swynnerton, Director of Tsetse Research, Tanganyika Territory.
- (b) That as on previous occasions the Colonial Office should be invited to consider the desirability of arranging for Sir Guy Marshall to attend the meeting of the Colonial Development Advisory Committee, at which this application would be considered, in order that he might offer the Committee any explanations in regard to it which they might desire.

---

2, Whitehall Gardens, S.W.1.,

9th April, 1937.

G. O.

Mr. Grossmith. 1574

Mr. Flood 15 f.

Mr. O

Sir C. Parkinson.

Sir G. Tomlinson.

Sir C. Bottomley

Sir J. Smuckburgh.

Permt. U.S. of S.

Parby U.S. of S.

Secretary of State.

S W  
Ackd. (14)Downing Street,  
19 April, 1937.

Sir,

I am etc to refer to the letter from this Department of to-day's date on the subject of Tsetse Fly control in Kenya, and to transmit to you for the information of the Tsetse Fly Committee, a copy of a despatch from the Acting Governor of Kenya, together with ~~twenty~~ copies of a Report by Mr. C.B. Symes and Mr. R.T. Vane on the eradication of Glossina palpalis from River Areas of Kenya by the "Block" method.

2. Mr. Ormsby Gore will be grateful for any observations which the Tsetse Fly Committee may desire to offer in connection with this Report.

I am, etc.,

(Signed) J. E. W. FLOOD

DRAFT.

THE SECRETARY,  
ECONOMIC ADVISORY COMMITTEE.

? Council

12<sup>th</sup> March, 1937 (9)20<sup>th</sup> April 1937  
Report enclosed  
in No 9.

FURTHER ACTION.

G. O.

Mr. Grossmith. 1574

Mr. Flood 15/8

Mr.

Sir C. Parkinson.

Sir G. Tomlinson.

Sir C. Bottomley.

Sir J. Stuchburgh.

Permt. U.S. of S.

Parly. U.S. of S.

Secretary of State.

Downing Street,

19 April, 1937

Sir,

I am etc to acknowledge the receipt of your letter of the 10th of April No. EAC/616, containing the recommendations of the Tsetse Fly Committee in regard to an application from the Government of Kenya for further assistance from the Colonial Development Fund for the purpose of the continuance of the campaign to eradicate Tsetse Fly in the South Kavirondo.

Mr. Ormsby Gore is grateful for the trouble which has been taken by the Tsetse Fly Committee, and, in accordance with their recommendations, he is submitting the Kenya Government's application to the Colonial Development Advisory Committee for the favourable consideration of that Committee.

**DRAFT.**

THE SECRETARY,  
ECONOMIC ADVISORY COUNCIL.

FURTHER ACTION.

8.

I am to add that Sir Guy Marshall

is being invited to attend the meeting of the

Committee at which the application will be

considered.

I am, etc.,

(Signed) J. E. W. FLOOD

*samples*

E

10B

C.D.A.C. 2162.

3c

COLONIAL DEVELOPMENT ADVISORY COMMITTEE.

Kenya.

Experiments in tsetse fly control.

With reference to C.D.A.C. 1151 and 1162, I circulate, for consideration, an application from the Government of Kenya for further grants of £1,900 per annum for three years for the continuance of experiments in tsetse fly control.

A Colonial Office memorandum and the usual financial summary are prefixed.

S. CAINE

Secretary to the Committee.

*Copy to Lt. G. Marshall (11)  
Kenya - (22)*

Colonial Office,

17th April, 1937.

18

FINANCIAL SUMMARY.

1. Dependency. Kenya.
2. Description of scheme. Continuance of experiments in tsetse fly control.
3. Date of commencement. As soon as approved.
4. Period of scheme. Three years.
5. Total Cost. £5,700.
6. Allocation of cost. Nearly all expenditure will be local.
7. Assistance desired. Free grant of £5,700.
8. Suggested terms of loan. Not applicable.
9. Probable yearly amounts required.

1937/38	£1,900
1938/39	£1,900
1939/40	£1,900

MEMORANDUM.

At their 53rd meeting on the 30th November, 1932, the Colonial Development Advisory Committee had before them an application from the Government of Kenya for a free grant of £5,160 to provide for the cost of experiments in Tsetse Fly control in certain Districts of the Colony (C.D.A.C. 1151).

It will be recalled that the proposals were supported by the Tsetse Fly Committee of the Economic Advisory Council, and that after discussing the application with Sir Guy Marshall, the Director of the Imperial Institute of Entomology, the Committee were pleased to recommend that the grant should be made. The grant was duly sanctioned.

The Government of Kenya has now submitted an application for a further grant of £1,900 a year for three years to provide for the continuance of investigational work on Glossina pallidipes in the Lambwe Valley of the South Kavirondo District. No assistance is desired for the continuance of measures for the eradication of Glossina palpalis from river areas on which a sum of £2,386 has been expended from the total grant of £6,160 made in 1932.

The Tsetse Fly Committee, to whom the Acting Governor's despatch has been referred, have recommended that support should be given by the Secretary of State to the present application for a grant of £1,900 for three years, on the grounds that the continuance of the campaign for eradicating Tsetse Flies undertaken by the Kenya Government in the South Kavirondo District would be likely

to

to prove of great benefit to that Territory. The Economic Advisory Council have concurred in this recommendation. The Secretary of State has no hesitation therefore, in recommending the application for the Committee's favourable consideration.

It is hoped that Sir Guy Marshall will be available to offer the Colonial Development Advisory Committee any explanations which they might desire in regard to this application.

The following papers are submitted for the Committee's consideration:-

Despatch No. 50 dated the 20th January, from the Acting Governor of Kenya containing the actual application for the grant of £1,900 a year for three years and a report on experiments on the control of Glossina pallidipes in Kenya, carried out with assistance from the Colonial Development Fund.

A report on measures taken for the eradication of Glossina palpalis from river areas, carried out with assistance from the Colonial Development Fund. (The members of the Committee are requested to return this report in due course).

Letter from the Economic Advisory Council dated the 10th April, in support of the present application.

Colonial Office,  
17th April, 1937.

ECONOMIC ADVISORY COUNCIL,  
2, Whitehall Gardens,  
London, S.W.1.

10th April, 1937.

Sir,

I am directed by the Economic Advisory Council, to request you to inform Mr. Secretary Ormsby Gore, that at their meeting held yesterday their Tsetse Fly Committee had under consideration your letter of the 15th ultimo (38299/37) transmitting an application from the Government of Kenya for a further grant of £1,900 a year, for three years, from the Colonial Development Fund for the purpose of financing the continuance of the campaign to eradicate Tsetse Fly in the South Kavirondo.

2. After full discussion, the Committee agreed:-

"(a) To recommend that the Economic Advisory Council should inform the Secretary of State for the Colonies that the Tsetse Fly Committee were of opinion -

- (i) that the continuance of the campaign for eradicating tsetse flies, undertaken by the Kenya Government in the South Kavirondo district, would be likely to prove of great benefit to that territory, and that they therefore recommended that support should be given by the Secretary of State for the Colonies to the application made by the Government of Kenya for a further

The Under Secretary of State,  
Colonial Office.

22

further grant of £1,900 a year for three years, to be made from the Colonial Development Fund for the purpose of financing this work;

- (ii) that as regards that part of the programme which was concerned with research work of a fundamental character (namely the studies of the bionomics of Glossina pallidipes referred to in paragraph 2a of the memorandum forming enclosure 2 to the letter from the Colonial Office under consideration) it was desirable that arrangements should be made for this side of the work to be carried out under the supervision of Mr. C.F.M. Swynnerton, Director of Tsetse Research, Tanganyika Territory.

- (b) That as on previous occasions the Colonial Office should be invited to consider the desirability of arranging for Sir Guy Marshall to attend the meeting of the Colonial Development Advisory Committee, at which this application would be considered, in order that he might offer the Committee any explanations in regard to it which they might desire."

3. The Council concur in the Committee's recommendations, which I am, therefore, to commend for the favourable consideration of the Secretary of State.

I am, etc.  
(Sgd.) FRANCIS HEMMING.

10A

TSETSE FLY RESEARCH.

Draft.  
Mr. F. Wood 15 above  
(in view of urgency) 13/4.

At their 53rd meeting on the 30th November, 1932, the Colonial Development Advisory Committee had before them an application from the Government of Kenya for a free grant of £6,160 to provide for the cost of experiments in Tsetse Fly control in certain Districts of the Colony (C.D.A.C.1151).

It will be recalled that the proposals were supported by the Tsetse Fly Committee of the Economic Advisory Council, and that after discussing the application with Sir Guy Marshall, the Director of The Imperial Institute of Entomology, the Committee were pleased to recommend that the grant should be made. The grant was duly sanctioned.

The Government of Kenya has now submitted an application for a further grant of £1,900 a year for three years to provide for the continuance of investigational work on Glossina pallidipes in the Lambwe Valley of the South Kavirondo District. No assistance is desired for the continuance of measures for the eradication of Glossina palpalis from river areas on which a sum of £2,386 has been expended from the total grant of £6,160 made in 1932.

See para 2  
of No. 1.  
+ para 2  
of No. 9.

The Tsetse Fly Committee, to whom the Acting Governor's despatch has been referred, have recommended that support should be given by the Secretary of State to the present application for a grant of £1,900 for three years, on the grounds that the continuance of the campaign for eradicating Tsetse Flies undertaken by the Kenya Government in the South Kavirondo District would be likely to prove of great benefit to that Territory. The Economic Advisory Council have

concurred

24

concluded in this recommendation. The Secretary of State has no hesitation therefore, in recommending the application for the Committee's favourable consideration.

It is hoped that Sir Guy Marshall will be available to offer the Colonial Development Advisory Committee any explanations which they might desire in regard to this application.

The following papers are submitted for the Committee's consideration:-

Despatch No. 50 dated the 20th January, from the Acting Governor of Kenya containing the actual application for the grant of £1,900 a year for three years and <sup>a</sup> report on experiments on the control of Glossina pallidipes in Kenya, carried out with assistance from the Colonial Development Fund.

A report on measures taken for the eradication of Glossina palpalis from river areas, carried out with assistance from the Colonial Development Fund. (The members of the Committee are requested to return this report in due course.)  
Letter from the Economic Advisory Council dated the 10th April, in support of the present application.

---

9

KENYA.

No. 161



RECEIVED  
- 7 APR 1937  
C. O. REGY

GOVERNMENT HOUSE,  
NAIROBI,  
KENYA.

12 March 1937.

Sir,

(13) ON 18307/32

With reference to despatch No. 927 of the 22nd December 1932, from Sir Philip Cunliffe-Lister (now Viscount Swinton), conveying approval of a free grant of £6160 from the Colonial Development Fund to cover the cost of experiments in tsetse fly control in Kenya, I have the honour to transmit to you, for your information, a copy of a report prepared by Mr. C. D. Symes, medical entomologist, and Mr. M. A. Vane, Tsetse Field Assistant, on the experiments carried out in connection with the eradication of G. palpalis in the Kaniadoto area of the South Kavirondo District. Twenty additional copies of this report are being forwarded under separate cover, for transmission to the Tsetse Fly Committee of the Economic Advisory Council.

13  
13

Copy to E. A. C.  
Copies of report.

copy 722

2. The purposes of the grant of £6160 were two, namely, work on G. pallidipes, the carrier of trypanosomiasis in cattle, concerning which a report was transmitted to you with my despatch No. 50 of the 20th January, and measures for the eradication of G. palpalis, the carrier of human trypanosomiasis. The sum of £2386 was expended from the grant for this latter purpose, and the experiments which form the subject of the present report constituted the first half ...

THE RIGHT HONOURABLE  
W. GRIMSBY GORE, F.C., M.P.,  
SECRETARY OF STATE FOR THE COLONIES,  
DOWNING STREET,  
LONDON, S. W. 1.

half of the scheme. The second part of the work, namely, the application of the methods of control to the lacustrine areas, is being carried out on the shores of Lake Victoria in the Central Kavirondo District, and a further report on the subject will be available in due course.

3. The aim of the experiments undertaken was to ascertain the possibility of eliminating G. palpalis from infested bush by the adoption of piecemeal methods of attack, consisting of hand catching and trapping adult tsetse in blocks of bush along the Kuja River and its tributaries, after such blocks had been isolated by clearings. Four blocks of bush were isolated, containing about 12½ miles of river, along some 11 miles of which flies have been reduced to negligible quantities, and on the remaining 1½ miles their density has dropped by about 93 per cent. Settlement is proceeding on 6 square miles which have been made safe in this manner, while the rivers are still being patrolled to prevent reinfestation.

The success of traps where the density of G. palpalis was high, and their failure in low densities, would appear to indicate the desirability of further investigation into the design of traps and the methods of increasing their attractiveness to tsetse.

4. Complete and valuable data concerning all branches of the work undertaken are included in the report, because although the experiment was essentially an investigation of the possibility of applying certain methods of control, it was hoped also to reclaim a troublesome fly infested area, as a basis for further work of this nature. The result would appear to

indicate ...

3  
indicate that given sufficient funds, G. palpalis  
could be eliminated from riverine areas by a method  
which is neither uneconomic nor devastating.

I have the honour to be,

Sir,

Your most obedient, humble servant,

*Arn. Wade*

ACTING GOVERNOR.



COLONY AND PROTECTORATE OF KENYA

**THE ERADICATION OF G. PALPALIS  
FROM RIVER AREAS BY THE  
"BLOCK" METHOD**

(An experiment financed by the Colonial Development Fund)

BY  
**C. B. SYMES,**  
*Medical Entomologist, Kenya*

AND  
**R. T. VANE,**  
*Team Field Assistant*

1957  
PRINTED BY THE GOVERNMENT PRINTER  
NAIROBI, KENYA COLONY

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## Chapter I—INTRODUCTION

Field observations and surveys over many years in connection with human trypanosomiasis in Nyanza Province gave rise to the belief that the tsetse fly responsible, *G. palpalis*, could be eliminated from very considerable stretches of lake shore and rivers, if not from all, by properly organized adult catching and pupæ destruction.

Our surveys had been made essentially to ascertain sources of infection then occurring in certain districts and to suggest measures for checking such infection.

We had recommended the usual measures for the breaking of contact between fly and people. These consisted mainly of clearing infested bush from centres of activity, such as canoe landings, fishing centres, watering places, and river crossings. Some of these recommendations were carried out; many were not. They offered few attractions to the local populations, nor were they a great deal more attractive to the Administration or to ourselves. Little, if any, progress, was possible towards a permanent eradication of sleeping sickness, and the re-occupation of large areas of fertile lake shore and river lands, until we could devise some method of getting rid of *G. palpalis* with a minimum amount of bush clearing.

Bush infested by *G. palpalis* borders rivers and lake shores and is usually never more than a few hundred yards in width. A series of clearings, a mile or two apart, in such bush, each clearing wide enough to be an effective barrier to fly movement, reduces an indefinitely long fly belt to a series of isolated fly colonies. If the clearings are well sited such colonies will be small enough to yield, relatively soon, to simple measures of extermination directed against them. That is, briefly, the idea which we have tried to put into practice at Kaniadoto.

We have made observations on *G. palpalis* only in the course of our practical experiment. The economic aspect of the method has been constantly in view. Costs have been fully recorded and are presented as a major portion of this report.

All the work has been supervised continuously by one of us (R. T. Vane).

We wish to thank the Senior Medical Officer, Kisii; officers of the Administration at Kisumu and Kisii, and Mr. C. F. M. Swynnerton and his staff of the Tsetse Research Department, Tanganyika, for their interest and help in various ways.

## Chapter II—AREA CONCERNED

### (a) Brief History of Sleeping Sickness.

Kaniadoto with its neighbouring locations, Kaniamwa, Kaniamkago, and Kabwoch, are in the South Kavirondo district of Nyanza Province, about 50 miles south-west of Kisumu and some 20 miles east of Lake Victoria. This area was selected for our experiment because it had been for many years a troublesome focus of sleeping sickness, and because we wished to take advantage of a certain amount of work that had already been done there. During the year 1927 the people inhabiting the neighbourhood of the Nthiwa, Pala and Kuja Rivers in this district were moved away from the infested bush in an attempt to check infection. One hundred and nine infected people were discovered by Enzer<sup>(1)</sup> in one sub-location with a population of 845. Two years later McLean<sup>(2)</sup> found another 48 cases in the district, and Wilkinson<sup>(3)</sup> still later recorded 128 new infections.

In 1929 a survey was carried out to ascertain the distribution and density of *G. palpalis*, and to discover sources of infection. It was found that infection was fairly scattered throughout the locations mentioned above, though the greatest number of cases occurred in Kaniadoto, and that most appeared to have been contracted locally at the much-used fords and watering places on the Nthiwa, Pala, Mirogi and Kuja Rivers.

As the result of this survey, an attempt was made to make protective clearings at the main fords with voluntary, unpaid labour. Olassi and Wadhadeng clearings were made, and Wadhatego was commenced. But a satisfactory conclusion appeared to be unlikely because of a lack of labour. This work, however, was made to constitute the first measure in our experimental scheme.

### (b) Topography.

The Nthiwa, Pala and Mirogi Rivers are tributaries of the Kuja River. The Mirogi River runs into the Pala, and the Pala and Nthiwa Rivers join and run through Odielo Bush to the Kuja River. (See Map I.)

The total length of river dealt with on these three tributaries is 20,825 yards, made up as follows:—

Nthiwa River—	Length of
	River Bed
	Yards
Wadhasaa Clearing	1,678
Block III	1,066
Wadhadeng Clearing	537
Block II	2,006
Olassi Clearing	903
Block I	3,868
	10,148

*Pala River.*—From north end of Wadhasaa Clearing to Kisii-Karungu road = 7,655 yards.

*Mirogi River.*—From confluence with Pala River to northern fly limit = 3,022 yards.

Vegetation types are common to these rivers, and consist of a variety of thorn bush with occasional large acacia trees. The bush belt varies in width from 100 to 700 yards approximately. On the upper reaches, near the Kisii-Karungu road, the bush gradually dwindles and gives place to grass and reeds, with occasional small clumps of acacia thicket.

The Nthiwa River is 15 to 25 feet wide, and varies in depth from 3 to 6 feet. During the drier periods it becomes a series of pools of various sizes, but never dries up completely. The Pala and Mirogi Rivers behave in the same way.

The Kuja River is a permanent stream, some 40 to 50 feet wide in this area, with steep cut banks and a good fast current. Its course is marked by very dense bush of the thorn-acacia types, varying in width from a few hundred yards (at Block VI) to about a mile (in Kabwach Forest).

Block VI includes 2,443 yards of river.

### (c) Fauna.

There is very little game in the vicinity of the tributaries. Waterbuck, bushbuck and oribi roam about alone or in pairs, and a very rare leopard or lion is seen. Herds of elephant take advantage of the riverine bush when travelling between the Kuja River and Lambwe Valley. They do not stay in the light bush during the daytime, however, but retire to the more extensive bush area on the Kuja. Hippopotamus wander up almost to the Kisii-Karungu road when there is a good flow of water. No crocodiles have been seen, but there are quite a large number of monitor lizards.

On the Kuja these types are generally more numerous; hippopotamus and crocodiles are frequently seen.

### (d) Inhabitants and Economics.

The people are Luo. They are, generally speaking, rather more backward in most things than the Luo of Central and North Kavirondo, because, perhaps, of their geographical position. Their country has been rather too inaccessible to attract the champions of native development.

Population in the locations most affected by our work—Kaniadoto, Kaniamwa, Kaniamkago and Kabwoch—is about 19,000. The most densely populated area is Kaniakela, in Kaniadoto, on the western side of the Nthiwa River. This area has produced the majority of infected people.

Physically, the people are poor, probably as the result of a deficient diet and of a variety of diseases. Besides sleeping sickness, they suffer from most if not all of the helminths, venereal, and, perhaps most important of all, malaria. McLean (2) recorded a 96 per cent malaria parasite rate in Kaniadoto.

As may well be assumed, they lack energy, initiative and ambition.

The chief crops grown are mtama, maize, wimbe, sweet potatoes, muhogo, simsim and groundnuts. The first is the main article of diet, though maize is becoming popular in recent years.

Until the last few years crops were grown almost entirely for home consumption, or barter at the local markets. Now, however, the export of groundnuts, simsim and maize is developing. Very recently cotton production has been encouraged, and this promises to be of great economic importance. Some areas of our reclaimed land have been set aside for this crop.

Cattle and goats graze in considerable numbers; the former particularly along the streams.

Small numbers of the men leave home to seek work in other parts of the country, and with the advent of the gold mines in South Kavirondo the number who do this has increased. The remainder spend their time tending cattle or goats, loafing around the markets, cutting poles and building huts, or occasionally breaking up land for their crops. The women are responsible for domestic duties that include carrying wood and water, and marketing produce.

Water is obtained from streams except during the wet season, when every convenient pool or puddle saves a long walk. Wood for domestic purposes is best obtained in the bush near the various rivers. There is very little to be had elsewhere. Poles suitable for hut-building are to be found only in this riverine bush. Traffic routes between locations and markets cut through this bush at fords on the rivers, and stock graze along its edges and enter it for water. And it is this bush that is infested with *G. palpalis*.

Short of a complete change of life, involving new water supplies, the establishment of plantations for wood and poles, new and very roundabout traffic routes, a cessation of stock raising, or hand feeding—there is little good grazing other than along the rivers—nothing but a complete evacuation of the country might have checked infection. Such a complete change is out of the question. So, in our opinion, was evacuation of population.

The rivers, with their forest and bordering grazing grounds, are of vital importance. They must be preserved and made safe. We have tried to show how this may be done by a direct attack on *G. palpalis*.

(c) Climate.

We had intended recording meteorological conditions throughout the period of the experiment at Kaniadoto. But our thermo-hygrograph was badly damaged in November, 1933, and could not be repaired, and attempts to obtain a screen and thermometers were not successful until October, 1934. These were set up at the camp, about a mile from the Kuja River.

Records are given in Appendix IV.

Rainfall was noted roughly by recording the number of days on which rain fell (Appendix III).

Briefly, there are the usual two wet seasons—the long rains of March and June, and the short rains of October to December. But rain continues in moderate amount during the months of July, August and September. January and February appear to be the only dry months. This frequent rain interferes with early burning of cut bush.

### Chapter III—CLEARINGS

All clearings were made at established traffic crossings at which it was usual for people to come for water, for bathing, and for watering cattle. The common aim was to provide early protection from infection, as well as to isolate blocks of bush for fly elimination. More specific reasons for the making of certain clearings are given below when necessary.

A summary of expenditure on labour for clearings is included in this section.

Details of each clearing are given below.

#### (a) Olassi Clearing, Nthiwa River.

(1) *Location*.—Between Block I and Block II, Nthiwa River. (See Map I.)

(2) *Dimensions*.—Total clearing, 700 yards along by 600 yards across river—approximately 88 acres. Cost, Sh. 348 (maintenance only). Length of river bed in clearing, 903 yards.

(3) *Description of original bush*.—This clearing had been made by labour supplied by the Administration in 1932, before work under the Colonial Development Fund scheme had started. The bush had then consisted of a close, though narrow, belt of thorn with a few large acacia trees.

(4) *Work carried out*.—In October, 1933, when work was commenced under the Colonial Development Fund, the clearing was in a fairly clean condition, with good grass growth down to the river bed.

During October and November, 1933, all regenerated and herbaceous growth was slashed and old stumps were repiled and burned. Since this time it has been necessary merely to clean up the river bed periodically. The clearing is now free from bush and regeneration, no work having been necessary since November, 1934.

#### (b) Wadhadeng Clearing, Nthiwa River.

(1) *Location*.—Between Block II and Block III, Nthiwa River.

(2) *Dimensions*.—Total clearing, 500 yards along by 900 yards across river; approximately 90 acres (approximately 18 acres of dense bush was cut out under the present scheme). Cost, Sh. 1,487. Length of river bed in clearing, 537 yards.

(3) *Description of original bush*.—This clearing had been made before work was commenced under this scheme. The bush was a very dense thorn with occasional big trees of the acacia group.

(4) *Work carried out*.—In October, 1933, the clearing was overgrown and rapidly reverting to bush. In November it was cleaned up, and old stumps were repiled and burned. Since then, except for an occasional cleaning of the stream bed, little work has been necessary on this portion. Grass has established itself throughout.

Since, however, the cleared area varied somewhat in width it was necessary to do more clearing to bring it to a uniform width of 500 yards. Later, too, in an attempt to prevent the incursion of flies from the Pala River, an extension in length was necessary. These works were commenced in December, 1933, the cut bush was burned off in August, 1934, and ordinary maintenance has been continued since.

The extension in length was only partly effective in preventing invasion from the Pala River. A complete elimination of the Pala flies was therefore essential. (See page 18.)

#### (c) Wadhasaa Clearing.

(1) *Location*.—At the junction of the Nthiwa and Pala Rivers.

(2) *Dimensions*.—Total clearing, 1,050 yards along by 1,000 yards across the river; approximately 90 acres of heavy bush and 127 acres of more open country, with occasional small clumps of thicket and trees; total, 217 acres. Cost, Sh. 3,472. Length of river bed in clearing, 1,678 yards.

(3) *Description of original bush*.—The riverine bush in the centre of the area to be cleared was comparatively narrow, in some places measuring not more than 100 yards across. At the northern and southern ends it was much wider. A semi-circular tongue of bush named Kakiugu, on the west side, extended from the southern end to within 250 yards of Block III. It was found necessary to cut off a considerable portion of this tongue. Between Kakiugu and the riverine bush the country was fairly open, with a considerable number of acacia and combretum trees. Everything was felled.

(4) *Object of clearing*.—During the first three months of fly catching in Block II it was found that flies were coming across in considerable numbers from the Pala River. Fly

elimination had to be commenced on the Pala River and its tributary, the Mirogi. Wadhasaa clearing was therefore made as a barrier to isolate the Nthiwa, Pala and Mirogi Rivers from the heavily infested Kuja River.

The clearing is the lower limit of the present reclaimed area. Since it is contiguous to the untreated Kuja River bush, people and cattle are not allowed in.

(5) *Work carried out.*—A clearing 850 yards wide commenced on the 10th February, 1934. Felling and piling the cut bush was completed by the 26th March, and burning was carried out early in April. The period between felling and burning was insufficient to allow a thorough drying of the cut vegetation. The burning was therefore not satisfactory. But, in spite of this, the area acted as a reasonable barrier to fly movements, and thus supported the eliminating operations in Block III (Nthiwa), and on the Pala and Mirogi Rivers.

Owing to the heavy rains the large amount of debris left in the clearing could not be burned until the following September. But this debris was stacked well away from the river bed in order that it should not facilitate the passage of patrolling female flies.

In November, 1934, a considerable portion of Kakingu bush was felled and piled. It was then found, by marking experiments, that flies managed to cross the 850 yards of clearing. (See page 37.)

The cleared area was therefore extended southwards 200 yards in December, 1934.

In February, 1935, the Kakingu bush and the 200-yard extension was burned. Grass seed, collected in the district, was sown in the clearing in May, 1934, and the results have proved satisfactory.

The unsatisfactory burning of this clearing has resulted in a considerable amount of regeneration from surviving stumps and roots. This will be controlled periodically until the adjacent Kuja bush is freed from fly. The choice of a suitable time for burning is obviously of importance. In this instance, circumstances did not permit of postponement, because a barrier was urgently necessary and the time available for the whole scheme was limited.

(d) *Wadhatego Clearing, Kuja River.*

(1) *Location.*—On the Kuja River at the foot of Unga Hill and at the junction of Kithuku stream with the Kuja River.

(2) *Dimensions and cost.*—Total clearing, 600 yards along by 1,000 yards across the river; approximately 124 acres of heavy bush. Length of river bed in clearing, 2,000 yards. Cost, Sh. 3,940.

(3) *Description of original bush.*—The river in this clearing twists and turns to such an extent that although the clearing is only 600 yards wide it contains 2,000 yards of river bed (i.e. 4,000 yards of river bank). Very dense bush covered the entire area, except for some 150 yards square that had been cut in 1932. This latter small area was in a very rapid state of regeneration, in some cases the re-growth being 8 feet high.

The stream bed of the Kithuku runs through this area on the southern side.

(4) *Object of clearing.*—To safeguard native traffic using Wadhatego ford for trading between Kabwach and Mirogi market, to provide safe and suitable watering places for natives living on the southern bank of the Kuja River, and to cut off the fly in the dense Kabwach Forest from the infestation down river.

Our initial plans included this clearing and one further north to provide a heavily infested "block" for trapping. But the rapid exhaustion of funds and time made it necessary to select an area further down the Kuja, with rather narrower bush but similar fly density, which would provide an earlier result. (See Block VI.) Wadhatego clearing therefore was left out of the scheme. It remains as a protection to traffic and a starting point for elimination of fly up-stream, which is now going on.

(5) *Work carried out.*—Felling and piling was commenced on the 25th December, 1933, and continued up to the 10th February, when all labour were transferred to Wadhasaa Clearing. It was recommenced on the 5th April, but owing to the rains the labour gang decreased considerably in size, and the work was not completed until the 12th June.

It was expected that August and September would be comparatively dry months, but of the 61 days, rain fell on 34. By this time the felled bush was almost entirely covered by creeper growth. On 24th September the labour started to reclean the clearing by cutting all re-growth; after allowing five days for the creeper growth to die and dry out, the cut bush was burnt in small sections as the work of cleaning up progressed. This continued up to the 27th October, when the dead wood was too saturated with rain to burn. The remaining portion was cleaned up in December, 1934, and February, 1935, when it was eventually burned.

Since this clearing was not a part of the main scheme, very little maintenance work has been carried out.

(e) *Wadhakech Clearing.*

(1) *Location.*—On the Kuja River, south of the tsetse fly control camp between Wanjawe and Odielo bush.

(2) *Dimensions.*—Total clearing, 200 yards along by 1,400 yards across river; approximately 25 acres dense heavy bush and 32 acres open bush; total, 57 acres. Cost, Sh. 1,378. Length of river in clearing, 350 yards.

(3) *Description of bush.*—The original bush was very dense for about 450 yards on the eastern side and then became lighter, with small open glades. A narrow native path ran through this. On the western side the river bank had heavy, dense bush, which gave place gradually to lighter growth and thickets. A cattle track ran through this.

(4) *Object of clearing.*—This is purely a cutting through the heavily infested Kuja bush to afford some degree of protection for the heavy native traffic between Kaniadoto and the two locations, Kawoch and Kaniamkago. This traffic had increased considerably during the period of the experiment.

The clearing will be enlarged to form a barrier clearing in connection with later operations.

(5) *Work carried out.*—Felling and piling was started on the 13th June, 1934, and completed on the 16th July.

A clean-up was necessary in November and again in January, 1935, when it was burnt. The fire was thorough; it left the clearing exceptionally clean.

A small amount of maintenance was carried out in May and June, and some slight attention to light re-growth will be necessary in the near future.

(f) *Wadhagulu Clearing.*

(1) *Location.*—At Wadhagulu ford on the Kuja River, opening on to Utangi Plain. This clearing is the northern barrier to Block VI.

(2) *Dimensions.*—Total clearing, 1,050 yards along by 1,700 yards across river; approximately 60 acres of heavy bush and 310 acres of open parkland; total, 370 acres. Cost, Sh. 2,602. Length of river in clearing, 1,833 yards.

(3) *Description of original bush.*—Original bush was comparatively narrow, averaging only about 300 yards deep. The eastern edge of the Utangi Plain forms the west bank of the river, which in a few places was almost free from bush. The Utangi Plain is open country with an occasional tree of the acacia group.

(4) *Work carried out.*—Clearing was commenced on the 14th July, 1934, and the riverine bush proper was completely felled and piled by the 17th August. Clearing the trees from the open parkland occupied four days. Ten days was spent from the 29th October cleaning the felled bush of creeper growth. On the 12th December, after a short dry spell, an attempt was made to burn. Rain prevented a successful burning. From 18th to 29th January, 1935, the debris was re-stacked and burned with greater success. Small maintenance work was carried out in March, May, June, July, August and September.

The clearing is now in a fairly clean condition, but a certain amount of work remains to be done to kill off regeneration from surviving roots.

(g) *Wadharia Clearing, Kuja River.*

(1) *Location.*—At Wadharia ford, on the Kuja River, south of Block VI.

(2) *Dimensions.*—Total clearing, 1,020 yards along by 900 yards across river; approximately 42 acres of heavy bush, and 190 acres of open parkland with occasional thicket; total, 232 acres. Total length of river in clearing, 1,393 yards. Cost, Sh. 1,811.

(3) *Description of original bush.*—The bush in this area, very similar to that at Wadhagulu, averaged about 200 yards deep. In places the west bank was devoid of bush, and opened direct on to Utangi Plain. The distance from Wadhagulu to Wadharia Clearing is approximately three-quarters of a mile.

(4) *Work carried out.*—Clearing was started on the 18th August, 1934; felling and piling were completed on the 7th September. Five days were spent in November and five days in January cleaning up the creeper growth, and the cut bush was burnt on the 14th and 15th January, 1935. Debris was collected and burnt in February. The river banks were cleaned in March, May, July and September. The clearing is now in a fairly clean condition, but a certain amount of maintenance and destruction of regeneration from surviving roots remain to be done.

(h) *General Summary.*

The work on the five new clearings, namely, Wadhasaa, Wadhatego, Wadhakech, Wadhagulu, and Wadharia, was commenced on the 28th December, 1933, and felling and piling was completed by the 7th September, 1934. Much creeper growth occurred in all clearings during the enforced period of waiting for weather conditions suitable for burning.

The combined total width of these new clearings is 3,920 yards along the river, with 7,254 yards of river bed (i.e. 8½ miles of river bank). The clearings contained approximately 340 acres of heavy, dense riverine bush and 620 acres of more open country with scattered trees and thickets. The cost of felling and piling heavy riverine bush is approximately Sh. 10/50 per acre (for labour only), and of open country Sh. 1/50 per acre. The cost of burning varies with the nature and density of the cut bush. Very dense bush burns much better and cleaner than patchy bush. The carrying off of cut vegetation by natives must be prevented; it results in incomplete burning.

The cost of slashing down creeper and secondary growth on a felled clearing is heavy. Clearings should be made, if possible, just before the dry season, to avoid a long waiting period, during which time secondary growth may become very dense.

TABLE I  
SUMMARY OF EXPENDITURE ON LABOUR FOR ALL  
CLEARINGS

	Men-days	Rate Per Day		Total
		Cents	Sh. cts.	
<b>OLASSI—</b>				
Maintenance only	1,208	20		241 60
<b>WADHADENG—</b>				
Extensions to Original Clearing (Felling and Piling Virgin Bush)	1,784	20		356 80
Maintenance	3,379	20		675 80
	5,163	20		1,032 60
<b>WADHASAA—</b>				
Felling and Piling Virgin Bush	6,685	20		1,337 00
Burning	2,342	20		468 40
Maintenance	3,031	20		606 20
	12,058	20		2,411 60
<b>WADHATEGO—</b>				
Felling and Piling Virgin Bush	6,456	20		1,291 20
Clearing Creeper Growth and Burning	6,854	20		1,370 80
Maintenance	370	20		74 00
	13,680	20		2,736 00
<b>WADHAKECH—</b>				
Felling and Piling Virgin Bush	2,645	20		529 00
Cleaning Creeper Growth	1,664	20		312 80
Burning	200	20		40 00
Maintenance	375	20		75 00
	4,784	20		956 80
<b>WADHAGULU—</b>				
Felling and Piling Virgin Bush	4,944	20		988 80
Cleaning Creeper Growth	1,197	20		239 40
Burning	1,519	20		303 80
Maintenance	1,377	20		275 40
	9,037	20		1,807 40
<b>WADHARIA—</b>				
Felling and Piling Virgin Bush	2,928	20		585 60
Cleaning Creeper Growth	1,365	20		273 00
Burning	734	20		146 80
Maintenance	1,266	20		253 20
	6,293	20		1,258 60

#### Chapter IV—ELIMINATION OF *G. PALPALIS*

##### (a) *Infested Blocks (See Map I).*

Blocks of infested bush isolated from the main body of fly on the Kuja and from one another were as follows:—

Nos. I and II on the Nthiwa River.

No. III comprising the lower portion of the Nthiwa River, together with the Pala and Mirogi Rivers. For our records this big block was split into two: No. 111, Lower Nthiwa and Pala Block, and the Upper Pala and Mirogi Block.

No. VI on the Kuja River below the Nthiwa junction.

(Nos. IV and V were selected north of the Nthiwa junction, but their isolation would have demanded too great an expenditure of money and time.)

##### (b) *General Outline of Operations.*

Paths were cut for fly boys through the bush along or near river banks in all blocks and control areas.

Trapping, hand-catching, and pupæ collections were the only methods used. Collection of pupæ was given up as uneconomical since breeding was found to be so very scattered. (See page 31.)

It was originally intended that various methods of fly destruction should be applied in Block I, using Block II as a control. The initial fly density in Block II, however, was considerably reduced by the training of fly boys. Block I was therefore used as a control, and Block II for the first steps in tsetse elimination. But when traps were available in November, 1934, two months after the beginning of operations, flies had been so reduced in Block II by previous hand-catching that the traps caught extremely few. Since the testing of traps was an essential part of our proposals, we installed them in Block I in February, 1934, which thereafter could not be used as a control. A control round was then established in the Odielo bush southwards of Wadhasaa Clearing. (See page 23.)

Between October, 1933, and February, 1935, the flies in Block II had been reduced by approximately 98 per cent (as indicated by catches per fly-boy-day).

Marking experiments indicated, however, that flies were crossing from the Pala River bush, which is only about 900 yards distant from the Nthiwa in the vicinity of the Wadhadeng Clearing.

The clearing of thicket between the two rivers appeared to be too costly. It was decided therefore to eliminate the fly in the whole of the Pala and Mirogi River bush.

Wadhasaa Clearing was made to isolate the whole of the belt from the Kuja River, and hand-catching began along these rivers. By March, 1935, flies had been reduced to negligible numbers. (See pages 28 and 33.)

At the same time reduction had been going on satisfactorily in Blocks I and II. (See pages 16 and 24.)

The reduction of *palpalis* in these three tributaries permits safe reoccupation of some six square miles of land which had been evacuated many years ago because of sleeping sickness. It frees from fly a much greater area than this, but the lower three square miles is being kept unoccupied until fly in the Odielo bush south of Wadhasaa has been eliminated.

Whilst fly-eradication progressed in the Nthiwa-Pala area, Block VI on the Kuja was isolated. (See page 26.) Though the clearings on each side were not burned until three months later, traps were introduced on the banks of the river. These were allowed to function alone for some six months. (See page 27.) Hand-catching was then started with considerable increases in captures. (See page 33.) Control fly rounds were carried out in the river bush north and south of the block. (See page 34.) Up to 30th September, 1935, nearly 40,000 flies had been taken from the block, with a reduction in density from about 170 per boy-day to 12.4 per boy-day.

Elimination is being continued.

(c) Descriptions of each block in their order of treatment, and the work carried out in them, are now given in greater detail.

##### (1) *Block II, Nthiwa River.*

*Description.*—This block, situated between Olassi and Wadhadeng Clearing on the Nthiwa River, is just over three-quarters of a mile in length. It carries very dense riverine bush, the greatest width of heavy bush being approximately 600 yards. On the northern side, numerous clumps of thickets form a connection with the heavy bush on the Pala River. On the south side, the country is fairly open and slopes up to a ridge on which there are several native *bomas*. The length of the river in Block II is 2,096 yards.

*Original Density of Fly.*—In May, 1929, Hopkins<sup>(4)</sup> recorded an average density of 9 males per boy-hour in this area. In July, 1932, Harper<sup>(5)</sup> recorded an average of 11 males per

boy-hour. His operations during 1932 and early 1933 appear to have reduced density very considerably, since it was only 12 per boy-day in October, 1933 (Table II). This is low.

*Elimination of Fly.*—Table II shows the progress of fly elimination during the two-year period from October, 1933, to September, 1935. Fly boys with hand nets were used throughout. For about two months pupae collection was also tried, but results were too insignificant to warrant continuance. Unfortunately the few pupae records we obtained were accidentally destroyed.

*Control.*—For a short time, Block I was used as a control for Block II. Comparative densities are shown in Table III. Normal fly fluctuations in untreated bush are shown in catches from Odielo bush (page 25).

TABLE II  
BLOCK II.—NTHIWA RIVER  
ELIMINATION OF *G. PALPALIS* BY HAND-CATCHING

MONTH	Days Catching	Fly-boy Days	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day
1933							
October..	12	127	741	502	297	1,522	11-984
November	26	244	809	813	313	1,935	7-930
December	22	505	764	779	79	1,622	3-211
1934							
January	27	306	427	387	28	842	2-751
February	22	296	37	47	—	84	0-283
March	27	216	25	19	—	44	0-203
April	25	100	11	7	—	18	0-180
May	27	108	21	22	4	47	0-435
June	26	145	12	10	1	23	0-158
July	26	104	7	15	1	23	0-221
August	24	98	4	0	0	21	0-194
September	27	108	3	0	0	4	0-041
October..	26	104	3	4	0	7	0-067
November	27	108	3	0	0	4	0-041
December	22	88	1	0	1	2	0-22
1935							
January	27	108	2	0	0	2	0-018
February	24	96	1	0	0	1	0-010
March	26	104	0	0	0	0	—
April	24	52	0	0	0	0	—
May	27	54	0	0	0	0	—
June	27	14	0	0	0	0	—
July	18	40	1	1	1	3	0-076
August	27	54	0	1	0	1	0-018
September	25	50	0	0	0	0	—
24 Months	571	3,227	2,880	2,616	708	6,304	—

TABLE III

DATE	BLOCK II (Hand-catching)			BLOCK I. CONTROL		
	Fly-boys Caught	Total Flies Caught	Flies Per Boy Day	Fly-boys Caught	Total Flies Caught	Flies Per Boy Day
1933						
16th Oct.	13	162	12-4	13	144	11-0
23th Oct.	7	119	17-0	7	159	22-7
7th Nov.	9	72	8-0	3	101	33-6
15th Nov.	7	34	4-8	3	111	37-0
20th Nov.	10	47	4-7	3	126	42-0
1934						
31st Jan.	19	8	0-4	3	145	48-3
2nd Feb.	16	5	0-3	3	129	43-0

TABLE IV  
BLOCK III AND LOWER PALA  
ELIMINATION OF FLY BY HAND-CATCHING

MONTH	Days Catching	Fly-boy Days	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day
1934							
February.	15	172	408	304	28	740	4-302
March ..	27	335	532	551	72	1,155	3-447
April ..	25	375	374	405	40	819	2-184
May ..	27	512	268	359	42	670	1-308
June ..	26	506	166	258	30	454	0-931
July ..	26	194	67	110	10	187	0-963
August ..	27	290	50	46	3	99	0-341
September	25	370	56	54	3	113	0-305
October..	27	432	45	57	5	107	0-247
November	26	312	53	67	9	129	0-413
December	22	264	32	43	4	79	0-299
1935							
January .	27	324	48	47	2	97	0-299
February.	24	168	9	10	0	19	0-113
March ..	26	269	9	15	0	24	0-089
April ..	24	281	13	19	6	38	0-135
May ..	27	264	20	47	10	77	0-291
June ..	25	430	43	112	19	174	0-404
July ..	27	406	56	65	4	125	0-307
August ..	27	264	15	19	0	34	0-128
September	25	168	2	5	0	7	0-044
	505	6,329	2,267	2,593	287	5,147	—

## (2) Block III, Nthiwa and Lower Pala.

**Description.**—Block III is situated between Wadhasaa and Wadhadeng Clearing on the Nthiwa River, and is connected to the bush on the Pala at the confluence of these two rivers. The northern limit of the Lower Pala is the native path which passes through Wadhadeng Clearing, and crosses the Pala River at a point opposite this clearing. The total length of bush is approximately  $1\frac{1}{2}$  miles. On the northern end it is connected directly with the bush on the Upper Pala and Mirogi Rivers. The block contains 3,066 yards of river bed.

**Original Density.**—Hopkins (4) recorded a density of 11 p.b.h. in this area in 1929.

In January, 1934, during a marking experiment, 1,000 flies were caught and marked by three boys in 17 days of six hours each.

Fly elimination began on the 1st February, 1934. On that day the catch averaged 7.5 flies per boy-day. Density was very low.

**Elimination of Fly.**—Fly boys were again used for hand-catching, with a short period of pupæ collection. Density was too low for successful trapping.

From early July, 1934, hand-catching was carried out in the Upper Pala and Mirogi area (page 21), which was not separated from this one. The smaller numbers recorded from this month onwards in Table IV are the result of this.

**Influence of Floods on Activity of *G. palpalis*.**—The apparent increase in flies after February, 1935, was probably due to a movement across the Wadhasaa Clearing during a flood period. There were two well-marked periods of river flooding—late October and early November, 1934, and May to July, 1935. Marked flies were released at the southern edge of Wadhasaa Clearing during both periods. Recaptures on the other side are shown in Table V compared with similar recaptures during normal periods.

TABLE V  
FLIES CROSSING WADHASAA CLEARING

PERIOD	Flies marked in Oct/Nov in bush	Marked flies recaptured in bush on Upper Pala and Lower Pala	Total flies caught in Block III and Lower Pala	% of caught flies marked	% of marked flies recaptured
Light Rains and Low Water—1st to 22nd Oct., 1934	576	1	57	1.7	0.2
During Flood Period—23rd Oct. to 8th Nov., 1934	1,000	26	84	30.9	2.6
Light Rains and Low Water—12th March to 27th May, 1935	587	3	108	2.7	0.5
During Flood Period—28th May to 8th July, 1935	1,785	27	160	18	1.5

**NOTE.**—At the time of October and November experiment, Wadhasaa Clearing was 850 yards wide and in the March to July experiment the clearing was 1,050 yards wide along the river.

**Collection of Pupæ.**—Pupæ searching, in addition to hand-catching of adults, was carried out in the months of February, March and April, 1934.

The pupæ searchers worked independently of the fly boys. They were paid at the rate of Sh. 5 per month. They selected what appeared to be likely breeding sites, and worked together in a group under the charge of an African laboratory assistant. Results were as follows:—

MONTH	Pupa-boy Days	PUPÆ	
		Empty	Full
1934—			
February	64	179	11
March	283	1,324	40
April	179	525	13
TOTAL	526	2,038	64

**Cost of Pupæ Collection.**—The total wages paid to pupæ searchers for the above period was Sh. 116. Each living pupa therefore cost Sh. 1/65.

During the same period (February, March, April), the cost of hand-catching was approximately 14 cents a fly.

**Breeding Sites of *G. palpalis*.**—Riverine bush in this area is relatively narrow, its extreme width being not more than 400 yards. Pupae and pupa cases were found scattered throughout the bush, the majority being found nearer the outskirts of the bush belt, in rotting leaf humus, and under light bush which produced a mosaic of sunlight and shade.

### (3) Upper Pala and Mirogi Rivers.

**Description of Block.**—The bush in this area is continuous with that of the Lower Pala, the lower limit of the block being marked by a native path. As already mentioned, the work here was recorded separately from that on the Lower Pala because of the unwieldy length of the whole of the Pala and Mirogi Rivers, and also because there appeared to be a distinct concentration of fly, as though a distinct colony, near the junction of the Pala and Mirogi Rivers.

The total length of river in this block is approximately five miles, and of riverine bush three and a half miles.

**Original Density.**—In 1929, Hopkins<sup>(4)</sup> recorded an average density of 15 m.p.b.h.

At the end of June, 1934, density was 13 per fly-boy-day. This was again recorded in July on the first day of elimination operations. It seems probable that density in this block had been reduced by earlier catching carried out in Block III (page 17).

**Elimination of Fly.**—Elimination in this area commenced on the 2nd July, 1934. Hand-catching was the method adopted, with a short period of pupae catching.

Table VI shows progress made from July, 1934, to September, 1935.

An interesting point is that no marked flies from the Odielo control bush were caught in this area. Moreover, the floods appear not to have influenced fly densities in these upper reaches. This suggests that fly movement on these rivers was rather more restricted than one might expect.

It was suspected that a slight interchange of flies went on between this block and Block I on the Nthiwa (*see map*). In May, 1934, about 700 flies were marked in Block I; of these five were captured on the Upper Pala between July and September, 1934. In August, 998 flies were marked in Block I, of which one was captured on the Upper Pala in December.

**Collection of Pupae.**—Pupae searching was carried out in September and October, 1934, with the following results:—

MONTH	Pupa-boy Days	PUPAE FOUND	
		Empty	Full
1934—			
September . . . . .	143	774	12
October . . . . .	208	653	5
TOTAL . . . . .	351	1,427	17

Most pupae were found near the outskirts of the bush, in loose, friable soil under a layer of rotting leaf humus, with light overhead shade.

Pupae collecting again proved to be very much more costly than hand-catching adults.

TABLE VI  
UPPER PALA AND MIROGI  
ELIMINATION BY HAND-CATCHING

MONTH	Days Catching	Fly-boy Days	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day
1934							
July . . . . .	26	314	375	371	69	815	2.598
August . . . . .	27	346	197	248	28	473	1.367
September . . . . .	25	250	151	125	12	288	1.156
October . . . . .	27	338	84	62	8	154	0.455
November . . . . .	26	260	52	55	8	115	0.442
December . . . . .	22	220	33	36	1	70	0.318
1935							
January . . . . .	27	270	28	29	2	80	0.218
February . . . . .	24	240	10	9	0	19	0.079
March . . . . .	26	292	12	15	1	28	0.095
April . . . . .	24	210	12	10	0	22	0.104
May . . . . .	26	186	8	5	3	16	0.085
June . . . . .	25	244	9	9	1	19	0.077
July . . . . .	27	312	9	13	0	22	0.070
August . . . . .	27	242	5	2	1	8	0.037
September . . . . .	25	174	4	3	0	7	0.040
TOTAL . . . . .	384	3,898	989	992	134	2,116	—

## (4) Block I, Nthita River.

**Description of Block.**—This block of  $1\frac{1}{2}$  miles of riverine bush is situated between Olassi Clearing on the south and the Kisi-Karungu road on the north. The bush at the southern end is fairly open; in the centre it is dense; at the northern end it thins out to clumps of thickets with a few trees of the acacia species, and finally to open banks with reeds and herbaceous growth.

The length of river in the block is 3,868 yards, or approximately two and one-fifth miles.

**Original Density.**—In 1933, Mr. J. O. Harper (4) recorded an average of 7 male flies per boy-hour over eleven catching sites.

In October, 1933, when the present operations were commenced, the density was 11 per boy-day. We cannot account for the apparent reduction in density.

*Elimination of Fly.*

From October, 1933, to February, 1934, this block acted as a control for Block II.

**Trapping.**—At the end of February, 1934, trapping sites were selected and cleared. During March, seventeen traps were installed, and in May another thirteen were in action. These were allowed to function until November, with results shown in Table VII.

TABLE VII  
NUMBER OF FLIES CAUGHT IN TRAPS

MONTH	Number of Traps	Male Flies	Female Flies	Total
1934—				
March	17	45	45	90
April	17	19	35	52
May	17/40	75	125	200
June	40	123	180	303
July	40	123	141	264
August	40	104	143	247
September	40	76	133	209
October	40	46	61	97
November	40	16	43	59
NINE MONTHS	—	627	894	1,521

This total is about 40 per cent of the number of flies taken on this block by all methods (see Table VIII).

All traps used were the 4 ft. single screen Buttock type designed by Mr. C. F. M. Swynnerton.

**Hand-catching.**—On the 1st November, 1934, hand-catching was commenced. For a comparison of the two methods the traps were left in position for one month while hand-catching was in progress.

The results of the two methods are briefly as follows:—

40 traps caught 59 flies in 28 days.

10 fly boys caught 1,324 flies in 26 days.

The total number of flies caught in this area up to September, 1935, was 4,059 (1,521 by trapping, 2,538 by hand-catching).

Hand-catching results in a quick reduction of density. This is desirable.

**Collection of Pupae.**—The following table shows the number of pupae collected in Block I.

MONTH	Pupa-boy Days	PUPAE FOUND	
		Empty	Full
November, 1934	148	248	11
December, 1934	190	489	10
TOTAL	338	737	21

(5) Control Fly Rounds for Blocks I, II and III  
and the Pala and Mirogi Rivers.

Control fly rounds for the purpose of watching normal fly fluctuations were commenced in the Odielo bush below Wadhasaa Clearing when that clearing was completed in April, 1934. (See Chart II.)

Paths were cut for this purpose from Wadhasaa Clearing through the Odielo bush and along the Kuja to Wadhakech Clearing (see map). Observations were made on fly activity in the northernmost Odielo bush, and also in the denser Kuja River bush, the records of these two areas being kept separate.

Catches are shown in Tables IXA and IXB.

TABLE VIII  
BLOCK I.—NTHIWA RIVER  
ELIMINATION BY HAND-CATCHING

MONTH	Days Catching	Fly-boy Days	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day
1934							
November	26	254	609	588	127	1,324	5-212
December	22	220	321	264	31	616	2-800
1935							
January	27	270	192	174	28	392	1-451
February	24	240	48	37	1	86	0-355
March	26	180	29	14	1	44	0-244
April	24	166	11	16	4	31	0-186
May	26	127	9	8	0	17	0-133
June	25	50	3	3	0	6	0-120
July	27	54	7	3	0	10	0-185
August	27	54	4	5	0	9	0-166
September	25	50	2	1	0	3	0-060
TOTAL	279	1,665	1,235	1,113	190	2,538	—

TOTAL NUMBER OF FLIES TAKEN OUT OF BLOCK I

	Male Flies	Female Flies	Pregnant Female Flies	Total
By Hand-catching	1,235	1,113	190	2,538
By Previous Control Fly Rounds	515	298	—	813
By Trapping	627	894	102	1,521
By Pupae	—	—	—	21
TOTAL	2,377	2,305	292	4,974

There appear to have been two peaks in a year—a main peak during the period May to July and a secondary one in November–December. These peaks were to a considerable degree due to an increase in female activity. It is interesting to note, too, that the percentage of pregnant females was higher during these peak periods. And there appears to be a correlation between activity and rainfall or resulting humidity, since the peaks followed the periods of heaviest and most frequent rainfall. (See Chart I.)

The Odielo curve follows that of the Wadhakech (Kuja) area by about a month (Chart I). It may be that the conditions responsible for fluctuations in activity or density are earlier on the Kuja, with its denser bush and higher humidities. We have previously drawn attention to the apparent increase of activity on the Nthiwa–Pala Rivers, during flood periods.

TABLE IXA  
ODIELO BUSH—CONTROL ROUND

MONTH	Days Catching	Fly-boy Days	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day	Percentage Females
1934								
April	4	8	157	46	15	228	28-500	27
May	2	4	130	79	29	238	59-500	41
June	4	8	485	204	82	771	96-375	37
July	4	8	783	243	57	1,083	135-375	28
August	2	4	240	59	18	317	79-250	24
September	3	6	127	77	24	228	38-000	44
October	—	—	—	—	—	—	—	—
November	1	2	53	21	5	79	39-500	33
December	4	8	253	164	48	465	58-125	45
1935								
January	4	8	368	205	24	597	74-625	38
February	4	8	177	81	17	275	34-375	35
March	1	2	65	24	2	91	45-500	28
April	1	2	41	28	14	83	41-500	50
May	1	2	39	61	27	127	63-500	70
June	—	—	—	—	—	—	—	—
July	2	4	239	127	20	386	96-500	38
August	4	8	303	144	35	482	60-250	37
September	4	8	271	125	24	420	52-500	35
TOTAL	—	90	3,741	1,688	441	5,879	65-0	36

TABLE IX  
WADHAKHECH (KUJA) CONTROL ROUND

Month	Days Catching	Fly-boy Days	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day	Percentage Females
1934								
April ..	4	8	414	172	34	620	77	33
May ..	4	8	975	518	154	1,647	205	41
June ..	4	8	1,109	338	92	1,539	192	28
July ..	4	8	1,120	373	108	1,601	200	30
August ..	4	8	846	366	54	1,266	158	33
September	4	8	850	230	31	1,111	138	23
October ..	4	8	841	193	35	1,069	133	21
November	4	8	993	260	49	1,302	162	24
December	4	8	938	331	97	1,366	170	31
1935								
January ..	4	8	596	174	15	785	98	24
February ..	4	8	677	187	39	903	112	25
March ..	4	8	709	154	43	906	113	22
April ..	4	8	847	206	30	1,083	135	22
May ..	4	8	717	351	77	1,145	143	37
June ..	4	8	1,004	675	136	1,815	226	45
July ..	4	10	1,333	555	107	1,995	199	33
August ..	4	8	1,069	295	67	1,431	178	25
September	4	8	752	183	41	976	122	23
TOTAL ..	—	146	15,790	5,561	1,209	22,560	154	30

(6) Block VI, Kujā River.

*Description.*—Block VI is situated at the eastern edge of Utangi Plain on the Kujā River, between Wadhagūlu and Wadharia Clearing.

It is approximately three-quarters of a mile long, and contains 2,443 yards of river bed. The greatest depth of bush through the middle is 800–900 yards.

On the west bank the bush forms a narrow fringe averaging not more than 200 yards deep. In some places, such as watering places, it is not more than 50 yards deep. The heaviest bush is on the east bank.

The vegetation consists of the usual dense thorn with occasional big acacia and fig trees.

*Original Density.*—In the 1929 survey<sup>(4)</sup> the average of four different sites was 25 males per boy-hour.

Before traps were placed in November, 1934, two fly rounds were made, with the following results:—

DATE	Number of Fly-boy	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day—6 Hours
2nd November	2	290	91	14	395	—
9th November	2	203	81	13	277	—
<b>TWO DAYS</b>	<b>4</b>	<b>493</b>	<b>152</b>	<b>27</b>	<b>672</b>	<b>168</b>

*Elimination of Fly.*

The methods tried were:—

- (i) November, 1934, to April, 1935, trapping with 65 S.S.B. traps.
- (ii) May, 1935, one month traps in conjunction with hand-catching.
- (iii) June to September, 1935, hand-catching with nets only.
- (iv) March, 1935, intensive pupæ search in one small area.

*Trapping.*—In November, 1935, after Wadhugulu and Wadharia Clearings had been made, but not burned, paths were cut on both banks of the river and sites for traps were selected. Thirty traps were put up on the east side and thirty-five on the west.

Map III shows the position of each trap.

Table X shows the total monthly catch on each bank.

TABLE X

MONTH	East Bank 30 Traps	West Bank 35 Traps	Total	Percentage of Catch From West Bank
November .. ..	359	2,619	3,014	Per cent
December .. ..	925	3,058	3,983	86
January .. ..	344	1,719	2,063	83
February .. ..	292	1,092	1,384	79
March .. ..	225	817	1,042	78
April .. ..	190	838	1,028	81
May .. ..	114	444	558	80
<b>TOTAL ..</b>	<b>2,485</b>	<b>10,587</b>	<b>13,072</b>	<b>81</b>

\*Five days catching on west bank before work commenced on the east bank.

Traps were cleared twice weekly. Details of each clearance are given in Appendix I, and of the monthly catch for each trap in Appendix II.

TABLE XI  
FLY ROUND AND MARKING EXPERIMENT, BLOCK VI

DATE	Fly-boys	EAST BANK				WEST BANK			
		Male Flies	Female Flies	Pregnant Female Flies	Total	Male Flies	Female Flies	Pregnant Female Flies	Total
8th March	2	—	—	—	—	84	25	10	119
15th "	2	48	13	3	64	57	37	7	101
26th "	2	47	13	4	64	66	24	8	98
2nd April	2	79	27	5	111	61	21	7	89
9th "	2	34	15	4	53	65	27	9	101
16th "	2	48	21	4	73	21	8	2	31
24th "	4	99	37	13	149	84	57	15	156
TOTAL ..	16	355	126	33	514	438	199	58	695

Total flies caught and marked, 793 males, 416 females=1,209 flies.  
Density over the period was 75 (marked) flies per boy-day.

It is interesting to note that more females than males were captured by the traps.

The much bigger catches on the west bank are striking, for the river is nowhere more than about 60 feet wide in this block. In an attempt to explain this we carried out weekly fly rounds on both banks between 8th March and 24th April. All flies caught during these rounds were marked and released by two boys. The boys started down the west bank and returned along the east bank on every occasion, except on 2nd and 16th April, when the order was reversed. The last round on the 24th April was carried out by two boys on each bank simultaneously. Catches are shown in Table XI.

On both banks more flies appear to have been caught and marked during the early hours of each day than later. The last round suggests that the fly population on the east bank was approximately the same as that on the west bank.

*Trapping of Marked Flies.*—Of the 1,209 marked flies released (Table XI) on both banks, 17 males and 2 females were trapped on the east bank and 96 males and 36 females on the west bank—12 per cent of the total number released. Though only 35 per cent more flies were released on the west than on the east bank, the recaptures in traps on the west side were about four times greater than on the east.

When hand-catching was started in May, 1935, the captures by an equally distributed number of boys on the east and west banks were 3,767 and 3,651 flies respectively. It seemed therefore that though densities were about equal, the traps on the west were very much more effective than those on the east bank.

All the traps were identically the same in structure and size. They were all slung on wires as near as possible to the river's edge, but the distance naturally varied somewhat with the nature of the banks. The immediate surroundings of traps, too, varied with the density of the vegetation, but bush types appeared to be general.

One factor, however, seems to have influenced results; that is, the siting of traps in relation to the curves of the river. It will be seen from Map III that nearly all of the most effective traps on both banks were sited on promontories. Traps 103 and 104, 97 and 98, 88 and 89, 74, 77, on the west bank, and trap 69 on the east bank, are so situated. This may account, not only for the higher catches in these particular traps, but also for the much better results on the west bank, since fewer sites of this kind were used on the east bank.

The effective traps on both banks therefore appear to have been so, to some extent, because they were able to attract flies away from the traps opposite to them. This is particularly noticeable in the behaviour of the two best traps on the east bank; number 69 deprived traps 75 and 76 of their flies, and 49 influenced the numbers captured by traps 101 and 102.

If this is a legitimate explanation, then the sight of *G. palpalis* is a factor well worth catering for in simple trapping.

Traps were probably a great deal too numerous in this block.

With regard to individual traps, there was one outstanding result. The trap on site No. 103 on the west bank accounted for 21 per cent of the flies caught on this bank. (See Appendix II.)

*Baiting of Traps.*—A few tests were made with a scent bait consisting of ether extract of elephant penis. This was not the best of baits for *palpalis*, but there was insufficient of any other kind available. The material was smeared along the

tops of the screens of the traps. One of these was placed in position in each of the trapping sites 102, 104 and 105, about three yards from the unbaited traps already on those sites. Every three days an exchange of positions was made of the baited and unbaited traps on each site. The trap at 103 was used as a control.

Table XII shows the captures for each three-day period.

Results were not very encouraging. The position of the traps in each site appears to have been a greater influence than the bait. If such small catches can indicate anything it is that most flies approaching the trapping sites came from one direction. A more satisfactory result is the definite increase in captures at site 104 and the decrease at 103. (See Table XII and Chart III.)

Other small tests in baiting, on similar lines, were carried out. Results indicate that this particular bait under the conditions existing may or may not increase the numbers of flies trapped. Probably the placing of a baited trap only a few yards away from an unbaited one was bad technique. It may be, too, that two traps, whether baited or not, constituted a greater attraction than a single trap, so that catches in sites with two traps may not properly be compared with those of only one trap.

TABLE XII  
SCENT BAIT\*

POSITIONS OF BAITED AND CONTROL TRAPS ON EACH SITE REVERSED  
AT EACH THREE-DAY PERIOD

DATE	Traps	SITE 102		SITE 104		SITE 105		103 (CONTROL)	
		Male	Female	Male	Female	Male	Female	Male	Female
8th-11th Nov.	Bait	1	0	11	9	0	2	—	—
	Control	1	3	17	15	4	6	20	37
11th-14th Feb.	Bait	2	1	29	12	0	0	—	—
	Control	1	0	10	6	0	2	3	6
15th-18th Feb.	Bait	2	0	14	20	3	0	—	—
	Control	2	1	5	7	0	0	2	10
19th-21st Feb.	Bait	2	0	8	9	0	1	—	—
	Control	0	0	1	0	1	1	2	0

Search for Pupæ.

*G. palpalis*.—The failure in other blocks to find what appeared to be a reasonable number of pupæ was repeated at the beginning of operations in this area. Five or six boys specially employed for this work had been unable to discover breeding grounds consistent with the density of adults.

There was nothing surprising in this, since in all previous *palpalis* surveys of river areas in Kenya we have only once (Aloach River, Kochia, 1926) found a considerable concentration of pupæ. The present work afforded an opportunity to discover reasons for this apparent unorthodox behaviour of a much-studied fly.

An area of approximately 12,000 square yards, based on about 293 yards of river bank, was marked off in typical bush on the west bank of the Kujæ River (see map). The area contained three obvious types of vegetation and shade:—

- (i) About 2,200 square yards of very dense bush and consequent deep shade on a damp, tacky soil.
- (ii) An old river bed with very high, but scanty low shade, which is obviously flooded for periods during the wet season and is therefore apparently suitable for breeding only along its edges. This had an area of some 1,000 square yards.
- (iii) The remaining bush, on a friable loam soil, covered with the usual vegetable debris and providing a mosaic of shade and sunlight.

There were 41 recumbent logs and trees in the whole area.

Seventy specially engaged boys were employed to search every inch of this area. The search was completed in 23 days, each boy covering about  $7\frac{1}{2}$  yards in a day of six hours. The positions of pupæ or pupa cases were marked by labelled sticks.

Results are interesting. In areas (i) and (ii) no pupæ or cases were found except on the edges of the old river bed. In area (iii) 3,584 pupa cases and 84 living pupæ were found. The latter were scattered throughout the area in 57 sites. The greatest concentration yielded 8 pupæ; most sites provided one or two each. Only 15 of the recumbent logs had pupæ within a foot of them, and only one sheltered a living pupa.

The many old cases were similarly widely scattered, the biggest concentration producing 24.

A map (Map ID) has been produced to show this area and the distribution of pupae and cases in relation to shade. This latter factor was measured very approximately by estimating the percentage of the various areas in shade on sunny days during the search. Thus 60 per cent shade means that more than half of an area under consideration was shaded. Depths of shade could not be indicated.

It is seen that the majority of breeding goes on in the middle gradations of shade; extremes of light and of shade are avoided.

Relative dryness and safety from floods seem to be sought after, for sites were most numerous on slightly raised ground. Often they occurred on small mounds.

Of the 83 living pupae, 56 were found within 15 yards of the fly path running along the river bank. The search was carried out in February, a dry period, and it may be that at such a time greater proximity to the river and its humidity is desired. Perhaps, too, the fly path itself had facilitated breeding near the river by opening up the bush that had previously hindered the flight of pregnant females. That the river is not always so attractive is seen on the map. Living pupae were found 45 yards from its bank.

*G. brevipalpis*.—Twenty-six pupae and 8,346 cases of *G. brevipalpis* were also collected during this search. They were distributed much in the same way as those of *G. palpalis*, but generally speaking they were under deeper shade.

If the number of living pupae of *G. brevipalpis* bears the same relation to living adults as do those of *G. palpalis* then the population of the former in this block must be considerably more than 12,000. Yet, such are habits of *G. brevipalpis*, that during the eleven months' operations only 46 adults have been captured by boys and traps.

*Costs of Pupae Collection*.—This intensive search necessitated an expenditure of Sh. 207 in wages for extra boys.

*Traps compared with Hand-catching*.—Hand-catching started in this block in May, 1935. For a month the 65 traps were allowed to function. The trap and boy catches were as follows:—

Sixty-five traps in 27 days (i.e. 1,755 trap-days) caught 174 males and 372 females.

Eleven boys (average) in 27 days (292 fly-boy-days) caught 3,246 males and 4,172 females.

A comparison of the efficacy and costs of the two methods is much too early. Traps are still in the very early stages of their evolution. But there is no doubt as to the method of choice at the moment. Hand-catching is about seventy-five times as quick as trapping at this density, and rapid elimination is obviously desirable.

*Hand-catching*.—Table XIII gives the monthly number of flies caught by fly-boys. During the period May to September, 1935, nearly 22,000 flies were captured, and the density had been reduced from 25 to 12 per fly-boy-day.

Control fly rounds were carried out in the bush below and above this block. Catches are given in Tables XIV A and B.

A comparison of the figures in Table XIII with those of Tables XIV leaves no doubt as to the reduction of flies in Block VI. This is shown in Chart IV.

TABLE XIII  
BLOCK VI.—KUJA RIVER  
ELIMINATION BY HAND-CATCHING

MONTH	Days Catching	Fly-boy Days	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day	Percentage Females
1935								
May	27	292	3,246	3,529	643	7,418	25.4	56
June	19	94	1,366	2,061	484	3,911	41.5	65
July	26	88	2,199	1,861	331	4,391	49.5	50
August	27	216	1,782	1,494	161	3,437	15.9	48
September	25	200	1,246	1,077	154	2,477	12.4	49
TOTAL	124	890	9,839	10,022	1,773	21,634	—	—

Density in November, 1934—168

TABLE XIVa  
WADHAGULU CONTROL FLY ROUND

MONTH	Days Catching	Fly-boy Days	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day	Percentage	Percentage
								Female	Pregnant
1934									
November	2	4	475	160	27	662	165	28	17
December	2	4	474	164	43	681	170	30	26
1935									
January	1	2	119	91	3	213	106	44	3
February	1	2	155	58	25	238	119	35	43
March	—	—	—	—	—	—	—	—	—
April	—	—	—	—	—	—	—	—	—
May	2	4	348	171	59	578	144	40	34
June	3	6	430	307	70	797	133	47	23
July	2	4	297	154	23	474	118	37	15
August	5	10	1,045	560	129	1,734	173	39	23
September	1	2	181	41	14	236	118	23	34
TOTAL	—	38	3,514	1,706	393	5,613	148	37	23

TABLE XIVb  
WADHARIA CONTROL FLY ROUND

MONTH	Days Catching	Fly-boy Days	Male Flies	Female Flies	Pregnant Female Flies	Total	Average Catch Per Fly-boy Day	Percentage	Percentage
								Female	Pregnant
1935									
February	2	4	308	134	35	497	124	38	29
March	2	4	301	185	66	552	138	43	35
April	—	—	—	—	—	—	—	—	—
May	2	4	181	123	42	346	86	47	34
June	3	6	293	118	59	470	78	37	50
July	4	8	580	241	65	886	110	34	27
August	5	10	1,213	370	59	1,642	164	26	16
September	4	8	603	293	88	984	123	38	30
TOTAL	—	44	3,479	1,464	434	5,377	122	35	29

Chapter V—EFFICACY OF BARRIER CLEARINGS  
Observations on Marked Flies.

It is useful perhaps to collect the various observations on marked flies and present them in one chapter.

(a) Experiment I.—Block I, Nthiwa River, November, 1933.

Object.—To test the efficacy of Olassi Clearing, 700 yards along the river.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
15th Nov. to 3rd Nov., 1933	515	431	946	Block II	7	9	16	1.3	2.0	26-1-34
				Control Fly Round in Block I	10	10	*20	1.9	2.3	2-2-34
	515	431	946		17	19	36			

Conclusions.—Flies were crossing the clearing in small numbers. The twenty marked with an asterisk occurred in a group of 274 during two fly rounds in Block I on the 31st January and the 2nd February.

(b) Experiment II.—Block I, Nthiwa River, May, 1934.

Object.—In April, 1934, the fly density in Block II had been 0.18 flies per boy-day. But in the following month the density figure increased to 0.435. We desired to ascertain a reason for the increase. Flies were again marked in Block I.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
11th to 26th May, 1934	330	471	701	Block II	4	8	12	1.2	1.7	1-8-34
				Pais River	2	3	5	0.6	0.6	13-8-34
				Block III	—	1	1	—	—	30-5-34
				Block I During Hand-catching	—	1	*1	—	—	17-12-34
	330	471	701		6	13	19	1.8	2.3	

*Conclusions.*—(i) Flies were still getting across Olassi Clearing from Block I. Since only 83 flies were caught between 11th May and 1st August in Block II, the influence of this invasion was considerable—14 per cent of the total catch.

(ii) Flies were also crossing the mile of scrub-covered higher land between the Nthiwa and the Pala Rivers.

(iii) The minimum age of the one female marked with an asterisk was 206 days.

(c) *Experiment III.*—Block I, Nthiwa River, September, 1934.

*Object.*—To indicate what percentage of the active fly population was being captured in the 40 traps installed in this block.

DATE OF MARKING	Total Flies Marked	Number Recaptured		Date of Last Recapture
		(a) By Traps	(b) By Hand	
23rd August to 27th September, 1934	998	(a) From 23rd August to 28th November .. 108		23-1-35
		(b) From 28th November 148		
		(b) On Pala River .. 1		
TOTAL	998	259		

*Conclusion.*—The total catch of flies in 40 traps, during the period 23rd August to 28th November, was 407. Marked flies (108) therefore constituted 24 per cent of the captures.

We deduced from this, perhaps quite wrongly, that 24 per cent of the total fly population had been marked (i.e. 998 flies), and that the probable population at the time was about 4,000. (The actual number caught after this date was 2,945.)

(d) *Experiment IV.*—Pala River, January, 1934.

*Object.*—To ascertain the extent of the fly invasion of Block II from the Pala River.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
3rd to 23rd Jan., 1934	500	502	1,002	Block II	14	6	20	2.8	1.2	8-3-34
				Pala River During Hand-catching	70	58	128	14.0	11.5	
	500	502	1,002		84	64	148	16.8	12.7	

*Conclusion.*—Small numbers of flies were crossing to Block II, which is quite near the Pala at its southern end.

It was therefore decided to attack the fly along the Pala and Mirogi Rivers.

(e) *Experiment V.*—Odielo (Control) Bush, May, 1934.

*Object.*—To test the barrier effect of an 850-yard clearing at Wadhasaa.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured
	Male	Female	Total		Male	Female	Total	
3rd to 29th May, 1934	—	—	1,600	Lower Pala	6	9	15	0.9
				Block III	5	9	14	0.9
			1,600		11	18	29	1.8

*Conclusion.*—Flies managed to cross this clearing. (The last marked fly seen in Odielo was captured on 7th August, 1934.)

(f) *Experiment VI.*

This was a repetition of No. V, with the same object, carried out in August, 1934, after the rains.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
7th to 29th August, 1934	495	560	1,055	Lower Pala	2	7	9	0.4	1.2	
				Block III	6	4	10	1.2	0.7	
					8	11	19	1.6	1.9	26-10-34

*Conclusion.*—As for Experiment V.

(g) *Experiment VII.—Odielo (Control) Bush, October, 1934.*

The figures for this test are included in Table V (page 19).

*Object.*—To note the effect, if any, on "crossing" flies of a second burning of debris.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
1st Oct. to 3rd Nov., 1934	478	522	1,000	Lower Pala ..	5	17	22	1.0	3.2	28-12-34
					Block III	4	9	13	0.9	
	478	522	1,000		9	26	35	1.9	4.9	

*Conclusion.*—Flies were still crossing the 850-yard clearing, and many more crossed during flood than during low water periods. But the analysis in Table V shows that during the non-flooding period only some 0.2 per cent of marked flies were recaptured across the clearing—a reduction of about 1.6 on the two previous results (Experiments V and VI). This reduction was presumably due to the second cleaning up.

(The last marked fly was caught on 5th February, 1935, at least 99 days after marking.)

(h) *Experiment VIII.—Odielo (Control) Bush, March-April, 1935.*

*Object.*—To test the efficacy of the recent widening of Wadhasaa Clearing to 1,050 yards.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
12th March to 2nd April, 1935	390	271	661	Lower Pala ..	1	—	1	—	—	21-3-35
					Block III	1	1	2	—	
	390	271	661		2	1	3	0.5	0.4	

*Conclusion.*—The number of flies crossing appears to have been reduced.

(i) *Experiment IX.—Odielo (Control) Bush, May-July, 1935.*

*Object.*—As for VIII, and to attempt to explain the increased activity in Block III and Lower Pala.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
21 Days between 28th May and 18th July, 1935	718	1,067	1,785	Lower Pala ..	13	16	29	1.8	1.5	
				Block III	1	4	5	0.1	0.4	
	718	1,067	1,785		14	20	34	1.9	1.9	

*Conclusion.*—Some of the data shown are included in Table V. Flies still crossed the 1,050 yards. The increase on the numbers shown in Experiment VIII is considered to be due to the increased activity during flood periods. This probably accounted for the higher catches in Block III and Lower Pala.

(j) *Experiment X.—Wadhagulu, February, 1935.*

*Object.*—To test the efficacy of Wadhagulu Clearing, 1,000 yards, on the north of Block VI during the dry season.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
2nd Feb. 1935 to	1,804	891	2,695	Block VI (Traps)	2	1	3	0.1	0.1	
				Block VI (Hand-catching)	2	29	31	0.1	3.2	21-8-35
	1,804	891	2,695		4	30	34	0.2	3.3	

*Conclusions.*—Flies were crossing 1,000 yards of clearing. The higher percentage of females captured is interesting.

## (k) Experiment XI.—Wadhagulu, May-July, 1935.

Object.—To test the efficacy of a 1,000-yard clearing on the north of Block VI during the rainy season.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
6 Days Between 24th May and 24th July, 1935	877	670	1,547	Block VI, Hand Catching	40	32	72	4.5	4.7	22-8-35
	877	670	1,547		40	32	72	4.5	4.7	

Conclusion.—Nearly four times as many flies crossed during this period as during the dry season (Experiment X).

## (l) Experiment XII.—Wadharia, March and April, 1935.

Object.—To test the efficacy of a 1,000-yard clearing at Wadharia, on the south of Block VI.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
5th March to 30th April, 1935	1,521	1,194	2,715	Block VI Traps	6	7	13	0.4	0.6	25-9-35
				Block VI Hand-catching	21	55	76	1.4	4.6	
	1,521	1,194	2,715		27	62	89	1.7	5.2	

Conclusion.—Flies managed to get across in appreciable numbers.

## (m) Experiment XIII.—Wadharia, May-July, 1935.

Object.—As for XII.

DATE OF MARKING	Number of Flies Marked			Where Recaptured	Number of Flies Recaptured			Percentage of Marked Flies Recaptured		Date of Last Recapture
	Male	Female	Total		Male	Female	Total	Male	Female	
8 Days between 24th May and 19th July, 1935	849	568	1,417	Block VI Hand-catching	13	31	44	1.5	5.5	
	849	568	1,417		13	31	44	1.5	5.5	

Conclusion.—As for XII.

## (n) General Conclusions.

These tests indicated that *G. palpalis* contrives to cross clearings up to 1,050 yards wide.

How it is done has not been ascertained. It may be that the stream banks, which during some part of the day provide shade, facilitate a flight passage. We have placed traps in the river bed in Wadhasaa Clearing to try to intercept specimens adopting this method, but no flies were caught. It is possible that they may be transported at least part of the distance by animals. On the Kuja River, hippo and crocodile may play this role; but they appear to be too few on the tributaries to be of great importance in this respect.

There appears to be no doubt that during both the brief periods of floods and the longer wet periods, larger numbers of flies crossed the cleared areas than during dry periods. This is consistent with the greater activity displayed everywhere by this species during warm damp weather.

The practical point is that a 1,000-yard clearing is not a completely effective barrier.

Bush from which *palpalis* has been eliminated cannot be left unwatched if separated from infested bush by only one clearing of 1,000 yards. Our Block III and Lower Pala bush is being patrolled to prevent a reoccupation by *tsetse*, until the fly in the Odielo bush on the south of Wadhasaa Clearing has been eliminated. In the meantime, settlement is not allowed to approach nearer to the infested Odielo bush than the northern edge of Wadhasaa Clearing.

## Chapter VI—OTHER POINTS OF INTEREST

### (a) Exposure of Labour to Risk of Infection with Trypanosomiasis.

In the past we had advocated that all bush clearing and similar work in infected areas be carried out in the early morning and late afternoon, to avoid broad contact between fly and workers during the hours of greatest fly activity—9 a.m. to 3 p.m. But in practice this is a very serious hindrance. Nyanza natives are emphatically opposed to labour after 4 p.m.

We therefore decided to adopt the hours of the ordinary working day, and to eliminate risk of serious infection by frequent medical inspection of all members of the staff. Inspections were carried out weekly by a senior dresser who had worked on trypanosomiasis for many years.

During the period October, 1933, to September, 1935, in an average labour gang of 90 men, ten infections were found. Of these, one was discovered after he had worked with us for only two days, two after five days, two after twelve days, and the remainder between thirty and three hundred and sixty days. It is certain that not more than seven, and probably only five, became infected whilst working with us.

All cases were taken from work and treated immediately after diagnosis. They are now reported to be fit and healthy.

No infection has been contracted by any of the fly-boys or pupa collectors.

### (b) Hand-catching with the Aid of Screens.

A screen consists of grey cloth on a framework of wood or iron, about 4 to 5 feet long by 2 to 2½ feet wide. It is carried hanging vertically between two boys walking in file. Both boys carry hand nets with which they catch flies that are attracted to and settle on the screen.

At the suggestion of Mr. C. F. M. Swynnerton, who designed the screen, we ascertained the value of such screens as an aid to hand-catching *G. palpalis*.

Briefly, they were of no value. They suffered much from thorns and branches in the narrower fly paths and less accessible places; they interfered with "snap" catching, and resulted in much smaller captures than could be obtained without them.

### (c) Breeding Season of *G. palpalis*.

There is evidence in our catches that pregnant females are more numerous during the period March to June or July. There is certainly a greater female activity at this period. Does this not suggest the period during which the production of larvæ is accelerated, even though breeding probably does not cease at any time?

### (d) *G. brevipalpis*.

This species is present throughout our *G. palpalis* areas. Its density is obviously much higher than we had previously assumed (see page 32).

It is essentially crepuscular and nocturnal in habits, and therefore our methods against *G. palpalis* can be of little use in reducing its numbers. Presumably it will not affect the incidence of human trypanosomiasis, since it is unlikely that contact with humans can be appreciable unless they illuminate their houses and open their doors at night. But, if close re-settlement goes on and cattle are kept in bomas near the *brevipalpis*-infested bush, the incidence of cattle trypanosomiasis might possibly increase.

At least we may soon get an opportunity to study the rôle of *G. brevipalpis* in the absence of any other tsetse.

### (e) Settlement.

The elimination of *G. palpalis* from the Nthiwa and Palamirogi streams has released about 8 to 9 square miles of previously unoccupied country for re-settlement.

In June, 1935, ninety-three families, consisting of about 400 people—men, women and children—applied for permission to settle in this area.

No restrictions will be imposed so long as the southern limit of settlement, a line running north-east and south-west through the upper edge of the Wadhasaa Clearing, is respected. This is being closely watched.

### Chapter VII—COSTS

#### (a) Details of Expenditure on Main Items of the Scheme.

Table XV gives labour allocation and costs for the main headings. The costs are based upon the average cost per labourer per day—shown at the bottom of the table. They are all a little higher than actual payments, as the result of estimating to the first decimal point. Actual payments for the several main items were as follows:—

(1) *Wages of labour*, Sh. 12,147.—The difference between this and the figure in Table XV is due to the fact that, though contracting for thirty days, men often disappear after working for a few days and fail to return to complete their contract and draw their wages.

(2) *Headmen (supervision)*, Sh. 1,414/80.

(3) *Tools*, Sh. 1,213/93.—Of these, tools to the value of Sh. 376/93 were handed over to the Lambwe Valley scheme, reducing our costs to Sh. 837/67.

(4) *Food*.—Free food was supplied only during the period January to September, 1933, when labour was being attracted to the mines. The average of 2.1 cents per man per day is merely used for the purpose of allocation for the whole period. (Actual costs for the period of issue were in the neighbourhood of 8 cents per man-day.)

(5) *Camp construction and maintenance*, Sh. 1,827/50, made up as follows:—

	Sh. cts.
Labour ... ..	1,428 40
Headmen (supervision) ...	157 00
Tools ... ..	92 85
Food ... ..	149 00

(6) Additional items of wages for the two-year period were:—

	Sh. cts.
Carpenters ... ..	664 32
One clerk ... ..	521 54
One lorry driver ... ..	1,260 00
Three entomological assistants (paid from departmental funds)	3,690 00

TABLE XV  
TOTAL LABOUR ALLOCATIONS AND COSTS

ALLOCATIONS	Men-days		Wages		Headmen Supervision		Tools		Food		Camp Construction Allocated		Totals	
	Sh. cts.		Sh. cts.		Sh. cts.		Sh. cts.		Sh. cts.		Sh. cts.		Sh. cts.	
Olessi Clearing .. ..	1,208		241 60		26 00		15 70		25 36		38 65		347 31	
Wedhassa Clearing .. ..	5,163		1,032 60		113 00		67 11		108 42		165 21		1,486 34	
Wedhassa Clearing .. ..	12,058		2,411 60		265 00		156 75		253 21		385 85		3,472 41	
Wedhatego Clearing .. ..	13,680		2,736 00		300 00		177 84		287 28		437 76		3,938 88	
Wedhatego Clearing .. ..	4,784		956 80		105 00		62 19		100 46		153 08		1,377 53	
Wedhatego Clearing .. ..	9,037		1,807 40		198 00		117 48		189 77		289 18		2,601 83	
Wedhatego Clearing .. ..	6,293		1,258 60		138 00		81 70		132 15		201 37		1,811 92	
Wedhatego Clearing .. ..	3,131		626 20		68 00		4 44		65 75		100 19		900 84	
Fly Round Paths .. ..	265		53 00		5 00		3 38		5 56		8 48		75 48	
Block I Paths .. ..	337		67 40		7 00		4 35		7 07		10 78		96 63	
Block II Paths .. ..	52		10 40		1 00		1 76		2 85		4 35		14 82	
Block VI Paths .. ..	136		27 20		3 00		1 45		2 37		3 61		39 16	
Grass Seeds .. ..	113		22 60		2 00		8 84		14 38		21 76		32 04	
Firebreaks .. ..	680		136 00		14 00		8 08		13 06		19 90		194 88	
Dispensary .. ..	822		124 40		13 00		92 85		149 00		—		178 44	
Traps .. ..	7,143		1,428 60		157 00		841 05		1,357 68		1,841 83		16,568 51	
Camp Construction and Maintenance														
<b>TOTAL</b>		64,702	12,940 40		1,415 00		841 05		1,357 68		1,841 83		16,568 51	
<b>Total Per Labourer Per Day</b> ..			20 cts.		2.2 cts.		1.3 cts.		2.1 cts.		3.2 cts.			

*(b) Detailed Costs of Clearing.*

Table XVI gives the costs of the various classes of work carried out on each clearing.

Felling and piling of heavy riverine bush costs about Sh. 15 an acre. Clearing open parkland with occasional thicket costs about Sh. 3/15 an acre.

Fifty-two men can cut and pile an acre of heavy bush in one day, and eleven men can cut an acre of open parkland with occasional thicket in the same time.

The cost of cleaning up creeper growth ready for burning varies, of course, with the density of the felled bush, the time that has elapsed since felling, and with the season. If wet weather interferes with the drying of felled bush, creeper and other secondary growth will appear. If, as may happen, burning cannot be done for many months, then this secondary growth will become very dense and correspondingly costly to cut before burning. It is obviously desirable to plan operations so that dry weather follows the initial felling, and burning can be completed quickly.

Costs for burning cover the final preparations necessary to obtain a thorough burn. If the bush has been dense, little preparation is necessary; the fires will sweep through it thoroughly in one burn. If it is scanty, its distribution on the ground must be made to produce as clean an initial burn as possible and so avoid much subsequent cleaning up.

The amount of maintenance necessary depends upon the thoroughness of felling and burning. Three clearings, Wadhakech, Wadhagulu and Wadharia, were maintained for the period February to September, 1935, at a cost of Sh. 870, or Sh. 1/40 an acre.

*(c) Paths.*

Paths through infested bush are very necessary for all work connected with *palpalis* elimination. After their initial cutting they can be kept clear by the fly-boys who use them. For this purpose all fly-boys were equipped with *pangas* (cane knives).

Table XVII gives the various paths made and the cost of labour employed to make them.

*(d) Traps.*

One hundred and thirteen ordinary four-foot S.S.B. traps were made, and thirty others fitted with a smaller box trap. In preparation for the work in the Lambwe, some forty more

were made for the Veterinary Department. The carpenters employed for this work spent about a third of their time on sharpening and repairing tools, camp construction, and various small jobs.

Payment for labour in making 183 traps amounted to Sh. 549, and for repairs to traps Sh. 203/76. Materials and labour for the 143 traps used by us cost Sh. 3,170, so that the total costs for one trap, excluding transport of materials, was approximately Sh. 23. All traps are, of course, still in good condition, and are being kept for later work. Seventy-five of them have been despatched for use in the Port Victoria-Sio scheme.

*(e) Measures Directly Connected with the Elimination of G. palpalis.*

In Table XVIII are shown details of fly-boy wages for hand-catching, trapping, pupa collecting, marking of specimens for observations on the efficacy of clearings, and of labour costs for making paths connected with these operations.

*(f) Tools.*

A list of tools purchased is given in Table XIX. Since we were able to hand over to the Lambwe scheme tools valued at Sh. 376/26, our costs were reduced to Sh. 837/67, or 1.3 cents per man-day.

TABLE XVI

DETAILED COSTS OF CLEARING, BASED UPON 28.8 CENTS PER MAN-DAY (TABLE XV)  
(INCLUDING WAGES OF LABOUR, NATIVE SUPERVISION, TOOLS, FOOD AND PROPORTION OF EXPENDITURE ON CAMP)

	Men-days	COST OF				ACREAGE		
		Felling and Piling	Clearing Creeper Growth Before Burning	Burning	Maintenance	Total	Heavy River Bush	Open Parklands Country
		Sh.	Sh.	Sh.	Sh.	Acres	Acres	Acres
CLASSIC CLEARING—								
Maintenance .. .. .	1,208	—	—	—	348	Not estimated	72	88
WADHANG CLEARING—								
Felling and Piling .. .. .	1,784	514	—	—	973	18	—	90
Maintenance .. .. .	3,379	—	—	—	—	—	—	—
WADHASA CLEARING—								
Felling and Piling .. .. .	6,685	1,925	—	—	—	—	—	—
Burning .. .. .	2,342	—	674	—	873	90	127	217
Maintenance .. .. .	3,081	—	—	—	—	—	—	—
WADHATEGO CLEARING—								
Felling and Piling .. .. .	6,456	1,859	—	—	—	—	—	—
Cleaning .. .. .	5,938	1,710	—	—	—	—	—	—
Burning .. .. .	916	—	264	—	107	124	—	124
Maintenance .. .. .	370	—	—	—	—	—	—	—
WADHAKETCH CLEARING—								
Felling and Piling .. .. .	2,645	762	—	—	—	—	—	—
Cleaning .. .. .	1,564	450	—	—	—	—	—	—
Burning .. .. .	200	—	58	—	—	—	—	—
Maintenance .. .. .	375	—	—	—	108	25	32	57

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TABLE XVI—Contd.

DETAILED COSTS OF CLEARING, BASED UPON 28.8 CENTS PER MAN-DAY (TABLE XV)  
(INCLUDING WAGES OF LABOUR, NATIVE SUPERVISION, TOOLS, FOOD AND PROPORTION OF EXPENDITURE ON CAMP)

	Men-days	COST OF				ACREAGE		
		Felling and Piling	Clearing Creeper Growth Before Burning	Burning	Maintenance	Total	Heavy River Bush	Open Parklands Country
		Sh.	Sh.	Sh.	Sh.	Acres	Acres	Acres
WADHAGULU CLEARING—								
Felling and Piling .. .. .	4,944	1,424	—	—	—	—	—	—
Cleaning .. .. .	1,197	344	—	—	—	—	—	—
Burning .. .. .	1,519	—	437	—	397	60	310	370
Maintenance .. .. .	1,377	—	—	—	—	—	—	—
WADHARIA CLEARING—								
Felling and Piling .. .. .	2,928	843	—	—	—	—	—	—
Cleaning .. .. .	1,365	—	392	—	—	—	—	—
Burning .. .. .	734	—	211	—	365	42	148	190
Maintenance .. .. .	1,266	—	—	—	—	—	—	—
TOTAL .. .. .	52,223	7,327	2,896	1,644	3,171	359	617	1,136

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TABLE XVII  
PATHS AND THEIR COSTS

	Length	Cost
	Yards	Sh. cts.
Block I along both banks .. .. .	7,736	149 38
Block II along both banks .. .. .	4,192	81 48
Block III along both banks .. .. .	4,132	81 48
Lower Pala along both banks		108 64
Upper Lala, one bank .. .. .	5,655	58 20
Mirogi River, one bank .. .. .	3,022	93 12
Block VI, both banks .. .. .	4,886	50 44
Odielo Bush, one bank .. .. .	2,640	306 52
Kuja River (Wadhakech to Wadhatego Clearing) both banks .. .. .	15,840	155 20
Kuja River (Wadhakech to Wadhagulu) both banks .. .. .	8,000	56,103
TOTAL .. .. .		1,084 46

Average Cost Sh. 1/94 per 100 yards.

(g) Wages to Fly-boys and Pupa Collectors.

For the whole period of twenty-four months, we employed an average of 30 fly-boys and 10 pupa collectors, whose wages were approximately 35 cents and 20 cents a day respectively. The former worked a total of 18,472 days and the latter 6,136 days. The total wages paid to these boys was Sh. 7,770/45. This does not include the Sh. 207/90 paid out to additional staff engaged on the special intensive pupa search in Block VI (page 31).

Total costs of the whole work are given in Table XX.

TABLE XVIII  
COSTS OF *G. PALPALIS* ELIMINATION

	*Fly-boy Days	Costs
		Sh. cts.
Block I—		
Control Rounds .. .. .	35	10 85
Trap Clearing .. .. .	144	44 64
Hand-catching .. .. .	1,665	516 15
Pupae .. .. .	338	104 78
Marking .. .. .	163	50 53
Paths .. .. .	—	149 38
Traps, 40 .. .. .	—	920 38
	—	1,796 33

\*The average daily rate of pay for fly-boys and pupa collectors was 31 cents.

TABLE XVIII—Contd.  
COSTS OF *G. PALPALIS* ELIMINATION

	*Fly-boy Days	Costs
		Sh. cts.
Block II—		
Hand-catching .. .. .	3,227	1,000 37
Pupae .. .. .	570	176 70
Paths .. .. .	—	81 48
	—	1,258 55
Block III and Lower Pala—		
Hand-catching .. .. .	6,329	1,961 99
Pupae .. .. .	526	163 06
Marking .. .. .	54	16 74
Paths .. .. .	—	81 48
	—	2,223 27
Upper Pala and Mirogi—		
Hand-catching .. .. .	3,898	1,208 38
Pupae .. .. .	351	108 81
Paths .. .. .	—	166 84
	—	1,484 03
Block VI—		
Traps, 65 .. .. .	—	1,495 00
Trap Clearing .. .. .	55	17 05
Hand-catching .. .. .	890	275 90
Pupae .. .. .	450	139 50
Marking .. .. .	16	4 96
Paths .. .. .	—	93 12
	—	2,025 53
Odielo—		
Control Rounds .. .. .	90	27 90
Marking .. .. .	250	77 50
Paths .. .. .	—	50 44
	—	155 84
Wadhakech—Odielo—		
Control Rounds .. .. .	146	45 26
Paths .. .. .	—	306 52
	—	351 78
Wadhagulu—		
Control Round .. .. .	38	11 78
Marking .. .. .	54	16 74
Paths .. .. .	—	77 60
	—	106 12

\*The average daily rate of pay for fly-boys and pupa collectors was 31 cents.

†The intensive pupa search in Block VI cost Sh. 207 in addition.

TABLE XVIII—Contd.  
COSTS OF *G. PALPALIS* ELIMINATION

	*Fly-boy Days	Costs
		<i>Sh. cts.</i>
WADHARIA—		
Control Round .. .. .	44	13 64
Marking .. .. .	46	14 26
Paths .. .. .	—	77 60
	—	105 50
WADHATEGO—		
Catching Flies Off Labourers .. .. .	553	171 43
†LAMBWE—		
Survey for Veterinary Department .. .. .	90	27 90
TRAINING FLY-BOYS .. .. .	1,600	496 00
INCIDENTAL FLY ROUNDS, MAKING NETS, ETC. (Approx.) .. .. .	1,686	522 66
SICKNESS (Approx.) .. .. .	1,300	403 00
TOTAL .. .. .	24,608	10,043 48

\*The average daily rate of pay for fly-boys and pupa collectors was 31 cents.

†A preliminary survey of the Lambwe Valley carried out for the Veterinary Department.

TABLE XIX  
TOOLS FOR CLEARING

	Costs
	<i>Sh. cts.</i>
100 Axes .. .. .	354 17
50 Mattocks .. .. .	162 50
50 Jembies .. .. .	77 00
350 Pangas .. .. .	572 26
2 Grindstones .. .. .	48 00
	1,213 93
Less Tools Handed Over to Lambwe Scheme .. .. .	376 26
TOTAL.. <i>Sh.</i>	837 67

TABLE XX  
TOTAL COSTS OF THE TWO YEARS' EXPERIMENT

	Costs	
	<i>Sh.</i>	<i>cts.</i>
Overseer's Salary .. .. .	12,000	00
Labour .. .. .	12,147	00
Labour Supervision .. .. .	1,414	80
Carpenter's Wages .. .. .	864	32
Clerk's Wages .. .. .	521	54
Lorry Driver's Wages .. .. .	1,260	00
Entomological Assistants' Wages .. .. .	3,690	00*
Fly-boys' and Pupa Collectors' Wages .. .. .	7,770	45
Extra Pupa Collectors' Wages .. .. .	207	90
Purchase of Tools for Clearing .. .. .	837	67
Purchase of Tools for Carpenters .. .. .	267	53
Purchase of Food .. .. .	1,357	60
Purchase of Trap Materials .. .. .	2,637	51
Purchase of Miscellaneous Articles .. .. .	590	25
Transport of Materials (Railway and Boat Freights) .. .. .	1,767	96
Lorry—Running and Repairs .. .. .	2,700	00
Travelling Expenses (Visiting Officers, Boys, etc.) .. .. .	940	00
Miscellaneous Expenditure .. .. .	840	00
	51,814	61
Less Adjustment for Expenditure on Behalf of Lambwe Valley Tactse Scheme .. .. .	400	00
TOTAL.. <i>Sh.</i>	51,414	61

\*Paid from Departmental Funds.

### Chapter VIII—SUMMARY AND CONCLUSIONS

We have carried out a trial elimination of *G. palpalis* on the Kuja River and its tributaries, the Pala, Mirogi, and Nthiwa in Kaniadoto, South Kavirondo.

The method adopted consisted of hand-catching and trapping adults in blocks of bush along these rivers after such blocks had been isolated by clearings.

Five clearings, varying in length from 500 yards to 1,050 yards, were made use of. (Two others were partly made, but were not used owing to an enforced change of plans.) These served to isolate four blocks of bush containing about  $12\frac{1}{2}$  miles of river. On some 11 miles of this, flies have been reduced to negligible numbers, and on the remaining  $1\frac{1}{2}$  miles their density has dropped by about 93 per cent. Settlement is proceeding on some six square miles of land thus made safe, while a patrol of the rivers still goes on to prevent reinfestation.

It has been shown that trapping (with the Swynnerton S.S. 4-foot or 6-foot trap) helps to reduce density in the initial stages of fly elimination, but that the traps do not function effectively in low densities.

It appears that traps were most effective when sited on promontories. This probably made them conspicuous to patrolling flies. Only one promising result was obtained from baiting, but the choice of bait was probably wrong.

Hand-catching appears to be an economical method of attack on *palpalis* in isolated blocks. It is the only satisfactory method for dealing with residual fly. Cloth screens proved to be of little value in hand-catching.

The breeding sites of *G. palpalis* on these rivers, and probably on most rivers, are too scattered to make the collection of pupae worth while.

Clearings up to 1,050 yards in length are not completely effective barriers to *G. palpalis*.

The evidence available suggests that during the period March to July reproduction by *G. palpalis* is accelerated.

The population of *G. brevipalpis* in this area appears to be about a third of that of *G. palpalis*. This species is not affected by our methods of elimination.

Costs are given of each step in the work. Some nine square miles of land have been reclaimed for settlement, six are being settled, and an additional block of about 3 square miles is rapidly becoming safe.

The approximate cost of eliminating *G. palpalis* in a mile of riverine bush has been about £40, whereas the cost of clearing a mile of such bush has been about £250. Champions of wholesale clearing might consider worth while a method that preserves useful bush and timber, prevents desiccation and erosion, and, at the same time, saves about £200 a mile.

#### Conclusions.

The aim of this work was to ascertain the possibility of eliminating *G. palpalis* from infested bush by the adoption of piecemeal methods of attack.

Along about 11 miles of river, flies are now, for all practical purposes, non-existent. In a block of more heavily infested bush of the Kuja River, density has been reduced from 168 to 12 by the capture in about eleven months of some 35,000 flies. All this has been accomplished at a cost of about £2,400.

Hand-catching was the chief method adopted, aided by trapping.

Voluntary settlement is proceeding in some six square miles already released for this purpose, and funds have been voted by the Local Native Council for continuing the work.

## APPENDIX I

BLOCK VI.—FLIES CAUGHT IN TRAPS, NOVEMBER, 1934  
TO MAY, 1935

DATE	EAST BANK (30 Traps)				WEST BANK (35 Traps)			
	Male	Fe- male	Un- known	Total	Male	Fe- male	Un- known	Total
Nov.								
15	—	—	—	395 54% Fe- males	445	408	82	2,619 53% Fe- males
19	50	62	7		188	230	20	
22	33	63	1		138	253	12	
26	43	46	4		189	301	26	
29	51	35	—		122	194	11	
	177	206	12		1,082	1,386	151	
Dec.								
3	62	55	2	925 57% Fe- males	105	69	8	3,058 65% Fe- males
6	28	39	—		80	113	2	
10	56	66	2		129	224	1	
13	24	38	1		68	176	5	
17	26	66	—		76	202	5	
20	36	31	1		102	156	1	
27	91	134	9	273	590	56		
31	58	92	8	181	415	21		
	381	521	23	1,014	1,945	99		
Jan.								
3	21	27	3	344 45% Fe- males	80	209	7	1,719 64% Fe- males
7	18	16	—		90	195	3	
10	30	37	—		84	144	11	
14	24	13	—		85	136	3	
17	11	8	—		38	66	3	
21	38	19	—		54	85	5	
24	18	11	—	41	65	2		
28	16	20	1	72	112	1		
31	7	6	—	54	71	3		
	183	157	4	598	1,083	38		
Feb.								
4	8	16	—	292 61% Fe- males	53	89	2	1,092 56% Fe- males
7	25	41	1		62	124	—	
11	22	51	1		109	152	6	
14	19	13	—		84	79	4	
18	12	19	—		61	61	5	
21	8	10	—		28	40	—	
25	6	21	—	26	39	—		
28	11	8	—	38	29	1		
	111	179	2	461	613	18		

## APPENDIX I—Contd.

BLOCK VI.—FLIES CAUGHT IN TRAPS, NOVEMBER, 1934  
TO MAY, 1935—Contd.

DATE	EAST BANK (30 Traps)				WEST BANK (35 Traps)			
	Male	Fe- male	Un- known	Total	Male	Fe- male	Un- known	Total
March								
4	19	32	—	225 60% Fe- males	38	58	2	817 59% Fe- males
7	11	7	—		21	22	2	
11	7	8	—		36	44	2	
14	9	18	—		45	77	—	
18	9	14	—		58	99	3	
21	2	16	—		41	57	—	
25	16	25	1	42	67	3		
28	16	15	—	40	60	—		
	89	135	1	321	484	12		
April								
1	21	15	—	190 51% Fe- males	43	52	—	838 58% Fe- males
4	7	12	—		35	50	2	
8	11	12	—		36	57	—	
11	6	3	—		55	54	1	
15	7	4	1		29	21	—	
18	6	13	—		19	39	1	
22	7	12	1	29	48	1		
25	10	10	—	43	52	—		
29	15	17	—	54	116	1		
	90	98	2	343	489	6		
May								
2	19	18	1	113 67% Fe- males	50	87	1	444 68% Fe- males
6	5	20	—		36	84	1	
9	3	7	—		8	20	—	
13	2	7	—		5	16	—	
16	6	10	—		12	28	—	
20	—	5	—		10	12	—	
23	—	2	—	8	18	—		
27	—	7	1	10	37	—		
	35	76	2	139	302	3		

## APPENDIX II

## BLOCK VI.—TRAP CAPTURES ON THE EAST BANK

Trap No.	Nov.	Dec.	Jan.	Feb.	March	April	May	Total
41	28	20	3	—	3	3	5	62
42	—	12	7	2	—	1	1	23
43	—	7	4	3	—	—	1	15
44	2	5	3	3	2	1	—	16
45	32	33	4	4	2	5	4	84
46	19	41	4	7	6	3	1	81
47	7	35	4	3	5	7	3	64
48	55	20	18	5	10	2	2	112
49	3	151	35	136	82	34	20	461
50	35	24	2	10	2	5	3	81
51	8	35	33	25	27	38	11	177
52	9	15	13	2	4	—	—	43
53	68	10	4	1	—	1	—	84
54	4	19	12	4	3	3	1	46
55	7	3	5	3	4	3	3	28
56	4	4	3	3	8	1	—	23
57	10	12	2	4	1	10	6	45
58	1	19	9	9	9	7	7	61
59	6	6	1	2	2	1	1	15
60	6	7	4	4	4	5	1	31
61	1	36	24	15	8	1	—	85
62	38	10	7	7	—	1	7	70
63	26	18	7	5	19	12	1	88
64	1	77	27	6	7	16	11	145
65	2	42	10	6	10	3	2	75
66	2	25	20	2	3	5	9	66
67	2	—	—	—	—	1	1	4
68	2	4	5	1	—	2	—	14
69	15	233	68	16	4	18	12	366
70	2	7	5	4	—	1	—	20
TOTAL.	395	925	344	292	225	190	114	2,485 55% Females

## APPENDIX II—Contd.

## BLOCK VI.—TRAP CAPTURES ON THE WEST BANK

Trap No.	Nov.	Dec.	Jan.	Feb.	March	April	May	Total
71	26	29	18	11	15	31	8	138
72	64	50	24	6	17	15	20	196
73	32	21	10	2	1	1	5	72
74	133	102	80	31	5	4	15	370
75	114	43	17	5	3	10	11	203
76	58	60	25	3	10	23	13	192
77	134	100	74	57	51	6	3	425
78	8	78	21*	4	5	6	6	128
79	84	56	36	7	34	32	29	278
80	19	16	5	3	3	3	1	50
81	2	—	2	4	4	2	3	17
82	139	48	20	6	16	17	2	248
83	41	61	29	15	19	1	2	168
84	23	26	7	3	22	7	1	89
85	-1	1	2	1	—	2	—	7
86	85	17	26	54	15	26	14	237
87	45	27	17	8	11	7	4	119
88	123	154	95	39	58	84	25	578
89	144	155	79	61	61	98	20	618
90	80	29	20	15	3	7	1	155
91	8	34	8	4	18	3	10	85
92	23	16	18	11	9	38	7	122
93	—	4	4	—	8	3	1	20
94	144	150	76	66	31	58	20	545
95	53	48	41	6	5	7	—	160
96	57	58	14	16	27	27	29	228
97	159	136	95	16	16	46	25	493
98	141	173	53	59	14	30	37	507
99	38	7	15	16	11	15	3	105
100	64	29	16	25	21	21	9	185
101	6	12	11	6	3	7	10	55
102	54	35	42	33	18	32	23	237
103	97	1,069	626	258	47	96	53	2,246
104	135	26	8	207	211	40	7	834
105	285	188	85	34	25	33	27	677
TOTAL.	2,619	3,058	1,719	1,092	817	838	444	10,587 59% Females

## APPENDIX III

## NUMBER OF DAYS ON WHICH RAIN FELL

YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1933	—	—	—	—	—	—	—	—	—	9	3	4
1934	1	2	15	25	23	11	15	15	19	24	18	17
1935	—	13	14	15	16	23	4	11	21	—	—	—

## APPENDIX IV

TEMPERATURE AND HUMIDITY RECORDS  
KUJA RIVER, KANIADOTO, SOUTH KAVIRONDO

1934	TEMPERATURE				HUMIDITY			
	Mean		Absolute		Max. +Min. -2	Mean Per- centage of Humidity		Lowest Percentage Humidity
	Max.	Min.	Max.	Min.		12 noon	2 p.m.	
November								
1-8	80.2	62.2	82.0	61.0	71.2	62	62	51
9-16	82.0	57.5	86.0	55.0	69.7	46	47	33
17-24	83.6	59.1	85.0	55.0	71.3	51	52	40
25-30	82.4	56.2	85.0	53.0	69.3	50	55	37
December								
1-8	82.0	56.7	85.0	54.0	69.3	54	53	39
9-16	81.5	58.0	86.0	56.0	69.7	51	55	39
17-24	82.2	58.2	85.0	55.0	70.2	53	52	43
25-31	81.3	57.0	85.0	53.0	69.1	55	62	45
1935								
January								
1-8	84.4	57.7	86.0	55.0	71.1	45	42	33
9-16	86.6	54.0	89.0	47.0	70.3	38	37	26
17-24	89.0	56.4	90.0	46.0	71.7	29	35	23
25-31	90.3	56.5	92.0	50.0	73.4	29	31	19
February								
1-8	87.9	59.9	95.0	55.0	73.9	40	38	14
9-16	83.6	60.9	86.0	57.0	72.3	47	48	33
17-24	81.2	61.2	86.0	60.0	71.2	55	67	43
25-28	79.5	61.2	82.0	60.0	70.3	59	70	47
March								
1-8	84.9	61.0	89.0	56.0	72.9	48	49	30
9-16	86.4	61.4	89.0	58.0	73.9	49	44	33
17-24	86.5	57.3	90.0	54.0	71.9	45	53	35
25-31	85.5	60.2	88.0	58.0	72.9	54	53	44
April								
1-8	84.4	59.0	86.0	58.0	71.7	55	49	34
9-16	79.4	60.4	85.0	57.0	69.9	62	78	48
17-24	85.1	57.4	87.0	55.0	71.3	51	45	39
25-30	84.2	61.0	86.0	56.0	72.6	49	46	38
June								
1-8	79.6	58.0	89.0	52.0	68.8	58	58	33
9-16	80.8	58.8	83.0	57.0	69.8	62	61	53
17-24	78.7	57.9	80.0	55.0	68.3	60	72	54
25-30	79.2	55.6	82.0	51.0	67.4	62	60	52
July								
1-8	80.3	56.3	81.0	51.0	68.3	53	56	47
9-16	80.6	51.3	84.0	49.0	65.9	48	49	44
17-24	83.4	50.7	86.0	49.0	67.1	41	43	29
25-31	84.5	54.5	87.0	46.0	69.5	35	36	25
August								
1-8	84.1	54.4	88.0	51.0	69.3	37	40	32
9-16	83.7	55.0	86.0	47.0	69.3	40	47	28
17-24	85.6	54.4	88.0	50.0	70.0	35	36	27
25-31	82.3	54.8	83.0	51.0	68.5	51	53	39
September								
1-8	82.5	58.0	84.0	55.0	70.3	50	54	45
9-16	82.6	57.1	86.0	53.0	69.9	50	52	41
17-24	86.1	54.9	87.0	52.0	70.5	39	40	33
25-30	85.8	57.4	89.0	55.0	71.6	44	62	32

## APPENDIX V

## REFERENCES

- (1) ENZER, A. J.—Sleeping Sickness Survey. *K. and E.A. Medical Journal*, Vol. IV, page 386.
- (2) McLEAN, N.—Sleeping Sickness Investigation in Kavirondo, 1930-1. *K. and E.A. Medical Journal*, Vol. VIII, page 180.
- (3) WILKINSON, W.—Unpublished Report.
- (4) HOPKINS, E. H.—Unpublished Report.
- (5) HARPER, J. O.—Unpublished Report.



PLATE 1

Kuja River bush at an old watering place in the Kabwach Forest: *G. palpalis* density high



PLATE 2

*G. palpalis* breeding sites on the Kuja River  
(Short sticks indicate where pupæ were found)



PLATE 3  
*G. palpalis* breeding sites on the Kuja River



PLATE 4  
*G. palpalis* breeding sites on the Kuja River

PLATE 5

*G. palpatis* breeding sites on the Kuja River  
(Short sticks indicate where pupae were found)



PLATE 6

*G. palpatis* breeding sites on the Kuja River  
(Short sticks indicate where pupae were found)

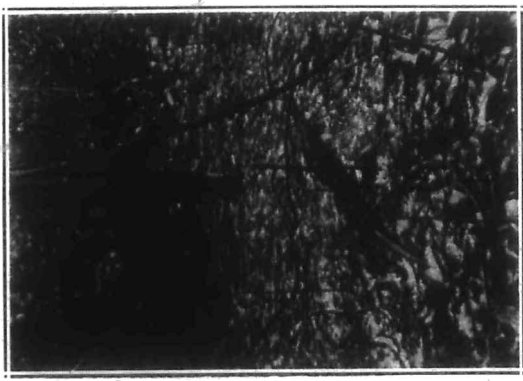




PLATE 7  
Pupa searchers at work



PLATE 8  
Burning Wadhakech clearing



PLATE 9

A 'clean' burn with uncut bush along the edge



PLATE 10

Re-growth of vegetation if thorough burning is not done soon after felling



PLATE 11

Wadhadeng clearing after a clean-up of first re-growth, in preparation for a second burning



PLATE 12

View of Wadhadeng clearing after a second burning



PLATE 14

The Kuja River above Kabwachi Forest:  
*G. palpatis* density getting low



PLATE 13

Wadharia clearing south of Block VI on the  
Kuja River



PLATE 15

The Kuja River showing vegetation frequented only by food-hunting females



PLATE 16

A ford on the Kuja River beyond the upper limit of *G. palpalis*

ves

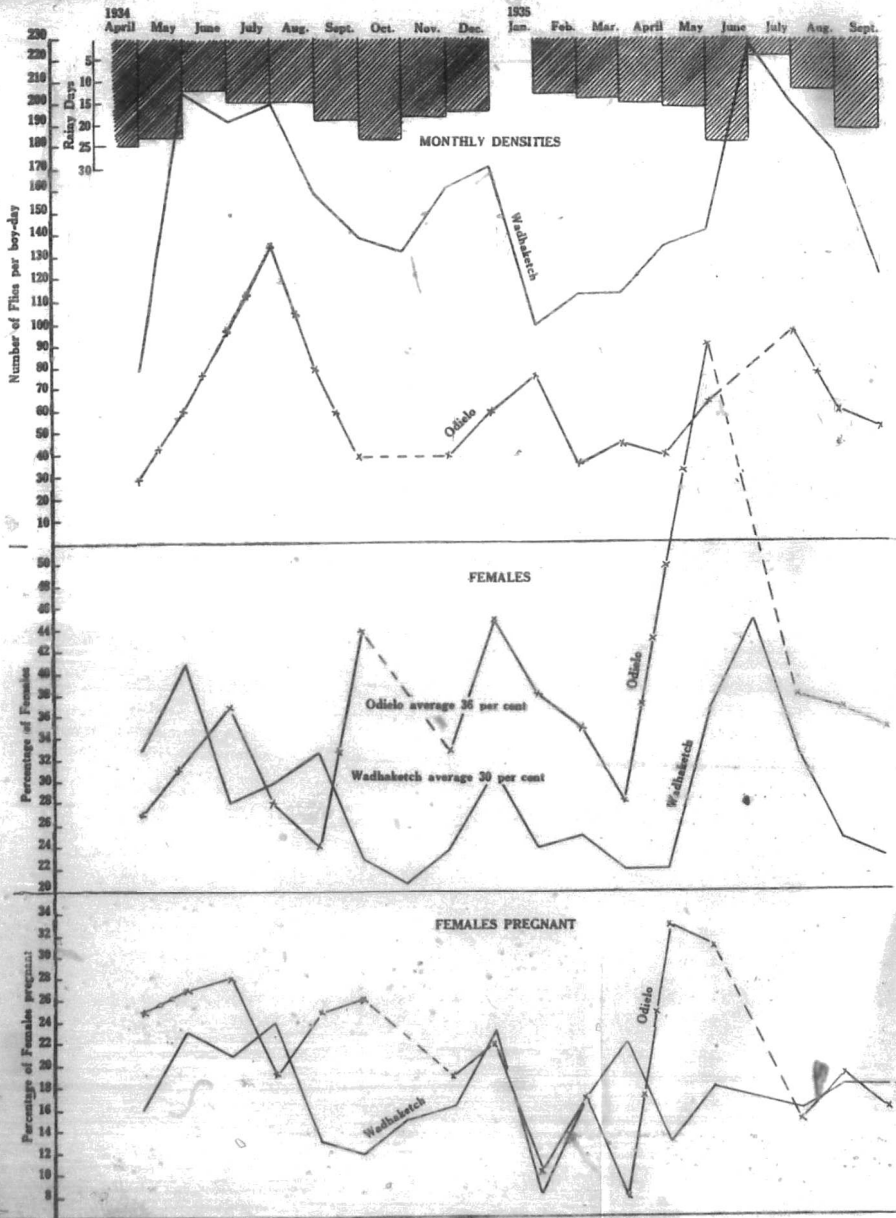
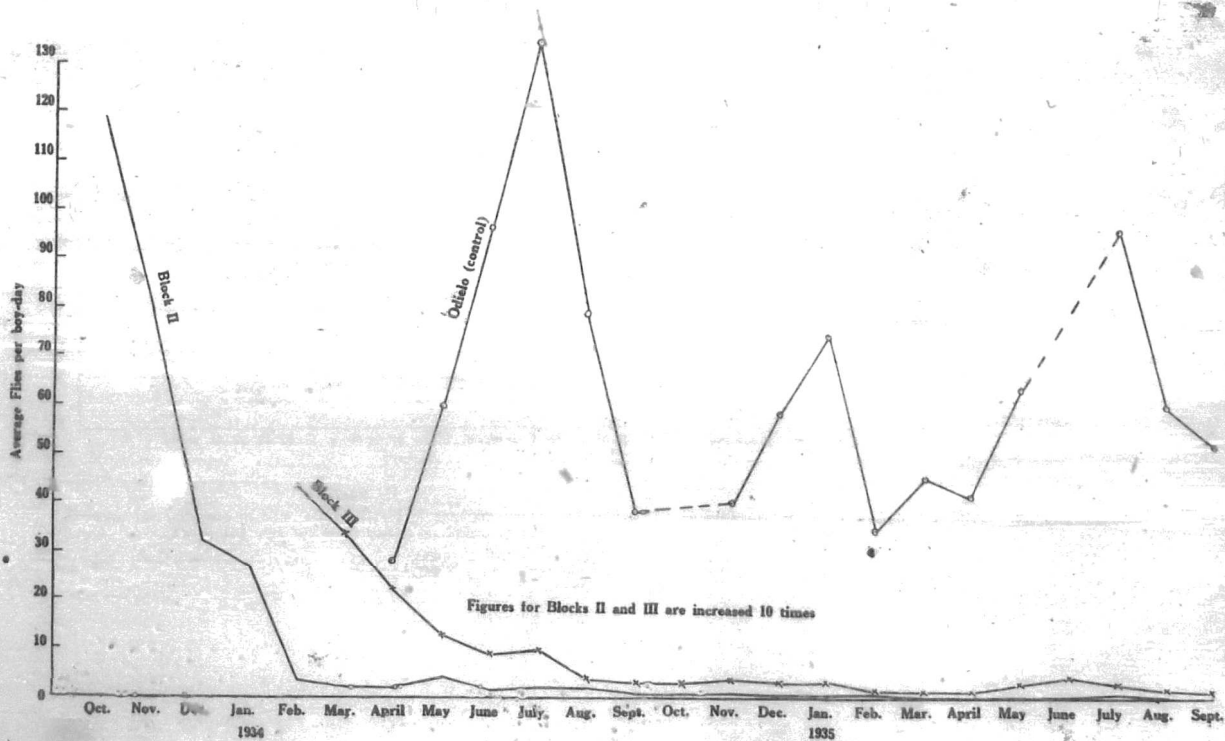


CHART I



Figures for Blocks II and III are increased 10 times

CHART II

Showing reduction of flies in Blocks II and III compared with Odielo control

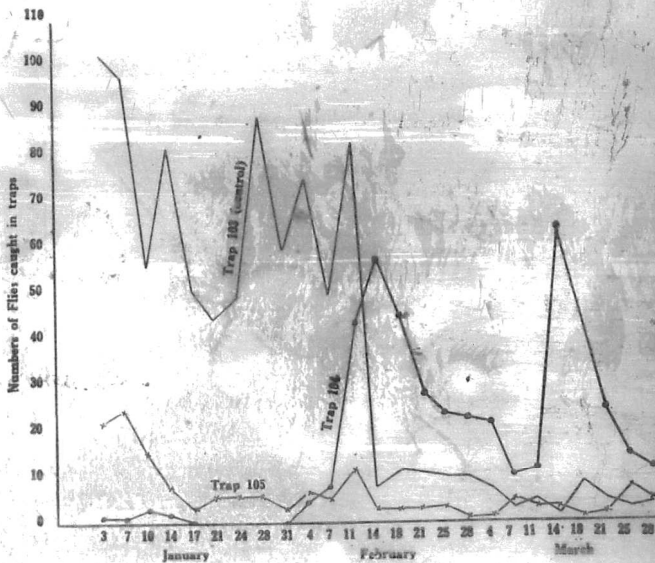


CHART III

Showing the influence of bait (ether extract of elephant penis) on captures, Traps 104 and 105 were baited on February 11th.

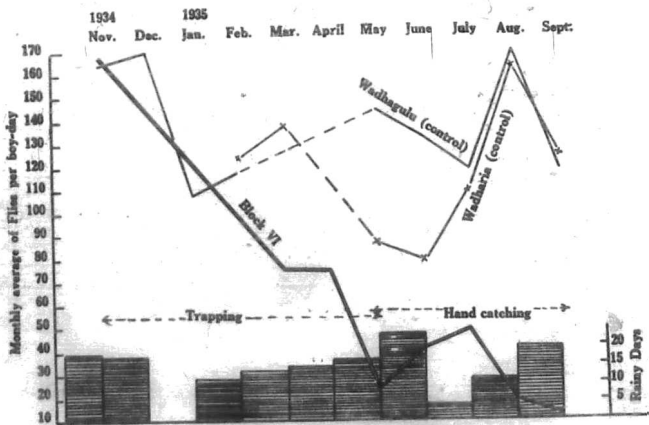
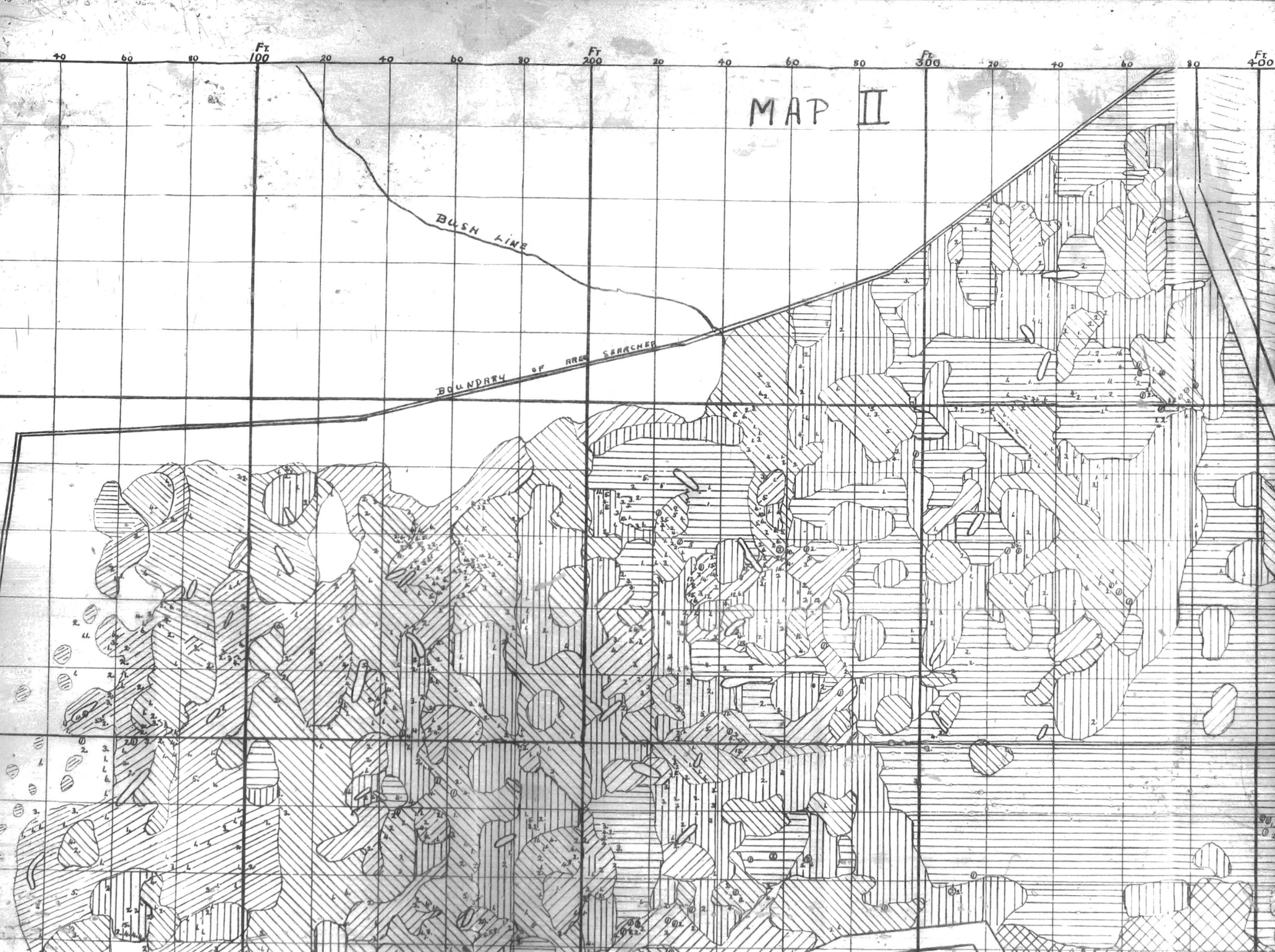


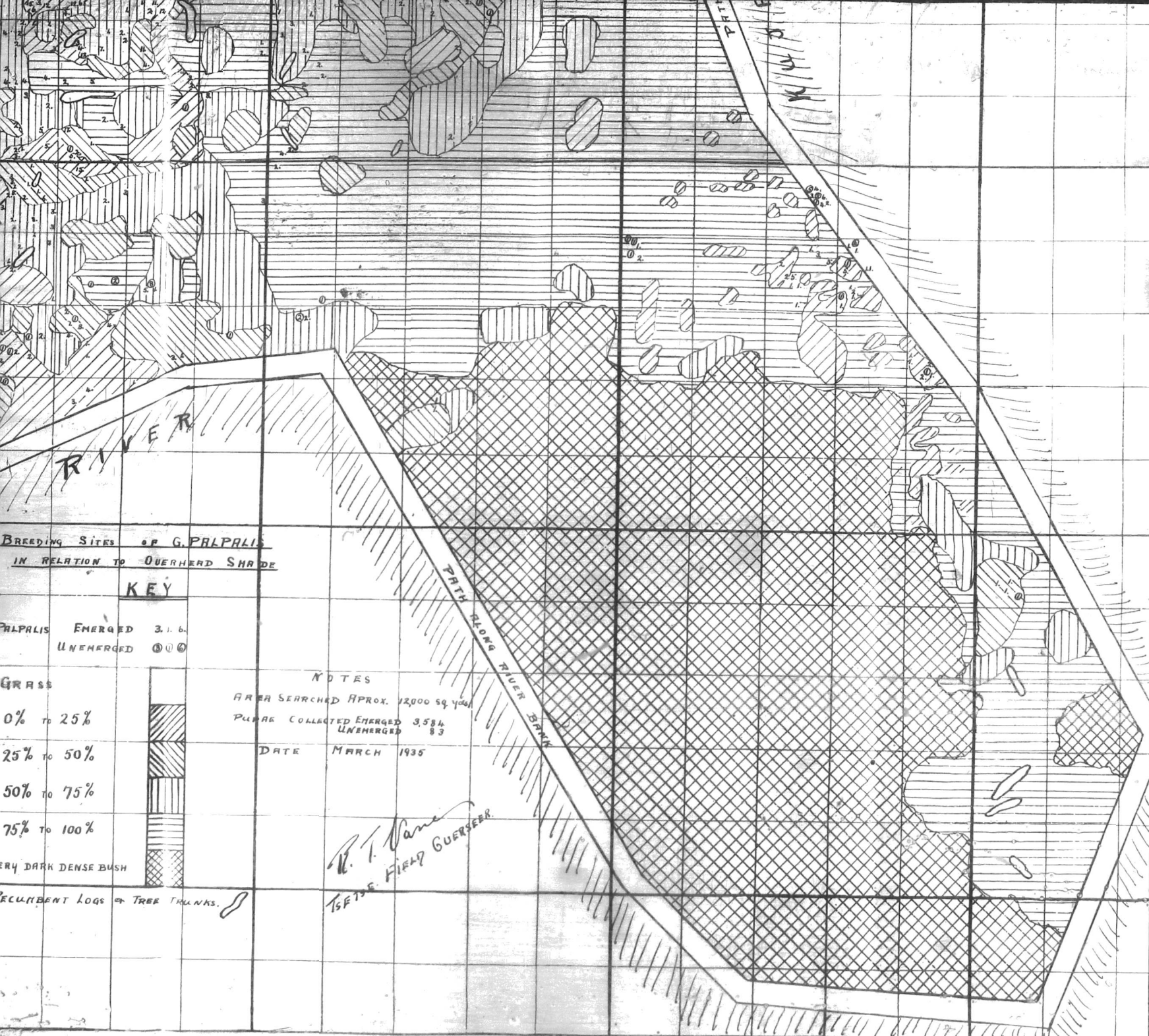
CHART IV  
Showing reduction of *G. palpalis* in Block VI



# MAP II







BREEDING SITES OF *G. PALPALIS*  
 IN RELATION TO OVERHEAD SHADE

KEY

*G. PALPALIS* EMERGED 3.1.6  
 UNEMERGED ①②③

GRASS  
 0% TO 25%  
 25% TO 50%  
 50% TO 75%  
 75% TO 100%  
 VERY DARK DENSE BUSH



RECUMBENT LOGS or TREE TRUNKS.

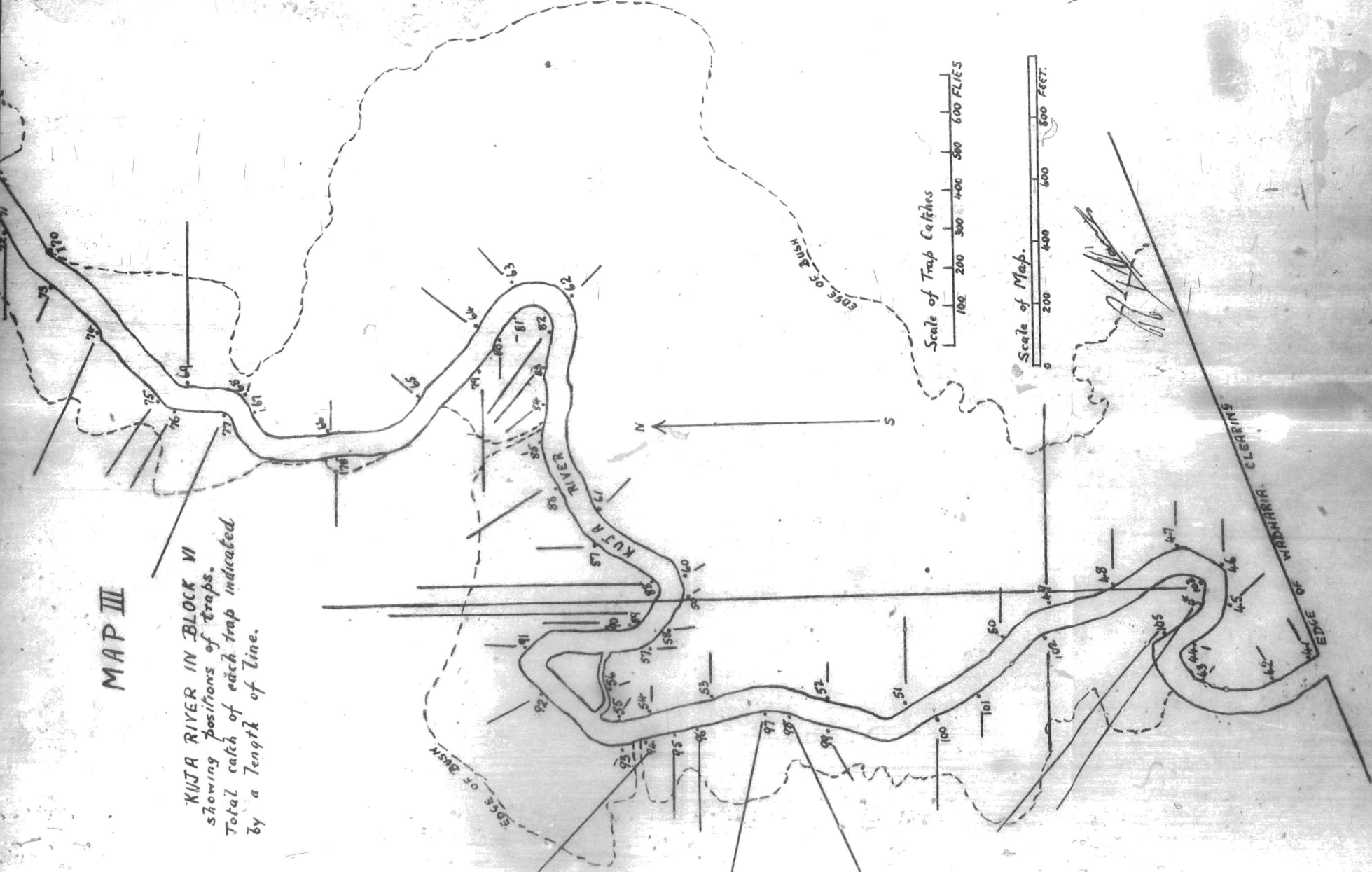
NOTES

AREA SEARCHED APPROX. 12000 sq yds  
 PUPAE COLLECTED EMERGED 3584  
 UNEMERGED 83  
 DATE MARCH 1935

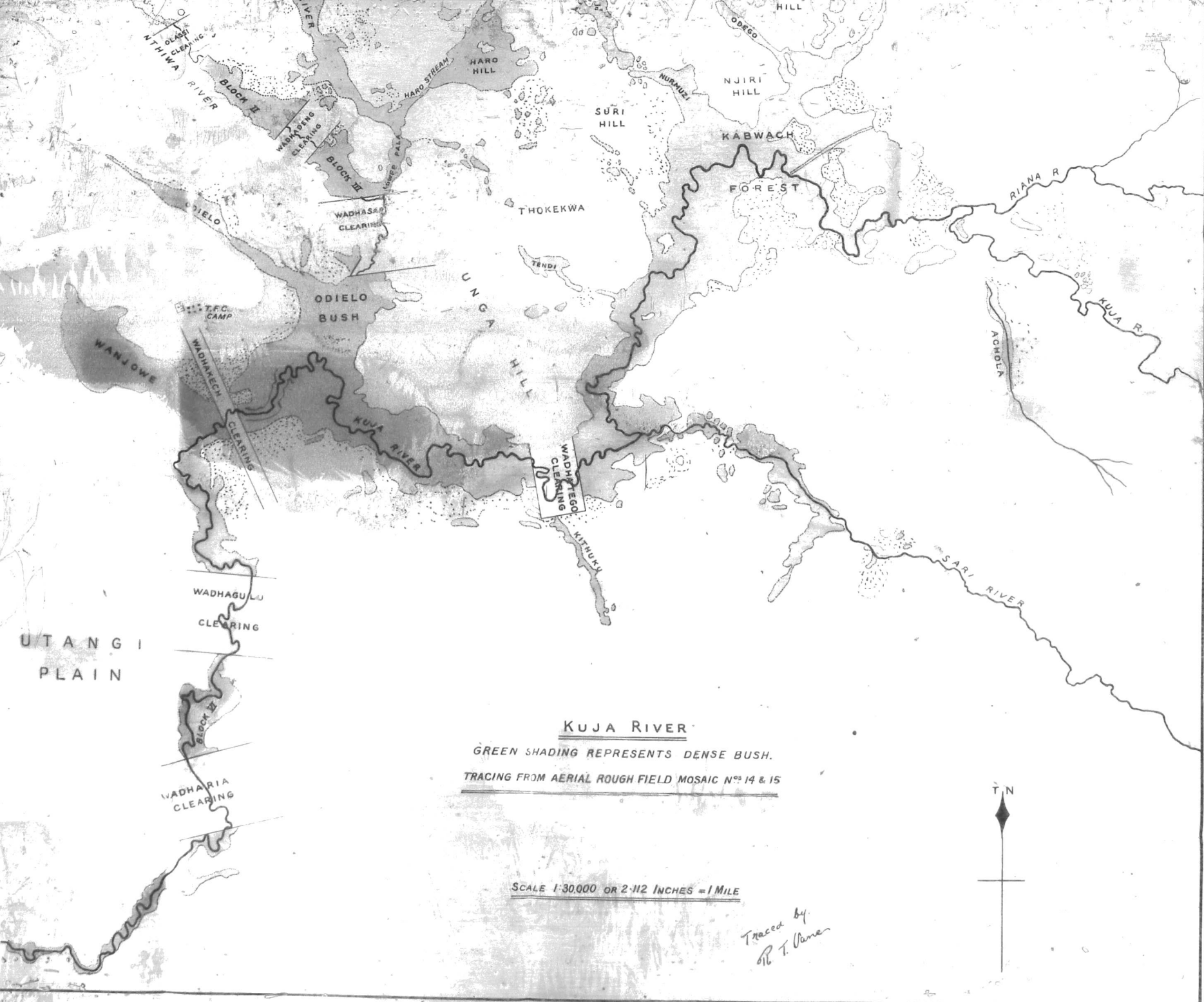
*R. T. Dame*  
 16155 FIELD GUERREER

# MAP III

KUJA RIVER IN BLOCK VI  
showing positions of traps.  
Total catch of each trap indicated  
by a length of line.







KUJA RIVER

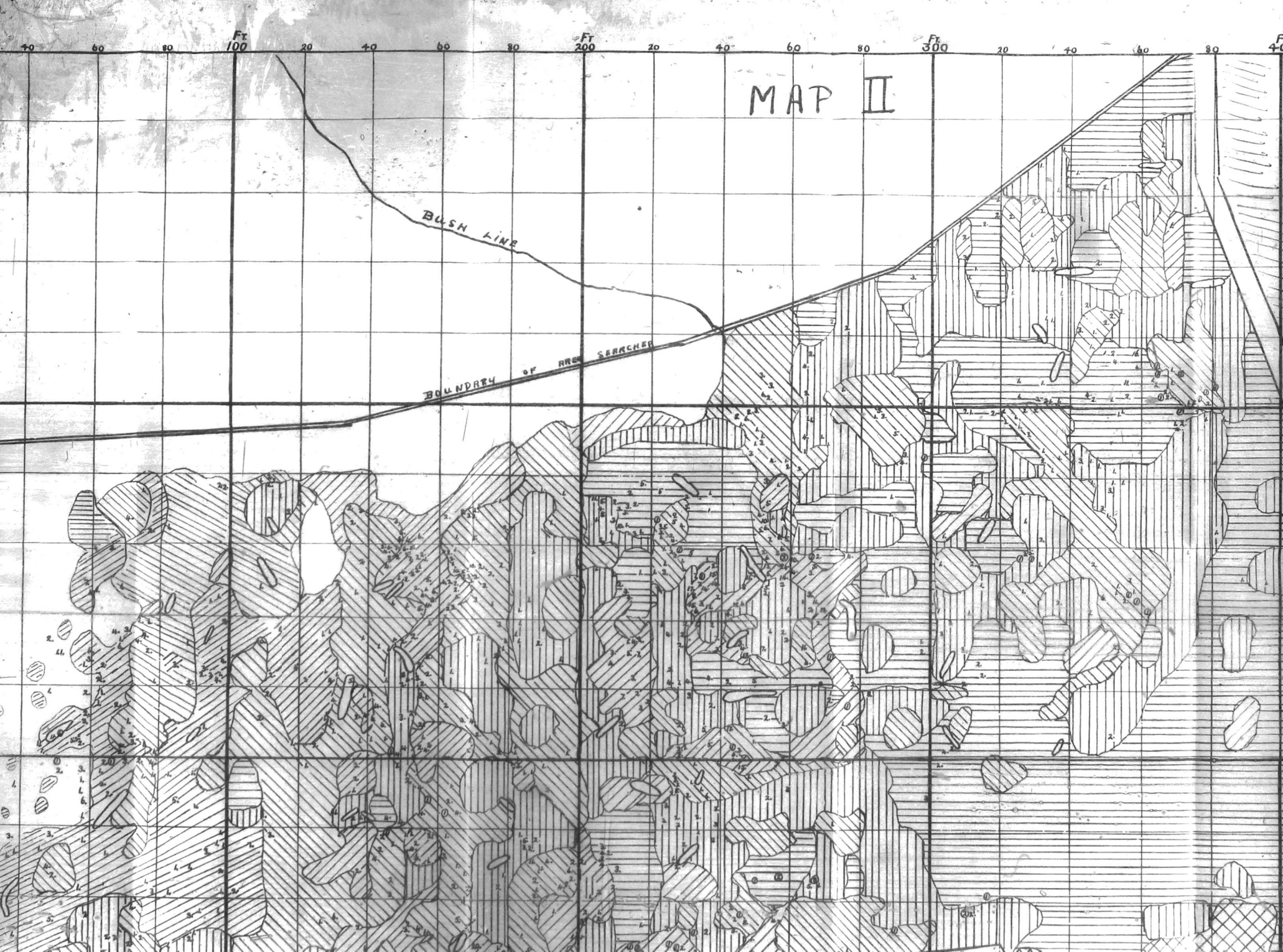
GREEN SHADING REPRESENTS DENSE BUSH.

TRACING FROM AERIAL ROUGH FIELD MOSAIC N°S 14 & 15

SCALE 1:30,000 OR 2-1/2 INCHES = 1 MILE

Traced by  
R. T. Damer

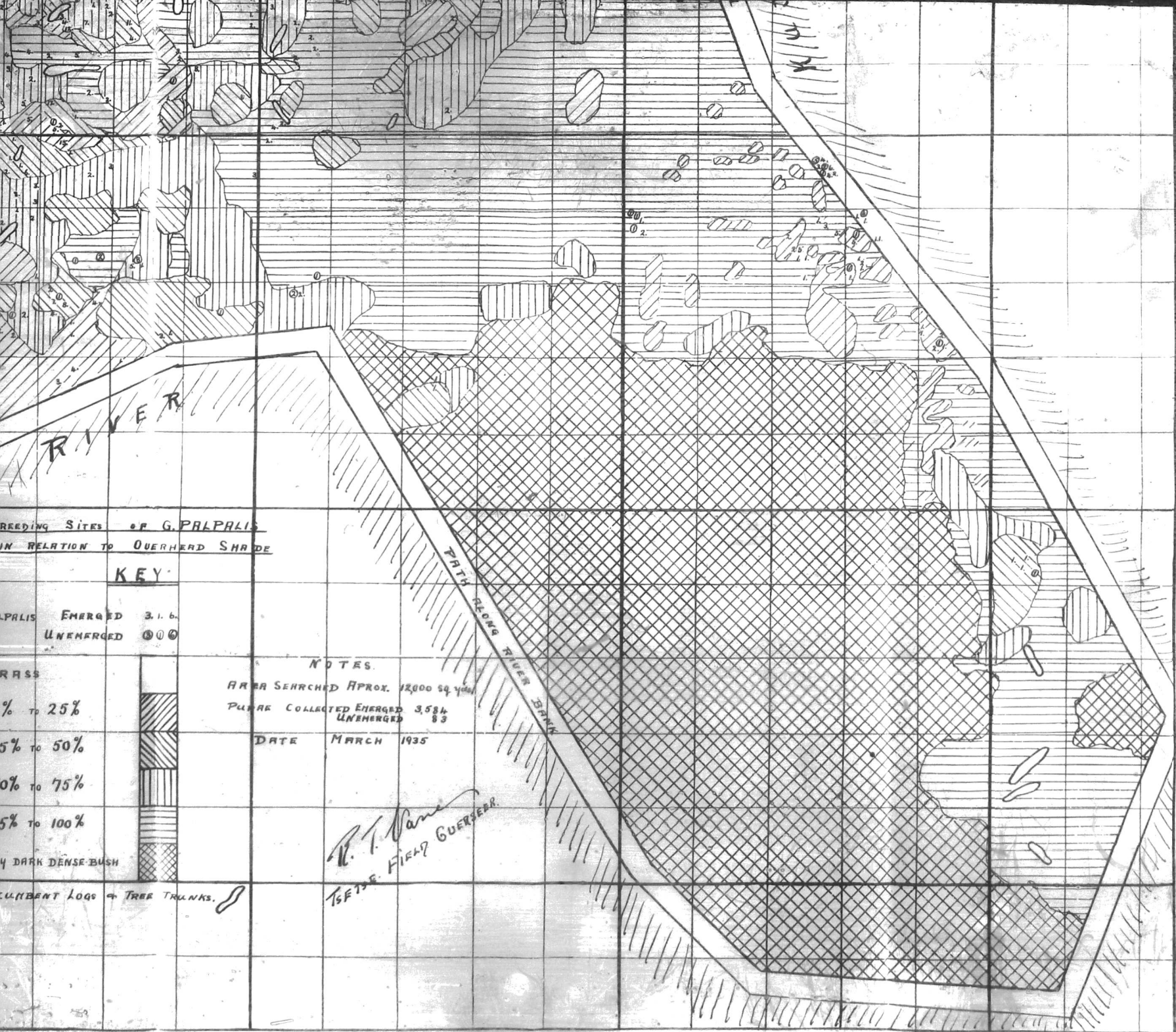




# MAP II







BREEDING SITES OF *G. PALPALIS*  
IN RELATION TO OVERHEAD SHADE

KEY

- G. PALPALIS* EMERGED 3.1.6.
  - UNEMERGED 0.0.0.
- PERCENTAGE OF OVERHEAD SHADE
- 0% TO 25%
  - 25% TO 50%
  - 50% TO 75%
  - 75% TO 100%
  - 4 DARK DENSE BUSH
  - CUMBERNUT LOGS & TREE TRUNKS.

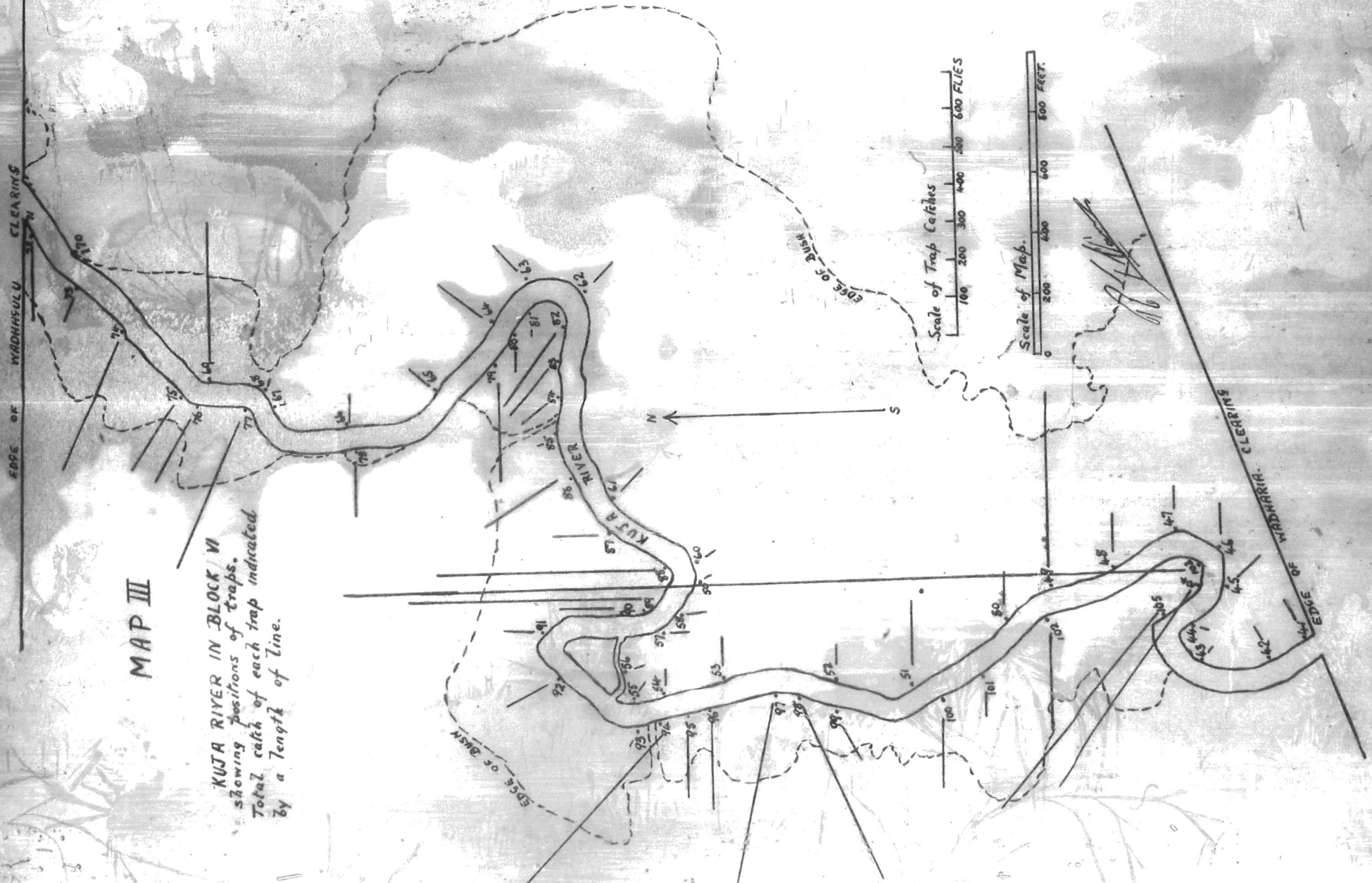
NOTES

AREA SEARCHED APPROX. 12000 sq yds  
 PUPAE COLLECTED EMERGED 3,584  
 UNEMERGED 83  
 DATE MARCH 1935

*R. T. Dame*  
 TSFTS. FIELD GUERRER

### MAP III

KUJA RIVER IN BLOCK VI  
showing positions of traps.  
Total catch of each trap indicated  
by a length of line.



Any further communication on this subject should be addressed to:-

THE SECRETARY,  
ECONOMIC ADVISORY COUNCIL,  
2, WHITEHALL GARDENS, S.W.1,  
and the following number quoted.

ECONOMIC ADVISORY COUNCIL,

2, WHITEHALL GARDENS,

LONDON, S.W.1.

E.A.C./616.

RECEIVED  
13 APR 1937  
C. O. REGY

10th April, 1937.

Sir,

I am directed by the Economic Advisory Council, to request you to inform Mr. Secretary Ormsby-Gore, that at their meeting held yesterday their Tsetse Fly Committee had under consideration your letter of the 15th ultimo (38299/37) transmitting an application from the Government of Kenya for a further grant of £1,900 a year, for three years, from the Colonial Development Fund for the purpose of financing the continuance of the campaign to eradicate Tsetse Fly in the South Kavirondo.

Ans d. (11)

2. After full discussion, the Committee agreed:-

(a) To recommend that the Economic Advisory Council should inform the Secretary of State for the Colonies that the Tsetse Fly Committee were of opinion -

(i) that the continuance of the campaign for eradicating tsetse flies, undertake by the Kenya Government in the south Kavirondo district, would be likely to prove of great benefit to that territory, and that they therefore recommended that support should be given by the Secretary of State for the Colonies to the application made by the Government of Kenya for a further grant of £1,900 a year for three years, to be made from the Colonial Development Fund for the purpose of financing this work;

(ii) that as regards that part of the programme which was concerned with research work of a fundamental character (namely the studies of the bionomics of Glossina pallidipes referred to in paragraph 2a of the memorandum forming enclosure 2 to the letter from the Colonial Office under consideration) it was desirable that arrangements should be made for this side of the work to be carried out under the supervision of Mr. C.F.M. Swynnerton, Director of Tsetse Research, Tanganyika Territory.

(b) That as on previous occasions the Colonial Office should be invited to consider the desirability of arranging for Sir Guy Marshall to attend the meeting of the Colonial Development Advisory Committee, at which this application would be considered, in order that he might offer the Committee any explanations in regard to it which they might desire."

3. The Council concur in the Committee's recommendations, which I am, therefore, to commend for the favourable consideration of the Secretary of State.

I am  
Sir,  
Your obedient Servant

*Francis Heenan*

The Under Secretary of State,  
Colonial Office.

CONFIDENTIAL.

E.A.C.(T.F.)  
32nd meeting.

Copy no. 5

ECONOMIC ADVISORY COUNCIL.

TSETSE FLY COMMITTEE.

The thirty-second meeting of the committee will be held in Conference Room "A", 2, Whitehall Gardens, S.W.1, on Friday, 9th April, 1937, at 3 p.m.

A G E N D A .

Continuance of campaign for eradicating tsetse flies in the south Kavirondo District, Kenya Colony. Copy of letter no. 38299/37, dated 15th March, 1937, covering an application from the Governor of Kenya for a further grant of £1,900 a year for three years from the Colonial Development Fund.

(Paper E.A.C.(T.F.) 465, already circulated.)

(Signed) FRANCIS HEMMING,

M. A. GREENHILL,

Joint secretaries to the committee.

2, Whitehall Gardens, S.W.1,

6th April, 1937.

6 82  
6  
(THIS DOCUMENT IS THE PROPERTY OF HIS BRITANNIC MAJESTY'S GOVERNMENT.)

CONFIDENTIAL.

E.A.C.(T.F.) 466

COPY NO. 17

ECONOMIC ADVISORY COUNCIL.

TSETSE FLY COMMITTEE.

Campaign to eradicate tsetse fly in the South and  
Central Kavirondo Districts, Kenya Colony.

Quarterly progress reports, 1st July to 30th  
September, 1936 and 1st October to 31st  
December, 1936.

(Previous paper: E.A.C.(T.F.) 453).

2, Whitehall Gardens, S.W.1.,

25th March, 1937.

QUARTERLY PROGRESS REPORT.  
1st July to 30th September, 1936.

- (1). Kenya. Tsetse Fly Control. Scheme No. 223.
- (2). 15th December, 1935.
- (3). Work commenced in Kamflets in October, 1935.
- (4). CENTRAL KAVIRONDO.

Port Victoria. Fly eradication is being continued. Pupae collections are made in all blocks. The collectors are taking simple artificial breeding grounds that are proving attractive to females. In the seven blocks of bush under treatment fly has been reduced by about 50% up to the end of September. Fly populations appear to be much greater than was indicated by the preliminary density catches.

LAMBWE VALLEY.

It is reported that during the last quarter, July to September, 1936, experimental work on the control of G. pallidipes in the Lambwe Valley has drawn to a close due to the lack of further funds. Much of the time has been occupied in detailed inspection by the Entomologist and the Overseer, and in preparing an interim report on the progress of the experiment in the last eighteen months. The report is now under consideration. Any proposal for the renewal of this grant will be forwarded to you under cover of a separate despatch.

- (5). -
- (6). -
- (7). Estimated expenditure in quarter commencing 1.10.36 ... .. Local 10. 0. 0.
- Estimated expenditures in quarter commencing 1.7.36 ... .. Local 10. 0. 0.
- Actual expenditure in quarter commencing 1.4.36 ... .. Local 10. 10. 30
- Total Actual expenditure from commencement of scheme to 31.3.36 ... .. Local 5,015. 19. 36
- (8). -
- (9). -
- (10). Yes.
- (11). Labour paid at standard rates.

QUARTERLY PROGRESS REPORT.

1st October to 31st December, 1936.

- (1) Kenya. Tsetse Fly Control. Scheme No. 223.
- (2) 16th December, 1932.
- (3) Work commenced in Kaniadoto in October, 1933.
- (4) 1. Port Victoria.

Reduction of fly in all blocks is proceeding though more slowly than was expected. It has been observed on numerous occasions that females can and do deposit larvae on to freshly turned or fine loose soil without any support whatever. Large numbers of pupae are being collected but if this habit is generally applicable then the task of "eradicating" breeding grounds is likely to be heavy.

- 2. Lambwe Valley.

The interim report mentioned in the last quarterly progress report has now been submitted; it contains a full account of the methods employed and the progress of experimental control by trapping and without clearing of the bush. Important, helpful data on the bionomics of G. pallidipes have been collected, and the hope is expressed that further financial assistance will enable us to continue with the investigations and to apply the accumulating information to practical control of this species of tsetse.

As far as the scheme supported by the grant from the Colonial Development Fund is concerned, the investigations ceased in August, 1936, due to the fact that the allocation of £2,120 was expended. There was a balance sufficient to enable the Overseer to remain in camp during September, 1936, in order to complete his observations and to prepare for the closing of the scheme.

After discussion it was agreed that an application be made to the Local Native Council of South Kavirondo for a grant to enable the work to be continued until an application for further assistance had been made to the Colonial Advisory Committee. The Local Native Council approved of a further grant to be used mainly for measures of a direct practical value to the inhabitants.

A revised scheme has been agreed upon and is now being carried out on the basis of previous experience from experimental work in the Lambwe Valley. To some small extent, fundamental observations are being continued so that there will not be a complete break should an additional grant be forthcoming from the Colonial Development Fund.

(5) -

(6) -

(7) Estimated expenditure in quarter commencing 1.1.37 ... ..	Local	£183. 0. 0
Estimated expenditure in quarter commencing 1.10.36 ... ..	Local	£247. 0. 0
Actual expenditure in quarter commencing 1.7.36 ... ..	Local	£374.17.94
Total actual expenditure from commencement of scheme ...	Local	£5355.10.30
(8) -		
(9) -		
(10) Yes.		
(11) Labour paid at standard rates.		

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(THIS DOCUMENT IS THE PROPERTY OF HIS BRITANNIC MAJESTY'S GOVERNMENT)

CONFIDENTIAL

E.A.C.(T.F.) 465

Copy no. 17

ECONOMIC ADVISORY COUNCIL

TSETSE FLY COMMITTEE

Continuance of campaign for eradicating tsetse flies  
in the south Kavirondo district, Kenya Colony

Copy of letter no. 38299/37, dated 15th March, 1937, from the Under Secretary of State, Colonial Office, to the Secretary, Economic Advisory Council, covering an application from the Governor of Kenya for a further grant of £1,900 a year for three years from the Colonial Development Fund

2, Whitehall Gardens, S.W.1,

22nd March, 1937.

Downing Street.

15th March, 1937.

38299/37

Sir,

I am directed by Mr. Secretary Ormsby Gore to refer to your letter of the 11th of November, 1932, No.EAC.339, and connected correspondence on the subject of the application made by the Government of Kenya for a grant from the Colonial Development Fund towards the financing of a Tsetse Fly campaign in the Kavirondo Reserves, and to transmit to you, for the consideration of the Tsetse Fly Committee of the Economic Advisory Council, the enclosed copy of a despatch from the Acting Governor covering an application for a further grant of £1,900 a year for three years. One full copy (with illustrations, etc.) of Dr. Lewis's Report is enclosed, together with four copies without the illustrations, etc.

20th Jan.

2. Mr. Ormsby Gore would be obliged for the observations of the Tsetse Fly Committee on this proposal before it is submitted to the Colonial Development Advisory Committee. In this connection I am to refer to the fifth paragraph of the recent report of the East Africa Sub-Committee of the Tsetse Fly Committee (E.A.C.(T.F.)463) and to point out that although an investigation into the 'ecology' of the Glossina pallidipes fly forms part of the programme of work to be undertaken, yet it is by no means the principal part and indeed, may be regarded as incidental in the execution of the work which the Kenya Government wishes to carry out. It appears that the proposed programme of work has received the approval of Mr. Swynerton.

3. Since it is desired to bring this application before the Colonial Development Advisory Committee at an early date I am to request that the matter may be submitted to the Tsetse Fly Committee as soon as may be convenient.

I am, Sir,  
Your obedient servant,

(Signed) J. E. W. FLOOD.

THE SECRETARY,

THE ECONOMIC ADVISORY COUNCIL.

ENCLOSURE I

KENYA

NO. 50

20th JANUARY, 1937.

Sir,

With reference to Sir Philip Cunliffe-Lister's (now Viscount Swinton's) despatch No.927 of the 22nd December, 1932, conveying approval of a free grant of £6,160 from the Colonial Development Fund to cover the cost of experiments in tsetse fly control in Kenya, I have the honour to transmit to you, for your information, a copy of a report prepared by Dr. E. A. Lewis, Entomologist in the Department of Agriculture, on the experiments carried out on the control of Glossina pallidipes in the Lambwe Valley of the South Kavirondo district. Twenty additional copies of this report are being forwarded under separate cover for transmission to the Tsetse Fly Committee of the Economic Advisory Council and, in connexion with the application contained in this despatch for further assistance from the Colonial Development Fund, to enable the experiments to continue, to the Colonial Development Advisory Committee. Only two copies of the report contain the full set of photographs, diagrams and charts: the remaining copies are illustrated only by a map of the Lambwe Valley.

2. The purposes of the grant of £6,160 were two, namely, measures against Glossina palpalis as the carrier of human trypanosomiasis, (a separate report on these measures will be transmitted to you shortly, but it is not proposed to ask for further assistance from the Colonial Development Fund for this purpose); and work on Glossina pallidipes, the carrier of trypanosomiasis in cattle. The sum of £2,120 was allocated from the grant to this latter purpose, and the accompanying report by Dr. Lewis describes the work done over a period of eighteen months and sets out the conclusions reached at the end of August, 1936, when this allocation was exhausted.

3. The report contains a detailed account of the field operations carried out in trapping, in partially clearing bush to create fly barriers and in isolating the main areas of dense, fly infested bush, and includes observations on the bionomics of Glossina pallidipes. The project, which may be regarded as a scientific investigation of African rather than merely local importance, is, however, incomplete. Dr. Lewis's conclusions are tentative, and if useful results are to be obtained from the work already done it is necessary that the experiments should be continued. The programme of work recommended is set out in the accompanying application for a free grant of £5,700 to be expended over a period of three years.

4. The sum of £2,120 allotted to the Lambwe Valley experiments has been supplemented by sums voted by the South Kavirondo Local Native Council for bush clearing in the valley, amounting to £100 in 1934, £600 in 1935, £980 in 1936 and a sum not exceeding £600 in 1937. The Local Native Council is naturally anxious to see some immediate practical results of value to the natives of the district, and it is clear that the Council cannot be asked to make further contributions without danger

THE RIGHT HONOURABLE  
W. ORMSBY GORE, P.C., M.P.,  
SECRETARY OF STATE FOR THE COLONIES,  
DOWNING STREET,  
LONDON, S.W. 1.

of confusion of objectives, which has to some extent characterised the work undertaken hitherto. The estimates of cost now furnished include, therefore, a sum of £800 per annum for labour in replacement of the contribution hitherto provided by the Local Native Council.

It should be emphasized that the project is primarily an investigation with a view to acquiring knowledge of the bionomics of Glossina pallidipes and to devising and testing various practical methods of controlling and eliminating this species without wholesale bush-clearing, which can only tend to accelerate soil erosion and desiccation. The importance of the experiment lies in the possibility of applying results to other large areas of Africa at present fly-infested.

5. The Conference on Co-ordination of Tsetse and Trypanosomiasis Research in East Africa held at Entebbe in January, 1956, recommended that in view of the short time the work in the Lambwe Valley had been in hand and its great importance, it should be continued at least until the next meeting of the Conference. Mr. Swynnerton approves, I understand, of the continuation of the programme, and has expressed his approval to the Tsetse Fly Committee of the Imperial Economic Committee.

6. In these circumstances I trust that you will be able to support the application now submitted for a grant of £5,700 to enable the work to be continued.

I have the honour to be,  
Sir,  
Your most obedient, humble servant,

A. de V. WADE

ACTING GOVERNOR.

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ENCLOSURE 2

MEMORANDUM OF APPLICATION FOR A FREE GRANT  
OF £5,700 TO ENABLE EXPERIMENTAL WORK ON  
GLOSSINA PALLIDIPES TO BE CONTINUED IN  
KENYA COLONY

1. Kenya.
2. The continuance of Scheme No.223 in respect of investigational work on Glossina pallidipes in the Lambwe Valley, South Kavirondo district, Kenya Colony. Twelve copies of a report on the experiments undertaken hitherto are forwarded. The programme of work proposed is as follows:-
  - (a) To continue studies into the bionomics of Glossina pallidipes:-
    - (a) The seasonal fluctuations, movements and activities of the species in relation to climate and weather, vegetation, and game.
    - (b) The activities of the fly at different hours of the day and the influence of temperature, shade and light, humidity (relative and saturation deficit) evaporation, cloud and other factors throughout the different seasons.
    - (c) The influence of seasons on dispersal and proportion of the sexes.
    - (d) The marking of flies to estimate true density, to ascertain movements and the ability of flies to cross prepared barriers cleared of bush and barriers of very dense bush.
    - (e) Micro-ecological studies in relation to the density of infestation; and the selection of breeding-sites.
    - (f) The distribution of breeding-places; and the provision of artificial breeding grounds.
    - (g) The varying degrees of concentration.
  - (b) To isolate the Nyaboro bush from the fly-infested block of Riamakanga, and from the fly-free area of Luatonga:-
    - (a) To maintain, extend and to widen corridors for trapping of Glossina pallidipes.
    - (b) To continue with clearing of undergrowth and to thin-out the trees in sections of Nyaboro as part of a scheme of discriminate clearing of bush.

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- (c) To widen the Kigoto - Kamaguthi corridor and to carry out discriminative clearing of the riverine bush in Riamakanga, and to extend trapping to Riamakanga.
- (d) To isolate Otuk from Ruma; and Roo from Ruma.
- (e) To devise traps more attractive to fly, and capable of effecting consistent, heavy catches.
- (f) To prepare large quantities of attractant for use with traps.
3. Immediately on approval.
4. Three years.
5. (a) Detailed annual estimates:

	£
1. Overseer @ £50 p.m.	360
2. Clerk @ £ 6 p.m.	72
3. 30 Fly boys @ £1 p.m.	360
4. 100 labourers @ Shs. 10/- p.m. (including rations)	600
5. 2 Meteorological Observers, 2 Game Scouts, 3 Carpenters and 2 Assistant Botanists @ £1-10 p.m.	162
6. Tools	65
7. Material (timber, hessian, gauze-wire, etc.)	75
8. Instruments (Meteorological) and apparatus	25 X
9. Stationery (field note-books, printed record forms, etc.)	50
10. Travelling and Subsistence	100
11. Contingencies	51
	£ 1,900

or £5,700 for three years.

X This estimate may be exceeded in the first year, but any excess would be covered by savings on other items.

(b) Yes.

6. Expenditure in Great Britain would only be expenditure on instruments and apparatus, i.e. £25 annually with a possible small addition in the first year.
7. The work has been in progress for nearly two years, but the grant is exhausted.
8. -----
9. -----
10. Direct grant.
11. -----
12. -----

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ENCLOSURE 3

REPORT OF EXPERIMENTS ON THE CONTROL  
OF GLOSSINA PALLIDIPES IN  
KENYA COLONY

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REPORT  
OF EXPERIMENTS ON THE  
CONTROL OF GLOSSINA PALLIDIPES  
IN KENYA COLONY

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\* \* \*

Investigations conducted under the auspices  
of the Veterinary Research Laboratory, Kabete,  
assisted by grants from the Colonial Development Fund  
and from the Local Native Council, South Kavirondo, Kenya Colony

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Prepared by

E. ANEURIN LEWIS, M.Sc., Ph. D.

Entomologist to the Division of Animal Industry,  
Department of Agriculture

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TSETSE-FLIES IN THE LAMBWE VALLEY, KENYA COLONY

Studies on Glossina pallidipes and experiments on its control

INTRODUCTION

Geography and Topography

The Lambwe Valley is in the South Kavirondo Native Reserve of Kenya Colony; it lies within latitudes  $34^{\circ} 10'$  and  $34^{\circ} 25'$  E and between longitudes  $0^{\circ} 30'$  and  $0^{\circ} 50'$  S; it stretches from Morea hill to the Kavirondo Gulf of Lake Victoria, a distance of twenty-three miles. The upper half of the valley seems to be enclosed by hills on the west, the south and on the east. The western group of hills are irregular, with the outstanding peak of Mirari reaching an altitude of about 7,000 feet above sea-level and 3,000 feet above the bed of the valley; the lower slopes are indented with numerous small valleys varying from two to three square miles, where most of the present native inhabitants have their cultivated plots and water-supplies. These hills are locally known as the Gwassi hills; they form an effective physical barrier between the valley to the east and the shores of Lake Victoria on the west. Morea hill stretches nearly across the Lambwe valley at its southern end; it separates the long strip of tsetse-infested country to the north from the comparatively fly-free area to the south. On each side of the Morea there is an opening leading from the Lambwe Valley to Maia point and Karungu on the Lake shore. The escarpment on the east rises steeply from 4,200 feet to about 5,200 feet, then extending as a plateau thickly populated by Jaluo clans of the Kavirondo people.

The distance across the valley immediately north of Morea is approximately four and a half miles; it gradually increases to nearly nine miles from Nyadenda to Kamwagi where the main valley turns northward and becomes much more open. The isolated mountain groups of Ruri on the east, and Gembe or Kasigunga on the west, break up the broadening valley, forming smaller valleys such as Kamwagi and Kisaka leading to the eastern plateau and Homa Bay. Holo Opiyo and Akatari connect the Lambwe with the shore of Lake Victoria to the west. Further north, the valley joins the low-lying littoral of the Kavirondo Gulf.

The land below 4,400 feet covers an area of 125 square miles. A considerable proportion of the valley is covered by very dense bush, more especially down its centre, from Morea to the vicinity of Ruri. Hidden by a belt of thick bush is the course of the Lambwe river which rises at Thaka near Morea. Seen from the air, or from the top of the eastern escarpment, the course of the Lambwe river is well-marked even through the most dense vegetation; but when descending into the valley, the river-bed is found to be generally ill-defined due to heavy silting. It is only during the rainy seasons, however, that water actually flows in the river, although small pools and swamps are found in the river-bed throughout the greater part of the year. After heavy showers that occur in this region during the rainy season, a large amount of water is discharged from the small mountain streams into the Lambwe, causing it to rise and flood the immediate neighbourhood. The river eventually flows through a small swamp on the shore of the lake and into the Kavirondo Gulf between Waturi and White Rock Point. The numerous small streams from the hillsides disappear underground before reaching the Lambwe river.

## Vegetation:

Irregular masses of dense bush extend along the banks of the Lambwe river from Morea to Ruri. They do not form a continuous belt but are broken into four large patches somewhat isolated by open country and scattered thickets. At the southern end of the valley, the dense bush spreads out from the river to the west; it tends to link up with thickets on the slopes of the hills and in the smaller valleys. Midway down the valley the vegetation between the western hills and the riverine bush consists of widely scattered trees, Balanites aegyptiaca being most numerous, while Boscia caloneura, Lannea Kirkii and Acacia seyal are present in comparatively small numbers. Below the eastern escarpment there is a narrow strip of park-land comprising Balanites aegyptiaca interspersed here and there with small areas of Acacia drepanolobium. This strip is followed by a thin line of more dense bush running parallel to the escarpment, and again by a narrow zone of open savannah before the riverine bush is reached. Between the northernmost block of dense bush and the shores of the Gulf, the country is flat, plain-like, with a uniform cover of Acacia drepanolobium.

Euphorbia turicalli and ambatch are found at Waturi and along the lake-shore. The former is the dominant species in a tangled mass of bush, and of the undergrowth in the shade of Euphorbia ingens. This bush provides suitable shelter for three species of tsetse-flies. The large masses of vegetation already mentioned are in Nyaboro, Riamakanga, Otouk and Ruma. The first is not entirely riverine; it is a compact mass with projecting tongues meeting some groups of bush on the hill-sides - notably Kigoto; and others connecting it with Riamakanga which comprises several smaller patches of more scattered bush. Euphorbia ingens is conspicuously dominant in Nyaboro; under its shelter thrive woody shrubs and stunted trees including Cadaba adenstricha, Capparis tomentosa, Euchlea divinorum, Grewia similis and other species; Rhus glaucescens, Harrisonia abyssinica and Gymnosporia senegalensis. Some more open spaces within Nyaboro contain patches of young Acacia seyal indicating the sites of native villages and shambas. Riamakanga block of bush contains an abundance of Euphorbia trees also, but on the whole they are either free from undergrowth or form the nucleus of separated thickets. Along the river in all areas Euphorbia thrives, but the density of the bush is due to the prevalence of tangled undergrowth. Euchlea divinorum and Rhus glaucescens are most abundant, and in addition to the shrubs in Nyaboro, other frequent components of the riverine undergrowth are Soutia buxifolia, Pluchia dioscoridis, Cissus rotundifolia, Acacia pennata, Croton spp., and Jasminum mairitianum.

The flora in Otouk and in Ruma is somewhat similar, but other species of trees and shrubs are found which, however, are not very common.

Without entering into further details as to the species of the flora, it is necessary to add that several valleys - Owiga, Rari, Nyadenda and Roo - in the western hills, and many ravines - viz. Kisingiri, Nyamarigi, Nyabor Ondiek and Kerlango - on the east escarpment are heavily wooded. In most cases the vegetation follows the beds of the streams and continues well down into the Lambwe Valley, The open country or "tree-veld" on either side of the riverine bush of the Lambwe provides good grazing, tall grasses being well established under the shade of the trees and shorter species occurring on the more recently abandoned cultivated land. Themoda triandra dominates the other species, the most common of which are Panicum coloratum, Panicum spp., Chloris gayana, Leptochloa obtusiflora, Sporobolus filipes, Amphilophis portusa, Andropogon pratensis,

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Cynodon dactylon (?), and various species of Hyparrhenya, Eustachys, Setaria and Digitaria. Members of the family Cyperaceae indicate localities of swampy land.

A thick carpet of Sansevieria covers the rich loam found in the dense riverine bush and in clumps of thicket throughout most of the valley. This plant is extremely abundant and seems to have assisted the shrubby undergrowth to suffocate and to replace the earlier grasses.

Climate:

A meteorological station was erected on Kiabakari hill in December, 1934, to ascertain the general climatic conditions of the Lambwe Valley prior to studies into the eco-climatic conditions in the bush and in localities of different fly-densities. The records were considered to be necessary to form a basis for comparative studies on the different climatic factors that might influence the activities and fluctuations of the fly-community; to estimate the possibilities of providing improved water-supplies in the event of successful control of G. pallidipes; and to formulate a scheme of re-settlement for the maintenance of cleared, and partially cleared, areas of bush country.

Most of the instruments for the general, and for the bush, stations were purchased from the grant allocated from the Colonial Development Fund. Additional instruments were provided by Mr. A. Walter, Director of the British East Africa Meteorological Service. Mr. Walter arranged for the instruction of the native meteorological observer; and has given encouragement and valuable help at all times. His advice and that of Mr. Grinstead, also of the Meteorological Service, is gratefully acknowledged; Mr. Grinstead was invited to visit the valley, and his report is given in full as follows:-

The following notes on the climate of this area are based on analyses of nineteen months' records obtained on Kiabakari, six weeks' records at the "bush" (Otouk) station and on observations made during a visit to the valley by the writer in April, 1936.

The Lambwe Valley, being situated close to the shores of Lake Victoria, has what may be termed a "modified coastal climate". Further, being situated well in the interior of Africa, its climate is to a large extent the result of local conditions as determined by the varying declination of the sun and its consequent influence on the Lake area. These local conditions are modified during the regimes of the south-east and north-east monsoonal currents, especially the former; but the influence is variable and not at present completely understood.

The proximity of the lake produces a comparatively small diurnal variation of temperature and humidity for a situation so near the equator. It is responsible for the very frequent showers and also for the diurnal variations of wind.

It is convenient to treat the various elements separately:-

(a) Temperature:

On Kiabakari, the mean annual temperature is 72° F., the maximum 84° F., and the mean minimum 63° F. The extremes are:- Maxima 95° - 100° F., minima 55° - 60° F.; and the daily range just over 30° F.

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At the meteorological station on the bush itself, the mean temperature appears to be some 2° - 3° F. lower than on Kiabakari, the mean maximum being approximately 10° F. lower. The reason for these variations is that the bush, being shaded, does not reach such a high temperature during the day nor, through reduced radiation, so low a temperature during the night. On clear, calm nights, however, cold air rolls down into the valley from both sides, giving frequent valley mists or fogs. It may be noted that the Dew Point of the air is about 61° F., so that with this process, mist is easily formed.

Curves of average variation of temperature on Kiabakari are given in the figure, from which it will be seen that the mean hourly values range from 66° F at 6 a.m. to 82° F at noon. The mean daily range is 21° F. The mean monthly temperatures range only from 70° F to 74°, June and July being the coolest months.

The diurnal variation at the bush station is retarded in phase in respect to that in the open, due to the entrapped cold air and poor circulation in the morning.

(b) Humidity:

The mean diurnal and annual variations of relative humidity are given in figure. The mean vapour pressure is approximately 19 mb. The range of the mean hourly values of relative humidity is from 52% to 75%; and of the mean monthly values from 57% to 70%. At the bush station, the humidity is normally from 5% to 10% higher than at Kiabakari, the greatest difference being during the two or three hours after sunrise.

(c) Evaporation:

Absolute values of evaporation are not available but Dr. Hirst has estimated the average annual evaporation in the Lake Victoria basin at approximately 50 inches. In the bush itself, the evaporation appears to be from 15 - 20% less.

(d) Cloud Amounts:

Except during the night hours, the sky is rarely cloudless; the mean cloud amounts at 8.30 a.m. and 2.30 p.m. being 6 and 7 tenths respectively.

(e) Rainfall:

The probable average rainfall as deduced from the Kiabakari records and from other available data is given in the figure. Very wide variations from the average may be encountered and no month can be relied upon to be dry. January is the driest month and the expectation of rain on any day is least in this month. In the other months, however, the average number of days of rain is thirteen, and the seasonal variation in amount is rather the result of intensity of rainfall than of frequency of occurrence. The rainfall is, of course, almost entirely of the "thunderstorm" type.

(f) Wind:

The wind of the valley is of a purely local type and is the result of the on-and-off-shore winds being modified by the topography. In the morning the wind is ENE (5 mph at 8.30 a.m.) and in the afternoon WSW (13 mph at 2.30 p.m.).

Soil:

The soil is volcanic in origin. On the western hill-slopes, it forms a very thin layer over rock; and its surface is strewn with large boulders. The small valleys contain a considerable amount of alluvial soil, and from an examination of the dry, flood-water courses, appears to be composed of talus scree, boulders and gravel that is often found in well defined layers. The soil on the hills and in the upper portions of these valleys is light in colour and in texture; it does not appear to be retentive. In the lower portions, deeper layers and more fertile soil are encountered. Here, and for some distance down into the main Lambwe Valley, the natives succeed in producing excellent crops of simsim (*Sesamum sp.*), maize (*Zea sp.*), mtama (*Sorghum sp.*) and chirogo (*Phaseolus sp.*) in years of normal rainfall. Bananas are grown along the stream-beds; ground-nuts appear to do well; and cotton, although not always of a very high quality, provides a useful cash crop. Cultivation is possible even on the hill-slopes. The earlier native inhabitants, as has already been mentioned, constructed stone terraces (see photo) over extensive areas. Ordinary digging and cultivation would doubtless have resulted in a serious amount of soil erosion, whereas the terraces have prevented this and have enabled the indigenous grasses to form a good cover providing also excellent grazing if not too heavily stocked. The lower reaches of the valleys of Oma, Owiga, Ugofo, Rari, Nyadenda and Nyakiya consist of a heavier and richer soil that is also darker and of a red loam type. In Oma and Owiga, there is a considerable amount of clayey soil. As one proceeds from the foot-hills to the flatter country in the main valley the dark loam merges into a typical "black-cotton" soil apparently derived from basalts. This region is often water-logged during the rains and becomes extremely hard in the dry seasons. Dobbs, writing of his experiences in the Kisingiri and Gwasssi districts in 1910, states "the Ulambwi (Lambwe) river exists only during the rains, when indeed the whole valley is a swamp. In dry weather, it is simply a line of caked mud running through thick bush to the lake".

From Nyaboro to Ruma - and beyond - this zone of "black-cotton" prevails; and it frequently converts the area into a marsh. It extends even into the Ruma bush, where one often finds the soil under a sheet of water.

The banks of the Lambwe river contain a large amount of sand, silt and mud brought down by the water when the river is in full spate. Within the bush, as may be expected, the soil is of a heavy forest loam usually covered by a thick layer of decaying leaves and twigs. There are also comparatively small glades with good grass, but where the depressed character of the surface and the clayey nature of the soil provide for the formation of small, shallow pools or wallows during the rains.

Water supply:

A report of this kind would be incomplete without some remarks on the water-supplies in the Lambwe valley.

Native people are reluctant to inhabit any area where there is an insufficient amount of water for human consumption and for the stock.

Cattle, sheep and goats being the form of native currency and wealth; milk and meat being essential to their health and welfare, it would be difficult to persuade the native people to re-settle an area where cultivation alone can be practised, and the production of food and cash crops the only means of existence.

Tsetse-fly infestation renders the keeping of stock impossible or, at any rate, highly precarious. A fly-infested area such as the Lambwe frequently has a rich cover of grass and would normally carry large herds of cattle. The abandonment of the area results in the neglect of water-holes that become silted up, or that disappear entirely. In time, areas that only a few decades ago supported thriving native communities are rendered waterless - or nearly so - and consequently uninhabited.

A scheme of tsetse-fly control is obviously bound up with the provisions necessary to keep the population and the stock in an area so that the people may continue to maintain it free from fly once it has been reclaimed. It would be inadvisable to attempt any persuasive measures for re-settlement until such time as would warrant a reasonable assurance of safety for the native stock and until such time as facilities were provided for a sufficient supply of water.

The prospects of watering places in the Lambwe valley were investigated by an officer engaged by the District Administration. It was found that there were many springs, wells and remains of old earth dams scattered over the valley. In 1934, an experienced hydrographic surveyor from the Public Works Department visited the Gwasssi location to investigate the actual and potential water resources. Unfortunately he was not asked to report on the whole valley. His recommendations were for that specific location. It is of interest here to note that owing to the steep slopes in the upper sections of the valleys (in the Gwasssi hills), and the geological formation, the conservation of earth dams in those sections would not be a feasible proposition. Boring for water appeared to be the most practicable method of obtaining additional supplies.

The Tsetse-fly Overseer was instructed to locate and to plot all possible sources of water in and near the valley. A list of these potential watering-places is given over-leaf.

It is of interest to learn from Mr. C. M. Dobbs' article that water was scarce in the Upper Gwasssi in 1910 and was then obtained only at the bottom of the deep pits that the natives dug in one of the side valleys running from the mountains. At a depth of about eight to ten feet, very good water was found. It was customary, even in those early days, for natives to make enormous "saucers" of mud and to fill these with water for calves, and in some cases, for the larger cattle.

Many of these "saucers" and several small pits are still to be found in different parts of the valley, at the foot of the hills and escarpment. Derelict earth dams can be traced in the main valley; and there is evidence that the inhabitants collected water from the mountain streams by means of deep channels and furrows that supplied fairly large surface reservoirs.

The Administration Department carried out a small experiment on water conservation near to, and in, the Lambwe Valley. An old earth dam existed in Lutonga just above Sanjuero; this was cleared out and the earth embankment on the lower side extended and built up. Up to the present it seems to be satisfactory and has a capacity of about

## Surface water-supplies in the Lambwe valley

Name	Locality	Flow (gals. per day) or capacity	Remarks
-	West Roo	?	Many small dams and game wallows that hold water only in the rains.
-	Akatari	?	Storm-water flows in stream-bed during rains; lost in seepage lower down the valley.
-	Holo Opiyo	?	As in Akatari.
-	Nyakiya	?	Permanent, small stream; earth-dams built across stream to conserve a supply in dry weather.
-	Nyadenda	147,000	Permanent stream at head of valley; two silted water-holes below; and one experimental earth tank.
-	Rari	?	Good permanent spring pools at head of valley; several dams below.
-	Ugoro	?	Permanent spring at head of valley; old water-holes below.
-	Kiabakari	?	Very small pits; and two, small, unused dams.
Kichiriba	Owiga	2,050	Not permanent.
Misembe	Owiga	1,700	Situated at the head of the valley.
-	Owiga	?	Small spring and dam below Chief's village.
-	Owiga	?	Two, old earth-dams below motor-track.
-	Kigoto	?	Two water-holes silted up.
-	Mchanja	770	Decreases in dry weather.
Oma	Misamba	2,500	Good flow of water.
Oma	Oma	500	Wells in clay, each well giving about 2 gallons per hour.
Masenyo	Tonga	150	Dries up in hot weather.
Mwibegenye	Tonga	500	Dries up periodically.
Misa	Tonga	1,250	Night flow conserved in dams.
-	Luatonga	168,000	Renovated dam - under experiment.
Sanjuero	Luatonga	?	Two, old, derelict dams.
Morea	Morea	?	Water-holes at the probable source of the Lambwe river.
-	Theka	?	Large dams fed by springs.
-	Genda	?	Spring and small stream. Also a much coveted salt-lick.
Kisingiri	Kisingiri	?	Springs, seasonal stream and rock pools.
-	Nyamirigi	?	As in Kisingiri.
-	Kerlango	?	As above.
-	Nyabor Ondiek	?	Old earth-dam fed by deep furrows from hill-slopes.
-	Sigama	?	A dam at the foot of the scarp.
-	Kangwagi	?	Small spring - not permanent.
-	Kangwagi	?	Permanent stream.
Sidede	Kisaka	?	Permanent water in small stream.
Siwalu	Kisaka	?	As at Sidede.
-	Goyo river	?	Large pools from seepage water
-	Lambwe river	?	Intermittent river. Numerous pools and game-pits in the river-bed. They last for a considerable time into the dry season.

In Nyaboro and other blocks of bush, there are numerous game-pits and wallows that become water-logged and hold surface-water during, and for some months after, the rains.

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168,000 gallons. Below Nyadenda a tank was dug to collect approximately 147,000 gallons. A long dam was built below the tank; it has not been sufficiently firm to withstand some of the rush of water after heavy thunderstorms. It seems not unlikely that numerous small watering centres could be provided in the Lambwe proper, and these would suffice until more permanent supplies could be arranged.

While on this subject, it is noteworthy that Dixey in his handbook on "Water supply" (1931), refers to the effects of deforestation on soil erosion and the depletion of water supplies, both surface and underground. In a locality like the Lambwe Valley, the wholesale clearing of bush may well aggravate the present lack of water, whereas partial clearing may serve to eliminate the tsetse and at the same time provide better situations for the construction of surface watering-places. Dixey expresses the opinion that the clayey floors of dambos and vleis usually make excellent sites for small reservoirs. In Roo and in Nyaboro there are several dambos that are now often used by game as mud-wallows or, during the rains, as drinking pools.

Wholesale clearing, apart from the immediate heavy cost, will tend to increase soil erosion and accelerate the complete desiccation of the valley.

Further efforts to solve the scarcity of water in the valley are under consideration by the local administrative officers.

#### Population and Stock:

The Lambwe valley is uninhabited. A few villages are concentrated in the small fertile valleys of Misamba, Mchanja, Owiga and Urogo; a few native huts are dotted about on the slopes of Kigoto and near the water holes at Theka; there is also a collection of villages in the Kaksingiri valley between Nyadenda and Holo Opiyo.

The population is small and concentrated in the valleys and at the foothills. The stock is negligible in so far as there are only a few hundred head of cattle that are usually to be found in and around the villages. The cattle are often taken out of the valleys to the lake-shore at Mtara bay and to the salt-licks in the vicinity of the Miramba river. They are grazed on the slopes of Kiangongo and Kigwa, and in the valleys of Tonga and Oma; they are seldom taken down into the Lambwe valley. The number has been increased slightly in recent months. There are now about three hundred cattle in the valley, but it is anticipated that no additional stock will be brought into the area without losses from animal trypanosomiasis. As far as this disease is concerned, several cases have occurred in the Chief's herd and among cattle taken into the area by other natives. In August, 1936, animals infected with T. congolense were treated with tartar emetic issued free of cost by the Veterinary Research Laboratory. Treatment will be continued in order to assist the present inhabitants to keep the small number of cattle now in their possession.

#### Game:

Game is abundant. Herds of elephant seem to have their home in Ruma; they move about a great deal and trek from Ruma to Otouk, Rari, Nyadenda, Roo and Ruri. They often visit the lake-shore and sometimes migrate to the Kuja river where experiments on the control of Glossina palpalis are being conducted. Buffalo roam about from one or more of the bush areas to others; they, sometimes, follow the elephant but may move further up the valley to Nyaboro and even to Kagana and Luatonga. Hartebeest and Topi frequent the savannah areas

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hills. Also, small numbers of G. pallidipes are periodically collected in Luatonga immediately south of Morea. On one occasion, it has been found near Gotbim a few miles south-east of Morea and between that hill and the Kaniadoto rest camp.

#### History:

A brief statement on the history of the valley and its people will indicate the need for further and closer studies on Glossina pallidipes, and the suitability of the area for research and experimental control.

It is fairly certain that the Lambwe valley was densely populated and contained numerous herds of cattle in the early years of the present century. On the hills there are definite traces of the habitations of an energetic tribe. Stone walls and terraces may still be seen on Kiangongo, Ugoro and on the slopes of Rari and Iringa. Disused water-holes and earth dams are to be found in the valley; and there is clear evidence of cultivated patches of land which have not long been abandoned. In the Administrative records for 1908 it is stated that cattle were fairly plentiful in Gwassi, plentiful in Kabwai, Kasigunga and numerous in Kaniamwa - these being locations or "rural districts" each including a section of the valley. In Kisingiri (or Usengere), the report of the year 1911 states, "There has been a great deal of sickness amongst the live-stock in recent years which is now somewhat depleted". Europeans who have known the area for very many years and who have always been in close touch with the natives speak of the numerous cattle in the valley in 1915 and corroborate the information given by the natives. One gathers from the present native inhabitants that heavy mortality from malaria and human sleeping sickness among the tribes on the lake-shore, especially in Kasigunga, gave rise to a fear that caused a steady evacuation of the area. As the people fell back the menace seemed to follow them. It extended to and destroyed their cattle and the people were forced to retreat up the Lambwe. Disease then attacked the cattle from other directions also and rapidly reduced their numbers. Witchcraft was suspected and it appears that the ruling chief Matunga - the present Chief's father - was murdered by the elders for placing witchcraft medicine in the grass and water that killed off many cattle. After this incident large numbers of the natives left the valley and journeyed to Tanganyika. The present Chief and many elders from the different locations state that, only after most of the people had left did the bush become thick, and beyond their control. They point out stretches of land at the edge of Nyaboro that were obviously cultivated not many years ago, and that are now rapidly reverting to dense bush.

It is not strange, perhaps, that the inhabitants at one time spoken of as energetic agricultural and pastoral people, are now said to be listless and suffering from "lake lassitude". Their wealth has dissipated; their relations scattered and they have become dispirited as their land has been ruined by the invasion of tsetse.

The first authentic record of the presence of G. pallidipes in the district - not actually in the Lambwe valley - is that by Christy in 1910. In his map of South Kavirondo he shows G. pallidipes occurring in Kisingiri (Usengere) about four or five miles inland from Mungere Bay - probably in the lake-side section of Roo. Brief references are made to the existence of "fly" and cattle disease in the Administrative records for several years later; but it was not until 1931 that an officer (Mr. J. Nimmo) of the Medical Department carried out a fly survey of the whole valley. This officer discovered only a few Glossina pallidipes in Roo; the fly density was higher in the lower reaches of Ruma bush and still higher in the

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upper half of Ruma. Smaller numbers were captured in Otouk, and few in Riamakanga. No flies were caught in Upper Riamakanga; none was collected in Nyaboro. No records of fly appear to have been made for that stretch between Ruma bush and the mouth of the Lambwe river, nor are there data, on the map, for the lake-shore between Waturi and Homa Bay.

Administrative officers in charge of the district must have long realised the value of utilising the Lambwe valley.

Its infestation by tsetse and the need for clearing the bush where elephant lived and from which they roamed to raid cultivated areas in the vicinity, prohibited the officers launching a scheme which would involve considerable expenditure incommensurate with immediate requirements. In a memorandum to the Kenya Land Commission, Major Buxton, referring to an experiment in individual land tenure under strict development conditions, pointed out that such an experiment might be made "(a) by the reclamation of land in the Kuja and Lambwe valleys where bush-clearing is in progress; (b).....; (c).....;" Major Bond, who was also a District Officer at Kisii refers to bush-clearing in a Memorandum dated 11th May, 1932. He divides bush-clearing into two categories, namely:-

- (a) Clearing of bush in connexion with the sleeping-sickness campaign.
- (b) Experimental clearing of bush in an attempt to eliminate big game and cattle fly, and induce a redistribution of the population.

He adds "As regards the latter category of bush-clearing, the experiment in the Olambwe (Lambwe) will be valuable, and there should be no difficulty or danger in re-introducing cultivation there, but the area will require careful watching for some years ....."

Commenting on Major Bond's remarks, Mr. H.R. Montgomery, then Provincial Commissioner, Nyanza Province, states that "A comprehensive scheme of bush clearing is well in hand, and will be carried on year by year".

The economic value of the Lambwe valley is widely appreciated, and the need for re-introducing its practical utility is recognised. The fly menace, however, is the chief difficulty; and it is a problem that still awaits solution. The species of tsetse involved - G. pallidipes - has not been studied as extensively as G. palpalis, G. morsitans and G. swynnertoni for instance. Its habits are only generally known, and they have not been subjected to continued scientific investigation and experimental analyses. Such studies are not without practical value in the Lambwe as in other larger areas of Kenya Colony, and they may lead to more efficient and economic methods of control than haphazard clearing of bush without adequate knowledge of the particular species of fly and its bionomics.

#### The need for exhaustive studies of G. pallidipes

The importance of studies of G. pallidipes and its experimental control will be appreciated by the knowledge that this tsetse is widely distributed in Kenya, and requests have been received from different districts for recommendations for its control and eradication. Recommendations have been made, but no assurance of complete success have been entertained because of the lack of accurate information on the reaction of the fly to such measures. The fly-infested districts in Kenya cover enormous areas - some being inhabited by pallidipes

only, while others contain also palpalis, brevipalpis, longipennis, swynnertoni and austeni. The pure pallidipes belts, however, offer excellent opportunities for thorough investigations into the biology of that species.

The problem is not confined to Kenya; it affects South Africa where Harris' carried out preliminary studies more especially on trapping; it exists in Tanganyika in mixed belts, and Swynnerton has considered it desirable to implement our present investigation in the Lambwe by another study in a mixed austeni - brevipalpis - pallidipes zone at Kilifi in Kenya. In Uganda G.pallidipes occurs together with palpalis and morsitans.

A brief account of the work on G.pallidipes in the Lambwe valley was submitted to the Conference on Co-ordination of Tsetse and Trypanosomiasis (Animal and Human) Research in East Africa; and it was recommended "that, in view of the short time the work in the Lambwe valley had been in hand and its great importance, it should be continued at least until the next meeting of the Conference".

The following is a more detailed report of the work carried out with the assistance of a grant from the Colonial Development Fund, supplemented by a further grant from the Local Native Council, South Kavirondo.

The scheme of experimental control of G.pallidipes

Grants:

Out of the sum of £6,160 voted by the Colonial Development Fund Committee for experiments on tsetse-fly control in Kavirondo, an allocation of £2,120 was made for experimental work on Glossina pallidipes in the Lambwe valley. It was approved that the experiments should be directed to control the tsetse by means of trapping and without clearing all the bush. Arrangements were made and agreed to by responsible officers of the Administration, Medical and Veterinary Departments that the cost of any necessary bush-clearing should be borne partly or entirely by grants of money from Local Native Council, South Kavirondo. The sums voted for the Lambwe project were £100 in 1934, £800 in 1935, and £600 in 1936. The vote of £600 in 1936 was governed by the condition that half the amount should be utilised for bush-clearing directly beneficial to the local natives, while the other half should be used in connection with the experimental clearings.

Staff:

It will be more convenient to deal at this juncture with the staff and the direction of the project.

Authority to expend the grant from the Colonial Development Fund in so far as the Lambwe experiments were concerned was vested in Dr. Paterson (Director of Medical Services), and Mr. Daubney (Chief Veterinary Research Officer), and it was agreed that the work in the Lambwe valley should be put into operation in 1935 after preliminary fly-surveys had been carried out in 1934. It was hoped that an experienced field-officer from Mr. Swynnerton's staff in Tanganyika could be engaged to supervise the programme of work on G.palpalis in the Kuja river area for the first year, and that he would be able to devote his attention to a prepared scheme in the Lambwe during the second year. This was later considered impracticable; and Mr. Swynnerton's advice was solicited on the possibility of providing another officer for the Lambwe. Commander D.E. Blunt was recommended for the post, and was appointed as Tsetse-fly Overseer in January, 1935. Mr. C.B. Symes, Medical Entomologist, Kenya, agreed that Mr. R.T. Vane,

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Overseer in the Kuja experiments, should recruit and train a nucleus of natives as fly-boys and pupae searchers for the Lambwe, that a number of single-screen or Shinyanga traps be constructed at Kaniadoto and that Mr. Vane should carry out a fly reconnaissance in the valley and submit his report during 1934.

Mr. Swynnerton accompanied by Mr. Daubney and Dr. E. A. Lewis (Veterinary Entomologist), visited the Lambwe valley in October, 1932, and the advice of Mr. Swynnerton was incorporated in a preliminary programme of experiments outlined by the Veterinary Entomologist and approved by Mr. Swynnerton (emphasising certain points) and by Mr. Daubney.

Two experienced native fly-boys were provided by the Department of Tsetse Research, Tanganyika; eleven were transferred from Kaniadoto, and several others were trained in the Lambwe during the early months of 1935. Only those natives who had proved efficient and reliable after a month's trial were finally engaged on regular fly-rounds. The number of boys engaged for patrols was twenty-four. Six were engaged to collect tsetse from traps and thirty were employed as pupae searchers. Many of the latter were transferred to bush-clearing, or promoted to game-observers, botanical assistants, or put in charge of small gangs of labourers. It was found to be extremely difficult to obtain an efficient native clerk; and it was only after several disappointments that a reliable headman was engaged. A native boy was trained as Meteorological Observer at the Meteorological Station, Kabete; and three native carpenters were recruited for construction of tsetse traps. The most promising natives were given a course of instruction on tsetse and their economic importance by the Entomologist at the Veterinary Research Laboratory, Kabete.

The continued illness of Commander D.E. Blunt towards the end of 1935 and in the first few months of 1936 compelled him to apply for admission to hospital and for medical examination. He was invalided out of the service in April, 1936, after observation and treatment for nearly three months. During Commander Blunt's illness, Mr. North-Lewis, a member of the Veterinary Research Laboratory, Kabete, was sent to supervise the field experiments until the vacancy of Tsetse-fly Overseer was filled by the appointment of Mr. W.P. Langridge, who was known to have had considerable experience in laboratory and field routine work.

A three-roomed hut, thatched with grass, was built on Uguro hill for the accommodation of the Overseer. Offices were provided near the hut; and a rest camp was constructed on the slopes of Sanjuero. The majority of labourers were housed in two long huts at Sanjuero, where there were also several huts for the headmen, fly-boys, medical dresser, and their families. Three further huts were erected near the rest-camp to be used, respectively, as a store for maize meal, for tools and as a dispensary. Several other huts were built for fly-boys and pupae collectors throughout the valley.

Labourers for bush-clearing were recruited from the different locations in South Kavirondo. At first, the natives turned out in satisfactory numbers - some two hundred and fifty were engaged in January, 1935. Later, however, the attraction of higher wages offered by the gold-mining syndicates in the vicinity caused many of the labourers in the Lambwe to leave. It was necessary, therefore, to increase the wages and to provide food for those employees receiving not more than 20/- per month. Although the number of labourers continued to be low, the quality of the work improved with experience and supervision.

Preliminary reconnaissances:

Before proceeding with the actual experiments it was desirable to obtain further information on the distribution of the fly, and the degree of infestation throughout the valley. Two reconnaissances were made - one from June 1st to June 6th, 1934, and another from June 16th to June 22nd, 1934. In the first period, the northern half of the valley was surveyed; in the second, the southern half was covered. Searches for fly were made also in the Nyadenda valley, Akatari ravine, Nyamatoto and Roo; Olando, Bado Ogono and Waturi; the lower stretch of the Lambwe from Powo stream to the lake-shore.

Table I shows, in brief, the result of the first survey:-

TABLE I.

Date	Species	M	F	Total	No. of Collectors	Place of Route	Time Taken to collect	Flies per boy-hour
2.6.34	<i>G. palpalis</i>	95	5	101	2	Waturi	9 a.m. - 1.30 p.m.	10
	<i>G. pallidipes</i>	24	1	25	2	"	" " "	2.5
	"	20	5	25	2	Bado Ogono	8.30 a.m. - 2 p.m.	2
	"	2	-	2	2	Olando	2 p.m. - 3 p.m.	1
3.6.34	"	3	5	8	2	Nyamatoto		
	"	48	26	74	4	(Open thickets)	8 a.m. - 3 p.m.	.5
	"	37	34	71	4	Roo Valley	10 mins 12.30-1 p.m.	(111) 82.5
	"	56	43	99	2	" "	20 mins)	(54)
4.6.34	"	2	-	2	5	Olando to Nyamatoto	1.30 p.m. - 2.30 p.m.	50
	"	2	-	2	5	Akatari	7.30 a.m. - 8 a.m.	.8
	"	1	-	1	2	Holo Opiyo	11.30 a.m. - 1 p.m.	
	"	1	-	1	2	Nyadenda	2 p.m. - 3 p.m.	
5.6.34	"	229	138	368	3	Nyadenda to Kerlango	8.45 a.m. - 12.30 p.m.	20.5
	"	26	18	43	2	Nyadenda to West Ruma	8.45 a.m. - 2.30 p.m.	5.7
	"	51	50	101	3	Ruma	11.45 a.m. - 12.30 p.m.	60.5
	"	14	9	23	3	"	12.30 p.m. - 2.30 p.m.	3.0

The majority of specimens in the last two totals from Ruma were collected on the fringes of dense bush as the fly-boys entered open thickets on the west side; and in scattered clumps of thicket in the east side respectively. Only occasional flies were caught in close vegetation and none in the dense interior of Ruma. Numerous tsetsees were taken when fly-boys were stationary near pools of water in roo, and also in small open glades about eighty yards away. The flies were no less numerous when the boys were moving slowly.

One male *G. pallidipes* was collected in Kerlango ravine.

The second reconnaissance was carried out after a short period of heavy rain. For several days it was dull and cloudy; and, in the early mornings, there were several hours of drizzle followed by bright sunshine.

Table II gives the result of this survey:-

TABLE II.

Date	Species	M	F	Total	No. of Collectors	Place or Route	Time taken to collect	Flies per boy-hour
16.6.34	No flies caught				6	Kerlango ravine	3 p.m. - 6 p.m.	
17.6.34	<i>G. pallidipes</i>	158	135	293	4	North Otouk	9.30 a.m. - 12.45 p.m.	22.5
	"	20	11	31	3	Otouk-Lambwe(N)	11.30 a.m. - 11.40 p.m.	60
	"			47	3	South Ruma (W)	12.5 p.m. - 12.10 p.m.	188.4
18.6.34	"	137	174	311	2	Otouk(Water-hole)	9 a.m. - 1 p.m.	39
	"	5	3	8	5	Otouk-Lambwe (S)	9.50 a.m. - 9.55 a.m.	19.2
	"			32	5	South Ruma (E)	11.40 a.m. - 11.45 a.m.	76.8
	"	36	32	68	5	Rari to Lambwe	12.30 p.m. - 1.45 p.m.	10.2
	"	8	6	14	2	Rari valley	11.30 a.m. - 1 p.m.	4.6
19.6.34	"	160	215	375	3	Kiabakari to Nyaboro	8.30 a.m. - 2.30 p.m.	25
	"	21	25	46	3	Godorobondo to Sanjuero	" "	3
20.6.34	No flies caught in Ruatonga							
21.6.34	<i>G. pallidipes</i>	102	163	265	3	Riamakanga-Lambwe (N)	8.30 a.m. - 11.30 a.m.	29.4
	"			9	2	Riamakanga-Lambwe (S)	10 a.m. - 11.30 a.m.	3
	"	39	74	113	2	Riamakanga-Owiga	11.30 a.m. - 1.30 p.m.	28
22.6.34	"	5	-	5	2	Kiatingiri )	6 a.m. - 2 p.m.	.6
	"	1	-	1	2	Nyamarigiri )	" "	.1
	"	16	20	36	2	Otouk - Gendu	" "	3
	"			140	2	South Otouk )	10 a.m. - 2 p.m.	17.5
	"	308	449	757	2	Otouk-Lambwe )		94.6

*G. pallidipes* was abundant in the open bush between Ruma and Otouk but much less common within the tangled shrubs and thickets of Otouk. The fly showed a definite preference for the numerous game paths, the river-bed and water-holes. Flies ceased to appear in the low scrub nearer the western hills. In Riamakanga there was a concentration along the river, but there were also large numbers on the outskirts of thickets a short distance from the riverine bush. It was noted that the vegetation in Riamakanga was much more open than that of Otouk, Ruma and Nyaboro. The flies caught on the route from Kiabakari to Nyaboro were mostly from Riamakanga area; fifty were collected on the edge of Nyaboro.

Throughout this period, only four *G. pallidipes* were captured in very dense bush.

These reconnaissances provided additional information to the more general survey of 1931; and they disclosed several differences from the result of that investigation. They showed that *G. palpalis* and *G. pallidipes* were present in a narrow zone along the Kavirondo Gulf; that the thorn-scrub area from near Povo stream to the mouth of the Lambwe harboured very few *pallidipes*, (only one specimen was caught). The thickest bush areas seemed unfavourable to *pallidipes*, and the flies were most frequently and abundantly met with in open tracks through the bush or on the borders of clumps and in glades. At the southern end of Ruma they were particularly numerous in a clearing

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made by the Administration a few years ago. The fly-density in Otouk was greatest along the river-bed; it decreased at the south end of this mass of bush; and again increased in Riamakanga. There was a distinct drop in the numbers for Nyaboro, and no specimens were found in Luatonga. It was made clear, also, that infestation was not confined to the main valley. Roo showed a high density; Nyadenda, Akatari, Nyamatoto and the lighter scrub on the hill-slopes harbour a not inconsiderable population of tsetse. The ravines of Kerlango, Kisingiri and Nyamarigi shelter at least a few flies.

The original programme:

The information gleaned from the reconnaissances provided a basis for the actual experimental project of controlling G.pallidipes by trapping and by partial clearing of the bush. It was obvious that the degree of success attained, and the progress of the work, should be ascertained from time to time in order to concentrate on any measures or to modify the plans in accordance with the developments. This could best be done by regular patrols by trained fly-boys along selected routes or "fly-rounds". Such routine work is essential in reclamation schemes so that the observer may keep "his finger on the pulse of the fly community".

The distribution of the bush and its natural rough division into blocks indicated the most economic method of partial clearing that would also serve for trapping experiments where the fly-densities differed.

The ideal scheme was an ambitious one involving considerable expenditure in labour; and in material for construction of traps. The isolation of the whole infested zone appeared feasible by an efficient barrier across the valley to the north of Ruma, and another barrier between Morea hill and Nyaboro bush. Roo could be separated from other areas by extending the north clearing along the western foot-hills from Nyamatoto to near Waturi.

Wide corridors between Otouk and Ruma; between Riamakanga and Otouk; also between Nyaboro and Riamakanga, would assist both research on the bionomics of G.pallidipes, and the scheme for its control. Comparisons could be made on the effect of reclamation efforts in blocks where the fly-density appeared to be low, moderate and high; and invaluable data could be collected on the degree of discriminate clearing of bush required to discourage further spread of tsetse, to eliminate the flies in lightly infested areas, and to reduce or eradicate the pest in those areas where G.pallidipes had become firmly established.

The modified programme - barrier clearings, corridors and partial clearing of bush.

Without the facilities to carry out this ambitious scheme, it was decided to utilise the available money for operations in the upper end of the valley and for studies on the habits of G.pallidipes in the whole area.

Morea hill marked the southern limit of fly-infestation; it would provide a natural obstruction to the vision of the tsetse if the slopes were cleared of bush; and it would further be protected by a wide barrier on the north side. Despite the heavy work involved in clearing such a barrier it seemed a most desirable beginning to the experiments; firstly, in order to safeguard Luatonga; and, secondly, to discourage any southern dispersal of flies following measures taken to render Nyaboro uninhabitable to the species of tsetse.

It was proposed to create a barrier that should not be less than 800 yards wide; and thereafter to increase its width according to the results obtained from studies on the ability of G. pallidipes to cross open country. Difficulties were encountered in several directions. The Overseer needed medical attention, the rains caused a slackening of bush-clearing, the planting season attracted the labourers back to their plots; and wholesale burning of felled timber and scrub was, for some time, impossible, due to the heavy showers of rain.

These difficulties were ultimately overcome; but the rate of progress was greatly checked. The cleared barrier is a little over 400 yards in width at present. Most of it has been thoroughly burnt, and regenerating bush has been stumped. The method of clearing is that recommended in Tanganyika. Small gangs of labourers are sent in advance to cut down, and to dig up, the scrubby undergrowth. They are provided with pangas and mattocks. Next follow gangs to cut and to pile the slender scrub and to prepare the ground for the felling of the larger trees. Other gangs again follow to cut the timber and to pile around the large stumps left in the ground. Euphorbia trees were left to dry or to rot. Balanites trees were felled and the stumps above ground were stripped of their bark. Rhus glaucescens and Harrisonia abyssinica seemed resistant to fire; they revived to such an extent as to necessitate the employment of a few gangs on stumping several weeks - and sometimes for months - after firing.

The cost of clearing this barrier of approximately 655 acres was 56/- per acre. There was a good proportion of dense thickets; some thick, low scrub most of which required digging out, the hampa being insufficient to provide for piling and burning the multiple stumps in a patch of ground.

Up to the present, the clearing has been maintained in a clean condition. It is hoped that during the planting season of 1936, the local natives will cultivate in the clearing, and that the areas unsuitable for crop-production will be kept clean by communal labour. From trapping experiments, and regular fly-patrols on the fringe of the bush bordering this clearing, it is fairly evident that G. pallidipes is reluctant to venture into this barrier. When, however, the fly population showed a decided increase from May to July, it was observed that there was a tendency for individual flies to disperse into Luatoga by way of the thorn-scrub near Theka, and perhaps more so to the vicinity of the villages west of Kagana. In view of this, and because the local natives had contributed substantially to the experimental scheme, it was agreed that an attempt should be made to isolate Nyaboro bush (and Kagana) further by extending the Nyaboro barrier along the west. This has been done, and so far with good results. The Kagana barrier is 1,550 yards long, and over 1,000 yards wide. Some of the area was covered with very dense, low scrub; other areas comprised dense thicket under the canopy of tall Euphorbias; and still others were merely widely separated patches of close-growing Euphorbias where native villages at one time existed. The average cost of felling, stumping and burning in this Kagana area was shillings 6/50 per acre.

A strip of bush-country stretching to the slopes of Kigoto hill still causes some anxiety; but it is hoped that the clearing of the undergrowth only, in the western section of Kagana may force back the fly into Nyaboro where intensive trapping is in operation.

Observation on marked flies showed that there was movement from Otouk into Riamakanga and Nyaboro. It was possible that the fly population in Nyaboro, therefore, was being augmented in this manner.

Corridors were cleared from Kigoto to Kamaguthi and from Ugoro to Kisingiri to prevent increased migrations and to facilitate the trapping of flies that might take advantage of these open avenues as feeding grounds. These corridors are inefficient as fly-barriers and need to be widened considerably. In the meantime, however, they suffice for observation purposes, and may later be utilised to isolate the blocks for exhaustive trapping. To what extent they may serve to intercept flies migrating from the densely-populated bush to the more highly-populated areas remains to be seen.

The Kigoto-Kamaguthi corridor is 2,526 yards long, and 25 yards wide. Along this line, there were many thickets of Euphorbia ingens, Suchlea divinorum, Capparis tomentosa; scrub and a number of Acacia seyal trees. All bush and scrub was out down, but some trees were left in order to ascertain whether they would attract females, and serve as breeding places. The average cost of clearing was shillings 18/- per acre.

The Ugoro-Kisingiri corridor is 4,296 yards long, and 175 yards wide. The open thickets, scrub and trees were cleared at a cost of shillings 13/- per acre.

The preparations for trapping experiments in Nyaboro increased the demand for labourers to clear narrow corridors. Benefiting from the experiences of research workers in other territories; and as a result of preliminary trials in the Lambwe, the advantages of traps placed in open paths were very evident as will be seen later in this report.

The majority of labourers was withdrawn from barrier-clearings and concentrated on the making of these corridors which were six feet wide. Tall grass and shrubs grew rapidly where the woody undergrowth and trees had been cut down. It was soon realised that unless the corridors were kept free from even tall grass, the traps became inconspicuous and far less attractive to the fly. The corridors, therefore, were thoroughly cleaned and maintained in that condition.

The corridors passed through very dense bush and forest; and clearing was sometimes extremely difficult. Rain, and the small numbers of labourers available, disturbed the continuity and the rate of the work, thus increasing the cost. The rapidity with which the grass grew also demanded additional attention.

All corridors, excepting No.10 which is ten yards wide, are, at present, two yards wide. No.10 and the others are about 2,430 yards long. The average cost of clearing was shillings 88/- per acre.

The construction of roads or tracks was essential to efficient supervision. The valley is accessible only by an exceptionally rough road, and there were hardly any means of moving up and down, or across the valley. A small gang of labourers was therefore engaged for this work, and for maintenance.

Partial or discriminate bush-clearing has not progressed as rapidly as was anticipated. What has been done is satisfactory in that the quality of the work permits easy cultivation, and should not be difficult to maintain.

The experiments are incomplete, and have not been carried sufficiently far to warrant definite conclusions on the effect of partial clearing on the infestation by G.pallidipes. Considerable experience has been gained; and it is felt that a stage has been reached at which it would seem highly undesirable to relinquish the

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experimental scheme, and to rely on wholesale clearing as the only method of combatting this tsetse pest.

The Administration have arranged to expend a further sum of £827 in 1937, to continue with the control of G. pallidipes in the southern section (Riamakanga and Nyaboro) of the valley. It is proposed to widen the Nyaboro and the Ugoro-Kisingiri barriers; and to continue the catching of tsetse in Riamakanga and Nyaboro. The Kagana clearing will be lengthened to include Kigoto hill; and on the east a barrier will be extended to meet the Ugoro-Kisingiri clearings. This project will assist in the isolation of Riamakanga and Nyaboro bush from Otouk and may prove a deterrent to migrating and following flies.

#### Traps and Trapping

Harris, Swynnerton and Chorley have each discussed the merits of traps to attract and to capture tsetse-flies in Zululand, Tanganyika and Uganda respectively. The Harris trap is reported to have made enormous catches of G. pallidipes. Swynnerton has shown that the Single Screen trap can catch large numbers of this fly; and he discusses several points which must be taken into consideration in estimating the effects of trapping on the fly population. He has also shown that G. pallidipes "is a specially trappable fly", and that a good trap without scent may take huge numbers of it where it is sufficiently dense and conditions suitable. For several reasons, it seemed advisable to investigate the possibilities of trapping-out the flies in the Lambwe along lines indicated by Swynnerton's experiences. It was noted that "where a sufficient continuance of suitable trapping conditions does exist or can be provided, there is great hope of reducing pallidipes to small numbers by traps in belts that are naturally small or that can be divided".

One of the most important features of trapping is the choice of a site frequented by the majority of the flies or that can be made attractive to most flies. This should apply to localities where the fly-density is high or where it is low. The form of the trap should allure the fly, and its mechanism should provide the means to intercept escape.

Tests were first carried out with the Single Screen (awning) trap in Ree where the fly-density proved to be high. In one case the trap was hung so that only a swinging movement could take place; in another, the trap was arranged so as to allow a revolving movement. Close observation on flies attracted to these traps showed that the tsetse settled on the lower portions of the screen. Many seemed too impatient to investigate further up and flew away before reaching the darker and shaded section of the screen. A large screen was therefore fixed above the cage and a narrow strip below with a view to bringing the cage nearer the feet of the trap.

The three traps were carefully fixed and tried out for six days. The result was as follows:-

<u>Trap</u>	<u>Adult flies</u>		<u>Young flies</u>	<u>Total</u>
	<u>Males</u>	<u>Females</u>		
S.S. (Swinging)	12	52	36	100
S.S. (Revolving)	70	66	64	200
S.S. (Screen above)	37	33	40	110

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Four ordinary S.S. traps provided with different coloured screens were then tried. They were placed in a line in Roo and exposed for nine days.

<u>Colour</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Hessian with grey and black strips	61	41	102
Screen black	61	59	120
Screen red	34	13	47
Screen grey	19	17	36

The black screen was more attractive to, and held, the flies for a longer period than the others.

Attention was then directed to the tendency of the flies to return to dappled light of breeding places. A trap was constructed with the object of simulating this light and increasing the attraction to female tsetse. The pagoda trap was made, and for convenience, tested with the Harris' trap for a period of eight days. In both cases the results were disappointing. Most of the flies attracted to the Harris trap settled on the Hessian and along the bottom edge, but only small numbers went inside. The pagoda was a little better on this occasion.

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Harris'	16	27	43
Pagoda	23	32	55

The behaviour of the flies on the Harris (or Zululand) trap suggested that a single screen at the entrance of the trap, and extending from a little distance within, to a short distance below, the entrance might serve to increase the trapping of flies attracted to the trap. This would be, in reality, a modification of the S.S. trap. If the awnings of the S.S. trap were brought down from the sides of the cage, supplied with buttocks of equal length on each side; and the screen shortened, the result would be a trap of the Box-screen type. This particular trap was designed by Commander Blunt; and, as will be seen, it shows great promise. In the meantime, however, further tests were carried out with stationary and revolving traps. A pattern designed by Mr. Vane for *G. palpalis* in Keniadoto was also tried out. The following results were obtained after a trial of nine days. During the last three days a box-screen trap was added to the series.

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Swinging S.S. (screen above)	15	22	37
Revolving S.S. (screen above)	41	35	76
" S.S. (ordinary)	52	52	104
Vane's	82	271	353
Box-screen	178	379	557

Another box-screen trap was tried out for a period of ten days at the end of which the flies caught totalled 956 - 220 males, 736

females. This particular type of trap was light and easy to handle, convenient to pack and transport, and could be manufactured at a low cost. Several more were prepared by the native carpenters on the spot and tested against traps of still different types. Flies continued to alight on the hessian sides only to escape again.

A further modification was introduced. Awnings were fixed to a trap of the box-screen type, and the hessian sides of the "box" were carried up to within a few inches of the base of the cage, thus providing access to the cage by another route. The trap was a further combination of the box-screen and the single-screen types.

After a trial of nine days, it caught 126 males, and 433 females, a total of 559 flies. It was again tried alongside the ordinary box-screen for two days. The result was:-

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Box-screen	51	60	111
Box-screen (with awnings)	11	57	68

Additional changes were now made in the arrangement of the narrow screen at the mouth of the trap. Two black strips were arranged to form an open  $\setminus /$  in one case, an inverted open  $( \wedge )$  in another; and two parallel strips of black cloth on each side of the original screen in still another trap. The records for the first of these traps were lost; those for the other two for a period of fourteen days are as follows:-

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Inverted Screen	16	103	119
Parallel Screen	54	141	195

Although these traps were catching well, many flies that settled on the screens did not go up to the cage, perhaps due to the reduced space at the mouth, or because the body of the trap was too high. A shallower box was prepared; but the catch was very much lower. Another device was tried to entice the flies into the trap once they had alighted on the screen. A strut of wood, covered with black cloth was placed diagonally across the trap inside the hessian. Such a bar was intended to break the light from the cage, and would perhaps induce the flies to explore the inside of the trap and ultimately endeavour to escape by way of the non-return cage.

This small alteration seemed to be a great improvement as the figures for fourteen-days' catching shows:-

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Box-screen (with strut)	46	161	207
Box-screen (ordinary)	19	85	104

There was another advantage in the use of the strut; it strengthened the rather flimsy framework of the trap.

Yet another experiment was carried out to improve the box-screen. A concentration of light entering the body through the wire-gauze cage might help the fly to decide on the upward direction of "flight" once it had arrived at the dark, shaded screen. The wire gauze at the sides of the cage was replaced by hessian thereby intensifying the light penetrating only by way of the gauze lid. Compared for fourteen days with a trap with wire gauze sides, the modified type showed a very slight improvement in the number of females caught. The number of males was nearly doubled

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
B.S. (with hessian sides)	91	326	417
B.S. (with wire sides)	48	332	380

Would a further intensification of the light above the trap prove still more conducive to heavier catches? The triangular entrance to the catching-cage has its two sides made of wire gauze. These were changed for three-ply boards with the following result in a trial of fourteen days:-

<u>Trap</u>	<u>Adult flies</u>		<u>Pregnant females</u>	<u>Young flies</u>	<u>Total</u>
	<u>Males</u>	<u>Females</u>			
B.S. (with wire gauze)	169	496	89	19	773
B.S. (with three-ply)	167	608	89	20	884

These preliminary trials were not sufficiently exhaustive to warrant strict comparisons of the different traps and the various modifications. They were not conducted in the light of a full knowledge of the fly community in the particular locality; and it is not intended to convey that the figures given denote a superiority of one kind of trap over another under all conditions and in every kind of locality. It did seem, however, that there were many advantages attributable to the Box-screen type. Other observations were made which might prove of value in a scheme of trapping on a large scale. A trap placed in a small glade or near a sheltered corner of the bush collected a considerable amount of dew overnight, and took several hours to dry. It did not attract the tsetse until it had been exposed to the sun and the hessian had warmed up. Traps placed over a game track received attention very much earlier; and those set near the bush in a wider avenue, or path, attracted still more flies. If a trap was fixed in the centre of a large glade, or a very broad path, it seemed less attractive, although on some days, it would draw a fair number of tsetse. It also seemed that a new trap, or a trap that had already been in use for more than a week, would catch more flies in a new site during the first two or three weeks than after exposure in the same site for over a month. This, however, was not invariable, but was sufficiently intriguing to justify further inquiry. Unfortunately, the need for close supervision of labour and the desire to proceed with the attempt to control fly-infestation in Nyaboro prohibited the continuation of the numerous experiments indicated by these preliminary trials.

TABLE-III

Date	Trap No.4			Trap No.29		
	Males	Females	Total	Males	Females	Total
7.10.35	19	50	69	2	10	12
8.10.35	3	15	18	3	5	8
9.10.35	7	5	12	-	5	5
10.10.35	6	12	18	2	8	10
11.10.35	4	11	15	2	9	11
12.10.35	6	10	16	1	14	15
14.10.35 x	4	17	21	2	20	22
15.10.35	1	6	7	-	3	3
16.10.35	1	3	4	2	6	10
17.10.35	3	4	7	-	9	9
18.10.35	-	4	4	1	4	5
19.10.35	-	4	4	1	8	9
	54	141	195	16	103	119

Trap No.4 is a box-screen type with a collecting cage provided with gauze-wire, and the sides not covered with hessian. The screen is of a black cloth.

Trap No.29 is similar to No.4 save that the screen is not a strip, but two strips arranged to form an inverted  $\backslash$  with an opening at its apex leading into the trap. The strips are black.

x denotes 2 day's catches.

TABLE IV

Date	Trap No. 25			Trap No. 30		
	Males	Females	Total	Males	Females	Total
7.10.35	2	20	22	8	24	32
8.10.35	3	12	15	6	21	27
9.10.35	4	11	15	9	23	32
10.10.35	1	5	6	-	13	13
11.10.35	1	6	7	4	8	12
12.10.35	1	8	9	7	12	19
14.10.35 x	-	10	10	7	12	19
15.10.35	2	2	4	5	2	7
16.10.35	2	-	2	2	25	27
17.10.35	3	4	7	-	6	8
18.10.35	-	2	2	1	7	8
19.10.35	-	5	5	1	5	6
	19	85	104	46	161	207

Trap No. 25 is a box-screen type with the collecting cage covered on all sides with mesh. The screen is a black cloth one foot wide.

Trap No. 30 is like No. 25, except that the screen extends half-way up the inside of the trap; the bottom half of the screen is of grey cloth, and the upper half of black cloth.

TABLE V

Date	Trap No. 4			Trap No. 30		
	Males	Females	Total	Males	Females	Total
21.10.35	3	11	14	9	42	51
22.10.35	3	10	13	9	17	26
23.10.35	10	18	28	25	27	52
24.10.35	1	18	19	5	14	19
25.10.35	-	11	11	4	27	31
26.10.35	-	5	5	1	5	6
28.10.35 x	1	26	27	1	35	36
29.10.35	2	19	21	5	18	23
30.10.35	5	22	27	3	22	25
31.10.35	1	33	34	3	36	39
1.11.35	12	60	72	11	28	39
2.11.35	10	99	109	15	47	62
	48	332	380	91	326	417

Trap No. 4 (See note, Table III)

Trap No. 30 (See note, Table IV)

x denotes 2 day's catches.

TABLE VI

Date	Trap No. 30			Trap No. 32		
	Males	Females	Total	Males	Females	Total
4.11.35	26	65	91	11	20	31
5.11.35	5	39	44	1	18	19
6.11.35	12	50	62	16	34	50
7.11.35	7	42	49	14	18	32
8.11.35	18	28	46	6	18	24
9.11.35	17	45	62	8	27	35
11.11.35 x	9	64	73	28	107	135
12.11.35	15	30	45	13	59	72
13.11.35	4	14	18	1	9	10
14.11.35	7	21	28	10	60	70
15.11.35	8	21	29	8	43	51
16.11.35	7	34	41	14	41	55
18.11.35 x	33	152	185	20	67	87
19.11.35	13	46	59	7	17	24
20.11.35	6	44	50	5	23	28
21.11.35	3	15	18	1	17	18
22.11.35	13	36	49	5	27	32
23.11.35	15	70	85	11	47	58
25.11.35 x	9	47	56	11	41	52
26.11.35	9	20	29	7	24	31
27.11.35	6	16	22	6	34	40
28.11.35	5	16	21	4	28	32
29.11.35	16	50	66	24	58	82
30.11.35	26	85	111	23	73	96
	289	1050	1339	254	908	1162

Trap No. 30 (See note, Table IV)

Trap No. 32 is similar to No. 30, but the screen is black in colour.

TABLE VII

Date	BOX-TRAP (Non-return cage of wire-gauze) Trap No. 32						BOX-TRAP (Non-return cage of wood) Board trap					
	Mature		Preg.	Young			Mature		Preg.	Young		
	M.	F.		M.	F.	Total	M.	F.		M.	F.	Total
16.12.35	62	149	10	3	2	226	56	118	8	3	4	189
17.12.35	24	38	7	-	4	73	22	98	12	1	2	135
18.12.35	19	43	16	4	2	84	21	82	13	-	3	119
19.12.35	15	33	19	-	-	67	13	74	10	-	1	98
20.12.35	9	24	4	-	-	37	11	34	5	-	-	50
21.12.35	7	36	8	-	-	51	6	39	7	1	-	55
23.12.35 x	8	60	9	1	-	78	8	65	14	-	-	87
24.12.35	2	22	2	-	2	28	3	18	6	-	-	30
25.12.35	1	20	2	-	-	23	5	24	5	1	-	35
26.12.35	1	5	-	-	-	6	4	19	4	1	2	30
27.12.35	-	3	-	-	-	3	3	5	2	-	-	10
28.12.35	2	2	1	-	-	5	2	6	-	-	1	9
"30.12.35 x	12	45	5	-	-	62	8	22	3	-	-	33
"31.12.35	7	16	6	1	-	30	2	4	-	-	-	6
	169	496	89	9	10	773	167	608	89	7	13	884
	Total Males			178			Total Males			174		
	Total Females			595			Total Females			710		

x denotes 2 day's catches.

" denotes dull days.

TABLE VIII

Date	BOX TRAP					HARRIS TRAP				
	M.	Mature F.	Preg. M.	Young F.	Total M.	Mature F.	Preg. M.	Young F.	Total M.	
2.12.35	2	8	6	-	16	4	2	-	6	
3.12.35	1	-	2	-	3	1	1	-	2	
4.12.35	1	6	3	-	10	2	-	-	2	
5.12.35	5	17	4	1	27	3	1	-	4	
6.12.35	4	11	6	1	22	2	-	-	2	
7.12.35	1	15	7	1	24	2	1	-	3	
9.12.35 x	2	11	-	-	13	7	-	-	7	
10.12.35	6	16	8	-	30	5	-	-	5	
11.12.35	1	14	4	-	19	2	-	-	2	
12.12.35	1	4	-	-	5	3	5	1	9	
13.12.35	-	5	-	-	5	1	7	-	8	
14.12.35	1	7	3	-	11	4	2	-	6	
16.12.35 x	5	26	4	-	35	1	16	5	23	
17.12.35	9	24	2	1	36	10	3	-	13	
18.12.35	6	19	8	-	33	2	8	2	12	
19.12.35	5	7	3	-	15	10	3	-	13	
20.12.35	1	6	2	-	9	1	6	-	7	
21.12.35	4	11	4	-	19	1	3	-	4	
23.12.35 x	1	8	-	-	9	1	9	-	10	
24.12.35	1	9	-	-	10	2	5	-	7	
25.12.35	2	7	5	-	14	3	6	-	9	
26.12.35	-	3	1	-	4	-	1	-	1	
27.12.35	-	2	1	-	3	-	-	-	-	
28.12.35	-	-	2	-	2	-	-	-	-	
30.12.35 x	1	12	-	-	13	4	-	-	4	
31.12.35	-	2	-	-	2	1	-	-	1	
60	250	75	2	2	389	22	115	21	1	160
Total Males					62			Total Males		22
Total Females					327			Total Females		137

x denotes 2 day's catches.

TABLE IX

Date	BOX TRAP					S.S. TRAP						
	M.	Mature F.	Preg. M.	Young F.	Total M.	Mature F.	Preg. M.	Young F.	Total M.			
17.12.35	129	416	21	5	6	577	46	74	6	2	4	132
18.12.35	37	198	19	6	2	262	6	14	-	-	-	20
19.12.35	65	256	42	2	4	367	8	18	-	2	-	28
20.12.35	49	195	18	4	3	269	5	6	1	-	-	12
21.12.35	36	191	34	1	4	266	6	8	4	-	-	18
23.12.35 x	10	172	20	2	-	204	2	10	4	-	-	16
24.12.35	15	64	5	1	-	85	-	8	-	-	-	8
25.12.35	13	47	7	3	-	70	2	5	-	-	-	7
26.12.35	3	9	3	-	-	15	-	1	1	-	-	2
27.12.35	5	12	4	-	-	21	-	1	-	-	-	1
28.12.35	2	10	3	-	1	16	-	2	-	-	-	2
30.12.35 x	13	47	10	-	1	71	1	14	-	-	-	15
31.12.35	1	11	4	-	-	16	1	3	-	-	-	4
376	1628	190	24	21	2239	77	164	16	4	4	265	
Total Males					400			Total Males				81
Total Females					1839			Total Females				184

x denotes 2 day's catches.

Note - Traps interchanged on the 23rd and 30th.

TABLE X

Trap No. 30

Harris' Trap

Date	Trap No. 30			Harris' Trap		
	Males	Females	Total	Males	Females	Total
1.1.36	-	4	4	-	2	2
2.1.36	2	10	12	1	7	8
3.1.36	11	48	59	2	11	13
4.1.36	7	38	45	7	11	18
6.1.36 x	15	61	76	11	49	60
7.1.36	4	38	42	5	22	27
8.1.36	16	81	97	9	53	62
9.1.36	6	34	40	1	10	11
10.1.36	11	33	44	3	13	16
11.1.36	3	41	44	4	24	28
13.1.36 x	8	30	38	4	13	17
14.1.36	11	62	73	2	26	28
15.1.36	17	94	111	9	87	96
16.1.36	17	53	70	4	25	29
17.1.36	13	62	75	2	19	21
18.1.36	13	54	67	1	10	11
20.1.36 x	14	109	123	3	36	39
21.1.36	13	85	98	1	24	25
22.1.36	-	14	14	-	7	7
23.1.36	5	38	43	2	3	5
24.1.36	4	26	30	-	6	6
25.1.36	7	41	48	2	13	15
27.1.36 x	12	38	50	3	27	30
28.1.36	7	34	41	1	10	11
29.1.36	20	86	106	4	26	30
30.1.36	8	29	37	3	18	21
31.1.36	14	50	64	3	12	15
	258	1293	1551	87	564	651
1.2.36	21	132	153	4	18	22
3.2.36	36	135	171	3	17	20
4.2.36	14	50	64	4	7	11
5.2.36	10	51	61	4	13	17
6.2.36	14	45	59	2	5	7
7.2.36	9	38	47	1	13	14
8.2.36	5	39	44	2	5	7
10.2.36 x	3	41	44	-	5	5
11.2.36	4	14	18	1	2	3
12.2.36	2	7	9	-	7	7
13.2.36	5	25	30	-	4	4
14.2.36	3	16	19	2	1	3
15.2.36	1	10	11	-	2	2
17.2.36 x	12	41	53	2	16	18
18.2.36	5	30	35	1	13	14
19.2.36	12	63	75	2	14	16
20.2.36	8	14	22	3	6	9
21.2.36	5	31	36	1	6	7
22.2.36	1	8	9	-	3	3
24.2.36 x	3	34	37	2	5	7
25.2.36	4	38	42	3	8	11
26.2.36	6	42	50	2	7	9
27.2.36	3	12	15	1	3	4
28.2.36	1	21	22	1	4	5
29.2.36	2	14	16	-	2	2
	191	951	1142	41	186	227

x denotes 2 day's catches.

Continued overleaf.

TABLE X (Cont.)

Trap No. 30

Harris' Trap

Date	Males	Females	Total	Males	Females	Total
3.3.36	18	32	50	13	3	16
3.3.36	18	91	109	6	17	23
4.3.36	19	112	131	12	61	73
5.3.36	5	21	26	2	5	7
6.3.36	7	42	49	6	4	10
7.3.36	1	5	6	2	1	3
9.3.36 x	3	24	27	1	5	6
10.3.36	4	13	17	1	4	5
11.3.36	6	25	31	-	7	7
12.3.36	5	8	13	2	6	8
13.3.36	9	52	61	4	8	12
14.3.36	5	19	24	2	8	10
16.3.36 x	5	17	22	1	5	6
17.3.36	13	38	51	7	18	25
18.3.36	6	27	33	1	8	9
19.3.36	5	15	20	2	8	10
20.3.36	2	7	9	-	2	2
21.3.36	1	6	7	-	6	5
23.3.36 x	10	33	43	7	32	39
24.3.36	3	23	26	2	8	10
25.3.36	1	8	9	4	10	14
26.3.36	5	21	26	-	5	5
27.3.36	-	5	5	-	3	3
28.3.36	7	15	22	6	12	20
30.3.36 x	5	10	15	-	2	2
31.3.36	4	13	17	2	7	9
	167	682	849	85	254	339

1.4.36	3	10	13	1	5	6
2.4.36	5	14	19	3	5	7
3.4.36	10	11	20	9	11	20
4.4.36	1	3	4	-	-	-
6.4.36 x	-	3	3	-	-	-
7.4.36	2	5	7	3	3	6
8.4.36	-	3	3	1	-	1
9.4.36	-	6	6	-	5	5
10.4.36	1	6	7	-	5	5
11.4.36	-	4	4	-	3	3
13.4.36 x	2	4	6	-	2	2
14.4.36	3	18	21	2	7	9
15.4.36	1	9	10	1	9	10
16.4.36	3	5	8	4	20	24
17.4.36	-	4	4	2	5	7
	39	107	146	26	78	104

x denotes 2 day's catches.

TABLE XI

Trap No. 32

S.S. (Gable-top) trap

Date	Males	Females	Total	Males	Females	Total
20.1.36	13	74	87	6	11	17
21.1.36	3	22	25	2	8	10
22.1.36	-	6	6	-	-	-
23.1.36	4	15	19	5	-	5
24.1.36	-	7	7	2	-	2
25.1.36	-	2	2	-	-	-
27.1.36 x	3	40	43	-	3	3
28.1.36	2	23	26	-	1	1
29.1.36	10	61	71	1	5	6
30.1.36	18	94	112	2	5	7
31.1.36	14	39	53	-	1	1
	67	384	451	18	34	52
1.2.36	42	97	139	-	4	4
3.2.36 x	10	50	60	2	11	13
4.2.36	4	23	27	5	6	11
5.2.36	11	35	46	-	3	3
6.2.36	6	23	29	2	5	7
7.2.36	9	32	41	3	4	7
8.2.36	4	17	21	-	-	-
10.2.36 x	7	39	46	-	-	-
11.2.36	2	21	23	-	4	4
12.2.36	1	11	12	-	1	1
13.2.36	2	11	13	1	1	2
14.2.36	3	7	10	-	-	-
15.2.36	-	7	7	-	1	1
17.2.36 x	4	33	37	1	-	1
18.2.36	5	10	15	-	1	1
19.2.36	3	17	20	1	-	1
20.2.36	1	7	8	-	-	-
21.2.36	2	10	12	-	-	-
22.2.36	-	5	5	-	-	-
24.2.36 x	1	6	7	-	-	-
25.2.36	2	14	16	-	1	1
26.2.36	5	24	29	1	1	2
27.2.36	2	12	14	-	-	-
28.2.36	1	17	18	-	2	2
29.2.36	-	14	14	-	-	-
	127	539	666	16	45	61

x denotes 2 day's catches.

Continued overleaf.

TABLE XI (Cont.)

Date	Trap No. 32			S.S. (Gable-top) trap		
	Males	Females	Total	Males	Females	Total
2.3.36	7	31	38	2	-	2
3.3.36	1	32	33	-	-	-
4.3.36	11	65	76	-	-	-
5.3.36	2	24	26	-	-	-
6.3.36	4	16	20	-	-	-
7.3.36	5	37	42	-	-	-
9.3.36 x	2	5	7	-	-	-
10.3.36	3	11	14	1	-	1
11.3.36	-	10	10	1	1	2
12.3.36	2	25	27	-	1	1
13.3.36	13	43	56	-	-	-
14.3.36	5	17	22	-	1	1
16.3.36 x	8	13	21	-	2	2
17.3.36	2	6	8	-	3	3
18.3.36	-	5	5	-	1	1
19.3.36	2	7	9	-	1	1
20.3.36	2	4	6	-	-	-
21.3.36	1	10	11	-	-	-
23.3.36 x	5	24	29	-	1	1
24.3.36	7	17	24	1	1	2
25.3.36	4	17	21	-	1	1
26.3.36	2	12	14	-	-	-
27.3.36	-	14	14	-	-	-
28.3.36	5	7	12	-	-	-
30.3.36 x	2	7	9	-	-	-
31.3.36	1	-	1	-	-	-
	96	459	555	5	13	18
1.4.36	-	5	5	-	-	-
2.4.36	2	5	7	-	-	-
3.4.36	28	24	52	-	-	-
4.4.36	-	-	-	-	-	-
6.4.36 x	-	-	-	-	-	-
7.4.36	2	3	5	-	2	2
8.4.36	-	6	6	-	-	-
9.4.36	-	2	2	-	-	-
10.4.36	1	6	7	-	-	-
11.4.36	1	5	6	-	-	-
	34	56	90	-	2	2

x denotes 2 day's catches.

A test in Otouk bush had proved disappointing, and it was felt that to abandon entirely the experiments with traps was not advisable. Four types of traps had shown promise:- The Single-Screen (or Shinyanga) trap provided with awnings; the Harris (or Zululand) trap; the type designed by Vane for palpalis; and the box-screen (or Kenya) trap with a black screen, and hessian sides to the catching cage. Dimensions and specifications of this trap are given in the appendix. Vane's trap was being tested in the Kuja river area where G.pallidipes existed in a mixed fly-belt. It was, therefore, considered inadvisable to duplicate the test at that time.

It should be explained that the preliminary tests were carried out, as opportunity permitted, during August and September; and that further tests with modified box-screen traps were carried out in October and November. Tables III, IV, V and VI give details of the latter; and Tables VII, VIII and IX show the differences in catches by the box-screen types of traps, the Harris and the Shinyanga traps during December, 1935. The figures show that the box-screen trap with a dark grey, or black, screen and strut is consistently better than the other types; the total number of flies caught vary from day to day and in most cases there appear short periods of increase alternating with short periods of decrease in the numbers of flies trapped. Is this rise and fall due to incursions of new flies after the capture of the older inhabitants of a particular patch of bush, or is it due to a peculiar activity related to the presence of game? It will be seen that this alternation occurs in the case of trapping in Nyaboro and Kagana bushes as well as in Roo; and it is also evident with hand-and-screen catching in the Lambwe round of Otouk.

Table IX shows that one box-screen is capable of trapping as many as 2,259 flies in a period of sixteen days, and Table IV shows that the number for approximately the same period in the same place may be as low as 104 flies.

Table X confirms the greater attraction of the box-screen over the Harris' trap; it shows again the fluctuations in the number of flies caught; and there is evidence to support the earlier impression that the attraction of a trap in one position is diminished on prolonged exposure. At times, however, the numbers show a sudden increase followed by a decrease of varying degrees. It is clear that all traps attract more females than males; the proportion of one sex to the other varies to a great extent.

It has not been possible to correlate the daily records of catches with the different aspects of the local environmental changes. Reference to the graphs illustrating the seasonal changes in fly-density in West Roo will reveal that in July and August, 1935, there was a sharp rise in the numbers of flies. The numbers then dropped as rapidly; and with the exception of a comparatively short rise in November, 1935, continued to drop until February, 1936. In January, 1936, the returns of routine catches by fly-boys were extremely low; there was a rise in February, followed by still sharper rises in March, April and May. Yet the traps during that period showed a steady decrease. A comparison of the actual numbers may not be justified, but the trend of the population, or apparent fly-density, is exactly opposite in the two cases. It seems, therefore very necessary to investigate the possibilities of estimating the true density of G.pallidipes. In the absence of experimental data, but in the light of experience with "trial tests" in Roo, traps were made for an attempt to trap flies in Nyaboro block of bush.

A motor-track had been made from Sanjuero labour camp, through the bush to the overseer's camp on Ugoro hill. G.pallidipes had already been captured by fly-boys on this track and off natives who had passed through

the bush. Traps were set on the road. Nyaboro bush was divided into two unequal portions, viz., Nyaboro proper, and Kagana. Intersecting corridors - six feet wide - were cleared for traps in Nyaboro proper, but Kagana was reserved for traps in natural sites.

Regular fly-patrols had been carried out in Kagana bush since March, 1935. The numbers of flies caught in four patrols each month is as follows:-

TABLE XII

Month	Mature flies		Young flies		Total
	Males	Females	Males	Females	
<u>1935</u>					
March	4	2	-	-	6
April	2	3	-	-	5
May	2	-	-	-	2
June	1	2	-	-	3
July	7	5	2	1	15
August	8	11	5	4	28
September	4	3	-	1	8
October	4	5	1	-	10
November	7	7	-	-	14
December	7	3	2	2	14
<u>1936</u>					
January	4	8	1	-	13
February	1	1	-	-	2
March	1	3	1	-	5
April	6	4	1	-	11
May	17	23	3	1	44
June	9	4	1	1	15
	84	84	17	10	195

From January to June in 1936, the catches were:- Mature males 38; Mature females 45; Young males 7; Young females 2; a total of 90 flies.

Fifty-five traps were set in Kagana and in the motor-road. The total catch of *G. pallidipes* in these six months from January to June, 1936 was 332, or 73 males and 259 females.

In this case, the traps effected a much greater reduction of the flies. Reference to the diagram illustrating the distribution of traps in Nyaboro and Kagana will show the irregular placing of the box-screen and the single-screen traps. This seemed to be necessary because it had been observed that the fly showed some preference to the fringes of dense bush along which there were tracks, gaps or open spaces for free movement. The observation was confirmed by the results of trapping. Most flies were caught in traps placed along the edges of dense bush, B.7, B.14, B.17, B.11 and B.12 being particularly good. B.11 and B.12 were situated near a game path in the most dense bush of Kagana. All traps in the motor-track caught well. In fact, of the 332 flies captured in Kagana, 206 were collected from eight traps in the roadway, 120 were

caught in twelve traps in or near dense bush, the remainder being taken in the other traps inside, or on the outskirts of, Kagana. Traps in the clearings on the west and south of the bush caught only six flies in the six months. In the open-thicket region of Kagana, and on the borders of the barrier clearings, it was very evident that the fly-infestation decreased rapidly. This may perhaps be explained by the clearing of much of the undergrowth that formed part of the scheme of discriminate clearing of bush, and also by the non-attractiveness of the fairly wide barrier between Kagana bush and the foot of the Gwasssi hills. It was observed also that pallidipes seemed to dislike open bush leading to a clearing with a hill or high land on the opposite side of the clearing.

The greatest number of flies was taken in May and June. Inside the bush the maximum was reached in April, and in the roadway the maximum was reached in May, although the flies were still numerous inside Kagana also in this last month.

On the whole it may be said of the traps that they revealed a denser population in Kagana than had hitherto been realised. The box-screen trap proved more efficient than the single-screen trap apart from the fact that the latter type was not as numerous as the former.

Additional fly-rounds were carried out through Kagana area with a view to catching-out as many flies as possible, and to compare the advantages, if any, of the one or other method of attacking flies. They are of special interest in that, unlike the results from hand-catching and from traps in Roo, here both show a rise at about the same period; viz., in May and June. The numbers caught by hand-nets and screen and bait oxen, however, were much higher than those caught by the traps.

TABLE XIII

Month	Motor track		Interior of Kagana		Kigoto end		Kagana border		Sanjuero border		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1936											
Jan.	4	3	-	7	-	-	-	-	-	-	-
Feb.	6	6	1	8	-	-	-	3	-	-	-
Mar.	7	6	4	15	-	-	-	-	-	-	-
Apr.	2	9	12	25	-	-	-	-	-	-	-
May	17	23	5	47	1	-	-	-	1	1	-
Jun.	9	10	4	15	-	-	-	-	-	-	-
	45	61	24	122	1	-	-	3	1	1	-

TABLE XIV

Month	Screen A		Screen B		Screen C		Screen D		Screen E		Bait oxen	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1936												
Feb.	13	7	-	-	-	-	9	9	-	-	9	9
Mar.	7	4	-	-	-	-	9	2	-	-	11	6
Apr.	7	7	-	-	4	5	11	11	-	-	17	8
May	28	40	12	18	12	26	24	41	67	57	27	33
Jun.	25	20	14	21	18	18	27	23	41	31	11	10
	80	78	26	39	34	49	80	86	108	88	75	66

M = Males  
F = Females

Screens B, C and D were carried by fly-boys through Kagana bush from the Sanjuero side to the Kigoto side; they were not taken along the same route as the ordinary routine fly-round in Kagana. Screens A, E, and the bait-oxen were taken round the bush on the days when the boys were not engaged in collecting flies from the traps; the majority of flies being taken on the motor track. From these observations it may be deduced that odd flies do venture to the borders of the cleared zones; and as the screens are taken through the bush frequently, they effect heavier catches than the numerous traps placed in what would normally appear to be favourable sites. The fly-boys always pass along the same route, and it is possible that even a long narrow track may attract more flies than irregular spaces that might appear to the fly to be enclosed.

If partial bush-clearing is pursued further in the Kagana area it will be interesting to observe its effect on the fly-infestation. It may be necessary only to dig out the tangled woody shrubs that create the dense bush favoured by the fly, and leave the larger trees in such a manner that a satisfactory sward of grass may inhibit regeneration of the shrubs; thereby making the present favourable haunts uninhabitable to this pest.

While investigations were proceeding in Kagana the available labour supply was engaged in clearing the narrow corridors in the western half of Nyaboro. Routine patrols had already proved that G. pallidipes was more prevalent in this zone than was indicated by the general fly-survey and later reconnaissances. At some periods - May and June, 1955; December, 1955, and January and February, 1956, - it was thought that the barrier clearing across the valley at Morea had forced back the fly and reduced them to very small numbers. The natives firmly believed that the tsetse had been eradicated in Nyaboro; and they expressed their desire to utilise the barrier for ploughing with oxen and for the production of crops. Wholesale clearing was looked upon with favour, and the making of the corridors was regarded as preparatory to clearing all the bush. It was soon appreciated that the flies had by no means been eradicated. Traps were set in the corridors in April, 1956. At first, only box-screen traps were used, but later the distribution of the traps was rearranged in order to test the comparative values of the box-screen and the single-screen (Shinyanga) traps in an area believed to be lightly infested with G. pallidipes.

The results for April and May, 1956, are for box-screen traps only; those for June include also the single-screen traps.

The routine fly-rounds through the interior of Nyaboro bush had shown a definite rise in fly-density from March to May, 1956, with a slight fall in June. The traps in nearly all the corridors confirmed the rise in March to April and in the period of April to May. In June, there was a very decided drop that was unfortunate for the purposes of comparison; yet it will be seen from the following table that, in every case, the single-screen was less effective in catching than was the box-screen.

TABLE XV

Corridor	No. 1		No. 2		No. 3		No. 4		No. 5											
	B-S	S-S	B-S	S-S	B-S	S-S	B-S	S-S	B-S	S-S										
Month 1936	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.										
April	7	19	15	30	27	47	12	28	4	7										
May	16	19	22	40	21	86	39	82	13	30										
June	6	9	1	7	8	12	7	7	18	34	2	11	8	12	2	5	4	5	3	4
Total	29	47	1	7	45	82	7	7	66	167	2	11	59	122	2	5	21	42	3	4

Corridor	No. 6		No. 7		No. 8		No. 9		No. 10											
	B-S	S-S	B-S	S-S	B-S	S-S	B-S	S-S	B-S	S-S										
Month 1936	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.										
April	22	53	16	21	8	26	4	8	31	75										
May	39	86	15	25	24	56	14	30	66	101										
June	9	7	3	6	1	8	-	2	7	9	2	7	5	3	-	1	23	38	6	14
Total	70	146	3	6	32	54	-	2	39	91	2	7	23	41	-	1	120	214	6	14

Sixty-nine traps caught 1,510 tsetse - 504 males; 1,006 females - in three months. In June, thirty-six box-screens captured 226 flies - 89 males, 137 females; while from thirty-three single-screen traps only 90 flies - 26 males, 64 females - were obtained.

Corridor No.10 produced the largest number of flies; No. 6 and No. 5 followed in the second and third places respectively, and No. 4 took the fourth place.

Due to re-arrangement of the traps, full discussion on the merits of traps situated in different kinds of vegetation is not possible, and it is not unlikely that the traps in the narrow corridors lost some of their attraction to the flies when the grass was permitted to become tall and rank, thus obscuring the foot of the traps from tsetse. Corridor No.10 is ten yards wide; it passes, for the greater part of its length, through the most dense bush of Nyaboro. Not far from the cleared corridor are many game wallows that are transformed to pools of water after heavy rainfall. A small herd of five buffalo lives in this area; and at rare intervals a few elephant visit these wallows but return more or less immediately to their more permanent haunts in Ruma. The other corridors are apparently too narrow and do not provide sufficient open space to render the traps easily visible to the flies.

Daily patrols by fly-boys in six corridors were begun in March, 1936; and in all corridors for April, May and June. The total catches tabulated below are astonishing when considered from previous experience in Nyaboro.

TABLE XVI

Corridor	No.1		No.2		No.3		No.4		No.5	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1936										
March	21	15	44	32	49	37	51	45	117	70
April	24	26	60	58	85	73	182	179	74	70
May	71	78	119	135	153	149	348	336	151	194
June	73	53	135	182	177	178	218	208	99	118
Total	189	172	358	407	462	437	799	768	421	452

TABLE XVI (Contd.)

Corridor	No.6		No.7		No.8		No.9		No.10	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
<u>1936</u>										
March	51	38	-	-	-	-	-	-	-	-
April	74	80	62	62	62	46	72	59	189	136
May	132	172	256	288	345	381	284	383	373	414
June	113	134	154	153	225	233	200	221	321	301
	370	424	452	503	632	660	556	663	883	851

They exceed the catches by traps and tend to force one to the tentative conclusion that pallidipes is not always shy of man. The screen, of course, provides added attraction and movement of the boys may well induce flies to follow. It is also evident that the expert collectors permit very few flies to escape once they have settled on their screen. It may be argued that the large numbers of flies caught by fly-boys in the corridors reduce the numbers which might otherwise have been drawn to and captured by the traps. There are no experimental data on which to base further observations on this point, but it may be explained that the boys do not linger unduly in the vicinity of traps, nor do they compete, as it were, with the traps. One party of boys has four corridors to patrol in a morning and therefore has to proceed fairly steadily along in order to cover the distance. Assuming that the majority of tsetses in an area of bush do not range up and down the corridor when the fly-boys are collecting, there is no reason why the catches by effective traps should be greatly disturbed by the fly-boys.

For some unknown reason the traps in Nyaboro and in Kagana have not yet proved as efficient in capturing G.pallidipes as fly-boys provided with hessian screens, but it remains to be seen what results will be obtained over a period longer than three months.

In June, 1936, the eastern half of Nyaboro was divided into numerous blocks of bush by increasing the number of corridors. As in Nyaboro west, the corridors were 400 yards apart. Additional box-screen traps have recently been set in these corridors. The data, so far collected, do not permit useful discussion.

Twenty-three traps - all of the box-screen type - have been placed along the Ugoro-Kisingiri corridor. This corridor has recently been widened from 50 to 175 yards; it was cleared of bush in order to isolate Otouk from Riamakanga and in order to reduce the migration of flies from the former to the latter. Traps along both sides of the clearing might attract and capture any flies frequenting the fringe of the bush and assist in intercepting those that might venture across the clearing. Up to the time of writing, only thirty-six flies - 6 males, 30 females - have been collected in the month of June.

Another form of trapping flies was instituted to safe-guard the comparatively fly-free area of Luatonga, to protect the few cattle in the Owiga valley, and to prevent extension of fly to the upper Kamgwagi location. De-flying stations were erected at Sanjuero, on the motor-track below Owiga valley, and below Sagama hill to the east of south Ruma. One fly was collected at the Kamgwagi in a period of four months, and five flies at the Owiga station for a similar period. At Sanjuero, however, larger numbers have been taken; frequently from

clothing of natives; and in one case from a lorry leaving the valley.

In order to estimate the potential danger to Luatonga and for advisory purposes the actual numbers of flies caught at the Sanjuero de-flying station were recorded. In March, 1936, 7 males and 6 females were collected; in April, 14 males and 16 females; in May, 55 males, 58 females; and in June, 9 males, 6 females; making a total of 171 G.pallidipes in four months. All these flies were taken off natives passing from the Lambwe valley, through Sanjuero, and proceeding in the direction of Karungu.

The importance of this Sanjuero de-flying station should not be under-estimated, especially in view of the desire to utilise the area to the south of Morea for cattle that have recently been brought to the neighbourhood, and the attraction to cattle of the provisional water-dam immediately west of the hill.

Efforts to improve the trapping of G.pallidipes by applying extracts of sebaceous glands from different regions of bovines proved unsuccessful. Only a few trials were made; and although there is always sufficient material available for extractions at the Veterinary Research Laboratory, Kabete, the apparatus for the preparation of reasonably large quantities of extracts is not available.

If one may draw conclusions from these trapping experiments, they must be provisional to further, more exhaustive information from tests over a longer period. Traps will capture larger numbers of flies in a dense area especially at the time the fly-population is at its height, and the flies most active. Even at this time, however, the catches are not consistently high, and the traps seem to lose some of their attractiveness. In the initial exploratory tests in Roo from August to December, 1935, 10,862 G.pallidipes were captured; and from January, 1936, to the middle of April, 1936, two box-screens, one Harris' trap and one modified single-screen trap caught 7,004 flies.

Three boys on weekly fly-rounds collected 2,441 flies in the first period, and 1,637 flies in the second period.

Nyaboro and Kagana were believed to be lightly infested with G.pallidipes. Traps erected in naturally favourable sites in Kagana revealed that the infestation was heavier than that indicated by weekly patrols, and traps in the Nyaboro corridors confirmed this fact. There is no doubt that the corridors helped considerably in bringing out the flies from the bush, and assisted in the reduction of the fly-population by trapping.

Daily fly-rounds by boys, however, showed that the infestation in Nyaboro was still heavier than that revealed by trapping. It is felt that more intensive study of siting traps with regard to the control of G.pallidipes is necessary, and that investigations into the value of attractants should be pursued.

Experience throughout these trials with traps indicates that trapping might with advantage be employed vigorously when the fly-density increases. Other methods of attack may be adopted to substitute trapping at other periods, and they may be directed to the destruction of the primary home or breeding haunts. It is not unlikely, however, that the efficiency of the traps can be sustained by improvements in the placing of good traps, and by preparing known hunting and breeding places where the traps can be set.

Whereas the use of traps has not yet proved highly effective in every instance, it would appear premature to condemn them; and to revert to hand-catching and wholesale clearing of bush, on the pretext that the

initial experiments have not been convincing. It is appreciated that trapping is yet in its infancy, and requires further careful study and support.

#### Observations on the fly-community:

The complete separation of the main blocks of fly-infested bush - Nyaboro, Riamakanga, Otouk, Ruma and Roo - by wide efficient barrier clearings has not yet been possible, nor has it been practicable with the available finances to isolate the fly-infested zone from the fly-free areas. The Nyaboro and Kagana barriers are being extended with further financial assistance from the Local Native Council, and the Overseer is supervising the work under direction.

It has been mentioned that narrow corridors were cleared of bush between Otouk and Riamakanga - the Kisingiri corridor; and between Riamakanga and Nyaboro - the Kigoto-Kamaguthi corridor. These corridors divide the upper end of the valley into three blocks. Ruma bush was the deciding factor for the fourth block; Roo, the fifth block; and the fly-infested zone of the lake-shore, including Waturi, formed the sixth block. Luatonga was included in the first block.

Theoretically, and as a working basis, the Lambwe valley was divided into six blocks, A, B, C, D, E and F. These blocks were believed to be infested in different degrees of fly-density. In Block A, or the Sanjuere block, Luatonga area to the south of Morea was either entirely free or very lightly infested at certain seasons only; Nyaboro - from Kagana to Theka - was known to harbour a few C.pallidipes. Block B, or Riamakanga, seemed to consist of several "pockets" of fly-concentration; Block C, or Otouk, was apparently fairly heavily infested in parts. Block D, or Ruma, was known to be the haunt of many elephant and buffalo; and, at the periphery of the most dense bush, heavy catches of the fly had been made. Roo, or Block E, had produced large numbers of C.pallidipes and, at times at any rate, seemed to be the most heavily infested area. In Waturi, or Block F, two species had been recorded, and later a third species was found there. It was felt that with these different zones in the valley, much could be learnt regarding the various aspects of infestation by C.pallidipes, and that any knowledge gained would be useful from the scientific point of view, and for application of control measures in the Lambwe as well as in other parts of the Colony.

Each block in the Lambwe comprised different types of vegetational zones. The majority extended from the hills on the west to the escarpment on the east. The western valleys were included in the respective block, as were also the wooded ravines on the escarpment.

The different vegetational zones or transects through such zones, were carefully chosen for inclusion in the fly-rounds; and in many instances, similar transects were, of necessity, duplicated even in one fly-round. This was considered to be advantageous to the investigations because the data from one such transect would either confirm those from another or indicate the existence of some factor other than that of the vegetational environment in a particular patch of bush or sector.

In each block, there were five fly-rounds that were divided into sectors based mainly on vegetational differences. The sectors were of different lengths, and they were all marked so that the fly-boys could enter into their note-books the number of flies caught in each one. The sectors were measured by means of a surveyor's perambulator, but it was not possible to carry out this work in all the blocks before the routine fly-rounds were put into operation. Those in blocks A, B

and C were completed early in 1935. It was not until 1936 that the rounds in Ruma and Roo could be measured. The routes taken by fly-boys in all blocks were always the same, and it was hoped that an opportunity would arise to permit an accurate division of these routes into sectors.

The following table shows the system of routine fly-rounds:-

Block	Number and Name of Fly-round	Length of Fly-round	Number of Sectors
A : Sanjuero	1. Luatonga-east	15,229 yards	12
	2. Luatonga-west	9,311 "	16
	3. Kagana	8,083 "	10
	4. Nyaboro Kati	8,126 "	10
	5. Theka	10,749 "	8
B : Riamakanga	6. Kigoto	13,339 "	15
	7. Kati	12,096 "	14
	8. Gendu	11,754 "	11
	9. Kisingiri	13,052 "	10
	10. Lambwe	5,515 "	9
C : Otouk	11. Kerlango	17,012 "	16
	12. Lambwe	6,241 "	8
	13. Nyamarigi	12,694 "	14
	14. Nyabor Ondiek	12,609 "	13
	15. Rari	8,565 "	8
D : Ruma	16. Ruma-north	8,576 " )	Sectors not demarcated.
	17. Lambwe-south	5,378 " )	
	18. Ruma-south	- " )	
	19. Goyo	12,950 " )	
	20. Lambwe-north	5,591 " )	
E : Roo	21. Nyakiya	- -	
	22. Nyamatoto	- -	
	23. Akatari	- -	
	24. Roo-hillside	4,532 yards	6
	25. Roo-lakeside	6,122 "	7
F : Watari	26. Watari	- -	-
	27. Bado Ogono	- -	-
	28. Ogono	- -	-
	29. Lambwe-south	- -	-
	30. Lambwe-north	- -	-

Extra fly-rounds were patrolled in order to ascertain the fly-infestation in areas that were not covered by the routine searches.

Three natives were engaged for each block. An extra party of three was employed for daily-record work in the Lambwe round (No. 12) of Otouk. A few trained boys were kept in reserve to replace regular collectors who might fall sick or who would wish to return to their homes for a short time. The fly-boys would start on a patrol at 7 a.m. Two boys would carry a screen and a net each; the third and senior boy would also take a net, his note-book and the daily-record form. The party would move along in single file, stopping for a few minutes at frequent intervals.

The two screen-boys would catch the flies from off the screen, the senior boy would collect any flies alighting on the other boys or himself. At the end of each sector, the number of flies caught were counted, the

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sexes separated and entered on the form. Young males and females, as well as old or mature males and females and pregnant females were noted, and the state of hunger or of feeding recorded. Usually, another patrol of the same round was carried out on the following day; but, in this case, the boys would go around in the opposite direction. No further patrols were made until a week or so had elapsed, when the same system would be followed on two consecutive days. The time taken to cover the distances of the fly-rounds was from five to seven hours, the boys traveling at an average rate of about two thousand yards an hour. The kind of form used for these daily records is given in Appendix I, No. 1.

The collections were examined, and the records checked by the Overseer at the end of each day. At the end of the month all records were transferred to another form (Appendix I, No. 2) for filing purposes and permanent record.

Several thousands of flies were caught in Otouk block, marked with a distinctive colour and released. The date and place of recapture was noted.

By this method of working, it was possible to obtain a fairly accurate idea of the behaviour of the fly-community.

#### Seasonal fluctuations:

The graphs illustrating the general climatic conditions in the Lambwe valley have been dealt with in the early part of this report. When compared with the normal conditions prevailing in the Lake Victoria zone, the climate is somewhat drier in the valley; and it will be noted that the rainfall is of the thunderstorm type. The wind sweeps through the valley and assists the sun to dry up the air, grass and soil in the open country; it ventilates the open bush, but does not always gain access to the interior of the dense bush in Ruma and Nyaboro. Roo is partly sheltered by the Kasigunga hills. The mean monthly temperature at Kiabakari is about 73°F. in January, February, March and April; it begins to drop in April and reaches its lowest point (70°F.) in June and July. Towards the middle of August it rises again to about 73°F. and continues at that average level to the middle of November. The mean relative humidity varies roughly in the opposite direction. It falls to about 57% in January and February; and towards the end of the latter month rises to 60%. In March it still increases; and reaches 70% in May. There is a very slight drop in June, July and August, after which it gradually falls to about 60% in December. The rainfall is well distributed; but there may be years of severe drought.

Conditions are obviously different in the bush, and a good deal of further work needs to be done in this "home" of the tsetse. The data available, however, strongly indicates the line of investigation to be pursued.

The seasons in the Lambwe may be divided into four periods:-

(1) Long dry season, from December to the middle of March; (2) Long rain season, from middle of March to the latter half of June; (3) Short dry season, from middle of June to the middle of September; (4) Short rain season, from September to November. January is the driest month and April may be considered the wettest month. June and July are the coolest months, while the warmest period may extend from January or February to March, and from September to October. During the warm period, the sky is, comparatively, fairly clear; whereas at other periods it is more cloudy.

Figures 1 and 2 illustrate the average number of flies per fly-boy in Nyaboro, Riamakanga, Otouk and Ruma; Figure 3 shows the numbers caught in East and West Roo. The average numbers for 10,000 yards are calculated from actual numbers for purposes of comparison. They are

brought to a common basis by virtue of the consistent manner in which the collections were made and which has already been described.

It will be observed that there is a striking similarity in the trend of the curves for Riamakanga, Otouk, East and West Roo; and that the curves for Nyaboro and Ruma do not differ very much.

In April, 1935, the numbers of flies caught by hand-nets and screens show a tendency to rise or, in the case of Roo, remained at a fairly high figure. In May, the flies were also numerous, and either showed a slight or a definite rise; or they remained at approximately the same density. Roo showed a slight drop. With the exception of East Roo, the fly population seemed somewhat similar in June. There was a distinct change in July, especially in Otouk, East and West Roo. Ruma showed a slight decline in numbers; but it was notable that Riamakanga and Nyaboro (in the south of the valley) revealed a larger number of G. pallidipes. After July - and to the end of 1935 - the numbers decreased rapidly. There was, however, a little recovery in August (for Otouk); in November for both sections of Roo and in Riamakanga; while Nyaboro maintained its apparent density until the end of August.

Comparatively, very low numbers were obtained in December and the following January.

The observations in 1936 are, like those in 1935, incomplete in so far as they are not available for a similar period; and in neither case is the information sufficiently complete for a calendar year. Nevertheless, the continuation of the investigations is helpful to a general understanding of the seasonal rhythm of G. pallidipes. In January, the fly-density - by which is meant the apparent and not the true density - was low in every block of bush. February appeared to be a little more favourable to the fly; and in March, there was a decided increase excepting in Nyaboro and Ruma where there appeared to be a lag. In April there was a further rise for Nyaboro, Riamakanga, Ruma and Roo. The numbers dropped in Otouk and West Roo. Little change took place during May; but in Otouk and Ruma (in the north section of the valley) the curve shows a sudden drop. June, on the whole, marked another low figure of flies caught.

September and January, or October and February, are periods of low fly-density. March, April and May - sometimes June - are months during which G. pallidipes is most numerous.

It is not possible, of course, to discuss fully the influence of the different climatic factors on the fly-communities in each area, and one cannot assert with conviction that one factor or a combination of factors is more important than another without specific experiments to test statistical data. The investigations have not been in operation for a sufficiently long period, and the conditions governing the utilisation of the grant did not permit of experiments on the many intriguing problems in connection with the biology of G. pallidipes.

Nevertheless, one is inclined to the view that this species of tsetse requires a warm habitat with a rather high percentage of humidity in its primary home. The rainfall, its distribution, intensity and the percentage of relative humidity fluctuate much in the same way in the Lanbe valley as does the fly-density. Yet there are peculiar differences that cannot be accounted for merely by these two, related factors. There is a reduction of flies in July when the temperature is lowest, and there are low numbers in January and September or in February and October when the temperature is high or the conditions dry. The exceptional large numbers of flies for July, 1935, in Riamakanga cannot be explained by climatic influences. Other, inexplicable conditions are responsible.

Average number of flies per fly-boy per 10,000 yards

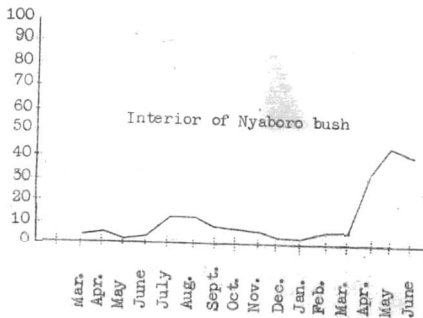
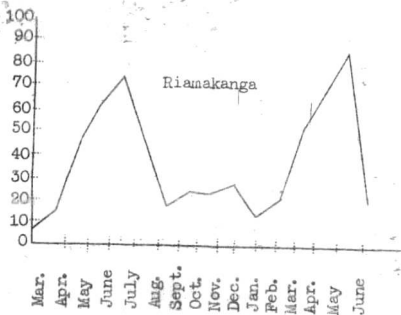


Fig. 1

Average number of flies per fly-boy per 10,000 yards

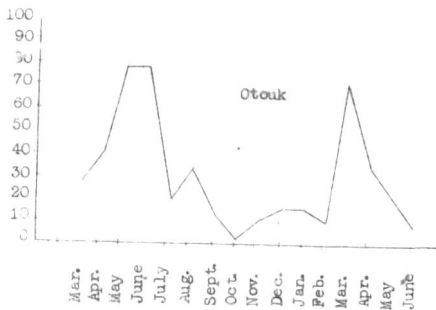
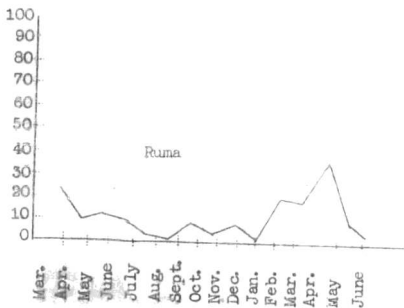
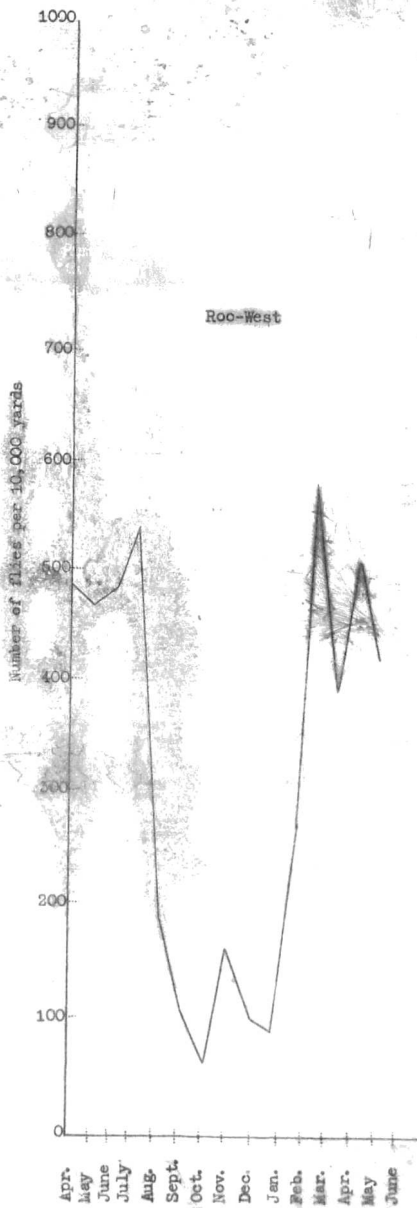


Fig. 2

Average number of flies per fly-boy per 10,000 yards



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Reference has already been made to the known differences between the climate at Kiabakari (page 5) and in the bush. The mean temperature is a few degrees lower than that at the general observation station, but the mean maximum temperature may be 10°F. lower. The humidity is normally 5% to 10% higher at the bush station which is situated in the centre of a clump of thicket, a yard or two from the bed of the Lambwe river in Riamakanga. The poor circulation of air, the density of the tangled undergrowth of bush and other conditions check or retard climatic changes in the forest or bush areas, and it would seem not impossible to modify these conditions so that G. pallidipes would find them less favourable to its existence. If the species is as susceptible to moderately severe changes as has been impressed upon us during the investigations, it is likely that the present scheme of work could be continued with good advantage.

Preliminary observations on the activity of G. pallidipes have been made. Flies appear to be active between 7.30 a.m. and 8 a.m. and continue to be so - and to attack readily - up to 10.30 a.m., after which they tend to disappear; and certainly become less active in open glades. In the shade of bush, however, they move freely until noon when usually they seek shelter and rest. Not infrequently, flies are active even during the hottest period of the day in heavily wooded areas, usually during a period of bright sunshine after a normal shower of rain. The Overseer (Mr. Langridge) reports that large numbers of flies attack quite freely while the dew is on the grass and the sun shining brightly. He is of the opinion that the humid atmosphere near the ground and the heat of the sun are conducive to great activity on the part of the fly. He has experienced that G. pallidipes always appears from near the ground, at grass-height level, and considers that this behaviour is due to the more favourable humidity immediately overlying the grass-covered soil.

On a clear, sunny day, Mr. Langridge observed no flies in the open at about noon, but on passing through open thickets, there were fairly large numbers.

Another factor that seems inimicable to the tsetse is direct sunlight. This is particularly so in the case of females. Even the males will not venture into well-lighted areas unless there is a tree, bush or other object providing shelter at no great distance from the fly's usual habitat.

G. pallidipes is not abundant on the lake-shore at Waturi; nor is it present in large numbers on the lower reaches of the Lambwe. Between Ruma and a short distance above the mouth of the river, tsetses are not usually found.

The fluctuations in the numbers of this species on the lake-shore differs from those in the riverine bush higher up the valley.

On Waturi peninsula, the greatest number of flies was collected in December, 1935, with slightly smaller numbers in July, 1935, and in March, 1936. Very few flies were collected in May, and in September, 1935; and in January, April and May, 1936. In June, G. pallidipes seemed to have disappeared. This rise and fall, and more frequent disappearance was also experienced near the mouth of the Lambwe river. In October, 1935, January, February, April and June, 1936, no pallidipes were captured by the fly-boys, although, in several instances the number of patrols was increased.

The charts illustrating records of daily catches in the Lambwe round, No. 12 (Otouk) and the daily records in the Nyaboro corridors show the changes that take place in the fly-community, and they show that when the mature flies are most numerous, the emergence of young flies is also greatest. The relation between the increase in emergence, and

the increase in mature flies needs further study especially with regard to climatic influences on the one hand, and the influence of "young" fly-population on the "mature" fly-population. Is the increase of the latter partly, largely, or entirely due to the favourable seasons affecting the pupae in the ground and accelerating development and emergence?

#### Dispersal:

It is evident that the dispersal of G. pallidipes is dependent upon the density of the fly-population in the primary habitat; on the food supply and accessibility of hosts; the climatic conditions in the "home" and in the country adjacent to it. It is also dependent upon the activity of the flies, the provision of shelter outside the permanent belt and visibility of suitable temporary habitats. Reference has been made to "following" flies or those individuals that have been transported on natives passing through the de-flying station at Sanjuero; and there seems very little doubt that the tsetse is frequently conveyed on, or often follows, cattle that are sometimes taken across the valley. These cattle, it may be mentioned, are few in number and are only moved from, and into, the valley in connection with native marriage contracts, or some other custom.

Analyses of catches made in the routine and in extra fly-rounds, show that G. pallidipes tends to spread from the permanent belt along the Lambwe during the period when flies appear most abundant; that is, in April and May; and sometimes as early as March or as late as June. The flies spread in both the westerly and the easterly directions as may be gathered from a perusal of Tables XVIII, XX and XXI. It will be observed also that there is some dispersal in July - the month which is usually coolest. This is, perhaps, not surprising when it is realised that the temperature outside the bush is hardly ever so low in this month as to incapacitate the flies. There is also a dispersal in November and December, but this is less extensive than that which occurs earlier in the year.

The valley of Nyadenda seemed rather isolated from other dense, bush covered zones, and it seemed likely that some measure could be adopted to connect this valley with other stretches of the Lambwe that could be protected from even seasonal fly-infestation. Despite careful search, no flies were collected in Nyadenda in March, April and May, 1935. One male was found in June. In July, however, G. pallidipes suddenly appeared. Fourteen males, sixteen females and two pregnant females were taken in four fly-rounds. In August, only two males were caught. After that month, no flies were seen until January, 1936, when seven males and seven females were taken. In February, three males and two females were obtained. Again, the fly disappeared from Nyadenda until April, when one male was taken on a path from Nyadenda crossing the saddle behind Iringa to the villages of Kaksingiri.

It has not been possible yet, to make a thorough examination of the data that have been collected during the last eighteen months, but one has been impressed with the Overseer's belief that G. pallidipes will not travel to any great extent in an area hemmed-in as the Lambwe valley is, without assistance from moving objects or animals. The bulk or darkness of the hills and escarpment seem to be unattractive to G. pallidipes and they occlude the vision necessary to the fly to extend its range in search of food, and obscure dark patches of bush which would otherwise appear more clearly to the fly.

The tendency of the tsetse to seek for new or more suitable haunts appears to be of paramount importance; and if an area of infested country cannot economically be reclaimed at present or within a prescribed period, it is desirable that strenuous efforts be made to arrest the encroachment of the pest in adjoining fly-free areas.

It has been seen from the preliminary tests with marked flies, that they move freely up and down the valley, from one block of bush to another. It has not been feasible to test the ability to cross a cleared barrier as yet.

As a final remark on dispersal in this report, the suggestion may be put forward that G. pallidipes seems to have occupied as its original home the valley of Roo; and it is from this belt that the greatest number of flies spread to the Lambwe river when the country was allowed to revert to bush.

#### Vegetation and G. pallidipes:

In 1912, Neave experienced that G. pallidipes, though not at all confined to river banks, is always associated with a fairly considerable amount of bush in rather low-lying river valleys; but given sufficient cover, it would no doubt be found a mile or so from water. He adds: "There would appear to be some ground for thinking that, in British South Africa, at any rate, this tsetse has a more marked seasonal prevalence than G. morsitans, being much more numerous at the end of the wet season and the months immediately following it than during the dry."

This is certainly the case in the Lambwe valley. The dense bush in river valleys provides a permanent home for G. pallidipes. The species is to be found throughout the year in the "forest" area of Nyaboro, three or four miles away from the bed of the Lambwe river; it roams extensively through the bush, but seems to be more concentrated in, or near, closed thickets; in patches of open thickets near densely bushed areas and in clumps of tall, intertwining shrubs. Table XVII gives an idea of the distribution and preferences of the fly in the different types of vegetation in Nyaboro block. Sector No. 1 passes through open thickets between the upper reaches of the Lambwe and a very dense patch of bush inside Nyaboro block; No. 2 approaches the border of this densely wooded area. No. 9 is on the west of this area; and No. 10 approaches the barrier clearing near Sanjuero camp. There appears to be no doubt that G. pallidipes finds most favourable conditions in heavily shaded bush adjoining fairly open thickets. In Nyaboro, the evergreen small trees and shrubs, Rhus glaucescens, Euclea divinorum, Cissus rotundifolia and the semi-deciduous Capparis tomentosa form a loose tangle of undergrowth under the canopy of Euphorbia ingens, thus providing an ideal habitat for G. pallidipes. Deciduous shrubs also found in the mass of undergrowth, include Harrisonia abyssinica, Grewia spp. and Cadaba adenstricha. Cordia ovalis and Jasminum mairitianum contribute to the bulk of undergrowth. These deciduous trees, however, assist in "opening-up" the dense bush at periods, and, but for the evergreen plants might serve to make these habitats untenable to the fly.

If one could venture to suggest a combination of trees and undergrowing shrubs suitable to pallidipes, it would be that of Rhus spp., Euclea divinorum, Capparis tomentosa under the shade of a tree - such as Euphorbia - with a spreading canopy.

Nyaboro bush is somewhat similar to Ruma bush; but in the latter, the vegetation is more dense throughout and the ground is usually swampy. In parts of Ruma, however, there are areas, raised above the swamp, that are eminently favourable to the tsetse. On the whole, flies in Ruma are most numerous on the periphery of the bush. It has already been remarked that the fly fluctuations are similar in both these areas. Riamakanga and Roo are also similar; both are narrow belts of bush along river-banks; both contain water-holes in the dry seasons and both receive water from flowing rivers in the rainy months. Roo, however, is definitely more sheltered from the winds; and it is not unexpected, therefore, that the fly-density is less subject to

adverse conditions which might affect Riamakanga. Outside the heavily wooded belts, conditions change more rapidly and are therefore less favourable to the fly. It has been pointed out that there are strips of bush, or patches of bush that may easily be crossed by ranging flies. It is hoped that facilities will be provided in the near future to render these strips and patches unattractive to the fly and thus restricting its dispersal. In the "parkland" forest below Byadenda, in the gall-Acacia "forest" above Ruma and in those areas where Boscia caloneura, Balanites aegyptiaca grow best, little more needs to be done than to extend the limits of the open-country or to create a barrier between the fly-infested belt and those areas that become lightly infested at certain seasons only.

#### Breeding-places:

It naturally follows that the breeding-places of G. pallidipes in the Lambwe should be concentrated in the densely-bushed areas. They are mostly found along the well-drained, and sheltered banks of the river. Figure 8 shows the concentration and distribution of breeding-places along a transect from the Lambwe river in South Otouk to the Gwassii foot-hills. The numbers of pupae include empty shells as well as live pupae. The density, or absence of bush is indicated; and it shows that, although the breeding-places are more concentrated and the "pupae" most numerous near the river, there are "pockets" as far as 2,250 yards away from the Lambwe. In this case, the fly has chosen a clump of thickets somewhat isolated from the riverine bush, but it will be noticed that there is a series of "stepping stones" along the line of the transect. In the diagram illustrating the corridors and bush-density in Nyaboro, it is shown that G. pallidipes will breed considerable distances away from a river and where no water exists. Pupae have been found in numerous places about four miles from the Lambwe, riverine bush. The bush in these places, however, has a thick ground layer of Sansevieria that seems to provide the requirements of the fly. Females may even choose dense bush for larviposition as may be seen in the case of the breeding-places between corridors Nos. 10 and 12; 3 and 4, and 2 and 3 in Nyaboro.

The Overseer, in his report for May, 1936, asks some interesting questions. Why does one find so many pupae and puparia in one isolated spot? Does one female, or a family of females, usually confine itself to the same place for breeding; and do the flies wander about for food but return to the same place to drop their young. Or is that particular spot so outstandingly favourable that many females choose it out of many other, apparently similar and equally suitable places?

It has been observed that breeding-places in Ruma are distributed differently from those in Otouk, Riamakanga, Roo and Nyaboro. They occur in a scattered manner along the Lambwe river which is rather exposed in this stretch. They also occur on "islands" in the swampy ground; they are most numerous in an old clearing and on the fringe of bush where the soil is dry. Investigations on these lines have not proceeded far so that it is not possible, yet, to provide accurate details to our colleagues of Tsetse-fly Research Department in Tanganyika with whom we are in close and regular communication. It would appear that the study of inundation and its effect on the pupae and on the fly-population is not without much practical importance.

Live pupae of G. pallidipes have been found under a stone beneath a Euphorbia tree above Roo and there is no dearth of evidence that this tsetse will deposit its young in many peculiar places - but not to a large and serious extent.

An examination of many thousands of pupae has revealed no evidence of parasitism by Syntomosphyrum. Commander Blunt discovered that some pupae appeared as if they had been "nibbled", and he found, later, two

pupae with small coleopterous larvae chewing into the body of the blackened pupae. These larvae had eaten their way into a cavity about half-way through the pupae. Specimens of the larvae were collected and forwarded to Sir Guy Marshall for identification. They were identified as larvae of a species of Idgia.

Other specimens of pupae, collected on Watari peninsula, were used in breeding experiments. Many of these failed to develop and on examination were found to have an ill-defined, dirty white spot on the outside of the shell. Several specimens were collected but there has been no opportunity to make a careful examination of these that appear to be affected by a fungoid growth.

#### The influence of Game on G. pallidipes:

The game in the Lambwe valley is plentiful; there are many different species of animals that move from place to place. Some have the bush as their habitat; others, the open country, the "parkland" or the Acacia forest. There is no obvious concentration when herds of a species collect for several days or weeks in a locality infested by fly. As already remarked, some groups of animals confine themselves to that area below Ruma bush, extending from below Roo to Ruri, and area that is free from fly.

Commander Blunt and the native observers, began a study of the movements of game in relation to any effect that might show on the fly-community and the spread of the tsetse.

Close attention was given to the herds of elephant. It seemed that they affected the catches by fly-boys on routine patrols. When the elephant were known to be absent from Otouk bush, the catches were normally large, but if these animals were in the vicinity, or had only recently moved away, the number of flies caught were either very small, or none at all appeared to the fly-boys. The catches as shown on the chart were carried out daily and the figures were, at first, rather convincing. Early in 1936, the elephant were driven north and did not return to Otouk for several months. Yet, the catches still fluctuated in the same way as before. Prior to this information, it was believed that the elephant attracted the flies; they served as admirable hosts for flies to feed to repletion and then the tsetses would seek shelter to digest their meal. The females would hide in the bush to deposit their young. The hypothesis is an interesting one, and worthy of further and closer attention.

Buffalo, in the Lambwe valley, frequently followed the elephant, and it seemed that this species was not unconnected with the changes in the numbers of flies caught by the boys. Small herds often move up the valley and remain in Nyaboro for several days. These animals have been watched closely; and the Overseer (Mr. Langridge) has always proceeded to the vicinity with three fly-boys. In each case, for four months, interesting catches have been made. Fly-boys on regular patrols have also caught more flies in the vicinity of a herd of buffalo in or near a sector where normally no flies have been collected. On every occasion there has been a sudden increase of flies when buffalo are near; and the majority have been half, or fully, engorged males.

As an example, one G. pallidipes was captured in sector No.1 of Round 3 in the Kagana in the last fortnight of July, 1936. There were no buffalo in the neighbourhood. On August 7th, five buffaloes moved from Nyaboro into sector No.1. The boys caught seven males and three females on that day in sector No.1; six males and five females in sector No.2. No flies were taken in the other sectors. In Nyaboro, Round No.4, there was a sudden rise in the number of flies taken in sector No.5 on August 11th. Seventeen males and four females were

taken a few hours after three buffalo had left the spot. On August 4th, fourteen engorged males, ten unfed males and one female were collected at the junction of corridors No.2 and No.8 where a small herd of buffalo had remained for several hours on that day.

In the case of buffalo, therefore, it seemed that the effect on the fly was the opposite of that put forward for the elephant.

Without expanding on further suggestive and inconclusive evidence, it is felt that these remarks will indicate a promising line of investigation. The data which has been collected seems to point to the fact that elephant, buffalo - possibly waterbuck and bushbuck - in particular, are more closely associated with G. pallidipes than game species of the savannah or open country. Figures show that the game in the valley does not assist dispersal to the extent shown by the number of flies taken off natives passing through the bush to fly-free areas. On the other hand it appears likely that the frequent rise and fall in the numbers of flies caught by fly-boys may be accounted for by the presence or absence of certain species of game in the fly-rounds.

## SUMMARY

A description is given of the fly-belt in the Lambwe Valley in the South Kavirondo Native Reserve of Kenya Colony.

The distribution and character of the vegetation are discussed; the climatic conditions are dealt with; and an account is given of the soil and water-sources in the valley. The game in the valley is briefly commented upon.

Glossina pallidipes infests nearly the whole of the valley. The permanent, primary belt is confined to the riverine bush from Morea to North Ruma; to Nyaboro bush immediately north of Morea which marks the southern limit of actual fly-belt; and to the sheltered river valley known as Roo. Between Ruma and the shore of the Kavirondo Gulf, there is a flat area of land with gall-acacia that is fly-free; and it separates the pure pallidipes-belt to the south from the mixed fly-belt along a narrow strip of country on the lake-shore. The country south of Morea hill is largely free from infestation; but some flies have been taken immediately above Morea, in Luatonga. The species of tsetse in this mixed fly-belt are G. palpalis, G. pallidipes and G. brevipalpis.

A brief historical review of the valley, its people and stock show that general infestation is comparatively recent and that the fly has gradually forced the inhabitants up the valley and to the foot-hills, ultimately causing the majority of the people to evacuate. Evidence of a one-time thriving population is given; and statements of Administrative officers show that there has always been a desire to control the fly-infestation and to reclaim a valuable piece of country.

The dire need for information on the habits of G. pallidipes is emphasised; and it is explained that the experiments carried out in the Lambwe valley with the assistance of £2,120 from the Colonial Development Fund, and £1,300 from the Local Native Council, have been in operation for a period of eighteen months. There were some difficulties in regard to labour supply owing to the attraction of better wages in the gold-mines. Later the Overseer (Commander Blunt) was indisposed and invalided home, thus necessitating the appointment of a new Overseer.

The grant from the Colonial Development Fund was expended in an endeavour to control infestation by G. pallidipes without clearing all the bush and by trapping.

A scheme for isolating the infested zone, and dividing the bush into five "blocks" is outlined; and a detailed account is given of the amount of clearing which has been done. The southern fly-barrier is a little over four miles long and 400 yards wide; its width is considered inefficient as a barrier. The Kagana barrier is nearly a mile long and 1,000 yards wide. The edge of the Kagana bush is being cleared of undergrowth to add to its efficacy against dispersing flies. Corridors have been cut across the valley from Kigoto to Kamaguthi, and from Ugoro to Kisingiri. The latter is being widened with the aid of a further grant from the Local Native Council; and arrangements have been made to extend the width of the Nyaboro barrier with financial assistance from native funds.

Trapping experiments are dealt with in detail. A new box-screen trap has been designed and it has shown considerable improvement on other traps in catching G. pallidipes in a heavily infested area. Comparative tests with many kinds of traps have been carried out in different types of fly-belts, the box-screen being more effective in every instance. The value of mechanical trapping in natural sites and prepared corridors is discussed; and trials have shown that the numerous, narrow corridors intersecting Nyaboro bush improve the results

of traps. These trials indicate the need for corridors wider than six feet, and the need for further investigations into the use of attractants. Traps left in one position for a prolonged period lose their attraction to fly; and extended trials show that trapping may with advantage be restricted to a period when the fly-density is high. At other times, hand catching and pupae collecting may prove better means of attack.

Special attention is drawn to the number of flies taken at the Sanjuero de-flying station, particularly in view of endeavours to provide water for cattle at a dam near Sanjuero hill.

The conclusions, however, are tentative, as it is felt that the experiments have been in operation for too short a period to warrant definite and final statements on the value of traps.

While carrying out measures calculated to control G.pallidipes, it became increasingly difficult to obtain a clear idea of the reaction of the fly-community. Statistical data from a system of routine patrols or fly-rounds provided means to gauge the activity and fluctuation of the fly-community; they provided figures to show periodic increases and decreases in the apparent population; and indicated the seasons when there was a tendency to dispersal from the permanent fly-belt. Experimental work not of immediate or direct practical value was handicapped by the lack of funds for this purpose.

An attempt has been made to give some idea of the influence of climate and season, vegetation and game, on the density of, and changes in, the fly-community in the Lambwe. It seems that G.pallidipes requires a fairly warm, humid atmosphere not exposed to sustained, bright sunlight as a permanent home; it shuns "parkland" or open forest of deciduous trees, especially if these vegetation types exist between the permanent belt and high hills that restrict the flies' vision. The period of greatest density is soon after the beginning of the rains to a varying period after the rains (March-June). There is a decided decrease in the numbers usually about January-February and September-October.

Dispersal to the eastern and western hills, as well as up and down the valley, tends to be greatest from about March to June.

G.pallidipes is abundant most frequently in the vicinity of dense bush, but large numbers may be obtained in semi-open bush providing shelter in the form of clumps of thickets.

Breeding-places are concentrated in, but not confined to, well-drained banks of river courses. They may occur in small "pockets" or more extensive areas up to four miles from the main River and where no surface water exists. These non-riverine breeding-places (and even those near the river), are almost invariably covered with a thick layer of dwarfed Sansevieria plants thriving in the shade of a network of scandent shrubs.

The species of wild game do not concentrate in any fly area. There is some evidence, however, that elephant and buffalo are responsible for the sudden appearance and disappearance of G.pallidipes. Instances are given of the influence of buffalo.

It has repeatedly been suggested in the text of the report that there is a keen and general desire to continue with the scheme of experimental control of G.pallidipes in the Lambwe valley. It has also been indicated that there is a need for experiments designed to give a better understanding of this species of tsetse. Without provision for the latter, the former can be useful only in so far as the Lambwe is concerned, whereas it is necessary to be able to apply

the knowledge gained from these experiments to similar problems in other fly-infested areas of Kenya Colony and other territories.

#### ACKNOWLEDGEMENT

In addition to the acknowledgements already made in the report, the writer wishes to record his indebtedness to Mr. R. Daubney (Chief Veterinary Research Officer) for his continual interest, guidance and encouragement throughout the whole period of this investigation; to the many officers of the Administration Department who have given valuable assistance and who have been instrumental in obtaining further financial support for the experimental project; and to the Overseers (Commander D. E. Blunt and Mr. Langridge), for the enthusiasm which they have shown in the work.

The writer is grateful also to the British East African Meteorological Service for printing all the forms used in recording the data collected in the field, for assistance in the taking of most of the photographs, and for duplicating this report.

Block A, Nyaboro:

Round - No. 4

Name: Nyaboro centre

Table VIII

Sector: MONTH	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7		No. 8		No. 9		No. 10		Total Adits Young	No. of Patrols
	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng		
1935	-	-	-	-	-	-	7	-	-	-	8	-	-	-	-	-	-	-	-	-	15	4
March	-	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	21	4
April	1	-	-	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	12	4
May	-	-	-	-	2	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	14	4
June	1	-	2	-	1	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	14	4
July	3	1	-	2	2	-	4	-	7	1	6	-	9	-	6	-	4	-	-	-	45	4
August	1	-	7	-	6	1	4	-	12	-	-	-	6	-	1	-	-	-	-	-	3	4
Sept.	1	-	8	-	5	-	1	-	5	1	6	-	7	-	5	-	1	-	-	-	38	4
Oct.	-	-	11	-	2	-	2	-	4	-	2	-	4	-	3	-	-	-	-	-	23	4
Nov.	3	1	9	-	2	-	2	-	4	-	2	-	4	-	3	-	-	-	-	-	16	4
Dec. 1936	1	-	-	-	2	-	2	-	1	-	2	-	4	-	6	-	-	-	-	-	19	4
Jan.	-	-	-	-	-	-	-	-	1	-	-	-	-	-	7	-	-	-	-	-	13	4
Feb.	2	-	12	4	1	-	-	-	3	1	-	-	-	-	2	-	-	-	-	-	13	4
March	1	-	2	2	2	-	2	-	3	1	3	1	-	-	1	-	-	-	-	-	13	4
April	4	1	12	-	2	-	7	-	13	1	4	-	-	-	1	-	-	-	-	-	43	4
May	4	2	19	2	5	-	21	2	4	-	7	-	6	-	14	-	-	-	-	-	80	4
June	9	-	4	2	13	1	18	2	3	1	9	-	4	-	9	-	-	-	-	-	91	4
Total	31	5	89	14	44	2	75	5	65	6	47	1	35	-	74	-	41	1	7	-	508	35
Length in yds.	1391		578		1242		539		1837		537		227		922		686		747		8,126	64

Type of vegetation through which the sectors pass:-

Open thickets, irregularly distributed.

Closed thickets, forming dense bush.

Open thicket near northern edge of Nyaboro block.

Between open thicket and *A. Seyal* (savannah) patch approaching interior of Nyaboro.

Dense bush with very small glades closed in.

Open thickets.

Low scrub (dense) on abandoned cultivated land.

Dwarfed, dense bush.

Dense or closed bush.

Open thicket with *A. Seyal* near northern border of Nyaboro barrier clearing.



Sector:	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13	No. 14	Total	No. of																
																	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng	Ad's Y'ng
1935	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-															
March	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1															
April	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	44															
May	-	-	2	2	13	3	4	1	-	-	-	-	-	-	-	-	30															
June	-	1	3	3	9	38	-	4	-	3	1	6	1	-	-	-	74															
July	-	3	4	1	14	2	19	-	46	-	4	8	1	-	-	-	124															
August	-	1	3	3	-	26	23	-	3	-	3	12	3	3	-	-	75															
Sept.	-	-	-	10	-	14	-	2	-	1	-	5	-	-	-	-	34															
Oct.	-	-	1	1	5	7	1	-	4	-	4	1	1	-	-	-	25															
Nov.	-	2	1	6	-	5	1	10	29	4	2	10	2	-	-	-	53															
Dec.	-	-	-	-	3	-	-	4	-	6	1	9	-	2	-	-	40															
1936	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-															
Jan'y.	-	1	-	-	-	5	-	-	-	-	1	-	-	-	-	-	9															
Feb'y.	-	-	-	-	2	1	-	-	-	3	-	3	1	-	-	-	18															
March	-	1	6	1	13	5	22	9	57	-	15	2	3	-	-	-	137															
April	-	2	3	-	10	3	43	7	29	-	15	2	-	-	-	-	91															
May	-	5	1	9	5	18	3	28	10	-	21	14	1	-	-	-	155															
June	-	1	3	3	1	8	3	21	-	10	10	2	5	-	-	-	38															
Total:-	2	14	6	41	10	108	16	207	26	252	29	87	24	35	7	12	2	43	2	120	21	32	10	14	5	13	-	980	158	64		
Length in yds.	576	1894	896	392	860	105	518	875	855	795	614	2093	1200	423																		
Type of vegetation through which the sectors pass:-																																
Thorn country at the foot of the Gwaasi hills.- <u>A. seyal.</u>																																
Dense scrub and patches of thick bush.																																
Border of cultivated land with open thickets; also native path.																																
Open bush with thickets on the south; approaching riverine thicket.																																
Dense riverine bush with intersecting game paths: Lambwe river - west.																																
Short or dwarfed shrubs forming closed thicket; Lambwe river - East.																																
Open glades or "mbuga".																																
Open bush interspersed with low scrub on slope of scarp - Gendu.																																
Along native path to very open bush.																																
Re-entering open bush and low scrub from Gendu - game paths.																																
Open mbuga with scattered thorn across Lambwe river.																																
Close thickets with elephant tracks.																																
Low scrub on side of native path.																																
Scattered patches of scrub on old, cultivated land.																																

Sector:	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13	No. 14	Total	No. of		
																	Ad's Y'ng	Ad's Y'ng
1935	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
March	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
April	-	-	-	3	3	-	-	29	-	-	-	-	-	-	-	-	44	
May	-	-	2	2	13	4	1	-	2	-	-	-	-	-	-	-	30	
June	-	1	3	3	9	38	4	-	4	-	8	1	1	-	-	-	74	
July	-	3	4	1	14	2	19	46	6	2	2	-	-	-	-	-	124	
August	-	1	3	-	10	-	26	23	3	1	-	3	3	-	-	-	75	
Sept.	-	-	-	-	10	-	14	-	2	-	1	-	-	-	-	-	34	
Oct.	-	-	1	-	5	7	1	-	4	-	1	-	-	-	-	-	25	
Nov.	-	2	1	6	-	5	1	10	29	2	10	2	6	1	9	2	53	
Dec.	2	-	-	-	3	-	-	-	4	-	2	6	1	9	2	4	40	
1936	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Jan'y.	-	1	-	-	5	-	-	-	-	-	1	-	-	-	-	-	9	
Feb'y.	-	-	-	-	2	1	-	-	-	-	3	-	-	-	-	-	18	
March	-	1	6	1	13	5	22	9	57	-	15	2	3	-	-	-	137	
April	-	1	2	3	10	-	28	6	10	-	15	2	1	-	-	-	24	
May	-	5	1	9	18	3	43	7	29	-	21	14	1	-	-	-	91	
June	-	1	3	1	8	3	21	-	10	2	5	5	1	-	-	-	155	
Total	2	14	6	41	108	16	207	26	282	29	87	24	35	7	12	2	43	980
Length in yds.	576	1894	896	392	860	105	518	875	855	795	614	2093	1200	423			158	64
Type of vegetation through which the sectors pass:-																		
Thorn country at the foot of the Gwesi hills. - <u>A. seyal.</u>																		
Dense scrub and patches of thorn bush.																		
Border of cultivated land with open thickets; also native path.																		
Open bush with thickets on the south; approaching riverine thicket.																		
Dense riverine bush with intersecting game paths: Lambwe river - west.																		
Short or dwarfed shrubs forming closed thicket; Lambwe river - East.																		
Open glades or "mbuga".																		
Open bush interspersed with low scrub on slope of scarp - Gendu.																		
Along native path to very open bush.																		
Re-entering open bush and low scrub from Gendu - game paths.																		
Open mbuga with scattered thorn across Lambwe river.																		
Close thickets with elephant tracks.																		
Low scrub on side of native path.																		
Scattered patches of scrub on old, cultivated land.																		

Table XIX

Section:	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	Total	No. of	
MONTH	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Ad's	Young	Patrols
1935												
March	2	8	4	19	-	-	-	-	-	33	-	4
April	26	10	12	19	16	4	5	-	-	92	11	4
May	29	40	31	21	6	29	3	32	2	191	22	4
June	35	30	16	19	6	40	4	21	-	210	15	4
July	47	30	18	31	6	20	-	32	-	260	19	4
August	13	6	2	12	53	12	32	-	20	199	25	4
Sept.	2	2	2	3	3	8	-	21	9	69	11	4
Oct.	4	1	5	4	-	-	-	11	2	54	4	4
Nov.	4	10	4	4	8	-	11	-	13	69	13	4
Dec.	12	2	4	20	19	-	11	4	5	97	26	4
1936												
Jan'y.	1	12	2	-	-	-	-	3	1	38	10	4
Feb'y.	2	4	10	-	8	-	20	1	8	75	7	4
March	7	12	2	10	31	3	24	4	176	302	27	4
April	16	9	7	3	24	7	33	2	45	246	56	4
May	1	17	4	24	6	25	-	36	0	226	54	4
June	1	1	-	2	-	-	-	5	-	50	14	4
Total:-	202	36	191	27	184	26	256	29	324	2211	314	4
Length in yds.	855	504	492	323	253	188	1093	848	958			

Type of vegetation through which the sectors pass:-

Mainly close thickets with overhead shade. - small glade and parts of river bed open.

Along elephant path through very close thickets with good amount of canopy shade.

Open bush and scrub on the right; Open thickets on the left with *A. seyal* and *Balanites*

Thick, tall coppice much broken by elephant tracks.

Tall, thin coppice with fair amount of overhead shade. Dense bush bordering small glades.

Thick coppice forming tunnel over Lambwe river. Tangle of bush fairly open.

Open country with small patches of thicket along river-bed.

Broken coppice on river-bed with large clumps of thicket bordering glades.

Riverine thicket on the right, water holes in river-bed and fairly open country on the left.







34°10'

34°18'

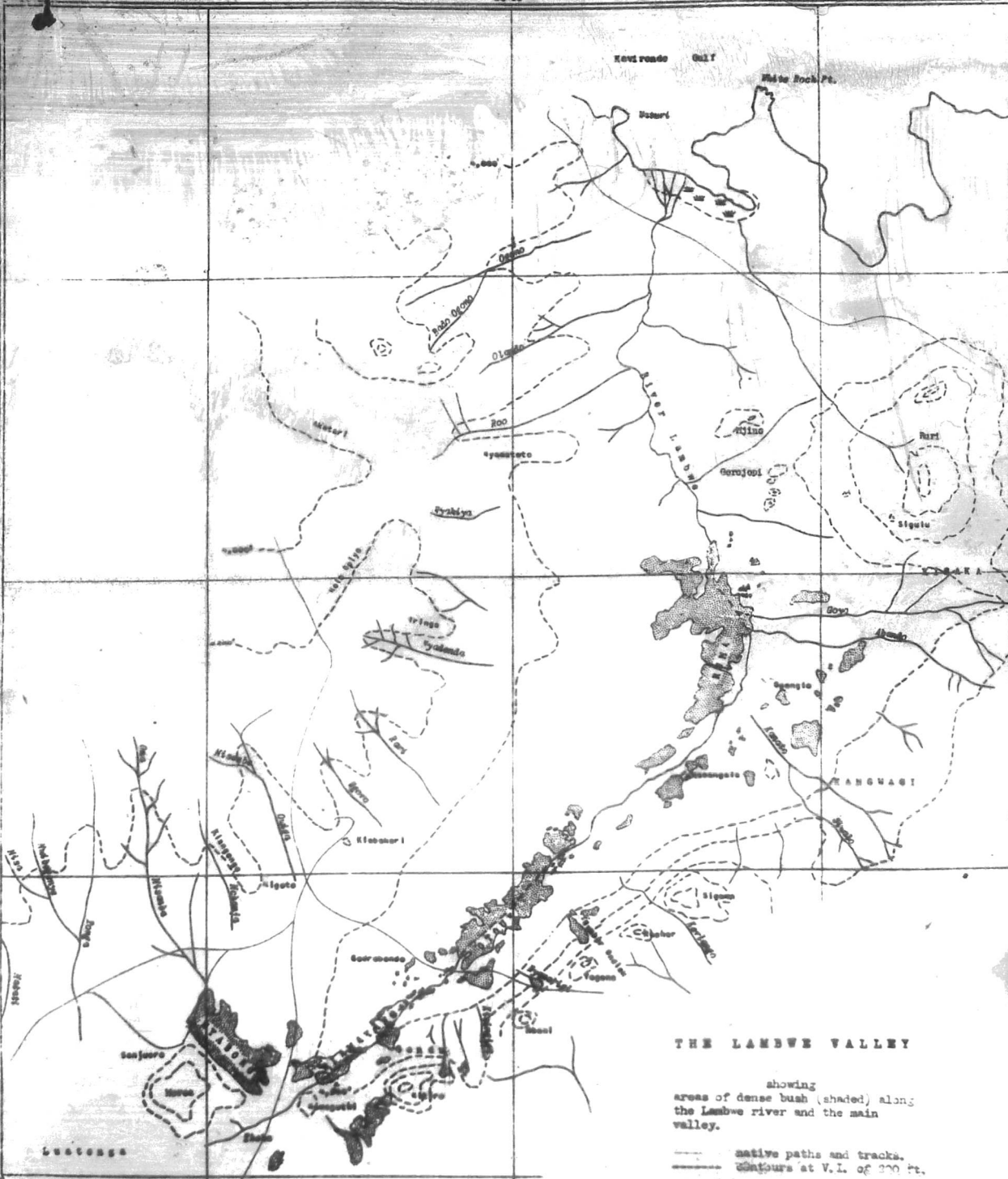
34°26'

0°00'

0°35'

1°00'

1°30'



**THE LAMBWE VALLEY**

showing areas of dense bush (shaded) along the Lambwe river and the main valley.

--- active paths and tracks.  
--- contours at V.I. of 200 ft.

Lusitanga

C. O.

C.D.  
R 3-MAR  
D 10 "

38299/37.

3 152

Mr. Flood  
Mr. O'Brien 3/3  
Lieut. Hunter 28.3.37

ackd. (4)  
ackd. (8)

Downing Street,  
15 March, 1937.

Sir C. Parkinson.

Sir G. Tomlinson.

Sir C. Bottomley.

Sir J. Shuckburgh.

Permt. U.S. of S.

Parly. U.S. of S.

Secretary of State.

( 18307/SL  
Nº 7 )

Sir,

**DRAFT.**

*J.V.*

THE SECRETARY,  
THE ECONOMIC ADVISORY COUNCIL.

I am etc., to refer to your letter of the 11th<sup>th</sup> November, 1932, No. EAC.339, and connected correspondence on the subject of the application made by the Government of Kenya for a grant from the Colonial Development Fund towards the financing of a Tsetse Fly campaign in the Kavirondo Reserves, and to transmit to you, for the consideration of the Tsetse Fly Committee of the Economic Advisory Council, the enclosed copy of a despatch from the Governor covering an application for a further grant of £1,900 a year for three years. One full copy (with illustrations, etc.,) of Dr. Lewis's Report is enclosed, together with four copies without the

**FURTHER ACTION.**

Reside for preparation of a memo for the E.A.C.

the illustrations, etc.

2. Mr. Ormsby Gore would be obliged for the observations of the Tsetse Fly Committee on this proposal before it is submitted to the Colonial Development Advisory Committee. In this connection I am to refer to *the fifth* paragraph ~~Five~~ of the recent report of the East Africa Sub-Committee of the Tsetse Fly Committee (EAC(TF) 463) and to point out that although an investigation into the 'ecology' of the *Glossina pallidipes* Fly forms part of the programme of work to be undertaken, yet it is by no means the principal part and indeed, may be regarded as incidental in the execution of the work which the Kenya Government wishes to carry out. *It appears that the proposed programme of work has received the approval of Mr. Symington*

3. Since it is desired to bring <sup>(application)</sup> this before the Colonial Development Advisory Committee at an early date <sup>I am</sup> ~~and~~ to request that the matter may be <sup>submitted to</sup> ~~brought before~~ the Tsetse Fly Committee as soon as ~~it~~ may be convenient.

I am, etc.,

*See 4.6.45. Flood -*

153

KENYA.  
No. 50



GOVERNMENT HOUSE  
NAIROBI,  
KENYA.

RECEIVED  
20 FEB 1937  
O.O. REGY

20 JANUARY, 1937.

Sir,

(13) on 18307/32

with reference to Sir Philip Cunliffe-Lister's (now Viscount Swinton's) despatch No.927 of the 22nd December, 1932, conveying approval of a free grant of £6,160 from the Colonial Development Fund to cover the cost of experiments in tsetse fly control in Kenya, I have the honour to transmit to you, for your information, a copy of a report prepared by Dr.E.A.Lewis, Entomologist in the Department of Agriculture, on the experiments carried out on the control of Glossina pallidipes in the Lambwe Valley of the South Kavirondo district. Twenty additional copies of this report are being forwarded under separate cover for transmission to the tsetse fly Committee of the Economic Advisory Council and, in connexion with the application contained in this despatch for further assistance from the Colonial Development Fund to enable the experiments to continue, to the Colonial Development Advisory Committee. Only two copies of the report contain the full set of photographs, diagrams and charts: the remaining copies are illustrated only by a map of the Lambwe Valley.

Recd - (22)

copy E.A.L. (3)

2. The purposes of the grant of £6,160 were two, namely, measures against Glossina palpalis

THE RIGHT HONOURABLE  
W. ORMSBY GORE, P.C., M.P.,  
SECRETARY OF STATE FOR THE COLONIES,  
DOWNING STREET,  
LONDON, S.W. 1.

as

as the carrier of human trypanosomiasis, (a separate report on these measures will be transmitted to you shortly, but it is not proposed to ask for further assistance from the Colonial Development Fund for this purpose); and work on Glossina pallidipes, the carrier of trypanosomiasis in cattle. The sum of £2,120 was allocated from the grant to this latter purpose, and the accompanying report by Dr. Lewis describes the work done over a period of eighteen months and sets out the conclusions reached at the end of August, 1936, when this allocation was exhausted.

3. The report contains a detailed account of the field operations carried out in trapping, in partially clearing bush to create fly barriers and in isolating the main areas of dense, fly infested bush, and includes observations on the bionomics of Glossina pallidipes. The project, which may be regarded as a scientific investigation of African rather than merely local importance, is, however, incomplete. Dr. Lewis's conclusions are tentative, and if useful results are to be obtained from the work already done it is necessary that the experiments should be continued. The programme of work recommended is set out in the accompanying application for a free grant of £3,700 to be expended over a period of three years.

4. The sum of £2,120 allotted to the Kavirua Valley experiments has been supplemented by sums voted by the South Kavirua Local Native Council for bush clearing in the valley, amounting to £100 in 1934, £600 in 1935, £980 in 1936 and a sum not exceeding £600 in 1937. The Local Native Council is

naturally

naturally anxious to see some immediate practical results of value to the natives of the District, and it is clear that the Council cannot be asked to make further contributions without danger of confusion of objectives, which has to some extent characterised the work undertaken hitherto. The estimates of cost now furnished include, therefore, a sum of £600 per annum for labour in replacement of the contribution hitherto provided by the Local Native Council.

It should be emphasized that the project is primarily an investigation with a view to acquiring knowledge of the bionomics of Glossina pallidipes and to devising and testing various practical methods of controlling and eliminating this species without wholesale bush-clearing, which can only tend to accelerate soil erosion and desiccation. The importance of the experiment lies in the possibility of applying results to other large areas of Africa at present fly-infested.

46342/3/10 e n  
Stand  
26 1 2

5. The Conference on Co-ordination of Tsetse and Trypanosomiasis Research in East Africa held at Entebbe in January, 1930, recommended that in view of the short time the war in the Lamuwa valley had been in hand and its great importance, it should be continued at least until the next meeting of the Conference. Mr. Swynnerton approves, I understand, of the continuation of the programme, and has expressed his approval to the Tsetse Fly Committee of the Imperial Economic Committee.

6. In these circumstances I trust that you will be able to support the application now submitted for a grant of £5,700 to enable the work to be continued.

I have the honour to be,

Sir,

your most obedient, humble servant,

C. D. Wade

ACTING GOVERNOR.

MEMORANDUM OF APPLICATION FOR A FREE GRANT  
OF 25,700 TO ENABLE EXPERIMENTAL WORK ON  
GLOSSINA PALLIDIPES TO BE CONTINUED IN  
KENYA COLONY.

-----+-----

1. Kenya.
2. The continuance of Scheme No.223 in respect of investigational work on Glossina pallidipes in the Lambwe Valley, South Kavirondo district, Kenya Colony. Twelve copies of a report on the experiments undertaken hitherto are forwarded. The programme of work proposed is as follows:-
  - (a) To continue studies into the bionomics of Glossina pallidipes:-
    - (a) The seasonal fluctuations, movements and activities of the species in relation to climate and weather, vegetation, and game.
    - (b) The activities of the fly at different hours of the day and the influence of temperature, shade and light, humidity (relative and saturation deficit) evaporation, cloud and other factors throughout the different seasons.
    - (c) The influence of seasons on dispersal and proportion of the sexes.
    - (d) The marking of flies to estimate true density, to ascertain movements and the ability of flies to cross prepared barriers cleared of bush and barriers of very dense bush.
    - (e) Micro-ecological studies in relation to the density of infestation, and the selection of breeding-sites.
    - (f) The distribution of breeding-places; and the provision of artificial, breeding grounds.
    - (g) The varying degrees of concentration.
  - (b) To isolate the Nyabere bush from the fly-infested block of Riamakanga, and from the fly-free area of Luatonga:-
    - (a)

(a)

- (a) To maintain, extend and to widen corridors for trapping of *Glossina pallidipes*.
- (b) To continue with clearing of undergrowth and to thin-out the trees in sections of Nyabere as part of a scheme of discriminate clearing of bush.
- (c) To widen the Kigote - Kamaguthi corridor and to carry out discriminative clearing of the riverine bush in Riamakanga, and to extend trapping to Riamakanga.
- (d) To isolate Oteuk from Ruma; and Ror from Ruma.
- (e) To devise traps more attractive to fly, and capable of effecting consistent, heavy catches.
- (f) To prepare large quantities of attractant for use with traps.

- 3. Immediately on approval.
- 4. Three years.

5. (a) Detailed annual estimates:

	£
1. Overseer @ £30 p.m.	360
2. Clerk @ £ 6 p.m.	72
3. 30 Fly boys @ £1 p.m.	360
4. 100 labourers @ Shs.10/- p.m. (including rations)	600
5. 2 Meteorological Observers, 2 Game Scouts, 3 Carpenters and 2 Assistant Botanists @ £1-10 p.m.	162
6. Tools	65
7. Material (timber, hessian, gauze-wire, etc.)	75
8. Instruments (Meteorological and apparatus)	25 X
9. Stationery (field note-books, printed record forms, etc.)	50
10. Travelling & Subsistence	100
11. Contingencies.	31
	£.1,900

or £5,700 for three years.

X This estimate may be exceeded in the first year, but any excess would be covered by savings on other items.

(b) Yes.

6. Expenditure in Great Britain would only be expenditure on instruments and apparatus, i.e. £25 annually with a possible small addition in the first year.
7. The work has been in progress for nearly two years, but the grant is exhausted.
8. -----
9. -----
10. Direct grant.
11. -----
12. -----

11.5

Report of Experiments on the Control  
of *Glossina Pallidipes* in  
Kenya Colony



Caru, Yagashiki, Hirose, Kasura's Middle, Kuroki, Yagashiki

Yama

Yama

Yama

Yama

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TSETSE-FLIES IN THE LAMBWE VALLEY, KENYA COLONY.

Studies on Glossina pallidipes and experiments on its control.

INTRODUCTION.

Geography and topography.

The Lambwe Valley is in the South Kavirondo Native Reserve of Kenya Colony; it lies within latitudes  $34^{\circ}10'$  and  $34^{\circ}25'E$  and between longitudes  $0^{\circ}30'$  and  $0^{\circ}30'S$ ; it stretches from Morea hill to the Kavirondo Gulf of Lake Victoria, a distance of twenty-three miles. The upper half of the valley seems to be enclosed by hills on the west, the south and on the east. The western group of hills are irregular, with the outstanding peak of Mirari reaching an altitude of about 7,000 feet above sea-level and 3,000 feet above the bed of the valley; the lower slopes are indented with numerous small valleys varying from two to three square miles, where most of the present native inhabitants have their cultivated plots and water-supplies. These hills are locally known as the Gwasssi hills; they form an effective physical barrier between the valley to the east and the shores of Lake Victoria on the west. Morea hill stretches nearly across the Lambwe valley at its southern end; it separates the long strip of tsetse-infested country to the north from the comparatively fly-free area to the south. On each side of the Morea there is an opening leading from the Lambwe Valley to Maia point and Karungu on the Lake shore. The escarpment on the east rises steeply from 4,200 feet to about 5,200 feet, then extending as a plateau thickly populated by Jaluoc clans of the Kavirondo people.

The distance across the valley immediately north of Morea is approximately four and a half miles; it gradually increases to nearly nine miles from Nyadenda to Kamwagi where the main valley turns northward and becomes much more open. The isolated mountain groups of Ruri on the east, and Gembe or Kasigunga on the west, break up the broadening valley, forming smaller valleys such as Kamwagi and Kisaka leading to the eastern plateau and Homa Bay. Holo Opiyo and Akatari connect the Lambwe with the shore of Lake Victoria to the west. Further north, the

valley joins the low-lying littoral of the Kavirondo Gulf.

The land below 4,400 feet covers an area of 125 square miles.

A considerable proportion of the valley is covered by very dense bush, more especially down its centre, from Morea to the vicinity of Ruri. Hidden by a belt of thick bush is the course of the Lambwe river which rises at Theke near Morea. Seen from the air, or from the top of the eastern escarpment, the course of the Lambwe river is well marked even through the most dense vegetation; but when descending into the valley, the river-bed is found to be generally ill-defined due to heavy silting. It is only during the rainy seasons, however, that water actually flows in the river, although small pools and swamps are found in the river-bed throughout the greater part of the year. After heavy showers that occur in this region during the rainy season, a large amount of water is discharged from the small mountain streams into the Lambwe, causing it to rise and flood the immediate neighbourhood. The river eventually flows through a small swamp on the shore of the lake and into the Kavirondo Gulf between Waturi and White Rock Point. The numerous small streams from the hillsides disappear underground before reaching the Lambwe river.

#### Vegetation:

Irregular masses of dense bush extend along the banks of the Lambwe river from Morea to Ruri. They do not form a continuous belt but are broken into four large patches somewhat isolated by open country and scattered thickets. At the southern end of the valley, the dense bush spreads out from the river to the west; it tends to link up with thickets on the slopes of the hills and in the smaller valleys. Midway down the valley the vegetation between the western hills and the riverine bush consists of widely scattered trees, Balanites aegyptiaca being most numerous, while Boscia caloneura, Lamnea Kirkii and Acacia seyal are present in comparatively small numbers. Below the eastern escarpment there is a narrow strip of park-land comprising Balanites aegyptiaca interspersed here and there with small areas of Acacia drepanolobium. This strip is followed by a thin line of more dense bush running parallel to the escarpment,



Southern portion of Otouk from the eastern escarpment. Note the scattered, stunted trees on the slopes and the belt of open bush at the foot of the escarpment.



The upper section of the Lambwe valley. Patches of dense bush alternate with light bush at the foot of the escarpment which is practically devoid of trees. The narrow ravines are heavily wooded.



The riverine bush of Otouk. Narrow tongues of heavy bush are seen projecting from the foot of the escarpment.



Ruma. The course of the Lambwe may clearly be seen running through the open country between Otouk(left) and Ruma bush on the bend of the river.



A view from Kitiro looking towards Ikoro and the Laibon settlement. Lake Victoria is seen in the background.



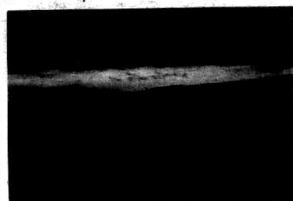
The west portion of Luatonga. The water-dam was recently renovated by the Administration.



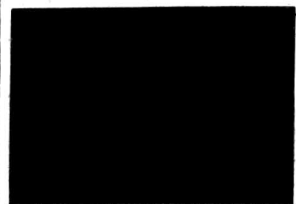
Ancient terraces for native cultivation on the slopes of Iringa hill.



Nyaboro bush, Morea and Theka from the eastern escarpment.



Nyaboro bush showing clearings. The Kigoto-Kamaguthi corridor is indicated by an arrow. Note the dense bush stretching from Kigoto(x) to the main valley



North Riamakanga and South Otouk from the east escarpment.



South Otouk from Kigwa. Note the wooded ravines on the scarp; open country below Kiabakari (foreground) and the cultivation at the foot of the Gwassi hills.



Riverine bush in North Riamakanga. Rari bush(') is seen extending from the west hills to Otouk.



Wooded ravines (Gendu on the right) on escarpment slopes. Ugoro-Kisingiri corridor indicated by an arrow.



Clumps of regenerating thickets between mid-Riamakanga and Kigoto.

and again by a narrow zone of open savannah before the riverine bush is reached. Between the northernmost block of dense bush and the shores of the Gulf, the country is flat, plain-like, with a uniform cover of Acacia drepanolobium.

Euphorbia turicalli and ambatch are found at Waturi and along the lake-shore. The former is the dominant species in a tangled mass of bush, and of the undergrowth in the shade of Euphorbia ingens. This bush provides suitable shelter for three species of tsetse-flies. The large masses of vegetation already mentioned are in Nyaboro, Riamakanga, Otouk and Ruma. The first is not entirely riverine; it is a compact mass with projecting tongues meeting some groups of bush on the hill-sides - notably Kigoto; and others connecting it with Riamakanga which comprises several smaller patches of more scattered bush. Euphorbia ingens is conspicuously dominant in Nyaboro; under its shelter thrive woody shrubs and stunted trees including Cadaba adenstricha, Capparis tomentosa, Euchlea divinorum, Grewia similis and other species; Rhus glaucesens, Harrisonia abyssinica and Gymnosporia senegalensis. Some more open spaces within Nyaboro contain patches of young Acacia seyal indicating the sites of native villages and shambas. Riamakanga block of bush contains an abundance of Euphorbia trees also, but on the whole they are either free from undergrowth or form the nucleus of separated thickets. Along the river in all areas Euphorbia thrives, but the density of the bush is due to the prevalence of tangled undergrowth. Euchlea divinorum and Rhus glaucesens are most abundant, and in addition to the shrubs in Nyaboro, other frequent components of the riverine undergrowth are Scutia buxifolia, Pluchia dioscoridis, Cissus rotundifolia, Acacia pennata, Croton spp., and Jasminum mairitianum.

The flora in Otouk and in Ruma is somewhat similar, but other species of trees and shrubs are found which, however, are not very common.

Without entering into further details as to the species of the flora, it is necessary to add that several valleys - Owiga, Rari, Nyadenda and Roo - in the western hills, and many ravines - viz. Kisingiri, Nyamarigi, Nyabor Ondiek and Kerliango - on the east escarp-

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*Balanites aegyptiaca* on  
lower slopes of escarpment  
near Kirlango.



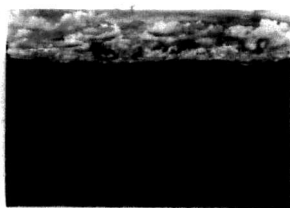
*Acacia seyal* in Nyaboro.



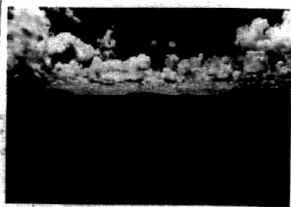
Clearing the first (west)  
half of Nyaboro fly-barrier  
(April, 1935.)



Nyadenda valley - dense  
bush, slightly obscured  
by cloud shadows.



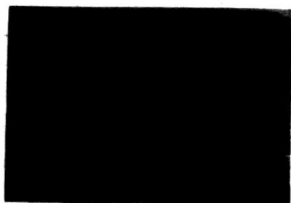
Closer view of dense bush  
in Nyadenda.



Otouk riverine bush from Kigwa. Note the scattered B. aegyptiaca below the cultivated plots.



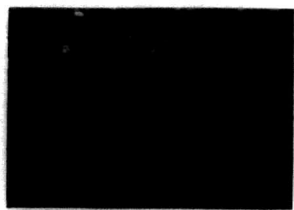
Acacia drepanolobium, B. aegyptiaca and Boscia caloneura to the west of South Ruma.



The open parkland between the mouth of Nyadenda and Ruma. An experimental water-dam is marked by an arrow.



A view from Iringa, looking towards Rari and Homa Mountain (in the background). Note the low scrub and the lines of taller dense vegetation.



A view from Iringa showing the demarcation between the thick growth of trees (on the left) and the parkland and Acacia forest in the valley.



The dark line of bush at the foot of the hills is Roo.

ment are heavily wooded. In most cases the vegetation follows the beds of the streams and continues well down into the Lambwe Valley. The open country or "tree-veld" on either side of the riverine bush of the Lambwe provides good grazing, tall grasses being well established under the shade of the trees and shorter species occurring on the more recently abandoned cultivated land. Themeda triandra dominates the other species, the most common of which are Panicum coloratum, Panicum spp., Chloris gayana, Leptochloa obtusiflora, Sporobolus filipes, Amphilophis pertusa, Andropogon pratensis, Cynodon dactylon (?), and various species of Hyparrhenya, Eustachys, Setaria and Digitaria. Members of the family Cyperaceae indicate localities of swampy land.

A thick carpet of Sansevieria covers the rich loam found in the dense riverine bush and in clumps of thicket throughout most of the valley. This plant is extremely abundant and seems to have assisted the shrubby undergrowth to suffocate and to replace the earlier grasses.

#### Climate:

A meteorological station was erected on Kiabakari hill in December, 1934, to ascertain the general climatic conditions of the Lambwe Valley prior to studies into the eco-climatic conditions in the bush and in localities of different fly-densities. The records were considered to be necessary to form a basis for comparative studies on the different climatic factors that might influence the activities and fluctuations of the fly-community; to estimate the possibilities of providing improved water-supplies in the event of successful control of G. pallidipes; and to formulate a scheme of re-settlement for the maintenance of cleared, and partially cleared, areas of bush country.

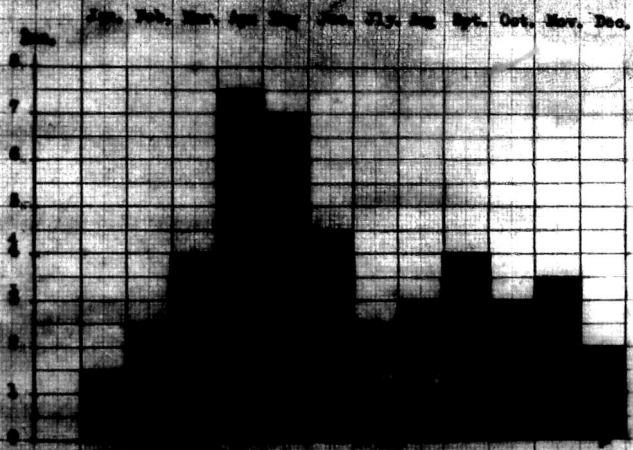
Most of the instruments for the general, and for the bush, stations were purchased from the grant allocated from the Colonial Development Fund. Additional instruments were provided by Mr. A. Walter, Director of the British East Africa Meteorological Service. Mr. Walter arranged for the instruction of the native meteorological observer; and has given encouragement and valuable help at all times. His advice and that of Mr. Grinstead, also of the Meteorological Service, is also



Mean monthly temperature and humidity



Mean monthly temperature and humidity  
— — — — — Temperature; - - - - - Relative humidity



Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

gratefully acknowledged; Mr. Grinsted was invited to visit the valley, and his report is given in full as follows:-

The following notes on the climate of this area are based on analyses of nineteen months' records obtained on Kiabakari, six weeks' records at the "bush" (Oteuk) station and on observations made during a visit to the valley by the writer in April, 1936.

The Lambwe Valley, being situated close to the shores of Lake Victoria, has what may be termed a "modified coastal climate". Further, being situated well in the interior of Africa, its climate is to a large extent the result of local conditions as determined by the varying declination of the sun and its consequent influence on the Lake area. These local conditions are modified during the regimes of the south-east and north-east monsoonal currents, especially the former; but the influence is variable and not at present completely understood.

The proximity of the lake produces a comparatively small diurnal variation of temperature and humidity for a situation so near the equator. It is responsible for the very frequent showers and also for the diurnal variations of wind.

It is convenient to treat the various elements separately:-

(a) Temperature:

On Kiabakari, the mean annual temperature is  $72^{\circ}\text{F}$ ., the maximum  $84^{\circ}\text{F}$ ., and the mean minimum  $63^{\circ}\text{F}$ .. The extremes are:- Maxima  $95^{\circ}$  -  $100^{\circ}\text{F}$ ., minima  $55^{\circ}$  -  $60^{\circ}\text{F}$ .; and the daily range just over  $30^{\circ}\text{F}$ .

At the meteorological station on the bush itself, the mean temperature appears to be some  $2^{\circ}$  -  $3^{\circ}\text{F}$ . lower than on Kiabakari, the mean maximum being approximately  $10^{\circ}\text{F}$ . lower. The reason for these variations is that the bush, being shaded, does not reach such a high temperature during the day nor, through reduced radiation, so low a temperature during the night. On clear, calm nights, however, cold air rolls down into the valley from both sides, giving frequent valley mists or fogs. It may be noted that the Dew Point

of the air is about  $61^{\circ}\text{F}$ ., so that with this process, mist is easily formed.

Curves of average variation of temperature on Kiabakari are given in the figure, from which it will be seen that the mean hourly values range from  $46^{\circ}\text{F}$  at 6 a.m. to  $82^{\circ}\text{F}$  at noon. The mean daily range is  $21^{\circ}\text{F}$ . The mean monthly temperatures range only from  $70^{\circ}\text{F}$  to  $74^{\circ}\text{F}$ , June and July being the coolest months.

The diurnal variation at the bush station is retarded in phase in respect to that in the open, due to the entrapped cold air and poor circulation in the morning.

(b) Humidity:

The mean diurnal and annual variations of relative humidity are given in figure. The mean vapour pressure is approximately 19 mb. The range of the mean hourly values of relative humidity is from 52% to 75%; and of the mean monthly values from 57% to 70%. At the bush station, the humidity is normally from 5% to 10% higher than at Kiabakari, the greatest difference being during the two or three hours after sunrise.

(c) Evaporation:

Absolute values of evaporation are not available but Dr. Hirst has estimated the average annual evaporation in the Lake Victoria basin at approximately 50 inches. In the bush itself, the evaporation appears to be from 15 - 20% less.

(d) Cloud Amount.

Except during the night hours, the sky is rarely cloudless; the mean cloud amounts at 8.30 a.m. and 2.30 p.m. being 6 and 7 tenths respectively.

(e) Rainfall:

The probable average rainfall as deduced from the Kiabakari records and from other available data is given in the figure. Very wide variations from the average may be encountered and no month can be relied upon to be dry. January is the driest month and the expectation of rain on

any day is least in this month. In the other months, however, the average number of days of rain is thirteen, and the seasonal variation in amount is rather the result of intensity of rainfall than of frequency of occurrence. The rainfall is, of course, almost entirely of the "thunderstorm" type.

(f) Wind:

The wind of the valley is of a purely local type and is the result of the on-and-off-shore winds being modified by the topography. In the morning the wind is ENE (5 mph at 8.30 a.m.) and in the afternoon WSW (13 mph at 2.30 p.m.).

Soil:

The soil is volcanic in origin. On the western hill-slopes, it forms a very thin layer over rock; and its surface is strewn with large boulders. The small valleys contain a considerable amount of alluvial soil, and from an examination of the dry, flood-water courses, appears to be composed of talus scree, boulders and gravel that is often found in well defined layers. The soil on the hills and in the upper portions of these valleys is light in colour and in texture; it does not appear to be retentive. In the lower portions, deeper layers and more fertile soil are encountered. Here, and for some distance down into the main Lambwe Valley, the natives succeed in producing excellent crops of simsim (Sesamum sp.), maize (Zea sp.), mtama (Sorghum sp.) and chirogo (Phaseol<sup>us</sup> sp.) in years of normal rainfall. Bananas are grown along the stream-beds; ground-nuts appear to do well; and cotton, although not always of a very high quality, provides a useful cash crop. Cultivation is possible even on the hill-slopes. The earlier native inhabitants, as has already been mentioned, constructed stone terraces (see photo) over extensive areas. Ordinary digging and cultivation would doubtless have resulted in a serious amount of soil erosion, whereas the terraces have prevented this and have enabled the indigenous grasses to form a good cover providing also excellent grazing if not too heavily stocked. The lower reaches of the valleys of Oma, Owiga, Ugoro, Rari, Nyadenda and Nyakiya consist of a heavier and richer soil that is also darker and of a red loam type. In Oma

and Owiga, there is a considerable amount of clayey soil. As one proceeds from the foot-hills to the flatter country in the main valley the dark loam merges into a typical "black-cotton" soil apparently derived from basalts. This region is often water-logged during the rains and becomes extremely hard in the dry seasons. Dobbs, writing of his experiences in the Kisingiri and Gwasssi districts in 1910, states "the Ulambwi (Lambwe) river exists only during the rains, when indeed the whole valley is a swamp. In dry weather, it is simply a line of caked mud running through thick bush to the lake".

From Nyaboro to Ruma - and beyond - this zone of "black-cotton" prevails; and it frequently converts the area into a marsh. It extends even into the Ruma bush, where one often finds the soil under a sheet of water.

The banks of the Lambwe river contain a large amount of sand, silt and mud brought down by the water when the river is in full spate. Within the bush, as may be expected, the soil is of a heavy forest loam usually covered by a thick layer of decaying leaves and twigs. There are also comparatively small glades with good grass, but where the depressed character of the surface and the clayey nature of the soil provide for the formation of small, shallow pools or wellows during the rains.

#### Water supply:

A report of this kind would be incomplete without some remarks on the water-supplies in the Lambwe valley.

Native people are reluctant to inhabit any area where there is an insufficient amount of water for human consumption and for the stock. Cattle, sheep and goats being the form of native currency and wealth; milk and meat being essential to their health and welfare, it would be difficult to persuade the native people to re-settle an area where cultivation alone can be practised, and the production of food and cash crops the only means of existence.

Tsetse-fly infestation renders the keeping of stock impossible or, at any rate, highly precarious. A fly-infested area such as the Lambwe frequently has a rich cover of grass and would normally carry large herds of cattle. The abandonment of the area results in the

neglect of water-holes that become silted up, or that disappear entirely. In time, areas that only a few decades ago supported thriving native communities are rendered waterless - or nearly so - and consequently uninhabited.

A scheme of tsetse-fly control is obviously bound up with the provisions necessary to keep the population and the stock in an area so that the people may continue to maintain it free from fly once it has been reclaimed. It would be inadvisable to attempt any persuasive measures for re-settlement until such time as would warrant a reasonable assurance of safety for the native stock and until such time as facilities were provided for a sufficient supply of water.

The prospects of watering places in the Lambwe valley were investigated by an officer engaged by the District Administration. It was found that there were many springs, wells and remains of old earth dams scattered over the valley. In 1934, an experienced hydrographic surveyor from the Public Works Department visited the Gwasssi location to investigate the actual and potential water resources. Unfortunately he was not asked to report on the whole valley. His recommendations were for that specific location. It is of interest here to note that owing to the steep slopes in the upper sections of the valleys (in the Gwasssi hills), and the geological formation, the conservation of earth dams in these sections would not be a feasible proposition. Boring for water appeared to be the most practicable method of obtaining additional supplies.

The Tsetse-fly Overseer was instructed to locate and to plot all possible sources of water in and near the valley. A list of these potential watering-places is given over-leaf.

It is of interest to learn from Mr. C.M. Dobbs' article that water was scarce in the Upper Gwasssi in 1910 and was then obtained only at the bottom of the deep pits that the natives dug in one of the side valleys running from the mountains. At a depth of about eight to ten feet, very good water was found. It was customary, even in those early days, for natives to make enormous "saucers" of mud and to fill these with water for calves, and in some cases, for

## Surface water-supplies in the Lambwe Valley

Name	Locality	Flow (gals. per day) or capacity.	Remarks
-	West Roo	?	Many small dams and game wallows that hold water only in the rains.
-	Akatari	?	Storm-water flows in stream-bed during rains; lost in seepage lower down the valley.
-	Bolo Opiyo	?	As in Akatari.
-	Nyakiya	?	Permanent, small stream; earth-dams built across stream to conserve a supply in dry weather.
-	Nyadenda	147,000	Permanent stream at head of valley; two silted water-holes below; and one experimental earth tank.
-	Rari	?	Good permanent spring pools at head of valley; several dams below.
-	Ugoro	?	Permanent spring at head of valley; old water-holes below.
-	Kiabakari	?	Very small pits; and two, small, unused dams.
Kichiriba	Owiga	1,050	Not permanent.
Misembe	Owiga	1,700	Situated at the head of the valley.
-	Owiga	?	Small spring and dam below Chief's village.
-	Owiga	?	Two, old earth-dams below motor-track.
-	Kigoto	?	Two water-holes silted up.
-	Mohanja	770	Decreases in dry weather.
Oma	Misamba	2,300	Good flow of water.
Oma	Oma	500	Wells in clay, each well giving about 2 gallons per hour.
Masenyo	Tonga	150	Dries up in hot weather.
Mwibegenye	Tonga	500	Dries up periodically.
Misa	Tonga	1,250	Night flow conserved in dams.
-	Luatonga	168,000	Renovated dam - under experiment.
Sanjuero	Luatonga	?	Two, old, derelict dams.
Morea	Morea	?	Water-holes at the probable source of the Lambwe river.
-	Theka	?	Large dams fed by springs.
-	Gendu	?	Spring and small stream. Also a much coveted salt-lick.
Kisingiri	Kisingiri	?	Springs, seasonal stream and rock pools.
-	Nyamarigi	?	As in Kisingiri.
-	Kerlango	?	As above.
-	Nyabor Ondiek	?	Old earth-dam fed by deep furrows from hill-slopes.
-	Sigama	?	A dam at the foot of the scarp.
-	Kangwagi	?	Small spring - not permanent.
-	Kangwagi	?	Permanent stream.
Sidede	Kisaka	?	Permanent water in small stream.
Siwalu	Kisaka	?	As at Sidede
-	Goyo river	?	Large pools from seepage water
-	Lambwe river	?	Intermittent river. Numerous pools and game-pits in the river-bed. They last for a considerable time into the dry season.

In Nyaboro and other blocks of bush, there are numerous game-pits and wallows that become water-logged and hold surface-water during, and for some months after, the rains.

the larger cattle.

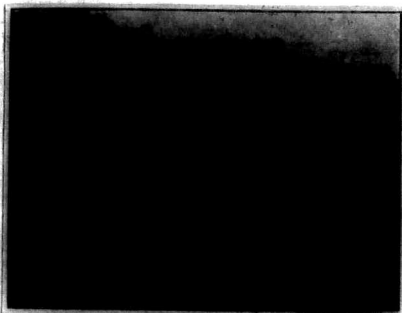
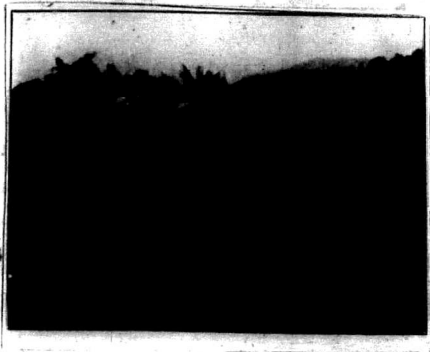
Many of these "saucers" and several small pits are still to be found in different parts of the valley, at the foot of the hills and escarpment. Derelict earth dams can be traced in the main valley; and there is evidence that the inhabitants collected water from the mountain streams by means of deep channels and furrows that supplied fairly large surface reservoirs.

The Administration Department carried out a small experiment on water conservation near to, and in, the Lambwe Valley. An old earth dam existed in Lutonga just above Sanjuero; this was cleared out and the earth embankment on the lower side extended and built up. Up to the present it seems to be satisfactory and has a capacity of about 168,000 gallons. Below Nyadenda a tank was dug to collect approximately 147,000 gallons. A long dam was built below the tank; it has not been sufficiently firm to withstand some of the rush of water after heavy thunderstorms. It seems not unlikely that numerous small watering centres could be provided in the Lambwe proper, and these would suffice until more permanent supplies could be arranged.

While on this subject, it is noteworthy that Dixey in his handbook on "Water supply" (1931), refers to the effects of deforestation on soil erosion and the depletion of water supplies, both surface and underground. In a locality like the Lambwe Valley, the wholesale clearing of bush may well aggravate the present lack of water, whereas partial clearing may serve to eliminate the tsetse and at the same time provide better situations for the construction of surface watering-places. Dixey expresses the opinion that the clayey floors of dambos and vleis usually make excellent sites for small reservoirs. In Roo and in Nyaboro there are several dambos that are now often used by game as mud-wallows or, during the rains, as drinking pools.

Wholesale clearing, apart from the immediate heavy cost, will tend to increase soil erosion and accelerate the complete desiccation of the valley.

Further efforts to solve the scarcity of water in the valley are



CATTLE WATERING TROUGHS. GWASHI MOUNTAIN, E. KAVIRONDO.

Reproduced, by permission, from an article  
by C.M. Dobbs published in "The Journal of  
the East Africa and Uganda Natural History  
Society." No.8, Vol.4, 1914.

under consideration by the local administrative officers.

#### Population and Stock;

The Lambwe valley is uninhabited. A few villages are concentrated in the small fertile valleys of Misamba, Mchanja, Owiga and Ugoga; a few native huts are dotted about on the slopes of Kigoto and near the water holes at Theka; there is also a collection of villages in the Kaksingiri valley between Nyadenda and Holo Opiyo.

The population is small and concentrated in the valleys and at the foothills. The stock is negligible in so far as there are only a few hundred head of cattle that are usually to be found in and around the villages. The cattle are often taken out of the valleys to the lake-shore at Mtara bay and to the salt-licks in the vicinity of the Miramba river. They are grazed on the slopes of Kiangongo and Kigwa, and in the valleys of Tonga and Oma; they are seldom taken down into the Lambwe valley. The number has been increased slightly in recent months. There are now about three hundred cattle in the valley, but it is anticipated that no additional stock will be brought into the area without losses from animal trypanosomiasis. As far as this disease is concerned, several cases have occurred in the Chief's herd and among cattle taken into the area by other natives. In August, 1936, animals infected with T. congolense were treated with tartar emetic issued free of cost by the Veterinary Research Laboratory. Treatment will be continued in order to assist the present inhabitants to keep the small number of cattle now in their possession.

#### Game;

Game is abundant. Herds of elephant seem to have their home in Ruma; they move about a great deal and trek from Ruma to Otouk, Rari, Nyadenda, Roo and Ruri. They often visit the lake-shore and sometimes migrate to the Kuja river where experiments on the control of Glossina palpalis are being conducted. Buffalo roam about from one or more of the bush areas to others; they, sometimes, follow the elephant but may move further up the valley to Nyaboro and even to Kagana and Luatonga. Hartebeest and Topi frequent the savannah areas and are usually found near Otouk or on the outskirts of Ruma bush. Roan seems to be restricted to the lower end of the valley, where<sup>23</sup> herds

of Impalla wander through the valley and are often to be seen in Luatonga. Waterbuck and Bushbuck are more numerous than it would at first appear, whereas Duiker, Steinbuck, Reedbuck and Klipspringer are more often seen.

Among the carnivores, Lion, Cheetah, Leopard, Serval cat and Hyena are not uncommon. An occasional Rhinoceros roams about; and the Warthog is fairly abundant.

There is no concentration of game in any particular part of the Lambwe. The elephant were driven from Ruma in January, 1936, and a small number settled between Ruri and the lake-side, where several herds of buffalo followed. In June, 1936, these animals returned to Ruma and Otouk.

If there is even a small concentration of game it would be in that stretch of country between Roo and Ruri. Buffalo frequent the slopes of Ruri; roan inhabit the Acacia plains above Ruma; and topi, hartebeest and impalla seem to prefer the semi-open country below Nyadenda; and move from there to Ruri. Bushbuck and waterbuck are always in fair numbers throughout the dense bush, the latter being most numerous along the Lambwe river.

Without the co-operation of the Game Warden (Capt. A. T. Ritchie), it would have been difficult to obtain much of the valuable information on game in the Lambwe valley. The writer gratefully acknowledges the facilities afforded in this direction.

Tsetse-fly infestation;

Glossina pallidipes infests nearly the whole of the Lambwe valley. It has been stated by the local natives that its introduction and gradual spread caused the evacuation of what was once a densely populated valley. This species of tsetse is present in a pure pallidipes belt from Nyaboro to a short distance north of Ruma; it occurs abundantly in Roo, and inhabits, to a less degree, the wooded valleys and gullies in the western hills and on the eastern escarpment. Between Ruma and Powo stream in the main valley, and between Roo and the same stream, the fly-infestation is lighter. The species has been unable to establish itself in the open thorn-scrub between Powo stream and the mixed tsetse belt on the lake-shore. G. pallidipes again

appears along the margin of the Kavirondo Gulf, where there is some dense scrub, Euphorbia turicalli and ambatch. In this case it is found in a mixed zone with G. palpalis and G. brevivalpis. Here, however, G. palpalis is the prevailing species of tsetse. G. pallidipes is less common, whereas adults of G. brevivalpis appear to be relatively scarce. As experienced with G. brevivalpis in the Kuja river area (Symes, 1935), so in the Waturi area of the Lambwe, adults of G. brevivalpis caught by the fly-boys on regular patrols were always few. Pupae of G. brevivalpis collected in the same area were also few, but empty puparia were found in much larger quantities.

It may be added that G. palpalis is not confined to the lake-shore. At certain seasons the species is found in dense vegetation along the streams of Ogono, Bado Ogono and Olando. On one occasion a single G. brevivalpis was taken in Roo.

As a further general observation it may be stated that both palpalis and pallidipes have been captured in the Holo Opiyo valley which connects the Lambwe valley with the palpalis belt or pocket at, and above, Ukongo Point on the lake-shore to the west of the Gwassi hills. Also, small numbers of G. pallidipes are periodically collected in Luatonga immediately south of Morea. On one occasion, it has been found near Gotbim a few miles south-east of Morea and between that hill and the Kaniadoto rest camp.

#### History:

A brief statement on the history of the valley and its people will indicate the need for further and closer studies on Glossina pallidipes, and the suitability of the area for research and experimental control.

It is fairly certain that the Lambwe valley was densely populated and contained numerous herds of cattle in the early years of the present century. On the hills there are definite traces of the habitations of an energetic tribe. Stone walls and terraces may still be seen on Kiangongo, Ugoro and on the slopes of Rari and Iringa. Disused water-holes and earth dams are to be found in the valley; and there is clear evidence of cultivated patches of land which have not long been abandoned. In the Administrative records

for 1908 it is stated that cattle were fairly plentiful in Gwassi, plentiful in Kabwai, Kasigunga and numerous in Kaniamwa - these being locations or "rural districts" each including a section of the valley. In Kisingiri (or Usengere), the report of the year 1911 states, "There has been a great deal of sickness amongst the live-stock in recent years which is now somewhat depleted". Europeans who have known the area for very many years and who have always been in close touch with the natives speak of the numerous cattle in the valley in 1915 and corroborate the information given by the natives. One gathers from the present native inhabitants that heavy mortality from malaria and human sleeping sickness among the tribes on the lake-shore, especially in Kasigunga, gave rise to a fear that caused a steady evacuation of the area. As the people fell back the menace seemed to follow them. It extended to and destroyed their cattle and the people were forced to retreat up the Lambwe. Disease then attacked the cattle from other directions also and rapidly reduced their numbers. Witchcraft was suspected and it appears that the ruling chief Matunga - the present Chief's father - was murdered by the elders for placing witchcraft medicine in the grass and water that killed off many cattle. After this incident large numbers of the natives left the valley and journeyed to Tanganyika. The present Chief and many elders from the different locations state that only after most of the people had left did the bush become thick, and beyond their control. They point out stretches of land at the edge of Nyaboro that ~~was~~<sup>are</sup> obviously cultivated not many years ago, and that ~~is~~<sup>are</sup> now rapidly reverting to dense bush.

It is not strange, perhaps, that the inhabitants at one time spoken of as energetic agricultural and pastoral people, are now said to be listless and suffering from "lake lassitude". Their wealth has disappeared; their relations scattered and they have become dispirited as their land has been ruined by the invasion of tsetse.

The first authentic record of the presence of G. pallidipes in the district - not actually in the Lambwe valley - is that by Christy in 1910. In his map of South Kavirondo he shows G. pallidipes occurring in Kisingiri (Usengere) about four or five miles inland from Mungere Bay - probably in the lake-side section of Roo. Brief

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references are made to the existence of "fly" and cattle disease in the Administrative records for several years later; but it was not until 1931 that an officer (Mr. J. Nimmo) of the Medical Department carried out a fly survey of the whole valley. This officer discovered only a few Glossina pallidipes in Roo; the fly density was higher in the lower reaches of Ruma bush and still higher in the upper half of Ruma. Smaller numbers were captured in Otouk, and few in Riamakanga. No flies were caught in Upper Riamakanga; none was collected in Nyaboro. No records of fly appear to have been made for that stretch between Ruma bush and the mouth of the Lambwe river, nor are there data, on the map, for the lake-shore between Waturi and Homa Bay.

Administrative officers in charge of the district must have long realised the value of utilising the Lambwe valley.

Its infestation by tsetse and the need for clearing the bush where elephant lived and from which they roamed to raid cultivated areas in the vicinity, prohibited the officers launching a scheme which would involve considerable expenditure incommensurate with immediate requirements. In a memorandum to the Kenya Land Commission, Major Buxton, referring to an experiment in individual land tenure under strict development conditions, pointed out that such an experiment might be made "(a) by the reclamation of land in the Kujia and Lambwe valleys where bush-clearing is in progress; (b).....; (c).....;" Major Bond, who was also a District Officer at Kisii refers to bush-clearing in a Memorandum dated 11th May, 1932. He divides bush-clearing into two categories, namely:-

- (a) Clearing of bush in connexion with the sleeping-sickness campaign.
- (b) Experimental clearing of bush in an attempt to eliminate big game and cattle fly, and induce a redistribution of the population.

He adds "As regards the latter category of bush-clearing, the experiment in the Olambwe (Lambwe) will be valuable, and there should be no difficulty or danger in re-introducing cultivation there, but the area will require careful watching for some years ....."

Commenting on Major Bond's remarks, Mr. H.R. Montgomery, then Provincial Commissioner, Nyanza Province, states that "A comprehensive scheme of bush clearing is well in hand, and will be carried on year by year".

The economic value of the Lambwe valley is widely appreciated, and the need for re-introducing its practical-utility is recognised. The fly menace, however, is the chief difficulty; and it is a problem that still awaits solution. The species of tsetse involved - G.pallidipes - has not been studied as extensively as G.palpalis, G.morsitans and G.swynnertoni for instance. Its habits are only generally known, and they have not been subjected to continued scientific investigation and experimental analyses. Such studies are not without practical value in the Lambwe as in other larger areas of Kenya Colony, and they may lead to more efficient and economic methods of control than haphazard clearing of bush without adequate knowledge of the particular species of fly and its bionomics.

The need for ~~exhaustive~~ studies of G.pallidipes.

The importance of studies of G.pallidipes and its experimental control will be appreciated by the knowledge that this tsetse is widely distributed in Kenya, and requests have been received from different districts for recommendations for its control and eradication. Recommendations have been made, but no assurance of complete success have been entertained because of the lack of accurate information on the reaction of the fly to such measures. The fly-infested districts in Kenya cover enormous areas - some being inhabited by pallidipes only, while others contain also palpalis, brevipalpis, longipennis, swynnertoni and austeni. The pure pallidipes belts, however, offer excellent opportunities for thorough investigations into the biology of that species.

The problem is not confined to Kenya; it affects South Africa where Harris carried out preliminary studies more especially on trapping; it exists in Tanganyika in mixed belts, and Swynnerton has considered it desirable to implement our present investigation in the Lambwe by another study in a mixed austeni - brevipalpis - pallidipes zone at Kilifi in Kenya. In Uganda G.pallidipes occurs together with

palpalis and morsitans.

A brief account of the work on G. pallidipes in the Lambwe valley was submitted to the Conference on Co-ordination of Tsetse and Trypanosomiasis (Animal and Human) Research in East Africa; and it was recommended "that, in view of the short time the work in the Lambwe valley had been in hand and its great importance, it should be continued at least until the next meeting of the Conference".

The following is a more detailed report of the work carried out with the assistance of a grant from the Colonial Development Fund, supplemented by a further grant from the Local Native Council, South Kavirondo.

The scheme of experimental control of G. pallidipes  
Grants:

Out of the sum of £8,160 voted by the Colonial Development Fund Committee for experiments on tsetse-fly control in Kavirondo, an allocation of £2,120 was made for experimental work on Glossina pallidipes in the Lambwe valley. It was approved that the experiments should be directed to control the tsetse by means of trapping and without clearing all the bush. Arrangements were made and agreed to by responsible officers of the Administration, Medical and Veterinary Departments that the cost of any necessary bush-clearing should be borne partly or entirely by grants of money from Local Native Council, South Kavirondo. The sums voted for the Lambwe project were £100 in 1934, £600 in 1935, and £600 in 1936. The vote of £600 in 1936 was governed by the condition that half the amount should be utilised for bush-clearing directly beneficial to the local natives, while the other half should be used in connection with the experimental clearings.

Staff:

It will be more convenient to deal at this juncture with the staff and the direction of the project.

Authority to expend the grant from the Colonial Development Fund in so far as the Lambwe experiments were concerned was vested in Dr. Paterson (Director of Medical Services), and Mr. Daubney (Chief Veterinary Research Officer), and it was agreed that the work in the Lambwe valley should be put into operation in 1935 after preliminary

fly-surveys had been carried out in 1934. It was hoped that an experienced field-officer from Mr. Swynnerton's staff in Tanganyika could be engaged to supervise the programme of work on G. palpalis in the Kuja river area for the first year, and that he would be able to devote his attention to a prepared scheme in the Lambwe during the second year. This was later considered impracticable; and Mr. Swynnerton's advice was solicited on the possibility of providing another officer for the Lambwe. Commander D.E. Blunt was recommended for the post, and was appointed as Tsetse-fly Overseer in January, 1935. Mr. C.B. Symes, Medical Entomologist, Kenya, agreed that Mr. R. T. Vane, Overseer in the Kuja experiments, should recruit and train a nucleus of natives as fly-boys and pupae searchers for the Lambwe, that a number of single-screen or Shinyanga traps be constructed at Kaniadoto and that Mr. Vane should carry out a fly reconnaissance in the valley and submit his report during 1934.

Mr. Swynnerton accompanied by Mr. Daubney and Dr. E. A. Lewis (Veterinary Entomologist), visited the Lambwe valley in October, 1932, and the advice of Mr. Swynnerton was incorporated in a preliminary programme of experiments outlined by the Veterinary Entomologist and approved by Mr. Swynnerton (emphasising certain points) and by Mr. Daubney.

Two experienced native fly-boys were provided by the Department of Tsetse Research, Tanganyika; eleven were transferred from Kaniadoto, and several others were trained in the Lambwe during the early months of 1935. Only those natives who had proved efficient and reliable after a month's trial were finally engaged on regular fly-rounds. The number of boys engaged for patrols was twenty-four. Six were engaged to collect tsetse from traps and thirty were employed as pupae-searchers. Many of the latter were transferred to bush-clearing, or promoted to game-observers, botanical assistants, or put in charge of small gangs of labourers. It was found to be extremely difficult to obtain an efficient native clerk; and it was only after several disappointments that a reliable headman was engaged. A native boy was trained as Meteorological Observer at the Meteorological Station, Kabete; and three native carpenters were recruited for construction of tsetse traps.

The most promising natives were given a course of instruction on tsetse and their economic importance by the Entomologist at the Veterinary Research Laboratory, Kabete.

The continued illness of Commander D. M. Blunt towards the end of 1935 and in the first few months of 1936 compelled him to apply for admission to hospital and for medical examination. He was invalided out of the service in April, 1936, after observation and treatment for nearly three months. During Commander Blunt's illness, Mr. North-Lewis, a member of the Veterinary Research Laboratory, Kabete, was sent to supervise the field experiments until the vacancy of Tsetse-fly Overseer was filled by the appointment of Mr. W.P. Langridge, who was known to have had considerable experience in laboratory and field routine work.

A three-roomed hut, thatched with grass, was built on Ugoro hill for the accommodation of the Overseer. Offices were provided near the hut; and a rest camp was constructed on the slopes of Sanjuero. The majority of labourers were housed in two long huts at Sanjuero, where there were also several huts for the headmen, fly-boys, medical dresser, and their families. Three further huts were erected near the rest-camp to be used, respectively, as a store for maize meal, for tools and as a dispensary. Several other huts were built for fly-boys and pupae collectors throughout the valley.

Labourers for bush-clearing were recruited from the different locations in South Kavirondo. At first, the natives turned out in satisfactory numbers - some two hundred and fifty were engaged in January, 1936. Later, however, the attraction of higher wages offered by the gold-mining syndicates in the vicinity caused many of the labourers in the Lambwe to leave. It was necessary, therefore, to increase the wages and to provide food for those employees receiving not more than 20/- per month. Although the number of labourers continued to be low, the quality of the work improved with experience and supervision.

#### Preliminary reconnaissances:

Before proceeding with the actual experiments it was desirable to obtain further information on the distribution of the fly, and the

degree of infestation throughout the valley. Two reconnaissances were made - one from June 1st to June 6th, 1934, and another from June 16th to June 22nd, 1934. In the first period, the northern half of the valley was surveyed; in the second, the southern half was covered. Searches for fly were made also in the Nyadenda valley, Akatari ravine, Nyamatoto and Roo; Olando, Bado Ogono and Waturi; the lower stretch of the Lambwe from Powo stream to the lake-shore.

Table I shows, in brief, the result of the first survey:-

TABLE I.

Date	Species	M	F	Total	No. of Collect-ors	Place of Route	Time Taken to collect	Flies per boy-hour
2.6.34	<i>G. palpalis</i>	96	6	101	2	Waturi	9 a.m. - 1.30 p.m.	10
	<i>G. pallidipes</i>	24	1	25	2	"	"	2.8
	"	20	6	26	2	Bado Ogono	8.30 a.m. - 2 p.m.	2
3.6.34	"	2	-	2	2	Olando	2 p.m. - 3 p.m.	1
	"	3	5	8	2	Nyamatoto (Open thickets)	5 a.m. - 3 p.m.	.6
	"	46	26	72	4	Roo Valley	10 mins)	111)
	"	37	34	71	4	"	20 mins) 12.30-1 p.m.	54) 88.6
4.6.34	"	56	43	99	2	Olando to Nyamatoto		
	"	2	-	2	5	Akatari	1.30 p.m. - 2.30 p.m.	80
	"	-	-	-	2	Holo Oyiyro	7.30 a.m. - 9 a.m.	.8
5.4.34	"	1	-	1	2	Nyadenda	11.30 a.m. - 1 p.m.	
	"	229	139	368	3	Nyadenda to Kerlango	2 p.m. - 3 p.m.	.6
	"	26	18	43	2	Nyadenda to West Ruma	8.45 a.m. - 12.30 p.m.	20.6
	"	51	50	101	3	Ruma	8.45 a.m. - 2.30 p.m.	3.7
	"	14	9	23	3	"	11.45 a.m. - 12.30 p.m. 12.30 p.m. - 2.30 p.m.	45.3 3.8

The majority of specimens in the last two totals from Ruma were collected on the fringes of dense bush as the fly-boys entered open thickets on the west side; and in scattered clumps of thicket in the east side respectively. Only occasional flies were caught in close vegetation and none in the dense interior of Ruma. Numerous tsetse were taken when fly-boys were stationary near pools of water in Roo, and also in small open glades about eighty yards away. The flies were no less numerous when the boys were moving slowly.

One male *G. pallidipes* was collected in Kerlango ravine.

The second reconnaissance was carried out after a short period of heavy rain. For several days it was dull and cloudy; and, in the early mornings, there were several hours of drizzle followed by

bright sunshine.

Table II gives the result of this survey:-

Date	Species	M	F	Total	No. of Collectors	Place or Route	Time taken to collect	Flies per boy-hour
16.6.34	No flies caught				6	Kerlanga Ravine	3 P.M. - 6 P.M.	
17.6.34	<i>G. pallidipes</i>	158	136	295	4	North Otouk	9.30 A.M. - 12.45 P.M.	22.5
	"	20	11	31	3	Otoug-Jambwe (N)	11.30 A.M. - 11.40 P.M.	60
	"			47	3	South Ruma (W)	12.5 P.M. - 12.10 P.M.	188.4
18.6.34	"	137	174	311	2	Otoug (Water-hole)	9 A.M. - 1 P.M.	
	"	5	5	10	5	Otoug-Jambwe (S)	9.50 A.M. - 9.55 A.M.	14.2
	"			32	5	South Ruma (E)	11.40 A.M. - 11.45 A.M.	76.8
	"	84	32	116	5	Rari to Jambwe	12.30 P.M. - 1.45 P.M.	10.2
	"	3	0	14	2	Rari valley	11.30 A.M. - 1 P.M.	4.6
19.6.34	"	160	215	375	3	Kiabakari to Nyaboro		
	"	21	25	46	3	Godorobondo to Sanjuero	8.30 A.M. - 2.30 P.M.	25
20.6.34	No flies caught in Lustoma							
21.6.34	<i>G. pallidipes</i>	102	163	265	3	Riamakanga-Lambwe (W)	8.30 A.M. - 11.30 A.M.	82.4
	"			9	2	Riamakanga-Lambwe (E)	10 A.M. - 11.30 A.M.	5
	"	39	74	113	2	Riamakanga-Owiga	11.30 A.M. - 1.30 P.M.	28
22.6.34	"	5	-	5	2	Kiabakari		1.6
	"	1	-	1	2	Nyaboro	6 A.M. - 8 P.M.	.1
	"	16	30	46	2	Otoug - Sanjuero		3
	"			107	2	South Otouk		17.8
	"	308	440	748	2	Otoug-Jambwe	10 A.M. - 2 P.M.	94.6

*G. pallidipes* was abundant in the open bush between Ruma and Otouk but much less common within the tangled shrubs and thickets of Otouk. The fly showed a definite preference for the numerous game paths, the river-bed and water-holes. Flies ceased to appear in the low scrub nearer the western hills. In Riamakanga there was a concentration along the river, but there were also large numbers on the outskirts of thickets a short distance from the riverine bush. It was noted that the vegetation in Riamakanga was much more open than that of Otouk, Ruma and Nyaboro. The flies caught on the route from Kiabakari to Nyaboro were mostly from Riamakanga area; fifty were collected on the edge of Nyaboro.

Throughout this period, only four *G. pallidipes* were captured in very dense bush.

These reconnaissances provided additional information to the more general survey of 1931; and they disclosed several differences

the result of that investigation. They showed that G. palpalis and G. pallidipes were present in a narrow zone along the Kavirondo Gulf; that the thorn-scrub area from near Povo stream to the mouth of the Lambwe harboured very few pallidipes, (only one specimen was caught). The thickest bush areas seemed unfavourable to pallidipes, and the flies were most frequently and abundantly met with in open tracks through the bush or on the borders of clumps and in glades. At the southern end of Ruma they were particularly numerous in a clearing made by the Administration a few years ago. The fly-density in Otouk was greatest along the river-bed; it decreased at the south end of this mass of bush; and again increased in Riamakanga. There was a distinct drop in the numbers for Nyaboro, and no specimens were found in Luatonga. It was made clear, also, that infestation was not confined to the main valley. Roo showed a high density; Nyadenda, Akatari, Nyamatoto and the lighter scrub on the hill-slopes harbour a not inconsiderable population of tsetse. The ravines of Keriang, Kisingiri and Nyamarigi shelter at least a few flies.

The original programme:

The information gleaned from the reconnaissances provided a basis for the actual experimental project of controlling G. pallidipes by trapping and by partial clearing of the bush. It was obvious that the degree of success attained, and the progress of the work, should be ascertained from time to time in order to concentrate on any measures or to modify the plans in accordance with the developments. This could best be done by regular patrols by trained fly-boys along selected routes or "fly-rounds". Such routine work is essential in reclamation schemes so that the observer may keep "his finger on the pulse of the fly community".

The distribution of the bush and its natural rough division into blocks indicated the most economic method of partial clearing that would also serve for trapping experiments where the fly-densities differed.

The ideal scheme was an ambitious one involving considerable expenditure in labour; and in material for construction of traps. The isolation of the whole infested zone appeared feasible by an

efficient barrier across the valley to the north of Ruma, and another barrier between Morea hill and Nyaboro bush. Roc could be separated from other areas by extending the north clearing along the western foot-hills from Nyamatoto to near Watari.

Wide corridors between Otouk and Ruma; between Riamakanga and Otouk; also between Nyaboro and Riamakanga, would assist both research on the bionomics of G. pallidipes, and the scheme for its control. Comparisons could be made on the effect of reclamation efforts in blocks where the fly-density appeared to be low, moderate and high; and invaluable data could be collected on the degree of discriminate clearing of bush required to discourage further spread of tsetse, to eliminate the flies in lightly infested areas, and to reduce or eradicate the pest in those areas where G. pallidipes had become firmly established.

The modified programme - barrier clearings,  
corridors and partial clearing of bush.

Without the facilities to carry out this ambitious scheme, it was decided to utilise the available money for operations in the upper end of the valley and for studies on the habits of G. pallidipes in the whole area.

Morea hill marked the southern limit of fly-infestation, it would provide a natural obstruction to the vision of the tsetse if the slopes were cleared of bush; and it would further be protected by a wide barrier on the north side. Despite the heavy work involved in clearing such a barrier it seemed a most desirable beginning to the experiments; firstly, in order to safeguard Luatonga; and, secondly, to discourage any southern dispersal of flies following measures taken to render Nyaboro uninhabitable to the species of tsetse.

It was proposed to create a barrier that should not be less than 800 yards wide; and thereafter to increase its width according to the results obtained from studies on the ability of G. pallidipes to cross open country. Difficulties were encountered in several directions. The Overseer needed medical attention, the rains caused a slackening of bush-clearing, the planting season attracted the labourers back to their plots; and wholesale burning of felled timber and scrub was, for some time, impossible, due to the heavy showers of



Felled Euphorbia in Nyaboro fly-barrier.



Felled B. aegyptiaca in Nyaboro. The stump is cleared of its bark.



A typical clump of thicket in Nyaboro before clearing operations begin.



Another thicket after the labour gangs have cleared the undergrowth.



Clearing in a part of Nyaboro where the character of the scrub indicates fairly recent cultivation.



A close view of Nyaboro



The Kisumu area

rain.

These difficulties were ultimately overcome; but the rate of progress was greatly checked. The cleared barrier is a little over 400 yards in width at present. Most of it has been thoroughly burnt, and regenerating bush has been stumped. The method of clearing is that recommended in Tanganyika. Small gangs of labourers are sent in advance to cut down, and to dig up, the scrubby undergrowth. They are provided with pangas and mattocks. Next follow gangs to cut and to pile the slender scrub and to prepare the ground for the felling of the larger trees. Other gangs again follow to cut the timber and to pile around the large stumps left in the ground. Euphorbia trees were left to dry or to rot. Balanites trees were felled and the stumps above ground were stripped of their bark. Rhus glaucescens and Harrisonia abyssinica seemed resistant to fire; they revived to such an extent as to necessitate the employment of a few gangs on stumping several weeks - and sometimes for months - after firing.

The cost of clearing this barrier of approximately 655 acres was 36/- per acre. There was a good proportion of dense thickets; some thick, low scrub most of which required digging out, the hampa being insufficient to provide for piling and burning the multiple stumps in a patch of ground.

Up to the present, the clearing has been maintained in a clean condition. It is hoped that during the planting season of 1936, the local natives will cultivate in the clearing, and that the areas unsuitable for crop-production will be kept clean by communal labour. From trapping experiments, and regular fly-patrols on the fringe of the bush bordering this clearing, it is fairly evident that G. pallidipes is reluctant to venture into this barrier. When, however, the fly population showed a decided increase from May to July, it was observed that there was a tendency for individual flies to disperse into Luatonga by way of the thorn-scrub near Theka, and perhaps more so to the vicinity of the villages west of Kagana. In view of this, and because the local natives had contributed substantially to the experimental scheme, it was agreed that an attempt should be made to isolate Nyaboro bush (and Kagana) further by extending the Nyaboro

barrier along the west. This has been done, and so far, with good results. The Kagana barrier is 1,550 yards long, and over 1,000 yards wide. Some of the area was covered with very dense, low scrub; other areas comprised dense thicket under the canopy of tall Euphorbias; and still others were merely widely separated patches of close-growing Euphorbias where native villages at one time existed. The average cost of felling, stumping and burning in this Kagana area was shillings 6/50 per acre.

A strip of bush-country stretching to the slopes of Kigoto hill still causes some anxiety; but it is hoped that the clearing of the undergrowth only, in the western section of Kagana may force back the fly into Nyaboro where intensive trapping is in operation.

Observation on marked flies showed that there was movement from Otouk into Riamakanga and Nyaboro. It was possible that the fly population in Nyaboro, therefore, was being augmented in this manner. Corridors were cleared from Kigoto to Kamaguthi and from Ugoro to Kisingiri to prevent increased migrations and to facilitate the trapping of flies that might take advantage of these open avenues as feeding grounds. These corridors are inefficient as fly-barriers and need to be widened considerably. In the meantime, however, they suffice for observation purposes, and may later be utilised to isolate the blocks for exhaustive trapping. To what extent they may serve to intercept flies migrating from the densely-populated bush to the more highly-populated areas remains to be seen.

The Kigoto-Kamaguthi corridor is 2,526 yards long, and 25 yards wide. Along this line, there were many thickets of Euphorbia ingens, Euclea divinorum, Capparis tomentosa; scrub and a number of Acacia seyal trees. All bush and scrub was cut down, but some trees were left in order to ascertain whether they would attract females, and serve as breeding places. The average cost of clearing was shillings 18/- per acre.

The Ugoro-Kisingiri corridor is 4,296 yards long, and 175 yards wide. The open thickets, scrub and trees were cleared at a cost of shillings 15/- per acre.

The preparations for trapping experiments in Nyaboro increased

the demand for labourers to clear narrow corridors. Benefiting from the experiences of research workers in other territories; and as a result of preliminary trials in the Lambwe, the advantages of traps placed in open paths were very evident as will be seen later in this report.

The majority of labourers was withdrawn from barrier-clearings and concentrated on the making of these corridors which were six feet wide. Tall grass and shrubs grew rapidly where the woody undergrowth and trees had been cut down. It was soon realised that unless the corridors were kept free from even tall grass, the traps became inconspicuous and far less attractive to the fly. The corridors, therefore, were thoroughly cleaned and maintained in that condition.

The corridors passed through very dense bush and forest; and clearing was sometimes extremely difficult. Rain, and the small numbers of labourers available, disturbed the continuity and the rate of the work, thus increasing the cost. The rapidity with which the grass grew also demanded additional attention.

All corridors, excepting No.10 which is ten yards wide, are, at present, two yards wide. No.10 and the others are about 2,430 yards long. The average cost of clearing was shillings 88/- per acre.

The construction of roads or tracks was essential to efficient supervision. The valley is accessible only by an exceptionally rough road, and there were hardly any means of moving up and down, or across the valley. A small gang of labourers was therefore engaged for this work, and for maintenance.

Partial or discriminate bush-clearing has not progressed as rapidly as was anticipated. What has been done is satisfactory in that the quality of the work permits easy cultivation, and should not be difficult to maintain.

The experiments are incomplete, and have not been carried sufficiently far to warrant definite conclusions on the effect of partial clearing on the infestation by G.pallidipes. Considerable experience has been gained; and it is felt that a stage has been reached at which it would seem highly undesirable to relinquish the experimental scheme, and to rely on wholesale clearing as the only

method of combatting this tsetse pest.

The Administration have arranged to expend a further sum of £827 in 1937 to continue with the control of G. pallidipes in the southern section (Riamakanga and Nyaboro) of the valley. It is proposed to widen the Nyaboro and the Ugoro-Kisingiri barriers; and to continue the catching of tsetse in Riamakanga and Nyaboro. The Kagana clearing will be lengthened to include Kigoto hill; and on the east a barrier will be extended to meet the Ugoro-Kisingiri clearings. This project will assist in the isolation of Riamakanga and Nyaboro bush from Otouk and may prove a deterrent to migrating and following flies.

#### Traps and Trapping.

Harris, Swynnerton and Chorley have each discussed the merits of traps to attract and to capture tsetse-flies in Zululand, Tanganyika and Uganda respectively. The Harris trap is reported to have made enormous catches of G. pallidipes. Swynnerton has shown that the Single Screen trap can catch large numbers of this fly; and he discusses several points which must be taken into consideration in estimating the effects of trapping on the fly population. He has also shown that G. pallidipes "is a specially trappable fly", and that a good trap without scent may take huge numbers of it where it is sufficiently dense and conditions suitable. For several reasons, it seemed advisable to investigate the possibilities of trapping-out the flies in the Lambwe along lines indicated by Swynnerton's experiences. It was noted that "where a sufficient continuance of suitable trapping conditions does exist or can be provided, there is great hope of reducing pallidipes to small numbers by traps in belts that are naturally small or that can be divided".

One of the most important features of trapping is the choice of a site frequented by the majority of the flies or that can be made attractive to most flies. This should apply to localities where the fly-density is high or where it is low. The form of the trap should allure the fly, and its mechanism should provide the means to intercept escape.

Tests were first carried out with the Single Screen (awning)

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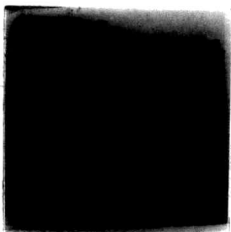
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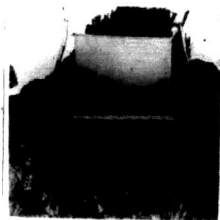
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The pagoda trap



The overhead screen trap with awnings.



A model of the Zululand trap.



The revolving single-screen trap. The centre pole is fixed in the mouth of a bottle.



The awning box-screen and the simple box-screen traps. The wire gauze of the cages is not covered with hessian

trap in Roo where the fly-density proved to be high. In one case the trap was hung so that only a swinging movement could take place; in another, the trap was arranged so as to allow a revolving movement. <sup>c</sup> Close observation on flies attracted to these traps showed that the tsetsees settled on the lower portions of the screen. Many seemed too impatient to investigate further up and flew away before reaching the darker and shaded section of the screen. A large screen was therefore fixed above the cage and a narrow strip below with a view to bringing the cage nearer the foot of the trap.

The three traps were carefully fixed and tried out for six days. The result was as follows:-

<u>Trap</u>	<u>Adult flies</u>		<u>Young flies</u>	<u>Total</u>
	<u>Males</u>	<u>Females</u>		
S.S. (Swinging)	12	52	37 <sup>b</sup>	100
S.S. (Revolving)	70	66	64	200
S.S. (Screen above)	37	33	40	110

Four ordinary S.S. traps provided with different coloured screens were then tried. They were placed in a line in Roo and exposed for nine days.

<u>Colour</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Hessian with grey and black strips.	61	41	102
Screen black	61	59	120
Screen red	34	13	47
Screen grey	19	17	36

The black screen was more attractive to, and held, the flies for a longer period than the others.

Attention was then directed to the tendency of the flies to return to dappled light of breeding places. A trap was constructed with the object of simulating this light and increasing the attraction to female tsetsees. The pagoda trap was made, and for convenience, tested with the Harris' trap for a period of eight days. In both cases the results were disappointing. Most of the flies attracted to the Harris trap settled on the Hessian and along the bottom edge, but only small numbers went inside. The pagoda was a little better on

this occasion.

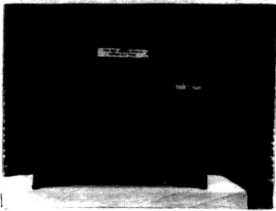
<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Harris'	16	27	43
Pagoda	23	32	55

The behaviour of the flies on the Harris (or Zululand) trap suggested that a single screen at the entrance of the trap, and extending from a little distance within, to a short distance below, the entrance might serve to increase the trapping of flies attracted to the trap. This would be, in reality, a modification of the S.S. trap. If the awnings of the S.S. trap were brought down from the sides of the cage, supplied with buttocks of equal length on each side; and the screen shortened, the result would be a trap of the Box-screen type. This particular trap was designed by Commander Blunt; and, as will be seen, it shows great promise. In the meantime, however, further tests were carried out with stationary and revolving traps. A pattern designed by Mr. Vane for G. palpalis in Kaniadoto was also tried out. The following results were obtained after a trial of nine days. During the last three days a box-screen trap was added to the series.

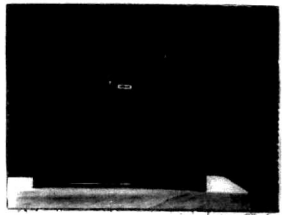
<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Swinging S.S. (screen above)	15	22	37
Revolving S.S. (screen above)	41	35	76
" S.S. (ordinary)	52	52	104
Vane's	82	371	353
Box-screen	178	379	557

Another box-screen trap was tried out for a period of ten days at the end of which the flies caught totalled 956 - 220 males, 736 females. This particular type of trap was light and easy to handle, convenient to pack and transport, and could be manufactured at a low cost. Several more were prepared by the native carpenters on the spot and tested against traps of still different types. Flies continued to alight on the hessian sides only to escape again.

A further modification was introduced. Awnings were fixed to a trap of the box-screen type, and the hessian sides of the "box" were carried up to within a few inches of the base of the cage, thus providing access to the cage by another route. The trap was a further



A box-screen trap exposed to show the structure.



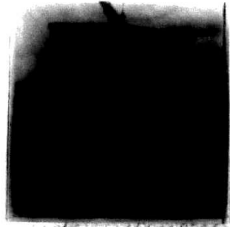
A 4-foot, box-screen trap with cage covered with hessian. This is the type in common use.



The "boat" trap in position in a game "stamping" ground in Otouk bush.



The triangular, revolving trap with screen.



The checkered type of overhead screen trap.

combination of the box-screen and the single-screen types.

After a trial of nine days, it caught 126 males, and 433 females, a total of 559 flies. It was again tried alongside the ordinary box-screen for two days. The result was:-

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Box-screen	51	60	111
Box-screen (with awnings)	11	57	68

Additional changes were now made in the arrangement of the narrow screen at the mouth of the trap. Two black strips were arranged to form an open  $\vee$  in one case, an inverted open ( $\wedge$ ) in another; and two parallel strips of black cloth on each side of the original screen in still another trap. The records for the first of these traps were lost; those for the other two for a period of fourteen days are as follows:-

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Inverted Screen	16	103	119
Parallel Screen	54	141	195

Although these traps were catching well, many flies that settled on the screens did not go up to the cage, perhaps due to the reduced space at the mouth, or because the body of the trap was too high. A shallower box was prepared; but the catch was very much lower. Another device was tried to entice the flies into the trap once they had alighted on the screen. A strut of wood, covered with black cloth was placed diagonally across the trap inside the hessian. Such a bar was intended to break the light from the cage, and would perhaps induce the flies to explore the inside of the trap and ultimately endeavour to escape by way of the non-return cage.

This small alteration seemed to be a great improvement as the figures for fourteen-days' catching shows:-

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Box-screen (with strut)	46	161	207
Box-screen (ordinary)	19	85	104

There was another advantage in the use of the strut; it strength-

ened the rather flimsy framework of the trap.

Yet another experiment was carried out to improve the box-screen. A concentration of light entering the body through the wire-gauze cage might help the fly to decide on the upward direction of "flight" once it had arrived at the dark, shaded screen. The wire gauze at the sides of the cage was replaced by hessian thereby intensifying the light penetrating only by way of the gauze lid. Compared for fourteen days with a trap with wire gauze sides, the modified type showed a very slight improvement in the number of females caught. The number of males was nearly doubled

<u>Trap</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
B.S. (with hessian sides)	91	326	417
B.S. (with wire sides)	46	332	380

Would a further intensification of the light above the trap prove still more conducive to heavier catches? The triangular entrance to the catching-cage has its two sides made of wire gauze. These were changed for three-ply boards with the following result in a trial of fourteen days:-

<u>Trap</u>	<u>Adult flies</u>		<u>Pregnant females</u>	<u>Young flies</u>	<u>Total</u>
	<u>Males</u>	<u>Females</u>			
B.S. (with wire gauze)	169	496	89	19	773
B.S. (with three-ply)	167	608	89	20	884

These preliminary trials were not sufficiently exhaustive to warrant strict comparisons of the different traps and the various modifications. They were not conducted in the light of a full knowledge of the fly community in the particular locality; and it is not intended to convey that the figures given denote a superiority of one kind of trap over another under all conditions and in every kind of locality. It did seem, however, that there were many advantages attributable to the Box<sup>x</sup>-screen type. Other observations were made which might prove of value in a scheme of trapping on a large scale. A trap placed in a small glade or near a sheltered corner of the bush collected a considerable amount of dew overnight, and took several hours to dry. It did not attract the tsetse until it had been exposed to the sun and the hessian had warmed up. Traps placed over

a game track received attention very much earlier; and those set near the bush in a wider avenue, or path, attracted still more flies. If a trap was fixed in the centre of a large glade, or a very broad path, it seemed less attractive, although on some days, it would draw a fair number of tsetse. It also seemed that a new trap, or a trap that had already been in use for more than a week, would catch more flies in a new site during the first two or three weeks than after exposure in the same site for over a month. This, however, was not invariable, but was sufficiently intriguing to justify further inquiry. Unfortunately, the need for close supervision of labour and the desire to proceed with the attempt to control fly-infestation in Nyaboro prohibited the continuation of the numerous experiments indicated by these preliminary trials.

TABLE III

Date	Trap No. 4			Trap No. 29		
	Males	Females	Total	Males	Females	Total
7.10.35	19	50	69	2	10	12
8.10.35	3	15	18	3	5	8
9.10.35	7	5	12	-	5	5
10.10.35	6	12	18	2	8	10
11.10.35	4	11	15	2	9	11
12.10.35	6	10	16	1	14	15
14.10.35 x	4	17	21	2	20	22
15.10.35	1	6	7	-	3	3
16.10.35	1	3	4	2	8	10
17.10.35	3	4	7	-	9	9
18.10.35	-	4	4	1	4	5
19.10.35	-	4	4	1	8	9
	54	141	195	16	103	119

Trap No. 4 is a box-screen type with a collecting cage provided with gauze-wire, and the sides not covered with hessian. The screen is of a black cloth.

Trap No. 29 is similar to No. 4 save that the screen is not a strip, but two strips arranged to form an inverted V with an opening at its apex leading into the trap. The strips are black.

x denotes 2 day's catches.

TABLE VI

Trap No. 30

Trap No. 32

Date	Males	Females	Total	Males	Females	Total
4.11.35	26	65	91	11	20	31
5.11.35	5	39	44	1	18	19
6.11.35	12	50	62	16	34	50
7.11.35	7	42	49	14	18	32
8.11.35	18	28	46	6	18	24
9.11.35	17	45	62	8	27	35
11.11.35 x	9	64	73	28	107	135
12.11.35	15	30	45	13	59	72
13.11.35	4	14	18	1	9	10
14.11.35	7	21	28	10	60	70
15.11.35	8	21	29	8	43	51
16.11.35	7	34	41	14	41	55
18.11.35 x	33	152	185	20	67	87
19.11.35	13	46	59	7	17	24
20.11.35	6	44	50	5	23	28
21.11.35	3	15	18	1	17	18
22.11.35	13	36	49	5	27	32
23.11.35	15	70	85	11	47	58
25.11.35 x	9	47	56	11	41	52
26.11.35	9	20	29	7	24	31
27.11.35	6	16	22	6	34	40
28.11.35	5	16	21	4	28	32
29.11.35	16	50	66	24	58	82
30.11.35	26	85	111	23	73	96
	289	1050	1339	254	908	1162

Trap No. 30 (See note, Table IV)

Trap No. 32 is similar to No. 30, but the screen is black in colour.

TABLE VII

## BOX-TRAP

(Non-return cage of wire-gauze)

## Trap No. 32

## BOX-TRAP

(Non-return cage of wood)

## Board trap

Date	Mature			Young			M.	Mature			Young		
	M.	F.	P. Preg.	M.	F.	Total		M.	F.	P. Preg.	M.	F.	Total
16.12.35	62	149	10	3	2	226	56	118	8	3	4	169	
17.12.35	24	38	7	-	4	75	22	98	12	1	2	135	
18.12.35	19	43	16	4	2	84	21	82	13	-	3	119	
19.12.35	15	33	19	-	-	67	13	74	10	-	1	98	
20.12.35	9	24	4	-	-	37	11	34	5	-	-	50	
21.12.35	7	36	8	-	-	51	6	39	7	1	-	53	
23.12.35 x	8	60	9	1	-	78	8	65	14	-	-	87	
24.12.35	2	22	2	-	2	28	6	18	6	-	-	30	
25.12.35	1	20	2	-	-	23	5	24	5	1	-	35	
26.12.35	1	5	-	-	-	6	4	19	4	1	2	30	
27.12.35	-	3	-	-	-	3	3	5	2	-	-	10	
28.12.35	2	2	1	-	-	5	2	6	-	-	1	9	
*30.12.35 x	12	45	5	-	-	62	8	22	3	-	-	33	
*31.12.35	7	16	6	1	-	30	2	4	-	-	-	6	
	169	496	69	9	10	773	167	608	89	7	13	884	

Total Males 178

Total Females 595

Total Males 174

Total Females 710

x denotes 2 day's catches.

\* denotes dull days.

TABLE VIII

Date	BOX TRAP					HARRIS TRAP							
	M.	Mature F. Preg.		Young M. F.		Total	M.	Mature F. Preg.		Young M. F.		Total	
2.12.35	2	8	6	-	-	16	-	4	2	-	-	6	
3.12.35	1	-	2	-	-	3	-	1	1	-	-	2	
4.12.35	1	6	3	-	-	10	-	2	-	-	-	2	
5.12.35	5	17	4	-	1	27	3	-	1	-	-	4	
6.12.35	4	11	6	-	1	22	-	2	-	-	-	2	
7.12.35	1	15	7	1	-	24	-	2	1	-	-	3	
9.12.35 x	2	11	-	-	-	13	-	7	-	-	-	7	
10.12.35	6	16	8	-	-	30	-	5	-	-	-	5	
11.12.35	1	14	4	-	-	19	-	2	-	-	-	2	
12.12.35	1	4	-	-	-	5	3	5	1	-	-	9	
13.12.35	-	5	-	-	-	5	1	7	-	-	-	8	
14.12.35	1	7	3	-	-	11	4	-	2	-	-	6	
16.12.35 x	5	26	4	-	-	35	1	16	5	-	1	23	
17.12.35	9	24	2	1	-	36	-	10	3	-	-	13	
18.12.35	6	19	8	-	-	33	2	8	2	-	-	12	
19.12.35	5	7	3	-	-	15	-	10	3	-	-	13	
20.12.35	1	6	2	-	-	9	1	6	-	-	-	7	
21.12.35	4	11	4	-	-	19	1	3	-	-	-	4	
23.12.35 x	1	8	-	-	-	9	1	9	-	-	-	10	
24.12.35	1	9	-	-	-	10	2	5	-	-	-	7	
25.12.35	2	7	5	-	-	14	3	6	-	-	-	9	
26.12.35	-	3	1	-	-	4	-	-	1	-	-	1	
27.12.35	-	2	1	-	-	3	-	-	-	-	-	-	
28.12.35	-	-	2	-	-	2	-	-	-	-	-	-	
30.12.35 x	1	12	-	-	-	13	-	4	-	-	-	4	
31.12.35	-	2	-	-	-	2	-	1	-	-	-	1	
<hr/>													
60	250	75	2	2	389	22	115	21	-	1	160		
<hr/>													
Total Males					62	Total Males					22		
Total Females					327	Total Females					137		

x denotes 2 day's catches.

TABLE IX

BOX TRAP

S.S. TRAP

Date	BOX TRAP					S.S. TRAP							
	M.	Mature F. Preg.		Young M. F.		Total	M.	Mature F. Preg.		Young M. F.		Total	
17.12.35	129	416	21	5	6	577	46	74	6	2	4	132	
18.12.35	37	198	19	6	2	262	6	14	-	-	-	20	
19.12.35	63	256	42	2	4	367	8	18	-	2	-	28	
20.12.35	49	105	18	4	3	269	5	6	1	-	-	12	
21.12.35	36	191	34	1	4	266	6	8	4	-	-	18	
23.12.35 x	10	172	20	2	-	204	2	10	4	-	-	16	
24.12.35	15	64	5	1	-	85	-	8	-	-	-	8	
25.12.35	13	47	7	3	-	70	2	5	-	-	-	7	
26.12.35	3	9	3	-	-	15	-	1	1	-	-	2	
27.12.35	5	12	4	-	-	21	-	1	-	-	-	1	
28.12.35	2	10	3	-	1	16	-	2	-	-	-	2	
30.12.35 x	13	47	10	-	1	71	1	14	-	-	-	15	
31.12.35	1	11	4	-	-	16	1	3	-	-	-	4	
<hr/>													
376	1628	190	24	21	2239	77	164	16	4	4	265		
<hr/>													
Total Males					400	Total Males					81		
Total Females					1839	Total Females					184		

x denotes 2 day's catches.

Note - Traps interchanged on the 23rd and 30th.

TABLE X  
Trap No. 30 Harris' Trap

Date	Males	Females	Total	Males	Females	Total
1.1.36	-	4	4	-	2	2
2.1.36	2	10	12	1	7	8
3.1.36	11	48	59	2	11	13
4.1.36	7	38	45	7	11	18
6.1.36 x	15	61	76	11	49	60
7.1.36	4	38	42	5	22	27
8.1.36	16	81	97	9	53	62
9.1.36	6	34	40	1	10	11
10.1.36	11	33	44	3	13	16
11.1.36	3	41	44	4	24	28
13.1.36 x	8	30	38	4	13	17
14.1.36	11	62	73	2	26	28
15.1.36	17	94	111	9	87	96
16.1.36	17	53	70	4	25	29
17.1.36	13	62	75	2	19	21
18.1.36	13	54	67	1	10	11
20.1.36 x	14	109	123	3	36	39
21.1.36	13	85	98	1	34	35
22.1.36	-	14	14	-	7	7
23.1.36	5	38	43	2	3	5
24.1.36	4	26	30	-	6	6
25.1.36	7	41	48	2	13	15
27.1.36 x	12	38	50	3	27	30
28.1.36	7	34	41	1	10	11
29.1.36	20	86	106	4	26	30
30.1.36	8	29	37	3	18	21
31.1.36	14	50	64	3	12	15
<hr/>						
	258	1293	1551	87	564	651
<hr/>						
1.2.36	21	132	153	4	18	22
3.2.36	56	135	171	3	17	20
4.2.36	14	50	64	4	7	11
5.2.36	10	51	61	4	13	17
6.2.36	14	45	59	2	5	7
7.2.36	9	38	47	1	13	14
8.2.36	5	39	44	2	5	7
10.2.36 x	3	41	44	-	5	5
11.2.36	4	14	18	1	2	3
12.2.36	2	7	9	-	7	7
13.2.36	5	25	30	-	4	4
14.2.36	3	16	19	2	1	3
15.2.36	1	10	11	-	2	2
17.2.36 x	12	41	53	2	16	18
18.2.36	5	30	35	1	13	14
19.2.36	12	63	75	2	14	16
20.2.36	8	14	22	3	6	9
21.2.36	5	31	36	1	6	7
22.2.36	1	8	9	-	3	3
24.2.36 x	3	34	37	2	5	7
25.2.36	4	38	42	3	8	11
26.2.36	8	42	50	2	7	9
27.2.36	3	12	15	1	3	4
28.2.36	1	21	22	1	4	5
29.2.36	2	14	16	-	2	2
<hr/>						
	191	951	1142	41	186	227

x denotes 2 day's catches.

Continued overleaf.

TABLE XI

Trap No. 52

S. S. (Cable-top) trap

Date	Males	Females	Total	Males	Females	Total
20.1.36	13	74	87	6	11	17
21.1.36	5	22	25	2	8	10
22.1.36	-	6	6	-	-	-
23.1.36	4	15	19	5	-	5
24.1.36	-	7	7	2	-	2
25.1.36	-	2	2	-	-	-
27.1.36 x	5	40	45	-	5	5
28.1.36	2	23	26	-	1	1
29.1.36	10	61	71	1	5	6
30.1.36	18	94	112	2	5	7
31.1.36	14	39	53	-	1	1
	67	384	451	18	34	52
1.2.36	42	97	139	-	4	4
3.2.36 x	10	50	60	2	11	13
4.2.36	4	25	27	5	6	11
5.2.36	11	36	46	-	5	5
6.2.36	6	23	29	2	5	7
7.2.36	9	32	41	3	4	7
8.2.36	4	17	21	-	-	-
10.2.36 x	7	39	46	-	-	-
11.2.36	2	21	23	-	4	4
12.2.36	1	11	12	-	1	1
13.2.36	2	11	13	1	1	2
14.2.36	3	7	10	-	-	-
15.2.36	-	7	7	-	1	1
17.2.36 x	4	33	37	1	-	1
18.2.36	5	10	15	-	1	1
19.2.36	5	17	20	1	-	1
20.2.36	1	7	8	-	-	-
21.2.36	2	10	12	-	-	-
22.2.36	-	5	5	-	-	-
24.2.36 x	1	6	7	-	-	-
25.2.36	2	11	13	-	1	1
26.2.36	5	24	29	1	1	2
27.2.36	2	13	14	-	-	-
28.2.36	1	17	18	-	2	2
29.2.36	-	14	14	-	-	-
	127	559	666	16	45	61

x denotes 2 day's catches.

Continued overleaf.

TABLE XI (Cont.)

Trap No. 52

S. S. (Gable-top) trap

Date	Males	Females	Total	Males	Females	Total
2.3.36	7	51	58	2	-	2
3.3.36	1	32	33	-	-	-
4.3.36	11	65	76	-	-	-
5.3.36	2	24	26	-	-	-
6.3.36	4	16	20	-	-	-
7.3.36	5	37	42	-	-	-
9.3.36 x	2	5	7	-	-	-
10.3.36	5	11	14	1	-	1
11.3.36	-	10	10	1	1	2
12.3.36	2	25	27	-	1	1
13.3.36	13	43	56	-	-	-
14.3.36	5	17	22	-	1	1
16.3.36 x	8	15	21	-	2	2
17.3.36	2	6	8	-	3	3
18.3.36	-	5	5	-	1	1
19.3.36	2	7	9	-	1	1
20.3.36	2	4	6	-	-	-
21.3.36	1	10	11	-	-	-
23.5.36 x	5	24	29	-	1	1
24.3.36	7	17	24	1	1	2
25.3.36	4	17	21	-	1	1
26.3.36	2	12	14	-	-	-
27.3.36	-	14	14	-	-	-
28.3.36	5	7	12	-	-	-
30.3.36 x	2	7	9	-	-	-
31.3.36	1	-	1	-	-	-
<hr/>						
	96	459	555	5	13	18
<hr/>						
1.4.36	-	5	5	-	-	-
2.4.36	2	5	7	-	-	-
3.4.36	28	24	52	-	-	-
4.4.36	-	-	-	-	-	-
6.4.36 x	-	-	-	-	-	-
7.4.36	2	3	5	-	2	2
8.4.36	-	6	6	-	-	-
9.4.36	-	2	2	-	-	-
10.4.36	1	6	7	-	-	-
11.4.36	1	5	6	-	-	-
<hr/>						
	34	56	90	-	2	2
<hr/>						

x denotes 2 day's catches.

TABLE XI (Cont.)

Trap No. 32

S. S. (Gable-top) trap

Date	Males	Females	Total	Males	Females	Total
2.3.36	7	31	38			
3.3.36	1	32	33	2	-	2
4.3.36	11	65	76	-	-	-
5.3.36	2	24	26	-	-	-
6.3.36	4	16	20	-	-	-
7.3.36	5	37	42	-	-	-
9.3.36 x	2	5	7	-	-	-
10.3.36	3	11	14	-	-	-
11.3.36	-	10	10	1	-	1
12.3.36	2	25	27	1	1	2
13.3.36	13	43	56	-	1	1
14.3.36	5	17	22	-	-	-
16.3.36 x	8	13	21	-	1	1
17.3.36	3	6	9	-	2	2
18.3.36	-	5	5	-	3	3
19.3.36	2	7	9	-	1	1
20.3.36	2	4	6	-	1	1
21.3.36	1	10	11	-	-	-
23.3.36 x	5	24	29	-	-	-
24.3.36	7	17	24	-	1	1
25.3.36	4	17	21	1	1	2
26.3.36	2	12	14	-	1	1
27.3.36	-	14	14	-	-	-
28.3.36	5	7	12	-	-	-
30.3.36 x	2	7	9	-	-	-
31.3.36	1	-	1	-	-	-
	96	459	555	5	13	18
1.4.36	-	5	5	-	-	-
2.4.36	2	5	7	-	-	-
3.4.36	28	24	52	-	-	-
4.4.36	-	-	-	-	-	-
6.4.36 x	-	-	-	-	-	-
7.4.36	2	3	5	-	-	-
8.4.36	-	6	6	-	2	2
9.4.36	-	2	2	-	-	-
10.4.36	1	6	7	-	-	-
11.4.36	1	5	6	-	-	-
	34	56	90	-	2	2

x denotes 2 day's catches.

A test in Otouk bush had proved disappointing, and it was felt that to abandon entirely the experiments with traps was not advisable. Four types of traps had shown promise:- The Single-Screen (or Shinyanga) trap provided with awnings; the Harris (or Zululand) trap; the type designed by Vane for palpalis; and the box-screen (or Kenya) trap with a black screen, and hessian sides to the catching cage. Dimensions and specifications of this trap are given in the appendix. Vane's trap was being tested in the Kuja river area where G. pallidipes existed in a mixed fly-belt. It was, therefore, considered inadvisable to duplicate the test at that time.

It should be explained that the preliminary tests were carried out, as opportunity permitted, during August and September; and that further tests with modified box-screen traps were carried out in October and November. Tables III, IV, V and VI give details of the latter; and Tables VII, VIII and IX show the differences in catches by the box-screen types of traps, the Harris and the Shinyanga traps during December, 1935. The figures show that the box-screen trap with a dark grey, or black, screen and strut is consistently better than the other types; the total number of flies caught vary from day to day and in most cases there appear short periods of increase alternating with short periods of decrease in the numbers of flies trapped. Is this rise and fall due to incursions of new flies after the capture of the older inhabitants of a particular patch of bush, or is it due to a peculiar activity related to the presence of game? It will be seen that this alternation occurs in the case of trapping in Nyaboro and Kagana bushes as well as in Roo; and it is also evident with hand-and-screen catching in the Lambwe round of Otouk.

Table IX shows that one box-screen is capable of trapping as many as 2,239 flies in a period of sixteen days, and Table IV shows that the number for approximately the same period in the same place may be as low as 104 flies.

Table X confirms the greater attraction of the box-screen over the Harris' trap; it shows again the fluctuations in the number of flies caught; and there is evidence to support the earlier impression that the attraction of a trap in one position is diminished on prolonged exposure.

At times, however, the numbers show a sudden increase followed by a decrease of varying degrees. It is clear that all traps attract more females than males; the proportion of one sex to the other varies to a great extent.

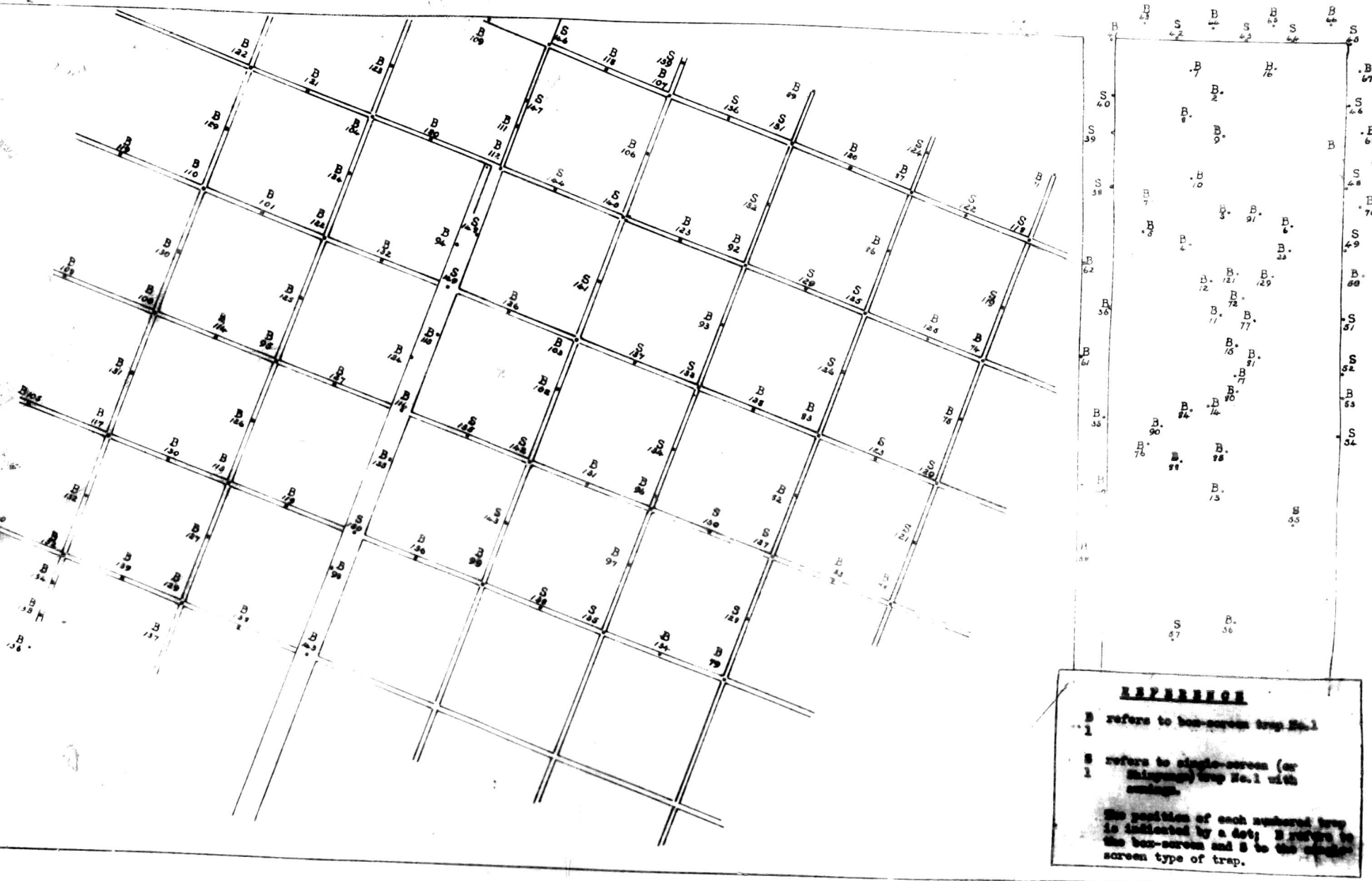
It has not been possible to correlate the daily records of catches with the different aspects of the local environmental changes. Reference to the graphs illustrating the seasonal changes in fly-density in West Roo will reveal that in July and August, 1935, there was a sharp rise in the numbers of flies. The numbers then dropped as rapidly; and with the exception of a comparatively short rise in November, 1935, continued to drop until February, 1936. In January, 1936, the returns of routine catches by fly-boys were extremely low; there was a rise in February, followed by still sharper rises in March, April and May. Yet the traps during that period showed a steady decrease. A comparison of the actual numbers may not be justified, but the trend of the population, or apparent fly-density, is exactly opposite in the two cases. It seems, therefore, very necessary to investigate the possibilities of estimating the true density of G. pallidipes. In the absence of experimental data, but in the light of experience with "trial tests" in Roo, traps were made for an attempt to trap flies in Nyaboro block of bush.

A motor-track had been made from Sanjuero labour camp, through the bush to the overseer's camp on Ugoro hill. G. pallidipes had already been captured by fly-boys on this track and off natives who had passed through the bush. Traps were set in the road. Nyaboro bush was divided into two unequal portions, viz., Nyaboro proper, and Kagana. Intersecting corridors - six feet wide - were cleared for traps in Nyaboro proper, but Kagana was reserved for traps in natural sites.

Regular fly-patrols had been carried out in Kagana bush since March, 1935. The numbers of flies caught in four patrols each month is as follows:-

Continued overleaf -

# Traps in Nyaboro and Kagana



**REFERENCE**

B refers to box-screen trap No. 1  
 S refers to single-screen (or  
 Shingaga) trap No. 1 with  
 wings.

The position of each numbered trap  
 is indicated by a dot; B refers to  
 the box-screen and S to the single  
 screen type of trap.

TABLE XIII

Month	Mature flies		Young flies		Total
	Males	Females	Males	Females	
<u>1955</u>					
March	4	2	-	-	6
April	2	3	-	-	5
May	2	-	-	-	2
June	1	2	-	-	3
July	7	5	2	1	15
August	8	11	5	4	28
September	4	5	-	1	8
October	4	5	1	-	10
November	7	7	-	-	14
December	7	3	2	2	14
<u>1956</u>					
January	4	8	1	-	13
February	1	1	-	-	2
March	1	3	1	-	5
April	6	4	1	-	11
May	17	23	3	1	44
June	9	4	1	1	15
	84	84	17	10	195

From January to June in 1956, the catches were:- Mature males 38; Mature females 43; Young males 7; Young females 2; a total of 90 flies.

Fifty-five traps were set in Kagana and in the motor-road. The total catch of G. pallidipes in these six months from January to June, 1956 was 332, or 73 males and 259 females.

In this case, the traps effected a much greater reduction of the flies. Reference to the diagram illustrating the distribution of traps in Nyaboro and Kagana will show the irregular placing of the box-screen and the single-screen traps. This seemed to be necessary because it had been observed that the fly showed some preference to the fringes of dense bush along which there were tracks, gaps or open spaces for free movement. The observation was confirmed by the results of trapping. Most flies were caught in traps placed along the edges of dense bush, B.7, B.14, B.17, B.11 and B.12 being particularly good. B.11 and B.12 were situated near a game path in the most dense bush of Kagana. All traps in the motor-track caught well. In fact, of the 332 flies captured in Kagana, 206 were collected from eight traps in the roadway, 120 were caught in twelve traps in or near dense bush, the remainder being taken in the other traps inside, or on the outskirts of, Kagana. Traps in

the clearings on the west and south of the bush caught only six flies in the six months. In the open-thicket region of Kagana, and on the borders of the barrier clearings, it was very evident that the fly-infestation decreased rapidly. This may perhaps be explained by the clearing of much of the undergrowth that formed part of the scheme of discriminate clearing of bush, and also by the non-attractiveness of the fairly wide barrier between Kagana bush and the foot of the Gwassi hills. It was observed also that pallidipes seemed to dislike open bush leading to a clearing with a hill or high land on the opposite side of the clearing.

The greatest number of flies was taken in May and June. Inside the bush the maximum was reached in April, and in the roadway the maximum was reached in May, although the flies were still numerous inside Kagana also in this last month.

On the whole it may be said of the traps that they revealed a denser population in Kagana than had hitherto been realised. The box-screen trap proved more efficient than the single-screen trap apart from the fact that the latter type was not as numerous as the former.

Additional fly-rounds were carried out through Kagana area with a view to catching-out as many flies as possible, and to compare the advantages, if any, of the one or other method of attacking flies. They are of special interest in that, unlike the results from hand-catching and from traps in Roo, here both show a rise at about the same period; viz., in May and June. The numbers caught by hand-nots and screen and bait oxen, however, were much higher than those caught by the traps.

TABLE XIII

Month	Motor track		Interior of Kagana		Kigoto end		Kagana border		Sanjuero border	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1936										
Jan.	4	5	-	7	-	-	-	-	-	-
Feb.	6	5	1	8	-	-	-	3	-	-
Mar.	7	6	4	19	-	-	-	-	-	-
Apr.	2	9	10	86	-	-	-	-	-	-
May	17	26	5	47	1	-	-	-	1	1
Jun.	9	10	4	15	-	-	-	-	-	-
	45	61	24	182	1	-	-	3	1	1

M = Males

F = Females

TABLE XIV

Month	Screen A		Screen B		Screen C		Screen D		Screen E		Bait oxen	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
<u>1936</u>												
Feb.	13	7	-	-	-	-	9	9	-	-	9	9
Mar.	7	4	-	-	-	-	9	2	-	-	11	6
Apr.	7	7	-	-	4	5	11	11	-	-	17	8
May	28	40	12	18	12	36	24	41	67	57	27	33
Jun.	25	20	14	21	18	18	27	23	41	31	11	10
	80	78	26	39	34	49	80	86	108	88	75	66

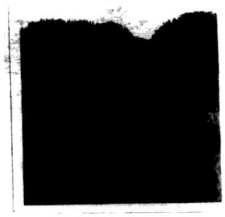
M = Males

F = Females

Screens B, C and D were carried by fly-boys through Kagana bush from the Sanjuero side to the Kigoto side; they were not taken along the same route as the ordinary routine fly-round in Kagana. Screens A, E, and the bait-oxen were taken round the bush on the days when the boys were not engaged in collecting flies from the traps; the majority of flies being taken on the motor track. From these observations it may be deduced that odd flies do venture to the borders of the cleared zones; and as the screens are taken through the bush frequently, they effect heavier catches than the numerous traps placed in what would normally appear to be favourable sites. The fly-boys always pass along the same route, and it is possible that even a long narrow track may attract more flies than irregular spaces that might appear to the fly to be enclosed.

If partial bush-clearing is pursued further in the Kagana area it will be interesting to observe its effect on the fly-infestation. It may be necessary only to dig out the tangled woody shrubs that create the dense bush favoured by the fly, and leave the larger trees in such a manner that a satisfactory sward of grass may inhibit regeneration of the shrubs; thereby making the present favourable haunts uninhabitable to this pest.

While investigations were proceeding in Kagana the available labour supply was engaged in clearing the narrow corridors in the western half of Nyaboro. Routine patrols had already proved that G. pallidipes was more prevalent in this zone that was indicated by the general fly-survey and later reconnaissances. At some periods - May and June, 1935; December, 1935, and January and February, 1936, - it was



Traps in motor-track through Nyaboro. Box-screen in the fore-ground, S.S. in the back-ground.



A close view of a round-end, box-screen trap in the motor-track, Nyaboro.



Examining a lorry at the de-flying station, Nyaboro.



A party of fly-boys with a bait-ox. One boy is seen taking a tsetse off his leg.

thought that the barrier clearing across the valley at Morea had forced back the fly and reduced them to very small numbers. The natives firmly believed that the tsetse had been eradicated in Nyaboro; and they expressed their desire to utilise the barrier for ploughing with oxen and for the production of crops. Wholesale clearing was looked upon with favour, and the making of the corridors was regarded as preparatory to clearing all the bush. It was soon appreciated that the flies had by no means been eradicated. Traps were set in the corridors in April, 1936. At first, only box-screen traps were used, but later the distribution of the traps was rearranged in order to test the comparative values of the box-screen and the single-screen (Sninyanga) traps in an area believed to be lightly infested with G. pallidipes.

The results for April and May, 1936, are for box-screen traps only; those for June include also the single-screen traps.

The routine fly-rounds through the interior of Nyaboro bush had shown a definite rise in fly-density from March to May, 1936, with a slight fall in June. The traps in nearly all the corridors confirmed the rise in March to April and in the period of April to May. In June, there was a very decided drop that was unfortunate for the purposes of comparison; yet it will be seen from the following table that, in every case, the single-screen was less effective in catching than was the box-screen.

TABLE IV.

Corridor	No. 1				No. 2				No. 3				No. 4				No. 5			
	B-S		S-S		B-S		S-S		B-S		S-S		B-S		S-S		B-S		S-S	
Month 1936	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
April	7	19			15	30			27	47			12	28			4	7		
May	16	19			22	40			21	86			39	62			13	30		
June	6	9	1	7	6	12	7	7	18	34	2	11	6	12	2	5	4	5	3	4
Total	29	47	1	7	45	82	7	7	66	167	2	11	59	122	2	5	21	42	3	4
Corridor	No. 6				No. 7				No. 8				No. 9				No. 10			
	B-S		S-S		B-S		S-S		B-S		S-S		B-S		S-S		B-S		S-S	
Month 1936	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
April	22	53			16	21			8	26			4	8			31	75		
May	39	66			15	26			24	56			14	39			66	101		
June	9	7	3	6	1	8	-	2	7	9	2	7	5	3	-	1	23	36	6	14
Total	70	146	3	6	32	54	-	2	39	91	2	7	23	47	-	1	120	214	6	14



A box-screen trap in Corridor No. 5 of Nyaboro. The grass is not cut short.



A box-screen trap across elephant tracks in one of the glades of Otouk bush.



A clean Corridor (No. 2) in Nyaboro. S. S. awning trap in the background.



An overhead, S.S. trap across a narrow, elephant track in Otouk bush.

Sixty-nine traps caught 1,510 tsetse - 504 males; 1,006 females - in three months. In June, thirty-six box-screens captured 226 flies - 89 males, 137 females; while from thirty-three single-screen traps only 90 flies - 26 males, 64 females - were obtained.

Corridor No.10 produced the largest number of flies; No. 6 and No. 3 followed in the second and third places respectively, and No. 4 took the fourth place.

Due to re-arrangement of the traps, full discussion on the merits of traps situated in different kinds of vegetation is not possible, and it is not unlikely that the traps in the narrow corridors lost some of their attraction to the flies when the grass was permitted to become tall and rank, thus obscuring the foot of the traps from tsetse.

Corridor No.10 is ten yards wide; it passes, for the greater part of its length, through the most dense bush of Nyaboro. Not far from the cleared corridor are many game wallows that are transformed to pools of water after heavy rainfall. A small herd of five buffalo lives in this area; and at rare intervals a few elephant visit these wallows but return more or less immediately to their more permanent haunts in Runa. The other corridors are apparently too narrow and do not provide sufficient open space to render the traps easily visible to the flies.

Daily patrols by fly-boys in six corridors were begun in March, 1936; and in all corridors for April, May and June. The total catches tabulated below are astonishing when considered from previous experience in Nyaboro.

TABLE XVI

Corridor	No.1		No.2		No.3		No.4		No.5	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1936										
March	21	15	44	52	49	37	51	45	117	70
April	24	26	60	58	83	73	182	179	74	70
May	71	78	119	155	153	149	348	356	151	194
June	73	53	135	182	177	178	218	308	99	118
	189	172	358	407	462	437	799	768	421	452

Continued overleaf

47.  
TABLE XVI (Cont.)

Corridor	No. 6		No. 7		No. 8		No. 9		No. 10	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1936										
March	51	38	-	-	-	-	-	-	-	-
April	74	80	62	62	62	46	72	59	189	136
May	132	172	256	266	245	381	284	383	373	414
June	113	134	134	158	225	233	200	221	331	301
	370	424	452	503	632	660	556	663	883	851

They exceed the catches by traps and tend to force one to the tentative conclusion that pallidipes is not always shy of man. The screen, of course, provides added attraction and movement of the boys may well induce flies to follow. It is also evident that the expert collectors permit very few flies to escape once they have settled on their screen. It may be argued that the large numbers of flies caught by fly-boys in the corridors reduce the numbers which might otherwise have been drawn to and captured by the traps. There are no experimental data on which to base further observations on this point, but it may be explained that the boys do not linger unduly in the vicinity of traps, nor do they compete, as it were, with the traps. One party of boys has four corridors to patrol in a morning and therefore has to proceed fairly steadily along in order to cover the distance. Assuming that the majority of tsetse in an area of bush do not range up and down the corridor when the fly-boys are collecting, there is no reason why the catches by effective traps should be greatly disturbed by the fly-boys.

For some unknown reason the traps in Nyaboro and in Kagana have not yet proved as efficient in capturing G. pallidipes as fly-boys provided with hessian screens, but it remains to be seen what results will be obtained over a period longer than three months.

In June, 1936, the eastern half of Nyaboro was divided into numerous blocks of bush by increasing the number of corridors. As in Nyaboro west, the corridors were 400 yards apart. Additional box-screen traps have recently been set in these corridors. The data, so far collected, do not permit useful discussion.

Twenty-three traps - all of the box-screen type - have been placed along the Ugoro-Kisingiri corridor. This corridor has recently been

widened from 50 to 175 yards; it was cleared of bush in order to isolate Otouk from Riamakanga and in order to reduce the migration of flies from the former to the latter. Traps along both sides of the clearing might attract and capture any flies frequenting the fringe of the bush and assist in intercepting those that might venture across the clearing. Up to the time of writing, only thirty-six flies - 6 males, 30 females - have been collected in the month of June.

Another form of trapping flies was instituted to safe-guard the comparatively fly-free area of Luatonga, to protect the few cattle in the Owiga valley, and to prevent extension of fly to the upper Kamgwagi location. De-flying stations were erected at Sanjuero, on the motor-track below Owiga valley, and below Sagama hill to the east of south Ruma. One fly was collected at the Kamgwagi in a period of four months, and five flies at the Owiga station for a similar period. At Sanjuero, however, larger numbers have been taken; frequently from clothing of natives; and in one case from a lorry leaving the valley.

In order to estimate the potential danger to Luatonga and for advisory purposes the actual numbers of flies caught at the Sanjuero de-flying station were recorded. In March, 1936, 7 males and 6 females were collected; in April, 14 males and 16 females; in May, 55 males, 58 females; and in June, 9 males, 6 females; making a total of 171 G. pallidipes in four months. All these flies were taken off natives passing from the Lambwe valley, through Sanjuero, and proceeding in the direction of Karungu.

The importance of this Sanjuero de-flying station should not be under-estimated, especially in view of the desire to utilise the area <sup>to</sup> of the south of Morea for cattle that have recently been brought to the neighbourhood, and the attraction to cattle of the provisional water-dam immediately west of the hill.

Efforts to improve the trapping of G. pallidipes by applying extracts of sebaceous glands from different regions of bovines proved unsuccessful. Only a few trials were made, and although there is always sufficient material available for extractions at the Veterinary Research Laboratory, Kabete, the apparatus for the preparation of reasonably large quantities of extracts is not available.

If one may draw conclusions from these trapping experiments, they must be provisional to further, more exhaustive information from tests over a longer period. Traps will capture larger numbers of flies in a dense area especially at the time the fly-population is at its height, and the flies most active. Even at this time, however, the catches are not consistently high, and the traps seem to lose some of their attractiveness. In the initial exploratory tests in Roo from August to December, 1935, 10,862 G.pallidipes were captured; and from January, 1936, to the middle of April, 1936, two box-screens, one Harris' trap and one modified single-screen trap caught 7,004 flies.

Three boys on weekly fly-rounds collected 2,441 flies in the first period, and 1,637 flies in the second period.

Nyaboro and Kagana were believed to be lightly infested with G.pallidipes. Traps erected in naturally favourable sites in Kagana revealed that the infestation was heavier than that indicated by weekly patrols, and traps in the Nyaboro corridors confirmed this fact. There is no doubt that the corridors helped considerably in bringing out the flies from the bush, and assisted in the reduction of the fly-population by trapping.

Daily fly-rounds by boys, however, showed that the infestation in Nyaboro was still heavier than that revealed by trapping. It is felt that more intensive study of siting traps with regard to the control of G.pallidipes is necessary, and that investigations into the value of attractants should be pursued.

Experience throughout these trials with traps indicates that trapping might with advantage be employed vigorously when the fly-density increases. Other methods of attack may be adopted to substitute trapping at other periods, and they may be directed to the destruction of the primary home or breeding haunts. It is not unlikely, however, that the efficiency of the traps can be sustained by improvements in the placing of good traps, and by preparing known hunting and breeding places where the traps can be set.

Whereas the use of traps has not yet proved highly effective in every instance, it would appear premature to condemn them; and to revert to hand-catching and wholesale clearing of bush, on the pretext that the

initial experiments have not been convincing. It is appreciated that trapping is yet in its infancy, and requires further careful study and support.

Observations on the fly-community:

The complete separation of the main blocks of fly-infested bush - Nyaboro, Riamakanga, Otouk, Ruma and Roo - by wide efficient barrier clearings has not yet been possible, nor has it been practicable with the available finances to isolate the fly-infested zone from the fly-free areas. The Nyaboro and Kagana barriers are being extended with further financial assistance from the Local Native Council, and the Overseer is supervising the work under direction.

It has been mentioned that narrow corridors were cleared of bush between Otouk and Riamakanga - the Kisingiri corridor; and between Riamakanga and Nyaboro - the Kigoto-Kamaguthi corridor. These corridors divide the upper end of the valley into three blocks. Ruma bush was the deciding factor for the fourth block; Roo, the fifth block; and the fly-infested zone of the lake-shore, including Waturi, formed the sixth block. Luatonga was included in the first block.

Theoretically, and as a working basis, the Lumbwe valley was divided into six blocks, A, B, C, D, E and F. These blocks were believed to be infested in different degrees of fly-density. In Block A, or the Sanjuero block, Luatonga area to the south of Mores was either entirely free or very lightly infested at certain seasons only; Nyaboro - from Kagana to Theka - was known to harbour a few G.pallidipes. Block B, or Riamakanga, seemed to consist of several "pockets" of fly-concentration; Block C, or Otouk, was apparently fairly heavily infested in parts. Block D, or Ruma, was known to be the haunt of many elephant and buffalo; and, at the periphery of the most dense bush, heavy catches of the fly had been made. Roo, or Block E, had produced large numbers of G.pallidipes and, at times at any rate, seemed to be the most heavily infested area. In Waturi, or Block F, two species had been recorded, and later a third species was found there. It was felt that with these different zones in the valley, much could be learnt regarding the various aspects of infestation by G.pallidipes, and

that any knowledge gained would be useful from the scientific point of view, and for application of control measures in the Lambwe as well as in other parts of the Colony.

Each block in the Lambwe comprised different types of vegetational zones. The majority extended from the hills on the west to the escarpment on the east. The western valleys were included in the respective block, as were also the wooded ravines on the escarpment.

The different vegetational zones or transects through such zones, were carefully chosen for inclusion in the fly-rounds; and in many instances, similar transects were, of necessity, duplicated even in one fly-round. This was considered to be advantageous to the investigations because the data from one such transect would either confirm those from another or indicate the existence of some factor other than that of the vegetational environment in a particular patch of bush or sector.

In each block, there were five fly-rounds that were divided into sectors based mainly on vegetational differences. The sectors were of different lengths, and they were all marked so that the fly-boys could enter into their note-books the number of flies caught in each one. The sectors were measured by means of a surveyor's perambulator, but it was not possible to carry out this work in all the blocks before the routine fly-rounds were put into operation. Those in blocks A, B and C were completed early in 1935. It was not until 1936 that the rounds in Rama and Roo could be measured. The routes taken by fly-boys in all blocks were always the same, and it was hoped that an opportunity would arise to permit an accurate division of these routes into sectors.

(continued overleaf)

The following table shows the system of routine fly-rounds:-

Block	Number and Name of Fly-round	Length of Fly-round	Number of Sectors
A : Sanjuero	1. Luatonga-east	15,229 yards	12
	2. Luatonga-west	9,511 "	16
	3. Kagana	8,083 "	10
	4. Nyaboro Kati	8,126 "	10
	5. Theka	10,749 "	8
B : Riamakanga	6. Kigoto	13,339 "	15
	7. Kati	12,096 "	14
	8. Gendu	11,754 "	11
	9. Kisingiri	13,052 "	10
	10. Lambwe	5,515 "	9
C : Otouk	11. Kerlango	17,012 "	16
	12. Lambwe	6,241 "	8
	13. Nyamarigi	12,694 "	14
	14. Nyabor Ondiek	12,609 "	13
	15. Rari	8,565 "	8
D : Ruma	16. Ruma-north	8,576 "	Sectors not demarcated.
	17. Lambwe-south	5,378 "	
	18. Ruma-south	- "	
	19. Goyo	12,950 "	
	20. Lambwe-north	5,591 "	
E : Roo	21. Nyakiya	- "	6 7
	22. Nyamatoto	- "	
	23. Akatari	- "	
	24. Roo-hillside	4,532 yards	
	25. Roo-lakeside	6,122 "	
F : Waturi	26. Waturi	- "	-
	27. Bado Ogono	- "	
	28. Ogono	- "	
	29. Lambwe-south	- "	
	30. Lambwe-north	- "	

Extra fly-rounds were patrolled in order to ascertain the fly-infestation in areas that were not covered by the routine searches.

Three natives were engaged for each block. An extra party of three was employed for daily-record work in the Lambwe round (No. 12) of Otouk. A few trained boys were kept in reserve to replace regular collectors who might fall sick or who would wish to return to their homes for a short time. The fly-boys would start on a patrol at 7 a.m. Two boys would carry a screen and a net each; the third and senior boy would also take a net, his note-book and the daily-record form. The party would move along in single file, stopping for a few minutes at frequent intervals.

The two screen-boys would catch the flies from off the screen, the senior boy would collect any flies alighting on the other boys or himself. At the end of each sector, the number of flies caught were counted, the sexes separated and entered on the form. Young males and females, as well

as old or mature males and females and pregnant females were noted, and the state of hunger or of feeding recorded. Usually, another patrol of the same round was carried out on the following day; but, in this case, the boys would go around in the opposite direction. No further patrols were made until a week or so had elapsed, when the same system would be followed on two consecutive days. The time taken to cover the distances of the fly-rounds was from five to seven hours, the boys travelling at an average rate of about two thousand yards an hour. The kind of form used for these daily records is given in Appendix I, No.1.

The collections were examined, and the records checked by the Overseer at the end of each day. At the end of the month all records were transferred to another form (Appendix I, No.2) for filing purposes and permanent record.

Several thousands of flies were caught in Otouk block, marked with a distinctive colour and released. The date and place of recapture was noted.

By this method of working, it was possible to obtain a fairly accurate idea of the behaviour of the fly-community.

Seasonal fluctuations:

The graphs illustrating the general climatic conditions in the Lambwe valley have been dealt with in the early part of this report.

When compared with the normal conditions prevailing in the Lake Victoria zone, the climate is somewhat drier in the valley; and it will be noted that the rainfall is of the thunderstorm type. The wind sweeps through the valley and assists the sun to dry up the air, grass and soil in the open country; it ventilates the open bush, but does not always gain access to the interior of the dense bush in Ruma and Nyaboro. Roo is partly sheltered by the Kasigunga hills. The mean monthly temperature at Kiabakari is about 75°F. in January, February, March and April; it begins to drop in April and reaches its lowest point (70°F.) in June and July. Towards the middle of August it rises again to about 75°F. and continues at that average level to the middle of November. The mean relative humidity varies roughly in the opposite direction. It falls to about 57% in January and February; and towards the end of the latter month rises to 60%. In March it still increases; and reaches 70% in

May. There is a very slight drop in June, July and August, after which it gradually falls to about 60% in December. The rainfall is well distributed; but there may be years of severe drought.

Conditions are obviously different in the bush, and a good deal of further work needs to be done in this "home" of the tsetse. The data available, however, strongly indicates the line of investigation to be pursued.

The seasons in the Lambwe may be divided into four periods:- (1) Long dry season, from December to the middle of March; (2) Long rain season, from middle of March to the latter half of June; (3) Short dry season, from middle of June to the middle of September; (4) Short rain season, from September to November. January is the driest month and April may be considered the wettest month. June and July are the coolest months, while the warmest period may extend from January or February to March, and from September to October. During the warm period, the sky is, comparatively, fairly clear; whereas at other periods it is more cloudy.

Figures 1 and 2 illustrate the average number of flies per fly-boy in Nyaboro, Riamakanga, Otouk and Ruma; Figure 3 shows the numbers caught in East and West Roo. The average numbers for 10,000 yards are calculated from actual numbers for purposes of comparison. They are brought to a common basis by virtue of the consistent manner in which the collections were made and which has already been described.

It will be observed that there is a striking similarity in the trend of the curves for Riamakanga, Otouk, East and West Roo; and that the curves for Nyaboro and Ruma do not differ very much.

In April, 1935, the numbers of flies caught by hand-nets and screens show a tendency to rise or, in the case of Roo, remained at a fairly high figure. In May, the flies were also numerous, and either showed a slight or a definite rise; or they remained at approximately the same density. Roo showed a slight drop. With the exception of East Roo, the fly population seemed somewhat similar in June. There was a distinct change in July, especially in Otouk, East and West Roo. Ruma showed a slight decline in numbers; but it was notable that Riamakanga and Nyaboro (in the south of the valley) revealed a larger number of G. pallidipes. After July - and to the end of 1935 - the numbers

54a.

Average number of flies per fly-boy per 10,000 yards.

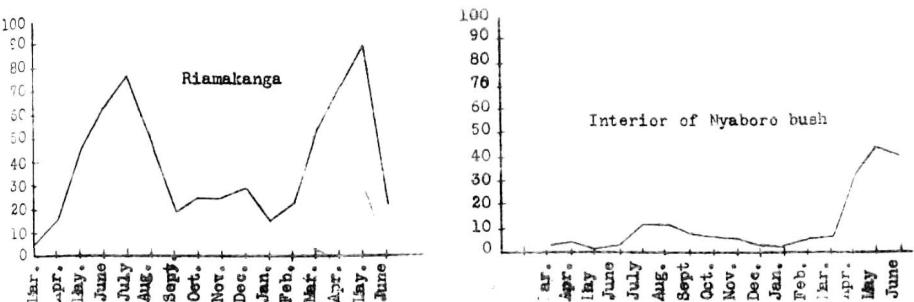


Fig. 1.

Average number of flies per fly-boy per 10,000 yards.

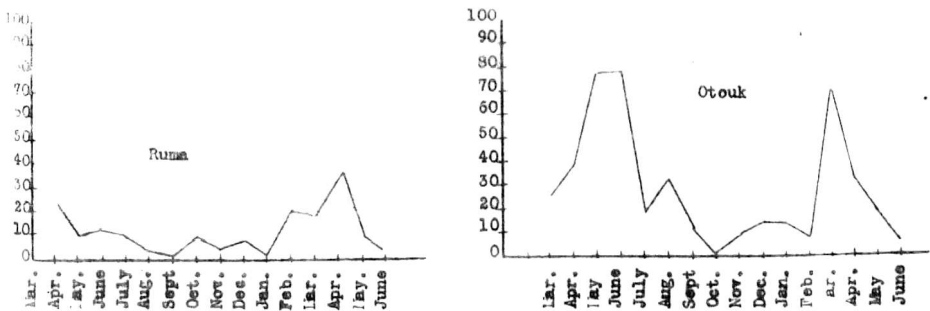


Fig. 2.

54b.

Average number of flies per fly-boy per 10,000 yards.

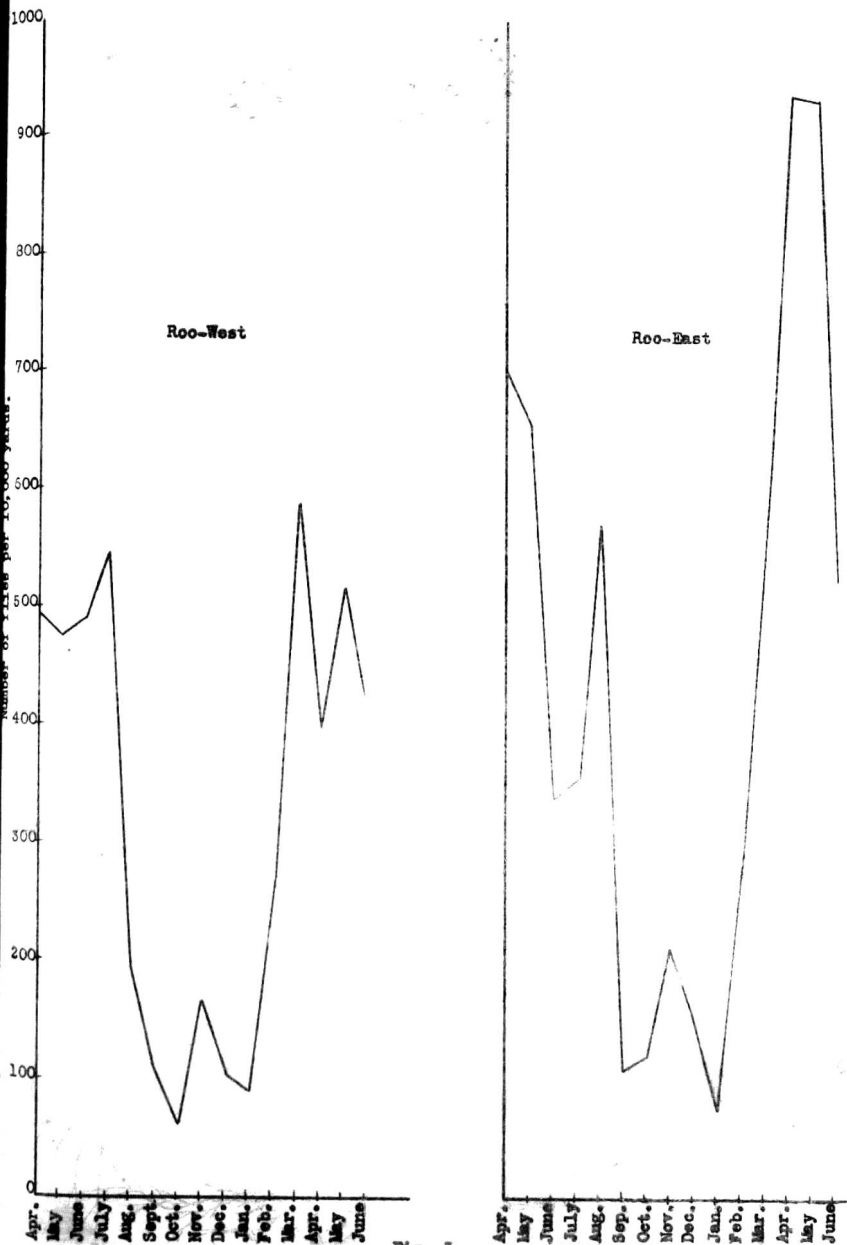


Fig. 3.

decreased rapidly. There was, however, a little recovery in August (for Otouk); in November for both sections of Roo and in Riamakanga; while Nyaboro maintained its apparent density until the end of August.

Comparatively, very low numbers were obtained in December and the following January.

The observations in 1936 are, like those in 1935, incomplete in so far as they are not available for a similar period; and in neither case is the information sufficiently complete for a calendar year. Nevertheless, the continuation of the investigations is helpful to a general understanding of the seasonal rhythm of G. pallidipes. In January, the fly-density - by which is meant the apparent and not the true density - was low in every block of bush. February appeared to be a little more favourable to the fly; and in March, there was a decided increase excepting in Nyaboro and Ruma where there appeared to be a lag. In April there was a further rise for Nyaboro, Riamakanga, Ruma and Roo. The numbers dropped in Otouk and West Roo. Little change took place during May; but in Otouk and Ruma (in the north section of the valley) the curve shows a sudden drop. June, on the whole, marked another low figure of flies caught.

September and January, or October and February, are periods of low fly-density. March, April and May - sometimes June - are months during which G. pallidipes is most numerous.

It is not possible, of course, to discuss fully the influence of the different climatic factors on the fly-communities in each area, and one cannot assert with conviction that one factor or a combination of factors is more important than another without specific experiments to test statistical data. The investigations have not been in operation for a sufficiently long period, and the conditions governing the utilisation of the grant did not permit of experiments on the many intriguing problems in connection with the biology of G. pallidipes.

Nevertheless, one is inclined to the view that this species of tsetse requires a warm habitat with a rather high percentage of humidity in its primary home. The rainfall, its distribution, intensity and the percentage of relative humidity fluctuate much in the same way in the Lambwe valley as does the fly-density. Yet there are peculiar

differences that cannot be accounted for merely by these two, related factors. There is a reduction of flies in July when the temperature is lowest, and there are low numbers in January and September or in February and October when the temperature is high or the conditions dry. The exceptional large numbers of flies for July, 1935, in Riamakanga cannot be explained by climatic influences. Other, inexplicable conditions are responsible.

Reference has already been made to the known differences between the climate at Kiabakari (page 5) and in the bush. The mean temperature is a few degrees lower than that at the general observation station, but the mean maximum temperature may be 10°F. lower. The humidity is normally 5% to 10% higher at the bush station which is situated in the centre of a clump of thicket, a yard or two from the bed of the Lambwe river in Riamakanga. The poor circulation of air, the density of the tangled undergrowth of bush and other conditions check or retard climatic changes in the forest or bush areas, and it would seem not impossible to modify these conditions so that G. pallidipes would find them less favourable to its existence. If the species is as susceptible to moderately severe changes as has been impressed upon us during the investigations, it is likely that the present scheme of work could be continued with good advantage.

Preliminary observations on the activity of G. pallidipes have been made. Flies appear to be active between 7.30 a.m. and 8 a.m. and continue to be so - and to attack readily - up to 10.30 a.m., after which they tend to disappear; and certainly become less active in open glades. In the shade of bush, however, they move freely until noon when usually they seek shelter and rest. Not infrequently, flies are active even during the hottest period of the day in heavily wooded areas, usually during a period of bright sunshine after a normal shower of rain. The Overseer (Mr. Langridge) reports that large numbers of flies attack quite freely while the dew is on the grass and the sun shining brightly. He is of the opinion that the humid atmosphere near the ground and the heat of the sun are conducive to great activity on the part of the fly. He has experienced that G. pallidipes always appears from near the ground, at grass-height level, and considers that this behaviour is due

to the more favourable humidity immediately overlying the grass-covered soil.

On a clear, sunny day, Mr. Langridge observed no flies in the open at about noon, but on passing through open thickets, there were fairly large numbers.

Another factor that seems inimicable to the tsetse is direct sunlight. This is particularly so in the case of females. Even the males will not venture into well-lighted areas unless there is a tree, bush or other object providing shelter at no great distance from the fly's usual habitat.

G. pallidipes is not abundant on the lake-shore at Waturi; nor is it present in large numbers on the lower reaches of the Lambwe. Between Ruma and a short distance above the mouth of the river, tsetses are not usually found.

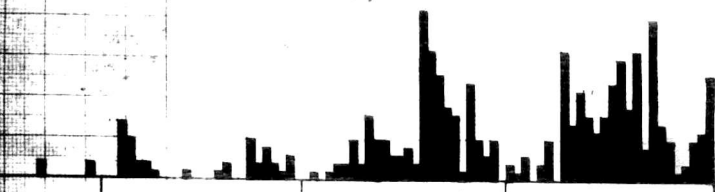
The fluctuations in the numbers of this species on the lake-shore differs from those in the riverine bush higher up the valley.

On Waturi peninsula, the greatest number of flies was collected in December, 1935, with slightly smaller numbers in July 1935, and in March, 1936. Very few flies were collected in May, and in September 1935; and in January, April and May, 1936. In June, G. pallidipes seemed to have disappeared. This rise and fall, and more frequent disappearance was also experienced near the mouth of the Lambwe river. In October, 1935, January, February, April and June, 1936, no pallidipes were captured by the fly-boys, although, in several instances the number of patrols was increased.

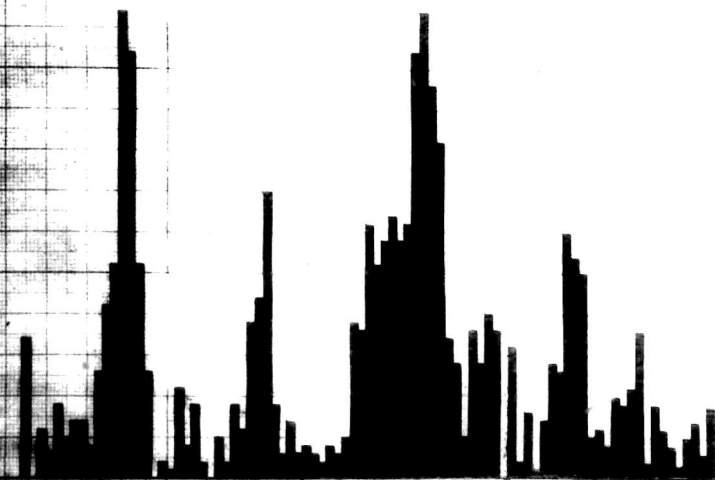
The charts illustrating records of daily catches in the Lambwe round, No. 12 (Otouk) and the daily records in the Nyaboro corridors show the changes that take place in the fly-community, and they show that when the mature flies are most numerous, the emergence of young flies is also greatest. The relation between the increase in emergence, and the increase in mature flies needs further study especially with regard to climatic influences on the one hand, and the influence of "young" fly-population on the "mature" fly-population. Is the increase of the latter partly, largely, or entirely due to the favourable seasons affecting the pupae in the ground and accelerating development and emergence?

Daily records of *G. pallidipes* caught by fly-boys in  
Corridors Nos. 1, and 4 of Nyaboro.

Corridor No. 3.  
Young flies



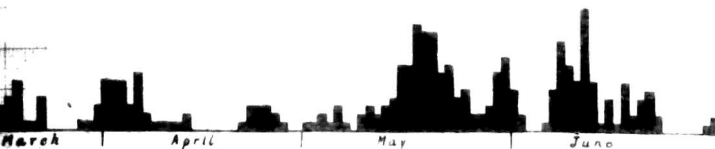
Corridor No. 4.  
Mature flies



Corridor No. 1.  
Young flies



Corridor No. 1.  
Mature flies



March

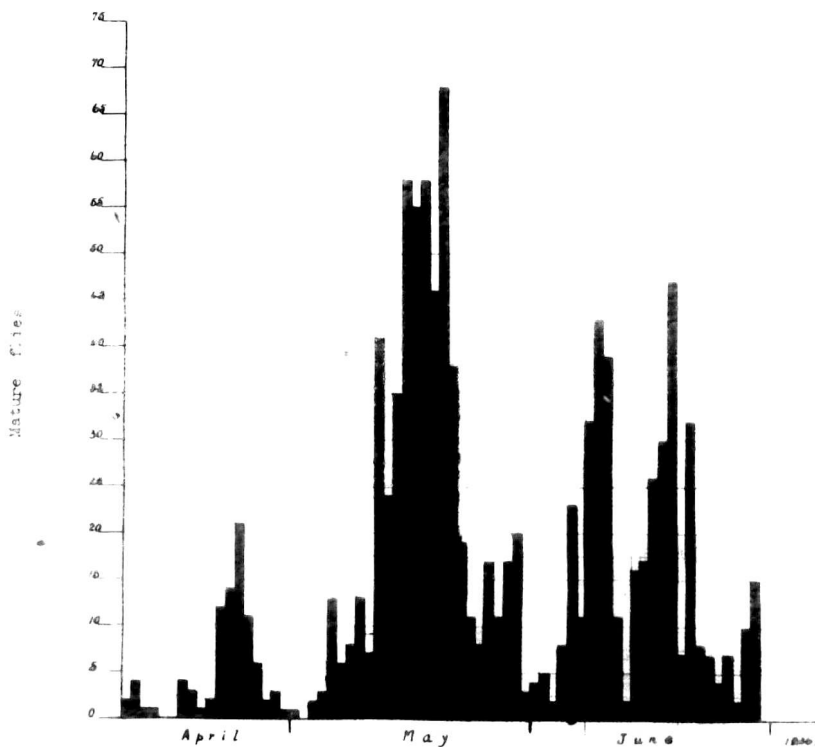
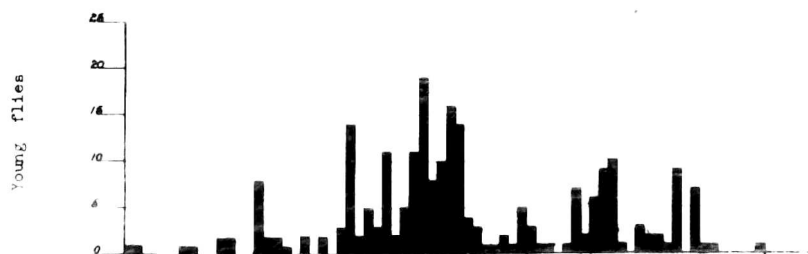
April

May

June

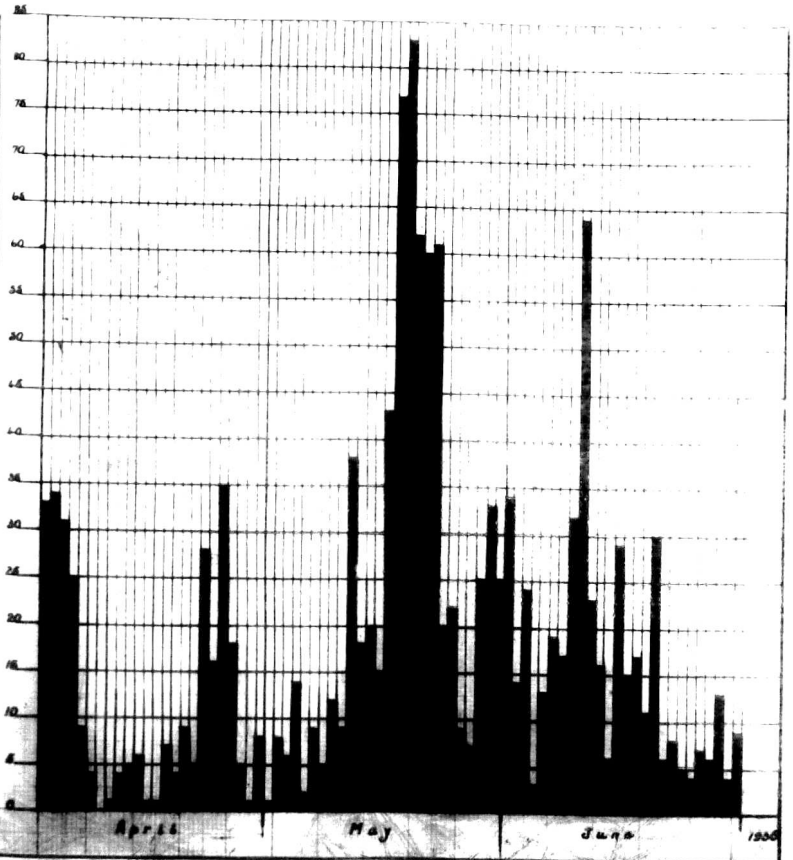
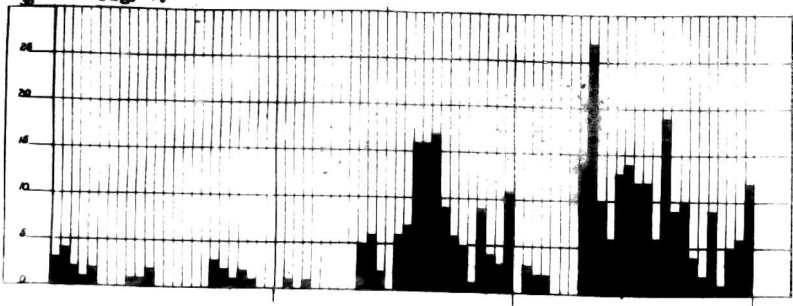
Daily records of *G. pallidipes* caught by fly-boys  
in Corridor No.8 of Nyaboro.

Fig. 6.



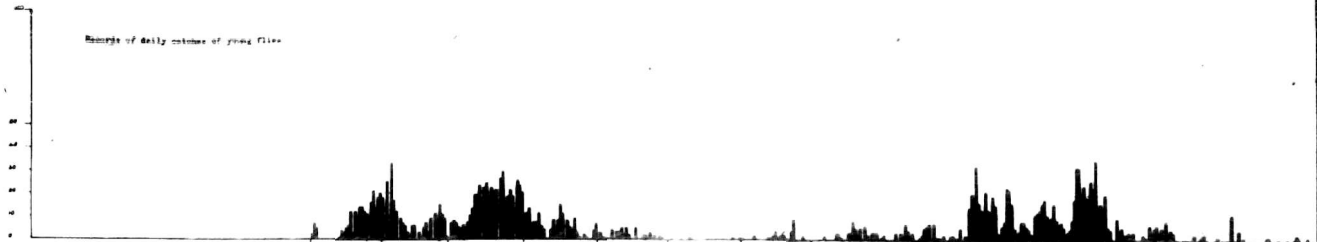
Daily records of *G. pallidipes* caught by fly-boys  
in Corridor No. 10 of Nyaboro.

Fig. 7.

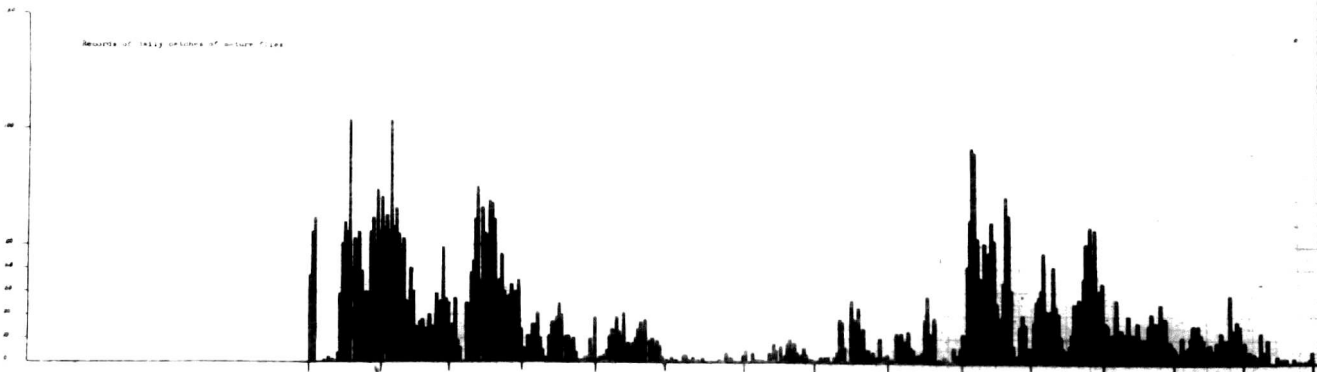


RECORDS OF DAILY CATCHES OF *G. PALLIDIPES* IN THE LAHORE SOUND (NO. 12) IN  
OTOK BLOCK, AND THE DISTRIBUTION OF RAINFALL AT FIAMWANG.

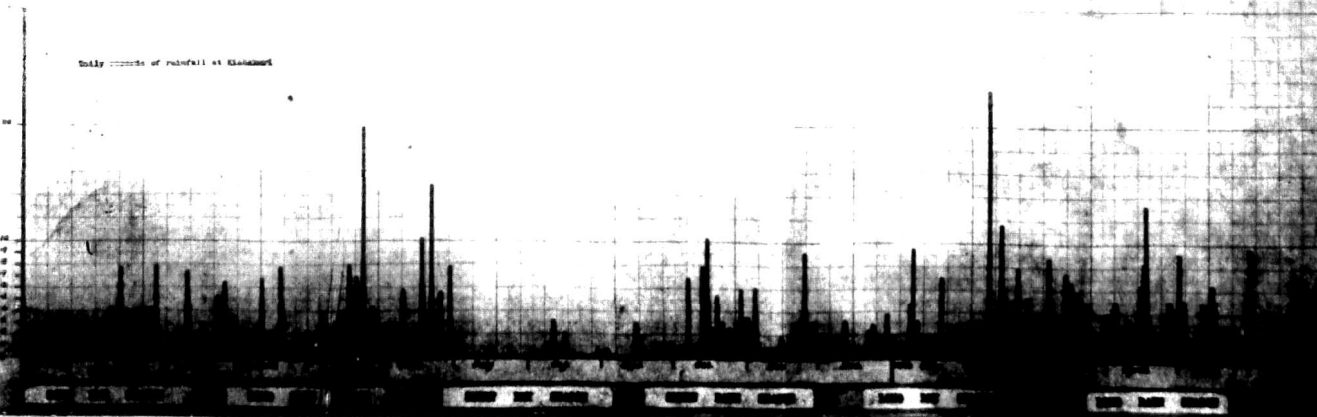
Records of daily catches of young flies



Records of daily catches of mature flies



Daily records of rainfall at Fiamwang



**Dispersal:**

It is evident that the dispersal of G. pallidipes is dependent upon the density of the fly-population in the primary habitat; on the food supply and accessibility of hosts; the climatic conditions in the "home" and in the country adjacent to it. It is also dependent upon the activity of the flies; the provision of shelter outside the permanent belt and visibility of suitable temporary habitats. Reference has been made to "following" flies or those individuals that have been transported on natives passing through the de-flying station at Sanjuero; and there seems very little doubt that the tsetse is frequently conveyed on, or often follows, cattle that are sometimes taken across the valley. These cattle, it may be mentioned, are few in number and are only moved from, and into, the valley in connection with native marriage contracts, or some other custom.

Analyses of catches made in the routine and in extra fly-rounds, show that G. pallidipes tends to spread from the permanent belt along the Lambwe during the period when flies appear most abundant; that is, in April and May; and sometimes as early as March or as late as June. The flies spread in both the westerly and the easterly directions as may be gathered from a perusal of Tables XVIII, XX and XXI. It will be observed also that there is some dispersal in July - the month which is usually coolest. This is, perhaps, not surprising when it is realised that the temperature outside the bush is hardly ever so low in this month as to incapacitate the flies. There is also a dispersal in November and December, but this is less extensive than that which occurs earlier in the year.

The valley of Nyadenda seemed rather isolated from other dense, bush covered zones, and it seemed likely that some measure could be adopted to connect this valley with other stretches of the Lambwe that could be protected from even seasonal fly-infestation. Despite careful search, no flies were collected in Nyadenda in March, April and May, 1935. One male was found in June. In July, however, G. pallidipes suddenly appeared. Fourteen males, sixteen females and two pregnant females were taken in four fly-rounds. In August, only two males were caught. After that month, no flies were seen until January, 1936, when seven males and

seven females were taken. In February, three males and two females were obtained. Again, the fly disappeared from Nyadenda until April, when one male was taken on a path from Nyadenda crossing the saddle behind Iringa to the villages of Kaksingiri.

It has not been possible yet, to make a thorough examination of the data that have been collected during the last eighteen months, but one has been impressed with the Overseer's belief that G. pallidipes will not travel to any great extent in an area hemmed-in as the Lambwe valley is, without assistance from moving objects or animals. The bulk or darkness of the hills and escarpment seem to be unattractive to G. pallidipes and they occlude the vision necessary to the fly to extend its range in search of food, and obscure dark patches of bush which would otherwise appear more clearly to the fly.

The tendency of the tsetse to seek for new or more suitable haunts appears to be of paramount importance; and if an area of infested country cannot economically be reclaimed at present or within a prescribed period, it is desirable that strenuous efforts be made to arrest the encroachment of the pest in adjoining fly-free areas.

It has been seen from the preliminary tests with marked flies, that they move freely up and down the valley, from one block of bush to another. It has not been feasible to test the ability to cross a cleared barrier as yet.

As a final remark on dispersal in this report, the suggestion may be put forward that G. pallidipes seems to have occupied as its original home the valley of Roo; and it is from this belt that the greatest number of flies spread to the Lambwe river when the country was allowed to revert to bush.

#### Vegetation and G. pallidipes:

In 1912, Neave experienced that G. pallidipes, though not at all confined to river banks, is always associated with a fairly considerable amount of bush in rather low-lying river valleys; but given sufficient cover, it would no doubt be found a mile or so from water. He adds: "There would appear to be some ground for thinking that, in British South Africa, at any rate, this tsetse has a more marked seasonal prevalence than G. morsitans, being much more numerous at the end of

the wet season and the months immediately following it than during the dry."

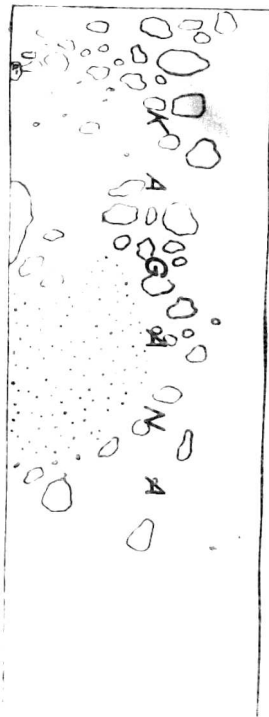
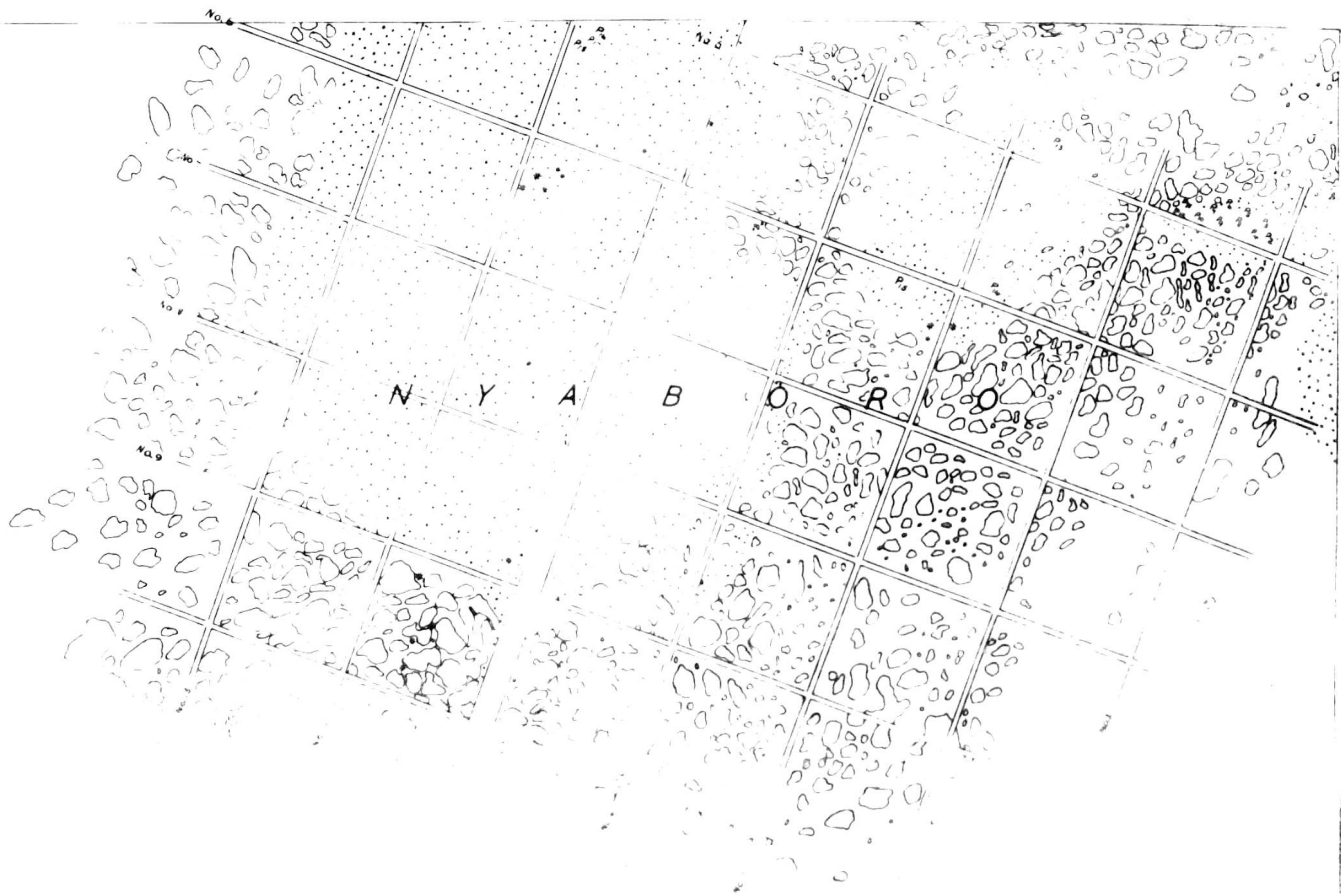
This is certainly the case in the Lambwe valley. The dense bush in river valleys provides a permanent home for G. pallidipes. The species is to be found throughout the year in the "forest" area of Nyaboro, three or four miles away from the bed of the Lambwe river; it roams extensively through the bush, but seems to be more concentrated in, or near, closed thickets; in patches of open thickets near densely bushed areas and in clumps of tall, intertwining shrubs. Table XVII gives an idea of the distribution and preferences of the fly in the different types of vegetation in Nyaboro block. Sector No. 1 passes through open thickets between the upper reaches of the Lambwe and a very dense patch of bush inside Nyaboro block; No. 2 approaches the border of this densely wooded area. No. 9 is on the west of this area; and No. 10 approaches the barrier clearing near Sanjuero camp. There appears to be no doubt that G. pallidipes finds most favourable conditions in heavily shaded bush adjoining fairly open thickets. In Nyaboro, the evergreen small trees and shrubs, Rhus glaucescens, Euclea divinorum, Cissus rotundifolia and the semi-deciduous Capparis tomentosa form a loose tangle of undergrowth under the canopy of Euphorbia ingens, thus providing an ideal habitat for G. pallidipes. Deciduous shrubs also found in the mass of undergrowth, include Harrisonia abyssinica, Grewia spp. and Cadaba adenstricha. Cordia ovalis and Jasminum mairitianum contribute to the bulk of undergrowth. These deciduous trees, however, assist in "opening-up" the dense bush at periods, and, but for the evergreen plants might serve to make those habitats untenable to the fly.

If one could venture to suggest a combination of trees and undergrowing shrubs suitable to pallidipes, it would be that of Rhus spp., Euclea divinorum, Capparis tomentosa under the shade of a tree - such as Euphorbia - with a spreading canopy.






Nyaboro bush is somewhat similar to Ruma bush; but in the latter, the vegetation is more dense throughout and the ground is usually swampy. In parts of Ruma, however, there are areas, raised above the swamp, that are eminently favourable to the tsetse. On the whole, flies

# NYABORO BUSH

## Corridors and pupae sites



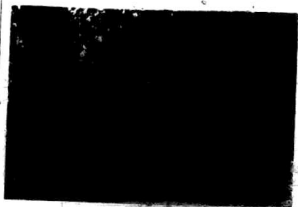
### SYMBOLS

-  indicates dense bush
-  indicates Acacia trees
-  indicates edges of thicket
-  denotes breeding site No. 1 (other breeding places are numbered consecutively).
-  shows the position of walkways habitually used by game.

in Ruma are most numerous on the periphery of the bush. It has already been remarked that the fly fluctuations are similar in both these areas. Riamakanga and Roo are also similar; both are narrow belts of bush along river-banks; both contain water-holes in the dry seasons and both receive water from flowing rivers in the rainy months. Roo, however, is definitely more sheltered from the winds; and it is not unexpected, therefore, that the fly-density is less subject to adverse conditions which might affect Riamakanga. Outside the heavily wooded belts, conditions change more rapidly and are therefore less favourable to the fly. It has been pointed out that there are strips of bush, or patches of bush that may easily be crossed by ranging flies. It is hoped that facilities will be provided in the near future to render these strips and patches unattractive to the fly and thus restricting its dispersal. In the "parkland" forest below Byadenda, in the gall-*Acacia* "forest" above Ruma and in those areas where *Boscia caloneura*, *Balanites aegyptiaca* grow best, little more needs to be done than to extend the limits of the open-country or to create a barrier between the fly-infested belt and those areas that become lightly infested at certain seasons only.

#### Breeding-places:

It naturally follows that the breeding-places of *G. pallidipes* in the Lambwe should be concentrated in the densely-bushed areas. They are mostly found along the well-drained, and sheltered banks of the river. Figure 8 shows the concentration and distribution of breeding-places along a transect from the Lambwe river in South Otouk to the Gwassi foot-hills. The numbers of pupae include empty shells as well as live pupae. The density, or absence of bush is indicated; and it shows that, although the breeding-places are more concentrated and the "pupae" most numerous near the river, there are "pockets" as far as 2,250 yards away from the Lambwe. In this case, the fly has chosen a clump of thickets somewhat isolated from the riverine bush, but it will be noticed that there is a series of "stepping stones" along the line of the transect. In the diagram illustrating the corridors and bush-density in Nyaboro, it is shown that *G. pallidipes* will breed considerable distances away from a river and where no water exists,



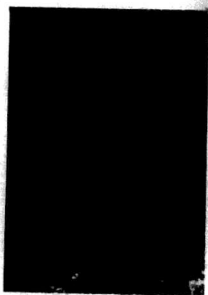
A typical breeding-place of G. pallidipes near the Lambwe river. Note the carpet of alocs beneath the Euphorbia tree.



Searching for pupae in dense thickets on the banks of the river in Otouk.



A breeding-place near the bush Meteorological station on the Lambwe river.



Many pupae were collected in this thicket in Nyaboro bush.



The Lambwe river in flood



The bush meteorological station; 5 yards from the river.



The thick live-fence of Euphorbia in its early stages.

The concentration and the distribution of breeding-places of *G. pallidipes*  
— in a transect from the Lambwe river(Block C.) to the foot  
of the western hills.

REFERENCE.



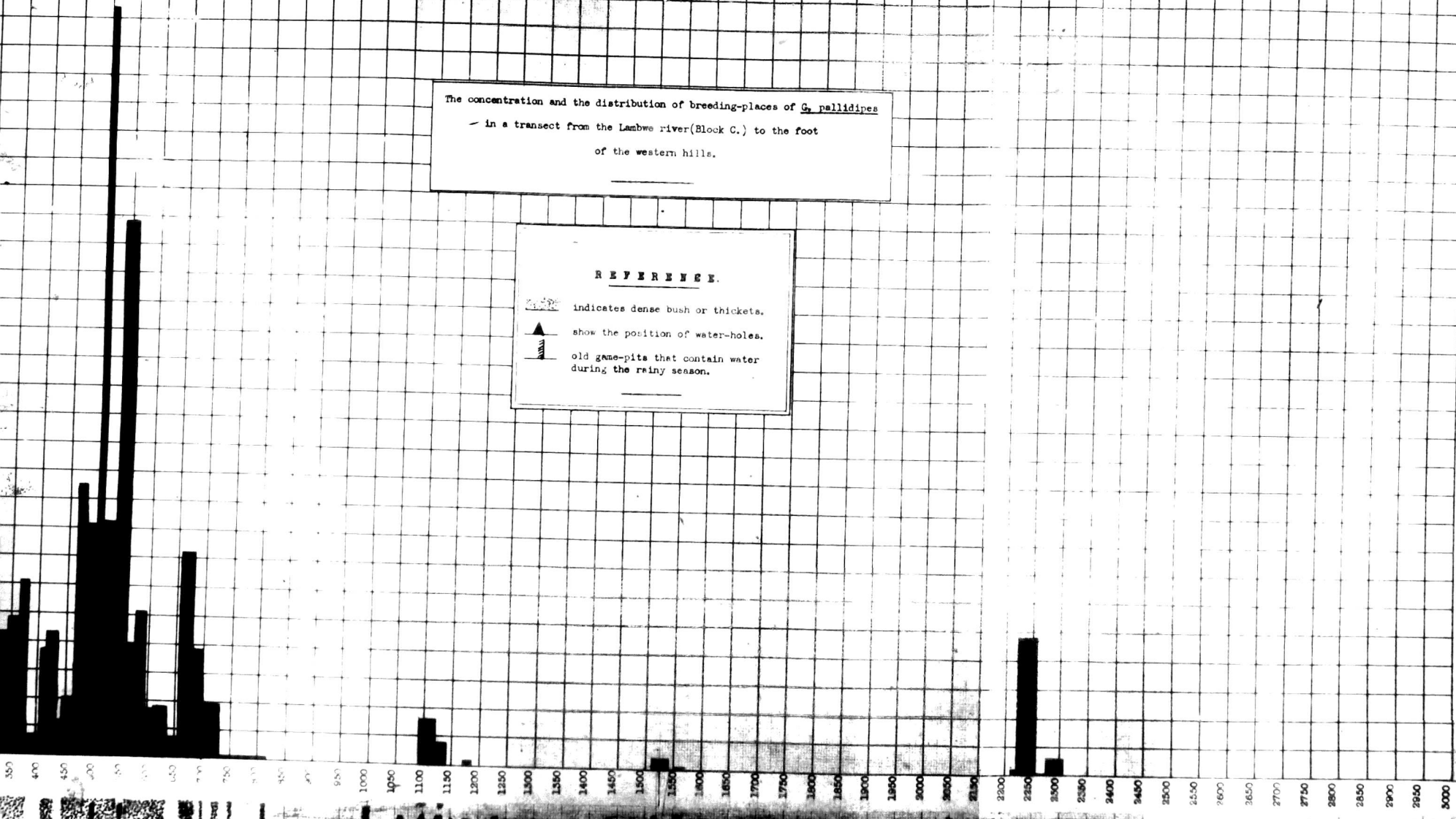
indicates dense bush or thickets.



show the position of water-holes.



old game-pits that contain water  
during the rainy season.



Pupae have been found in numerous places about four miles from the Lambwe, riverine bush. The bush in these places, however, has a thick ground layer of *Sansevieria* that seems to provide the requirements of the fly. Females may even choose dense bush for larviposition as may be seen in the case of the breeding-places between corridors Nos. 10 and 12, 3 and 4, and 2 and 3 in Nyaboro.

The Overseer, in his report for May, 1936, asks some interesting questions. Why does one find so many pupae and puparia in one isolated spot? Does one female, or a family of females, usually confine itself to the same place for breeding; and do the flies wander about for food but return to the same place to drop their young. Or is that particular spot so outstandingly favourable that many females choose it out of many other, apparently similar and equally suitable places?

It has been observed that breeding-places in Ruma are distributed differently from those in Otouk, Riamakanga, Roo and Nyaboro. They occur in a scattered manner along the Lambwe river which is rather exposed in this stretch. They also occur on "islands" in the swampy ground; they are most numerous in an old clearing and on the fringes of bush where the soil is dry. Investigations on these lines have not proceeded far so that it is not possible, yet, to provide accurate details to our colleagues of Tsetse-fly Research Department in Tanganyika with whom we are in close and regular communication. It would appear that the study of inundation and its effect on the pupae and on the fly-population is not without much practical importance.

Live pupae of *G. pallidipes* have been found under a stone beneath a *Euphorbia* tree above Roo and there is no dearth of evidence that this tsetse will deposit its young in many peculiar places - but not to a large and serious extent.

An examination of many thousands of pupae has revealed no evidence of parasitism by *Syntomosphyrum*. Commander Blunt discovered that some pupae appeared as if they had been "nibbled", and he found, later, two pupae with small coleopterous larvae chewing into the body of the blackened pupae. These larvae had eaten their way into a cavity about half-way through the pupae. Specimens of the larvae were collected and forwarded to Sir Guy Marshall for identification. They were identified



A breeding-place beneath  
a fallen Euphorbia.



A box-screen trap placed  
in checkered shade in an  
attempt to attract more  
females.



A small island of bush  
where numerous pupae of  
G. pallidipes were found.

as larvae of a species of Idgia.

Other specimens of pupae, collected on Waturi peninsula, were used in breeding experiments. Many of these failed to develop and on examination were found to have an ill-defined, dirty white spot on the outside of the shell. Several specimens were collected but there has been no opportunity to make a careful examination of these that appear to be affected by a fungoid growth.

The influence of Game on G. pallidipes;

The game in the Lambwe valley is plentiful; there are many different species of animals that move from place to place. Some have the bush as their habitat; others, the open country, the "parkland" or the Acacia forest. There is no obvious concentration when herds of a species collect for several days or weeks in a locality infested by fly. As already remarked, some groups of animals confine themselves to that area below Ruma bush, extending from below Roo to Ruri, an area that is free from fly.

Commander Blunt and the native observers, began a study of the movements of game in relation to any effect that might show on the fly-community and the spread of the tsetse.

Close attention was given to the herds of elephant. It seemed that they affected the catches by fly-boys on routine patrols. When the elephant were known to be absent from Otouk bush, the catches were normally large, but if these animals were in the vicinity, or had only recently moved away, the number of flies caught were either very small, or none at all appeared to the fly-boys. The catches as shown on the chart were carried out daily and the figures were, at first, rather convincing. Early in 1936, the elephant were driven north and did not return to Otouk for several months. Yet, the catches still fluctuated in the same way as before. Prior to this information, it was believed that the elephant attracted the flies; they served as admirable hosts for flies to feed to repletion and then the tsetses would seek shelter to digest their meal. The females would hide in the bush to deposit their young. The hypothesis is an interesting one, and worthy of further and closer attention.

Buffalo, in the Lambwe valley, frequently followed the elephant,

and it seemed that this species was not unconnected with the changes in the numbers of flies caught by the boys. Small herds often move up the valley and remain in Nyaboro for several days. These animals have been watched closely; and the Overseer (Mr. Langridge) has always proceeded to the vicinity with three fly-boys. In each case, for four months, interesting catches have been made. Fly-boys on regular patrols have also caught more flies in the vicinity of a herd of buffalo in or near a sector where normally no flies have been collected. On every occasion there has been a sudden increase of flies when buffalo are near; and the majority have been half, or fully, engorged males.

As an example, one G. pallidipes was captured in sector No.1 of Round 3 in the Kagana in the last fortnight of July, 1936. There were no buffalo in the neighbourhood. On August 7th, five buffaloes moved from Nyaboro into sector No.1. The boys caught seven males and three females on that day in sector No.1; six males and five females in sector No.2. No flies were taken in the other sectors. In Nyaboro, Round No.4, there was a sudden rise in the number of flies taken in sector No.5 on August 11th. Seventeen males and four females were taken a few hours after three buffalo had left the spot. On August 4th, fourteen engorged males, ten unfed males and one female were collected at the junction of corridors No.2 and No.8 where a small herd of buffalo had remained for several hours on that day.

In the case of buffalo, therefore, it seemed that the effect on the fly was the opposite of that put forward for the elephant.

Without expanding on further suggestive and inconclusive evidence, it is felt that these remarks will indicate a promising line of investigation. The data which has been collected seems to point to the fact that elephant, buffalo - possibly waterbuck and bushbuck - in particular, are more closely associated with G. pallidipes than game species of the savannah or open country. Figures show that the game in the valley does not assist dispersal to the extent shown by the number of flies taken off natives passing through the bush to fly-free areas. On the other hand it appears likely that the frequent rise and fall in the numbers of flies caught by fly-boys may be accounted for by the presence or absence of certain species of game in the fly-rounds.

## SUMMARY.

A description is given of the fly-belt in the Lambwe Valley in the South Kavirondo Native Reserve of Kenya Colony.

The distribution and character of the vegetation are discussed; the climatic conditions are dealt with, and an account is given of the soil and water-sources in the valley. The game in the valley is briefly commented upon.

Glossina pallidipes infests nearly the whole of the valley. The permanent, primary belt is confined to the riverine bush from Morea to North Ruma; to Nyaboro bush immediately north of Morea which marks the southern limit of actual fly-belt; and to the sheltered river valley known as Roo. Between Ruma and the shore of the Kavirondo Gulf, there is a flat area of land with gall-acacia that is fly-free; and it separates the pure pallidipes-belt to the south from the mixed fly-belt along a narrow strip of country on the lake-shore. The country south of Morea hill is largely free from infestation; but some flies have been taken immediately above Morea, in Luatonga. The species of tsetse in this mixed fly-belt are G. palpalis, G. pallidipes and G. brevipalpis.

A brief historical review of the valley, its people and stock show that general infestation is comparatively recent and that the fly has gradually forced the inhabitants up the valley and to the foot-hills, ultimately causing the majority of the people to evacuate. Evidence of a six-time thriving population is given; and statements of Administrative officers show that there has always been a desire to control the fly-infestation and to reclaim a valuable piece of country.

The dire need for information on the habits of G. pallidipes is emphasised; and it is explained that the experiments carried out in the Lambwe valley with the assistance of £2,120 from the Colonial Development Fund, and £1,500 from the Local Native Council, have been in operation for a period of eighteen months. There were some difficulties in regard to labour supply owing to the attraction of better wages in the gold-mines. Later the Overseer (Commander Blunt) was indisposed and invalided home, thus necessitating the appointment of a new Overseer.

The grant from the Colonial Development Fund was expended in an endeavour to control infestation by G. pallidipes without clearing all the

bush and by trapping.

A scheme for isolating the infested zone, and dividing the bush into five "blocks" is outlined; and a detailed account is given of the amount of clearing which has been done. The southern fly-barrier is a little over four miles long and 400 yards wide; its width is considered inefficient as a barrier. The Kagana barrier is nearly a mile long and 1,000 yards wide. The edge of the Kagana bush is being cleared of undergrowth to add to its efficacy against dispersing flies. Corridors have been cut across the valley from Kigoto to Kamaguthi, and from Ugoro to Kisingiri. The latter is being widened with the aid of a further grant from the Local Native Council; and arrangements have been made to extend the width of the Nyaboro barrier with financial assistance from native funds.

Trapping experiments are dealt with in detail. A new box-screen trap has been designed and it has shown considerable improvement on other traps in catching G. pallidipes in a heavily infested area. Comparative tests with many kinds of traps have been carried out in different types of fly-belts, the box-screen being more effective in every instance. The value of mechanical trapping in natural sites and prepared corridors is discussed; and trials have shown that the numerous, narrow corridors intersecting Nyaboro bush improve the results of traps. These trials indicate the need for corridors wider than six feet, and the need for further investigations into the use of attractants. Traps left in one position for a prolonged period lose their attraction to fly; and extended trials show that trapping may with advantage be restricted to a period when the fly-density is high. At other times, hand catching and pupae collecting may prove better means of attack.

Special attention is drawn to the number of flies taken at the Sanjuero de-flying station, particularly in view of endeavours to provide water for cattle at a dam near Sanjuero hill.

The conclusions, however, are tentative, as it is felt that the experiments have been in operation for too short a period to warrant definite and final statements on the value of traps.

While carrying out measures calculated to control G. pallidipes, it

became increasingly difficult to obtain a clear idea of the reaction of the fly-community. Statistical data from a system of routine patrols or fly-rounds provided means to gauge the activity and fluctuation of the fly-community; they provided figures to show periodic increases and decreases in the apparent population; and indicated the seasons when there was a tendency to dispersal from the permanent fly-belt. Experimental work not of immediate or direct practical value was handicapped by the lack of funds for this purpose.

An attempt has been made to give some idea of the influence of climate and season, vegetation and game, on the density of, and changes in, the fly-community in the Lambwe. It seems that G. pallidipes requires a fairly warm, humid atmosphere not exposed to sustained, bright sunlight as a permanent home; it shuns "parkland" or open forest of deciduous trees, especially if these vegetation types exist between the permanent belt and high hills that restrict the flies' vision. The period of greatest density is soon after the beginning of the rains to a varying period after the rains (March-June). There is a decided decrease in the numbers usually about January-February and September-October.

Dispersal to the eastern and western hills, as well as up and down the valley, tends to be greatest from about March to June.

G. pallidipes is abundant most frequently in the vicinity of dense bush, but large numbers may be obtained in semi-open bush providing shelter in the form of clumps of thickets.

Breeding-places are concentrated in, but not confined to, well-drained banks of river courses. They may occur in small "pockets" or more extensive areas up to four miles from the main river and where no surface water exists. These non-riverine breeding-places (and even those near the river), are almost invariably covered with a thick layer of dwarfed *Sansevieria* plants thriving in the shade of a network of scandent shrubs.

The species of wild game do not concentrate in any fly area. There is some evidence, however, that elephant and buffalo are responsible for the sudden appearance and disappearance of G. pallidipes. Instances are given of the influence of buffalo.

It has repeatedly been suggested in the text of the report that there is a keen and general desire to continue with the scheme of experimental control of *G. pallidipes* in the Lambwe valley. It has also been indicated that there is a need for experiments designed to give a better understanding of this species of tsetse. Without provision for the latter, the former can be useful only in so far as the Lambwe is concerned, whereas it is necessary to be able to apply the knowledge gained from these experiments to similar problems in other fly-infested areas of Kenya Colony and other territories.

#### ACKNOWLEDGEMENT.

In addition to the acknowledgements already made in the report, the writer wishes to record his indebtedness to Mr. R. Daubney (Chief Veterinary Research Officer) for his continual interest, guidance and encouragement throughout the whole period of this investigation; to the many officers of the Administration Department who have given valuable assistance and who have been instrumental in obtaining further financial support for the experimental project; and to the Overseers (Commander D.E. Blunt and Mr. Lengridge), for the enthusiasm which they have shown in the work.

The writer is grateful also to the British East African Meteorological Service for printing all the forms used in recording the data collected in the field, for assistance in the taking of most of the photographs, and for duplicating this report.



Block, B: Rameswanga

Round - No. 7

Name, Rameswanga Centre.

Table VIII

Sector	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7		No. 8		No. 9		No. 10		No. 11		No. 12		No. 13		No. 14		Total	No. of sectors
	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng	Ad's	Y'ng		
Thorn country at the foot of the Gowal hills. - <u>L. seyal.</u>																														
Dense scrub and patches of thick bush.																														
Border of cultivated land with open thickets; also native path.																														
Open bush with thickets on the south; approaching riverine thicket.																														
Dense riverine bush with intersecting game paths; Lambwe river - west.																														
Short or dwarfed shrubs forming closed thicket; Lambwe river - East.																														
Open glades or "mbuga".																														
Open bush interspersed with low scrub on slope of scarp - Gandu.																														
Along native path to very open bush.																														
Re-entering open bush and low scrub from Gandu - game paths.																														
Open mbuga with scattered thorn across Lambwe river.																														
Close thickets with elephant tracks.																														
Low scrub on side of native path.																														
Scattered patches of scrub on old, cultivated land.																														

Block. B. P. M. M. M. M. M.

Round - No. 10.

River - Lambwe River

Table XIX

Sector:	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7		No. 8		No. 9		Total	No. of records
	Ad's	T'ng	Ad's	T'ng	Ad's	T'ng	Ad's	T'ng	Ad's	T'ng	Ad's	T'ng	Ad's	T'ng	Ad's	T'ng	Ad's	T'ng		
2005 March	2	-	8	-	4	-	19	-	-	-	-	-	-	-	-	-	-	-	35	4
April	28	2	10	-	12	2	19	5	16	4	5	5	4	4	1	4	1	5	191	11
May	29	4	40	-	51	7	21	6	29	3	32	-	-	1	4	1	2	-	191	22
June	35	2	30	2	16	-	19	6	40	4	21	-	29	-	15	1	16	-	210	15
July	47	5	50	-	18	-	31	6	20	-	22	-	21	2	46	4	15	2	290	19
August	35	6	8	2	-	-	12	-	63	12	22	-	20	1	50	4	1	-	199	12
Sept.	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	199	12
Oct.	4	-	1	-	5	-	4	-	5	-	11	-	11	2	15	6	4	2	54	4
Nov.	4	1	10	4	4	-	4	-	8	-	11	-	11	4	5	7	2	-	69	5
Dec.	12	2	4	4	20	-	19	-	24	16	-	-	11	4	5	7	2	-	97	8
2006 Jan.	1	1	12	2	2	-	-	-	4	-	-	-	5	1	1	1	1	-	59	4
Feb.	2	-	-	-	10	-	16	-	8	-	11	-	20	1	1	1	1	-	59	10
March	7	2	22	6	10	-	16	-	8	-	11	-	20	1	1	1	1	-	75	7
April	16	2	22	3	28	7	33	2	45	21	64	2	22	4	14	15	3	6	302	27
May	1	1	19	4	24	6	25	-	26	8	14	5	29	15	14	15	3	6	246	22
June	1	1	1	1	2	2	-	-	-	-	5	-	4	2	28	6	10	2	225	14
Total: -	822	36	197	21	422	26	225	29	324	79	429	18	127	36	339	49	93	27	2211	154
Forest in year.	855	304	304	422	325	225	225	199	1023	646	623									
Type of vegetation through which the counters passed:-	Mainly close thickets with overhead shade. - small glade and parts of river bed open.																			
	Along elephant path through very close thickets with good amount of canopy shade.																			
	Open bush and scrub on the right; open thickets on the left with <i>Acacia</i> and <i>Balanites</i> .																			
	Thick, tall coppice much broken by elephant tracks.																			
	Tall, thin coppice with fair amount of overhead shade. Dense bush bordering small glades.																			
	Thick coppice forming tunnel over Lambwe river. Tangle of bush fairly open.																			
	Open country with small patches of thicket along river-bed.																			
	Broken coppice on river-bed with large clumps of thicket bordering glades.																			
	Riverine thicket on the right, water holes in river-bed and fairly open country on the left.																			



Block C, October -

Sketch - No. 13

Name: Zambouli

Table IX:

Sector:- MONTH	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7		No. 8		No. 9		No. 10		No. 11		No. 12		No. 13		No. 14		Total Totals	No. of acres
	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns	Ad's Y'ns	T'ns		
1935 March	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	4
April	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	4	
May	-	-	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	3	
June	-	-	2	-	15	-	3	-	-	-	-	-	-	-	-	-	-	-	-	16	-	6	-	-	-	-	-	40	3	
July	-	-	5	-	14	-	2	-	-	-	-	-	-	-	-	-	-	-	-	7	55	1	2	-	-	-	-	120	14	
August	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	3	2	-	-	-	-	12	1	
Sept.	-	-	-	-	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	3	5	-	-	-	-	-	10	3	
Oct.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nov.	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	5	-	
Dec.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	
Jan.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Feb.	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-	-	-	-	-	-	9	-	
March	-	-	2	-	10	-	1	-	-	-	-	-	-	-	-	-	-	-	-	13	1	1	2	-	-	-	-	28	4	
April	2	-	3	1	10	-	1	1	-	-	-	-	-	-	-	-	-	-	-	9	1	3	-	-	-	-	-	35	3	
May	1	-	1	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	6	1	3	-	-	-	-	-	15	1	
June	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	1	
Total:- in yrs.	1166	-	20	-	1007	-	3	-	5	67	-	5	11	-	3	2	-	-	1	1	1	1	1	1	1	1	1	324	36	64
Type of vegetation through which the sectors pass:-	Acacia "forest" <u>A. drepanolobium</u> .		Clumps of thicket alternating with open glades.		Riverine bush on the Lambwe.		<u>A. drepanolobium</u> belt adjoining riverine bush.		Open country on slope of scarp.		Gall- Acacia on sides of gorge leading from escarpment.		<u>A. seyal</u> open bushes of <u>Rhus</u> and gall-Acacia.		Clumps of <u>Rhus</u> and <u>Buchia divinorum</u> in flat, open patches.		Low scrub in old clearings. No canopy - few <u>Euphorbia</u> & <u>Balanites</u> .		Very dense bush and open game paths along Lambwe River.		Dense bush, broken up by elephant paths.		Open country with widely scattered bush.		Extensive glades leading to open country.		Very open country to western foothills.			





















