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Introduction

This document is a brief guide to an unpublished compendium of coordinated experiments on the performance of various traps for tsetse and biting flies conducted by the author and numerous colleagues during the 1990's, mostly in association with the ICIPE tsetse research programme in Nairobi, Kenya (Acknowledgements in the Appendices). Experimental trapping results have all been summarized relative to a consistent standard - a phthalogen blue cotton Nzi trap with white polyester netting (**STD** or code **NZI-COT** in the database). Initial experiments with this trap were documented in Mihok (2002); relevant experiments are also included here.

Altogether, the database represents results from 17 published and 26 unpublished experiments in 14 countries. Entries are provided for multiple taxonomic levels to suit any analysis objectives. Typically, entries are available by species and sex for tsetse, and by family/subfamily, genus and/or species for biting flies, with some information also available by sex for Stomoxyinae. The level of detail depends on the level of reporting as all possible analyses have been performed.

A few experiments may still be added to this data set if original records can be retrieved from authors. For all but one experiment, data have been re-analyzed in a consistent fashion and results have been checked against original electronic / paper records in the author's possession.

This database arose out of collaborative experiments designed to test the performance of matching polyester (Vestergaard Frandsen, Denmark, pure blue "pongee 2") and cotton (Awassa Textiles, Ethiopia, phthalogen blue) Nzi traps relative to conventional "local" traps preferred by various researchers for different species. These fabrics were chosen for large-scale trials based on good performance for diverse tsetse and biting flies at Nguruman, Kenya in Experiment 23 of Mihok (2002). The project expanded from these original objectives over the past ten years, but the main theme of testing diverse traps against a standard Nzi trap was maintained.

These data are a "work in progress" and are being prepared for publication in a "meta-analysis" with numerous co-authors. It is anticipated that a manuscript will be finalized and submitted to a journal in mid-2007. In the interim, the underlying data are being made available for the benefit of researchers interested in the utility of various traps and fabrics for both tsetse and biting flies. The database is expected to be error-free but should be considered as "draft" until it comes under more intense scrutiny as the meta-analysis is performed.

The complete database is in the EXCEL file **NZITRIALS RESPONSE RATIOS.XLS**.

The file contains the results of ANOVAs performed on log-transformed catches [Y=log(X+1)] with each row representing an *a prior*i paired comparison of an "experimental" trap to a STD phthalogen blue cotton Nzi trap. Hence, there are multiple entries for each experiment by trap type and by taxonomic group. Nearly all experiments represent daily catches; most experiments were replicated Latin square designs.

Numerous summary statistics are provided for interpretation, with the key statistic of interest being the RESPONSE RATIO [R] and its 95% confidence intervals. This statistic is one of the many options for summarizing relative results from an ANOVA; it has a rigorous statistical basis

in the literature on meta-analysis. In the most basic of terms, it represents the ratio of the catch in an experimental trap relative to the STD trap.

The reference information required to use these data is provided in a several Appendices.

The rest of this document is a straightforward overview of the information available using examples of the performance of Vestergaard Frandsen polyester versus STD cotton Nzi traps, and the performance of other conventional tsetse or biting fly traps relative to STD cotton Nzi traps. Only a minimum of interpretation has been provided.

The database currently contains 1,791 records representing 112 taxonomic entries for 50 trap types. All data have been entered, and hence caution must be used in selecting only useful information. One objective of the meta-analysis will be to explore how these data can best be used to obtain repeatable estimates of relative trap performance.

Given the diverse information available by trap, species and locality, the best way to explore the database is to simply cross-tabulate and filter the EXCEL file for any data of interest. Subsets of data can then be sorted and graphed using the templates provided in the EXCEL file to interpret specific trends.

Performance of VF Polyester Nzi Traps

As part of a coordinated effort to test standardized Nzi traps, most experiments included a Nzi trap made from Vestergaard Frandsen's original "pongee 2" pure blue 100% polyester from the mid-1990s (coded as **NZI-POL**). This is Fabric #24 in Appendix 1 of Mihok (2002). This special fabric was replaced by a similar bright “phthalogen blue” polyester fabric that was introduced by Vestergaard Frandsen at ISCTRC in 2003.

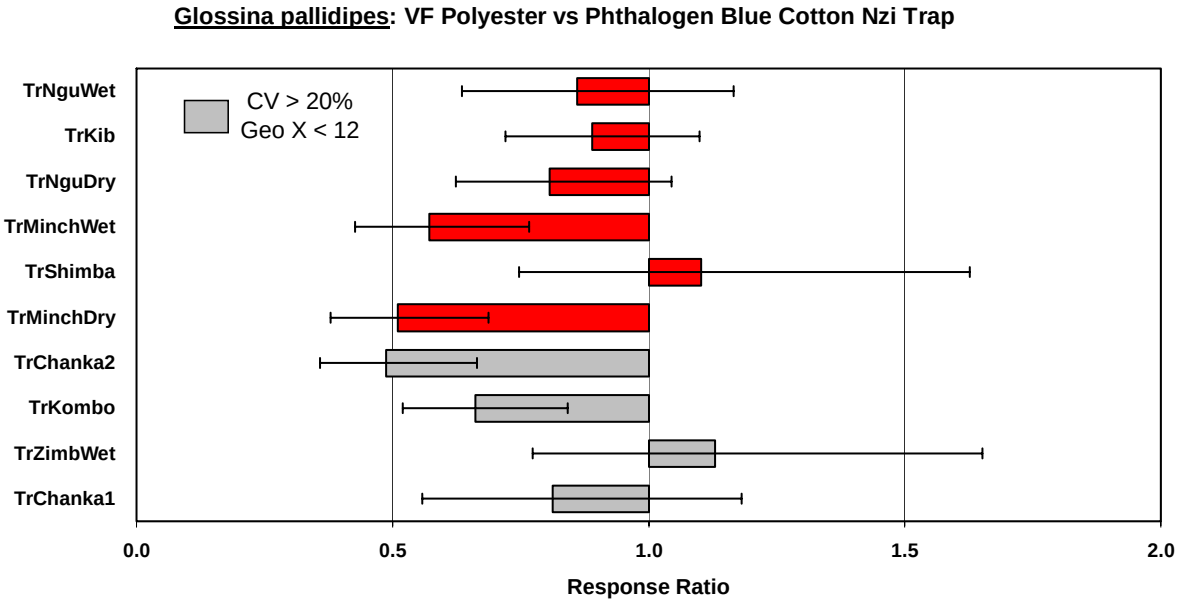
Glossina

Savannah Tsetse (morsitans group)

Fabric comparisons were performed for *Glossina pallidipes* in Kenya, Ethiopia and Zimbabwe with several robust experiments at high density, with replicates in wet and dry seasons, and with replicates in contrasting habitats (savannah, woodland, forest).

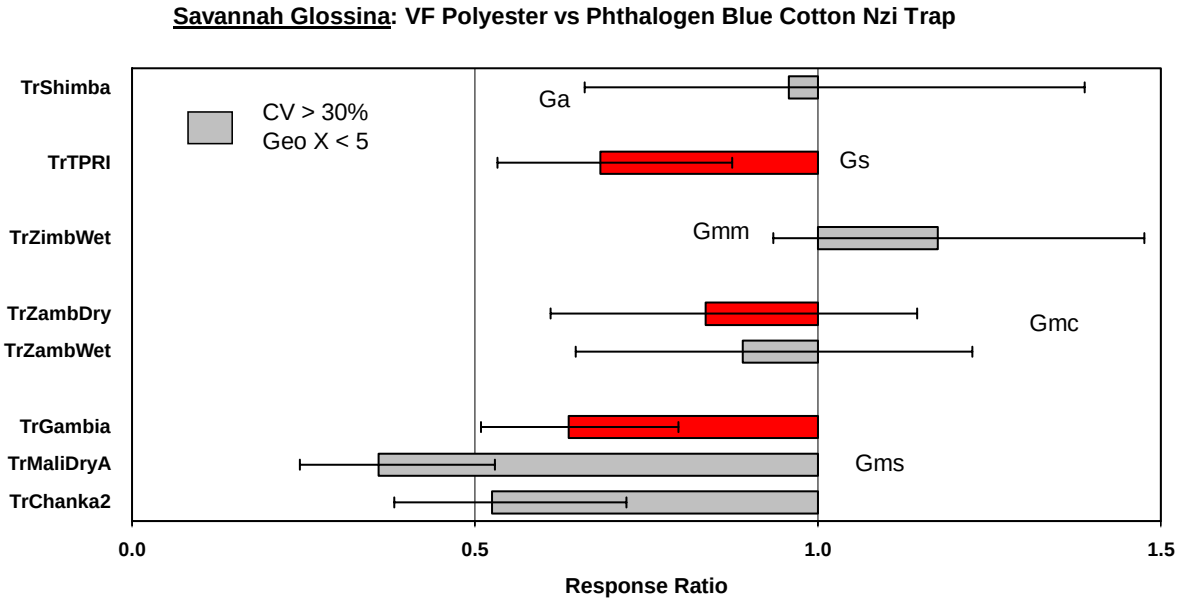
Catches were nearly always lower with VF polyester, with large and significant reductions in catch in several experiments conducted at different locations in Ethiopia (e.g. about ½ the catch of phthalogen blue cotton).

Here and in other graphs, some experimental bars are coded in grey to draw attention to “low” catches in the STD trap; low catches also typically correspond to high coefficients of variation (CV), reducing statistical power. In the graph below, experiments are sorted from top to bottom by the geometric mean catch (Geo X) in the STD trap (383 at the top in TrNguWet *versus* 3.5 in TrChanka1). The importance of data transformation, ANOVA design, sample sizes and statistical power in cross-comparisons among experiments will be examined as part of the meta-analysis. At present, there are no simple guidelines for interpreting the combined results of experiments.



Fabric comparisons were performed for other savannah tsetse *(G. austeni, G. swynnertoni, G. morsitans morsitans, G. morsitans centralis,G. morsitans submorsitans)* in Kenya, Ethiopia, Tanzania, Zambia, Zimbabwe, Mali and The Gambia, mostly in woodland or savannah habitats. Only a few of these experiments were done at high densities with good statistical power.

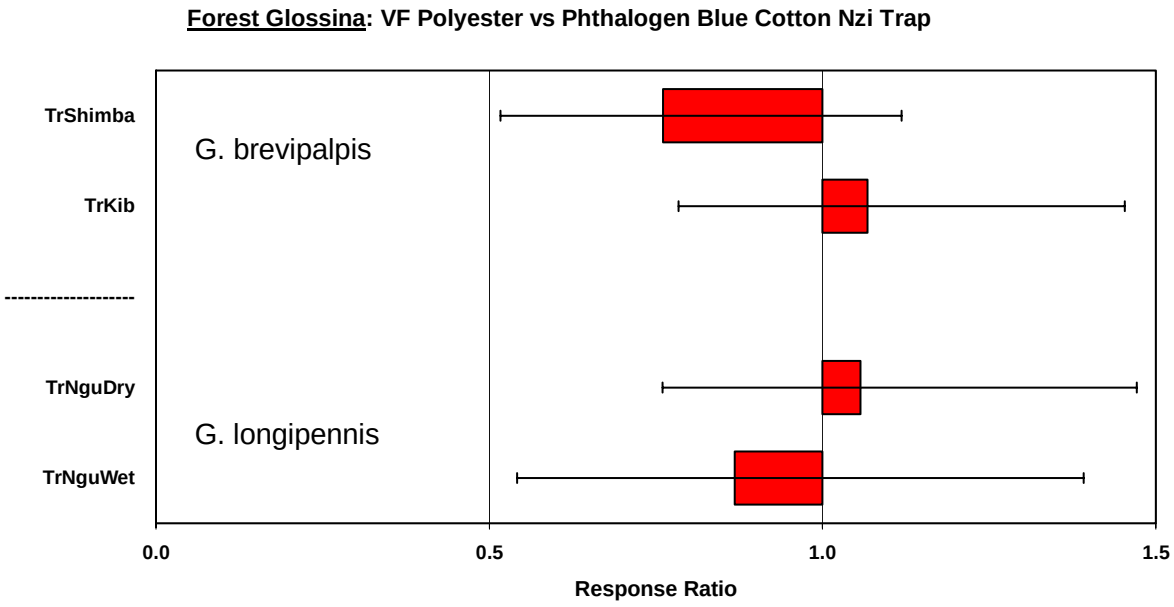
As with *G. pallidipes*, catches were typically lower with VF polyester, with a significant reduction in catch in several experiments.



Forest Tsetse (fusca group)

Fabric comparisons were performed for two forest tsetse species *(G. brevipalpis, G. longipennis)* in woodland and forest in Kenya only. These experiments were done at high densities with good statistical power.

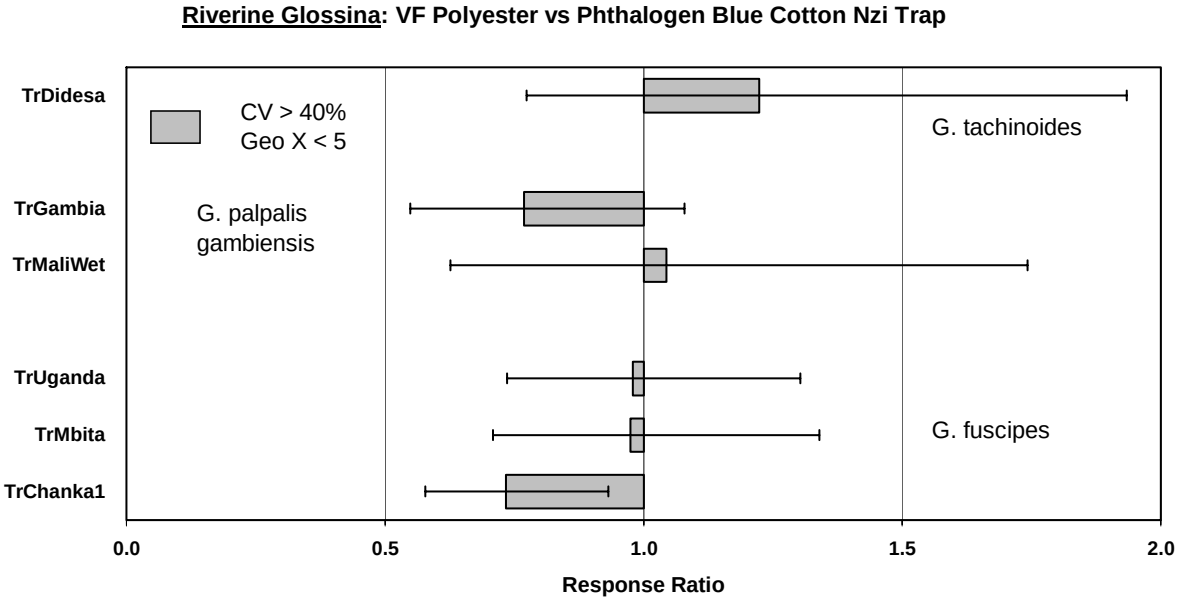
Catches were similar in polyester and cotton Nzi traps.



Riverine Tsetse (palpalis group)

Fabric comparisons were performed for riverine tsetse *(G. tachinoides, G. palpalis gambiensis, G. fuscipes)* in Kenya, Ethiopia, Mali, The Gambia, and Uganda, near rivers or lakes in both natural and peridomestic habitats. All of these experiments were conducted at low density with high coefficients of variation for catches.

Catches were similar in polyester and cotton Nzi traps.



Stomoxyinae

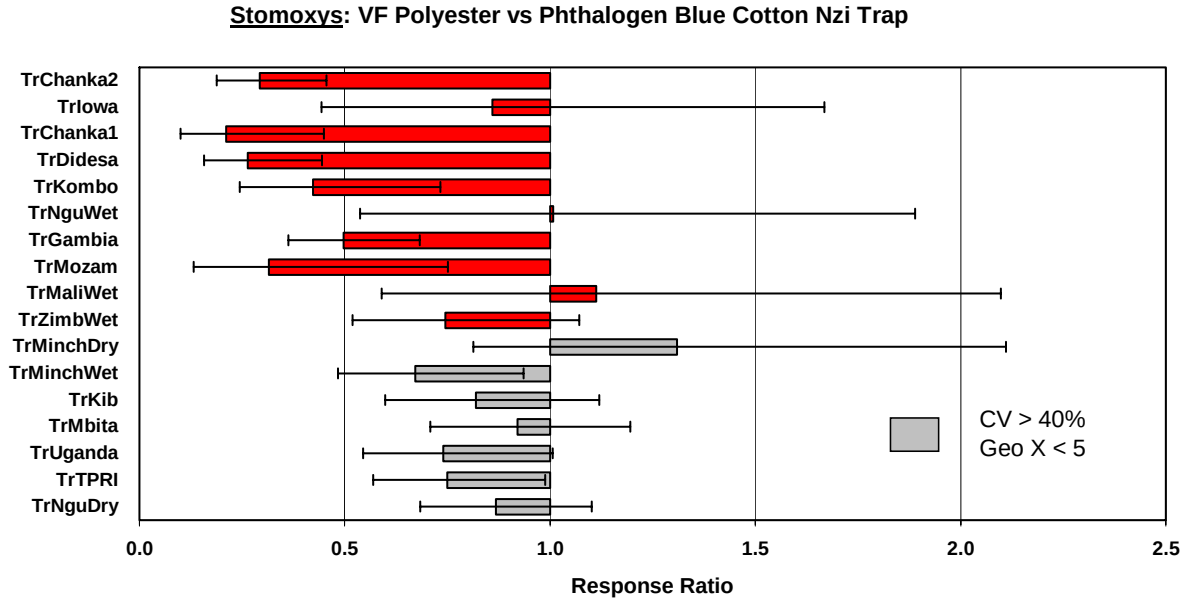
The database contains extensive information on numerous *Stomoxys* spp. with many entries coded by species and by sex. There is particularly good replication for *S. niger* sspp. and *S. calcitrans*. These species often account for the bulk of the catch of stable flies in Africa, even if researchers did not identify specimens to species.

Limited information is also available for *Haematobosca*, typically *H. latifrons*. Very little information was generated for other genera of Stomoxyinae, e.g. *Rhinomusca*, *Prostomoxys*, etc.

Stomoxys

Fabric comparisons were performed for stable flies in nine countries in diverse settings with numerous experiments conducted at high numbers. Catches were nearly always lower with VF polyester, with large reductions in catch some experiments (e.g. ¼ the catch of cotton).

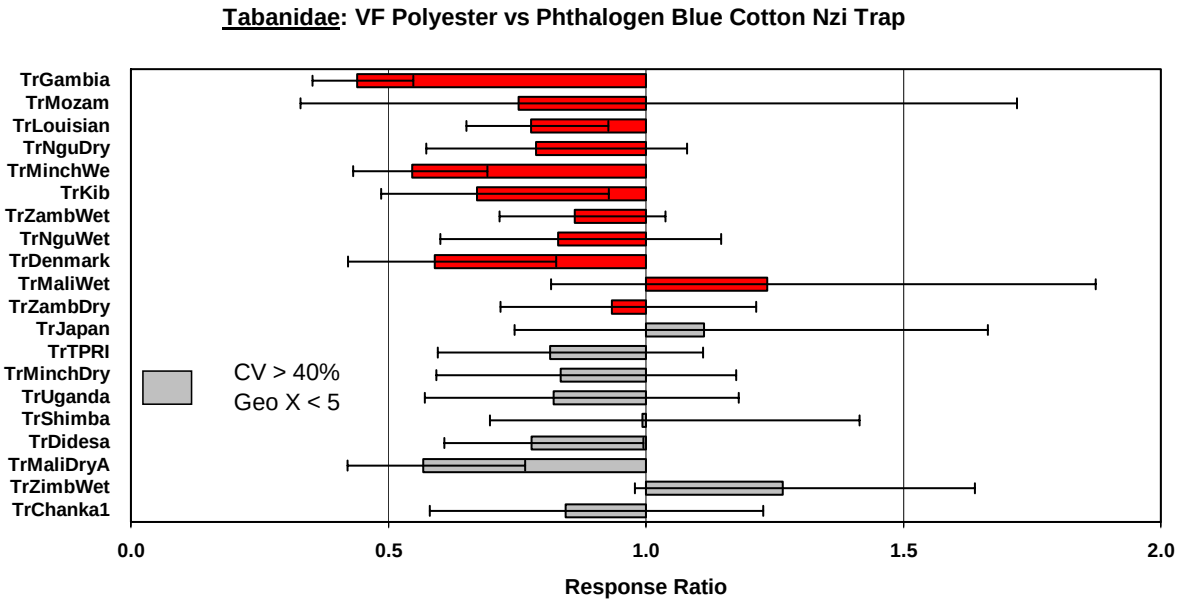
There were a few exceptions to general trends by species or locality, e.g. note the equivalent catches of polyester and cotton in a robust experiment at high density conducted in the USA for *S. calcitrans* (TrIowa), the only experiment conducted at a farm.



Tabanidae

The database contains extensive information on numerous genera and species of tabanids with fabric comparisons conducted in twelve countries. As for stable flies, catches were nearly always lower with polyester (e.g. ½ the catch of cotton), but with a few exceptions by species or locality.

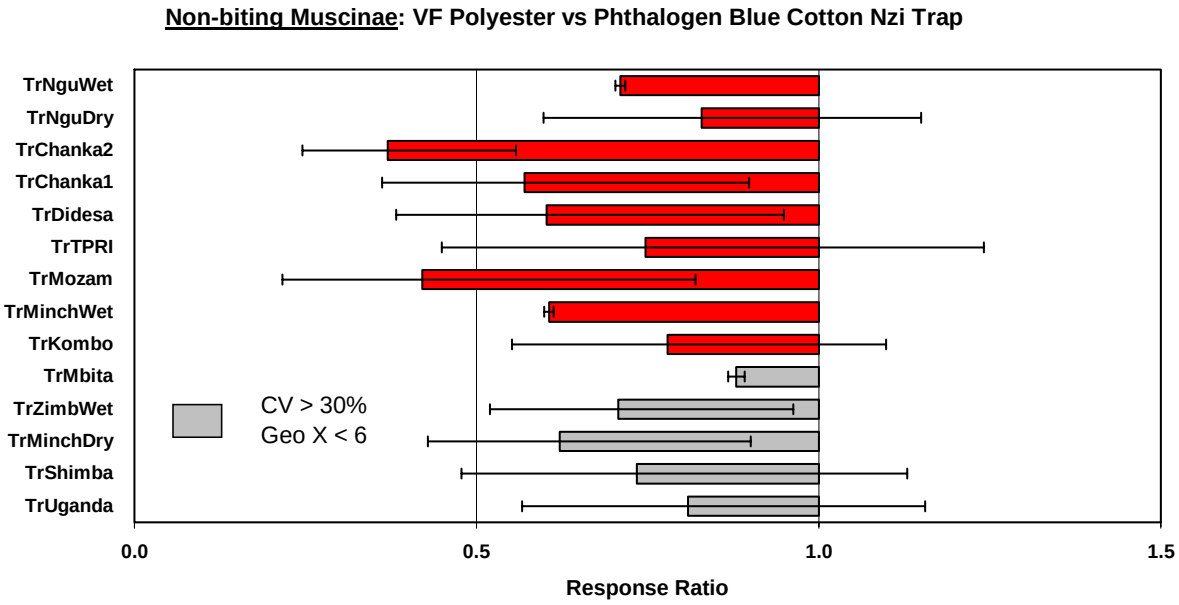
All researchers identified tabanids to genus, and most researchers identified tabanids to species. Hence the database can be filtered and explored for considerable detailed information on the responses of species in different countries, habitats, seasons, etc.



Non-Biting Muscinae

Some researchers recorded catches of non-biting Muscinae, which are typically ignored during counting, along with occasional catches of other non-target insects.

Results of fabric comparisons for non-biting Muscinae were similar to those for Stomoxyinae with uniformly lower catches with polyester versus cotton in all experiments.



Performance of Conventional Traps

Coordinated experiments were designed to test standard cotton and polyester Nzi traps relative to conventional “local” traps made from various fabrics, typically conducted as 3x3 Latin squares in triplicate. Various researchers also conducted experiments comparing only cotton Nzi traps to conventional traps. Altogether, the database contains a diverse collection of trap performance information that can be sorted and filtered to analyze for any specific patterns of interest.

Presently, there are entries for 50 “traps”, 18 of which are straightforward published designs that can be identified by their code names (nearly all cloth traps with just a few sticky traps). The remaining traps are minor variations on Nzi traps, mostly with NZI-*** codes or abbreviations that can be associated with detailed descriptions in publications. For example, the database contains several interesting tests of NZI-BLK / NZI-RED traps. These are “all-black” Nzi traps in terms of insect vision (the blue panels were replaced with either black or red cloth).

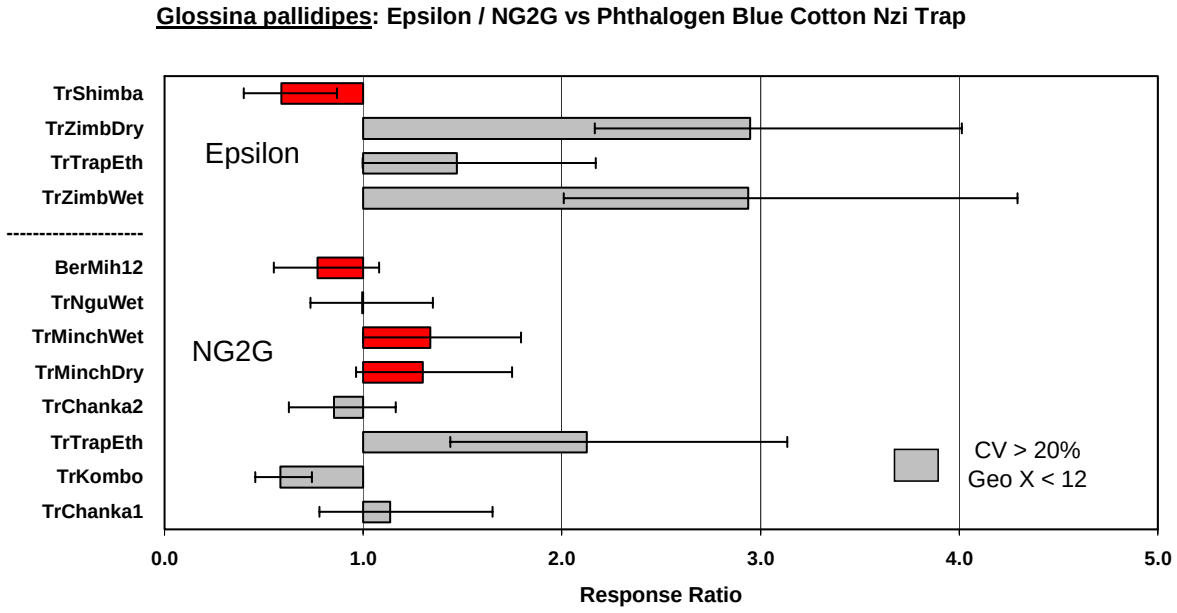
An annotated bibliography of papers that have used the Nzi trap is provided at the end of this document. Several of these publications include further comparisons of traps that have not yet been included in this database.

Glossina

Savannah Tsetse (morsitans group)

Box-style or triangular cloth traps are often used to sample savannah tsetse, e.g. the "NGU" series from Kenya, the Epsilon from Zimbabwe, the F3, M3, S3, etc. Below is an example for *G. pallidipes* of the data available for Epsilon and NG2G traps. This is the largest subset of data for one species of tsetse for similar trap styles. All of the traps were made out of "phthalogen blue" cotton (various suppliers). In other comparisons, interpretation of trap performance is sometimes confounded by traps being made out of different fabrics, or blues other than phthalogen blue.

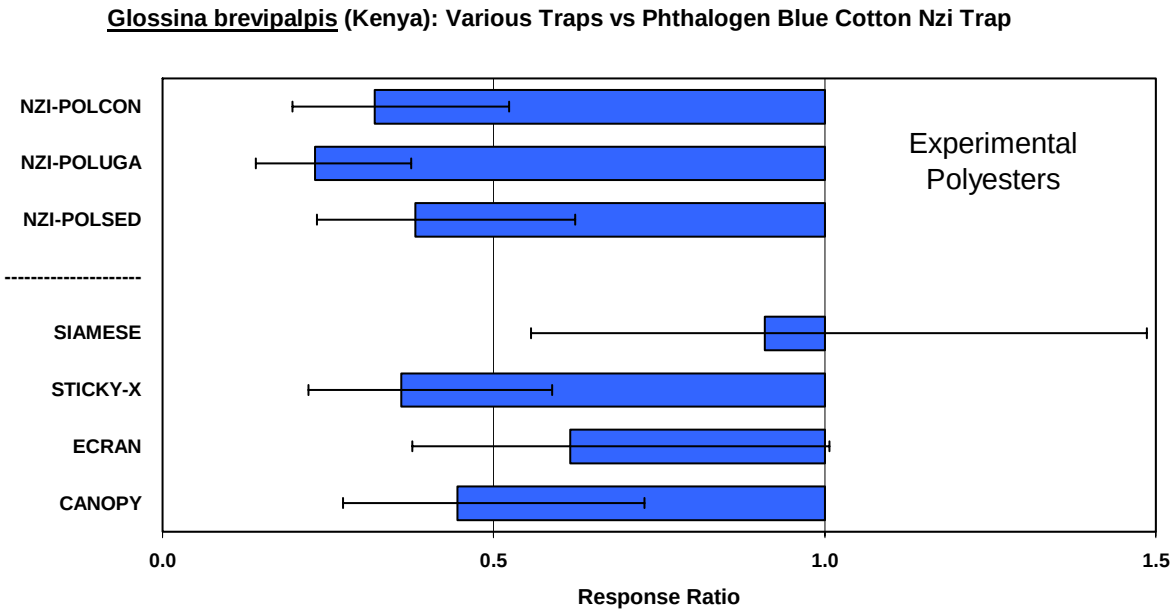
In most experiments, differences in catch relative to a STD Nzi trap are minor and without any consistent pattern in deviations from equal catches. The one notable exception is in the superior performance of the Epsilon trap in two experiments conducted in Zimbabwe. These experiments were the only experiments performed in the late afternoon instead of over a 24-h period. Hence, they may not reflect the integrated relative performance of traps throughout the day (e.g. electric net trap efficiency experiments for the NG2G show some major differences in efficiency during the course of the day).



Forest Tsetse (fusca group)

Relatively few experiments were conducted on fusca tsetse, and hence there is no large series of replicated conventional trap comparisons for this interesting group. An example of one early experiment is shown below for *G. brevipalpis*. This was experiment #20 in Mihok (2002) at the Shimba Hills Reserve in Kenya.

Note the good performance of the Siamese trap, which was designed for coastal tsetse species in this area, relative to other traps. Note also the poor performance of Nzi traps made out of several partially-texturized (somewhat shiny) Vestergaard Frandsen experimental polyesters.

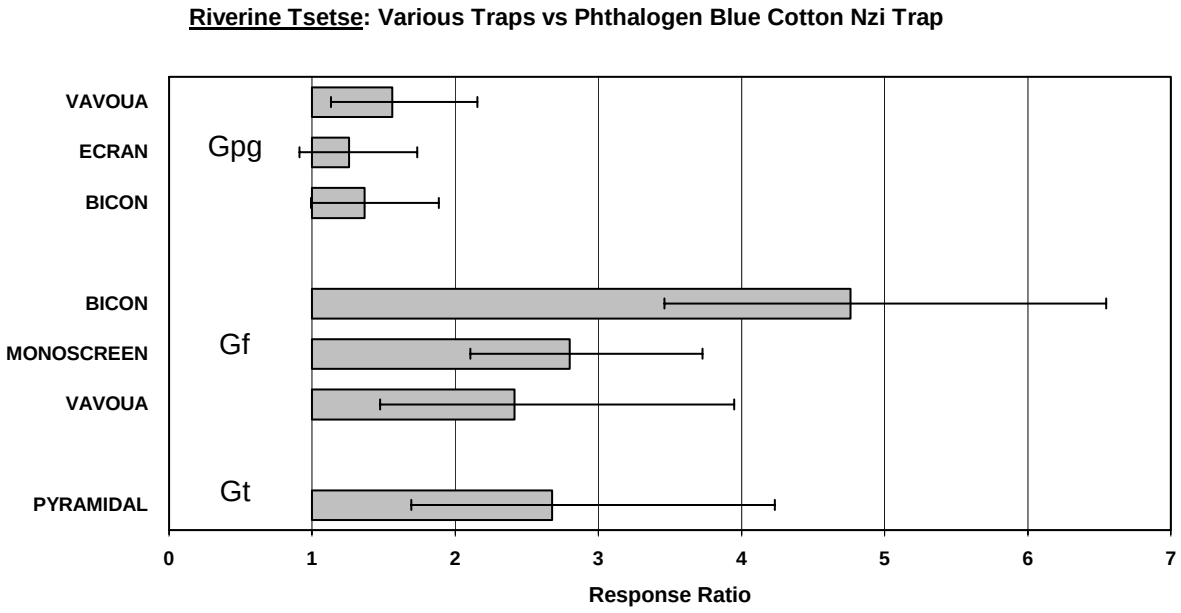


Riverine Tsetse (palpalis group)

The biconical trap, or various open-bottom, canopy-style traps such as the pyramidal, Vavoua, monoscreen, etc. are typically used to sample riverine tsetse. There are many examples in the database and in the published literature comparing the STD Nzi trap to these more open trap styles. A few examples for *G. palpalis gambiensis*, *G. fuscipes* and *G. tachinoides* are shown below from Kenya, Ethiopia, Uganda and Burkina Faso.

Catches in all of these experiments were low and coefficients of variation were high.

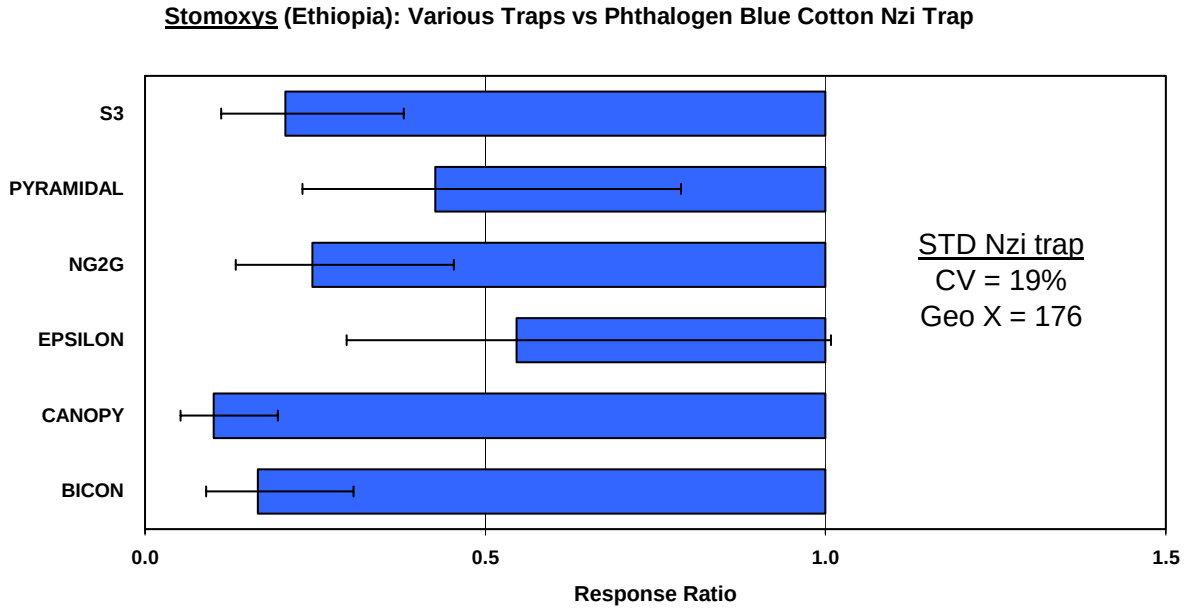
Results agree with the few other published studies on riverine tsetse (e.g. in Mali in IAEA, 2003) which indicate that the Nzi trap is not optimal for riverine tsetse relative to "open-style" traps.



Stomoxys

The database contains a wealth of information on the performance of Nzi traps for diverse Stomoxyinae to supplement the information in Mihok (2002). A well-replicated experiment conducted in Ethiopia (TrTrapEth) at very high densities of many species of *Stomoxys* is shown below. All of the traps were made from the same phthalogen blue cotton fabric to original design specifications.

With some locality and species differences, these results are typical of relative trap performance for key species in Africa such as *S. niger* and *S. calcitrans*. Generally, Nzi traps catch more *Stomoxys* than other basic cloth traps, with some particularly striking differences in catches for certain species.

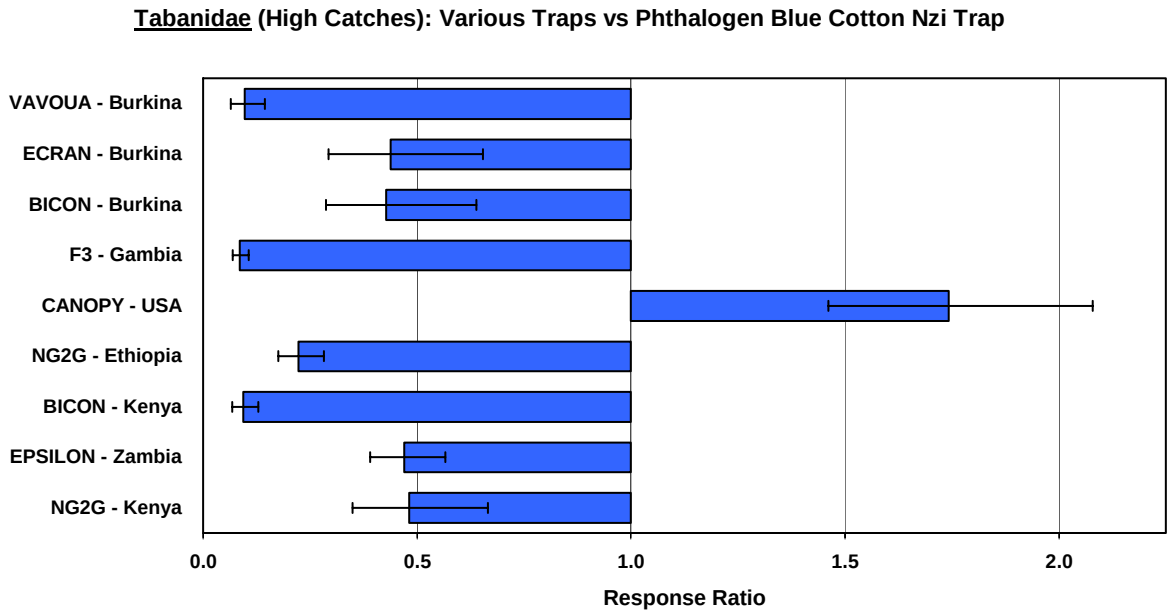


Tabanidae

The database contains a wealth of information on the performance of Nzi traps for many genera and species of tabanids with considerable additional information available in recent publications. The graph below is an example of the data available for experiments conducted at high numbers (Geo X for the STD Nzi trap > 20 and CV < 20%).

As with *Stomoxys*, there are occasional locality and species differences in trap performance relative to the Nzi, e.g. note the excellent performance of a canopy trap (with a beach ball decoy) in the experiment conducted in the USA (mainly *Tabanus fuscicostatus*).

Otherwise, Nzi traps invariably catch larger numbers of tabanids than other conventional cloth traps. Differences by locality or species can occasionally be striking. For example, in a trial conducted at very high tabanid numbers and diversity in The Gambia (TrGambia, Geo X = 131), the STD Nzi trap caught 11.7 times as many tabanids as the F3 trap in terms of the response ratio for log-transformed data, or 8.8 times as many tabanids in terms of the raw catches.



Nzi Trap Bibliography

The publication below is the original reference to the design of the Nzi trap with extensive comparisons against other trap designs.

Mihok, S. (2002) The development of a multipurpose trap (the Nzi) for tsetse and other biting flies. *Bulletin of Entomological Research* **92,** 385-403. **Medline**

Current information is maintained at http://www.nzitrap.com

Next Issue	**Mihok, S., Carlson, D.A., Krafsur, E.S. & Foil, L.D.** (2006) Performance of the Nzi and other traps for biting flies in North America. *Bulletin of Entomological Research*, (in press).
Request Directly from Author	**Desquesnes, M., Dia, M.L., Acapovi, G. & Yoni, W.** (2005) *Les vecteurs mécaniques des trypanosomoses animales; Généralités, morphologie, biologie, impacts et contrôle. Identification des espèces les plus abondantes en Afrique de l'Ouest*, Bobo-Dioulasso, Burkina Faso: Centre International de Recherche-Développement sur l'Elevage en zone Subhumide, 70 pages. Comparisons of Nzi and Tetra traps in Burkina Faso in a major review of the biology of tabanids in West Africa; contains excellent photographs of many species
Journal Table of Contents	**Dia, M.L., Desquesnes, M., Elsen, P., Lancelot, R. & Acapovi, G.** (2004) Evaluation of a new trap for tabanids and stomoxyines. *Bulletin de la Societe Royale Belge d'Entomologie*, **140**, 72-81. Comparisons of Nzi and Tetra traps in Burkina Faso
Medline	**Desquesnes, M. & , Dia, M.L.** (2004) Mechanical transmission of *Trypanosoma vivax* in cattle by the African tabanid *Atylotus fuscipes*. *Veterinary Parasitology* **119**, 9-19. Catching Tabanidae for experiments in Burkina Faso
Word **94 k**	**Koller, W.W., Barros, A.T.M., Madruga, C.R., Ismael, A.P.K., Martins, C.F., Soares, C.O., Araújo, F.R., Gorayeb, I.S., Mihok, S. & Araújo, C.P.** (2003) Tabanids of an area infected by *Trypanosoma vivax* in the Pantanal of Mato Grosso do Sul State, Brazil. pp. 3, CD-ROM 831.pdf *in* ISVEE/FCVPUC. *(Ed) International Symposium for Veterinary Epidemiology and Economics X, Viña del Mar, Chile*. Surveys of Tabanidae in Brazil
Medline	**Desquesnes, M. & Dia, M.L.** (2003) Mechanical transmission of *Trypanosoma congolense* in cattle by the African tabanid *Atylotus agrestis*. *Experimental Parasitology* **105**, 226-231. Catching Tabanidae for experiments in Burkina Faso

PDF **963k**	**IAEA**. (2003) *Improved attractants for enhancing tsetse fly suppression. Final report of the co-ordinated research project 1996-2002. IAEA-TECDOC-1373.* Vienna, Austria International Atomic Energy Agency, 121 pp. Nzi trap included in various trials with tsetse in Africa
Medline	**Desquesnes, M. & Dia, M.L.** (2003) *Trypanosoma vivax* mechanical transmission in cattle by one of the most common African tabanids, *Atylotus agrestis*. *Experimental Parasitology* **103**, 35-43. Catching Tabanidae for experiments in Burkina Faso
Abstract	**Ndegwa, P.N. & Ogodo, J.A.** (2002) Community structure and diel activity patterns of Stomoxyinae from odour-baited Nzi trap collections. *Insect Science and its Application* **22**, 281-287. Survey of Stomoxyinae in peridomestic settings in Kenya
English Abstract	**Doutoum, A.A., Delafosse, A., Elsen, P. & Amsler-Delafosse, S.** (2002) Vecteur potentiels de *Trypanosoma evansi* chez les dromadaires au Tchad oriental. *Revue d'Élevage et de Médecine Vétérinaire des pays tropicaux* **55,** 21-30. Survey of biting flies in Chad
English Abstract	**Acapovi, G.L., Yao, Y., N'goran, E., Dia, M.L. & Desquesnes, M.** (2002) Abondance relative des tabanidés dans la région des savanes de Côte d'Ivoire. *Revue d'Élevage et de Médecine Vétérinaire des pays tropicaux* **54**, 109-114. Survey of biting flies in the Ivory Coast
PDF **242k**	**Abeeluck, D., Ghoorbin, H.B. & Rawanansha, T.** (2001) Potential of olfactory and visual baits for the control of *Stomoxys nigra* Macq. (Diptera Muscidae) in Mauritius. pp. 91-97 *in* FARC. *(Ed) Annual Meeting of Agricultural Scientists, Proceedings.* Réduit, Mauritius, Food and Agricultural Research Council. Nzi trap and attractant tests at deer farms in Mauritius
Medline	**Kappmeier, K. & Nevill, E.M.** (2000) A newly developed odour-baited "H-trap" for the live collection of *Glossina brevipalpis* and *Glossina austeni* (Diptera Glossinidae) in South Africa. *Onderstepoort Journal of Veterinary Research* **67**, 15-16. Trap comparisons for *Glossina brevipalpis* and *Glossina austeni* in South Africa
Abstract PDF **153k**	**Ndegwa, P.N. & Mihok, S.** (1999) Development of odour-baited traps for *Glossina swynnertoni* Austen (Diptera Glossindae). *Bulletin of Entomological Research* **89**, 255-261. Trap comparisons for *Glossina swynnertoni* in Tanzania

Medline	**Sumba, A.L., Mihok, S. & Oyieke, F.A.** (1998) Mechanical transmission of *Trypanosoma evansi* and *T. congolense* by *Stomoxys niger niger* and *S. taeniatus* in a laboratory mouse model. *Medical and Veterinary Entomology* **12**, 417-422. Use of the trap to collect *Stomoxys* spp. for studying the mechanical transmission of trypanosomes
French Abstract	**Seignot, J.** (1997) Enquête séro-épidémiologique à propos des trypanosomoses equines et asines dans la région de Dakar, Sénégal. *These Vétérinaire, Université Claude Bernard de Lyon, France*, 145 pp. Survey of biting flies during an outbreak of trypanosomosis
Swahili Image 74k	**Muzuma, S.T.** (1997) Mtego wa Inzi. *Mfugaji wa Kagera* **3,** 10. Extension article in farmer's magazine describing the use of the Nzi trap on dairy farms in Tanzania

Appendices

Acknowledgements

This work represents the efforts of about 100 scientists, technicians and students
The key researchers involved are listed below, in alphabetical order by institution

Researcher	Affiliation
Marc Desquesnes	Centre de coopération internationale en recherche agronomique pour le développement – Département d'élevage et médecine vétérinaire, France
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Jean-Baptiste Rayaisse	Centre International de Recherche-Développement sur l'Elevage en zone Subhumide, Burkina Faso
Josue Okoth	Community-Based Vector Control Organization, Uganda
John Hargrove	Department of Veterinary Services, Zimbabwe
Sheila Trumper	Farm Africa, Kenya
Nigel Pollard	Grupo Madal, Quelimane, Mozambique
Paul Ndegwa	International Centre of Insect Physiology and Ecology, Kenya
Getachew Tikubet	International Centre of Insect Physiology and Ecology, Kenya
Adedapo Odulaja	International Centre of Insect Physiology and Ecology, Kenya
M. Mohamed-Ahmed	International Centre of Insect Physiology and Ecology, Kenya
Reardon Olubayo	International Centre of Insect Physiology and Ecology, Kenya
Momodou Ceesay	International Trypanotolerance Centre, Gambia
Elliot Krafsur	Iowa State University, USA
Japhet Kiragu	Kenya Trypanosomiasis Research Institute, Kenya
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Lane Foil	Louisiana State University, USA
Miressa Keno	National Tsetse and Trypanosomiasis Info. and Control Centre, Ethiopia
Hitoshi Sasaki	Rakuno Gakuen University, Japan
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Terzu Daya	Southern Region Nations, Nationalities and Peoples Agricultural Bureau, Ethiopia
Christian Sommer	The Royal Veterinary and Agricultural University, Denmark
Peter Kristensen	The Royal Veterinary and Agricultural University, Denmark
Charles Muangirwa	Tropical Pesticides Research Institute, Tanzania
Elisabeth Kimaro	Tropical Pesticides Research Institute, Tanzania
David Carlson	United States Department of Agriculture Research Service, USA
Floyd Dowell	United States Department of Agriculture Research Service, USA
Francis Oloo	Veterinary Department, Kenya
Mwangelwa Mwangelwa	Zambezi Livestock and Lands, Zambia

Database Variables

Error terms were calculated from ANOVAs for transformed data [Y=log(X+1) where X is the original raw catch].

Many entries are still being updated to include Error term degrees of freedom, critical t-values for the LSD test, arithmetic rather than log-transformed average catches for each trap type, etc. so that a complete suite of useful statistics can be calculated for different approaches in meta-analysis.

Species$	Unit of analysis for ANOVA, e.g. family or subfamily, genus, species, sex
Experiment$	Unique Identifier for each experiment
StdTrap$	Code for the Standard trap (here all NZI-COT)
StdOdour$	Abbreviation for baits (U=cow urine, A=acetone, O=Octenol, Sachet = phenols, etc.)
Stdlog	Mean transformed catch in the Standard trap [mean of Y or mean of log (X+1)]
MSQErr	Mean Square Error of the ANOVA (used to calculate the pooled standard error for each trap)
LSD	Least Significant Difference (transformed catch) for an a priori comparison of the trap to the standard
Explog	Mean transformed catch in the experimental trap [mean of Y or mean of log (X+1)]
ExpN	Sample size for the experimental trap
Prob$	SIG if LSD test is P < 0.05, NOT otherwise
	Actual probability can be re-calculated from data provided in other entries
ExpTrap$	Code for the Experimental Trap
RespRatio	Response Ratio as defined in the statistical notes below
LowDelta	Lower 95% Confidence Interval for the Response Ratio
UpDelta	Upper 95% Confidence Interval for the Response Ratio

DF	Denominator or Error Degrees of Freedom in the ANOVA
t	Critical t-value for the LSD test
StdMean	Mean untransformed or raw catch in the Standard trap [mean of X]
ExpMean	Mean untransformed or raw catch in the Experimental trap [mean of X]
ExpMax	Maximum untransformed or raw catch in the Experimental trap

Useful Calculations	
StdGeo	Standard Trap Detransformed Mean Catch [Geometric Mean or mean of log(X+1)]
StdBack	Standard Trap Backtransformed Mean Catch (Detransformed Mean Catch LESS One)
ExpGeo	Experimental Trap Detransformed Mean Catch [Geometric Mean or mean of log(X+1)]
ExpBack	Experimental Trap Backtransformed Mean Catch (Detransformed Mean Catch LESS One)
Index	Index of Increase (Ratio of the Backtransformed Mean Catches, Expt vs Standard)
CatchRatio	Ratio of RAW mean catch in Experimental Trap to Standard
PoolSD	Pooled Standard Deviation for log-transformed catches [SQRT(MSQErr)]
PoolSE	Pooled Standard Error for log-transformed mean catches [PoolSD / SQRT(ExpN)]
StdCV	Standard Trap Coefficient of Variation for log-transformed catches [100 * PoolSD / (10^Stdlog)]

Some Statistical Notes

The **BACKTRANSFORMED Mean** is the antilog of the log-transformed mean LESS ONE.

The **INDEX OF INCREASE** is the ratio of the treatment backtransformed mean to the standard backtransformed mean. This is one of several ways that entomologists often interpret their results; see FAO Training Manual below:

Dransfield, R.D. & Brightwell, R. (1992) Use of attractive devices for tsetse survey and control. pp. 1-196 in Hursey, B.S. & Slingenbergh, J.H.W. (Eds.) Training manual for tsetse control personnel, Volume 4. Rome, Italy, Food and Agriculture Organisation of the United Nations.

The **DETRANSFORMED Mean** is the **GEOMETRIC Mean**, i.e. without subtracting one. This is the basis of the ANOVA used for statistical interpretation of transformed data. Most ecologists do not use the "Index of Increase", they use the **RESPONSE RATIO.** This number and its confidence intervals are explicitly defined through the properties of logarithms and ratios.

The **RESPONSE RATIO** is the ratio of the treatment geometric mean to the standard geometric mean. The statistical properties of response ratios are discussed in the paper below:

Hedges, L.V., Gurevith, J . & P.l.S. Curtis (1999) The meta-analysis of response ratios in experimental ecology, Ecology 80(4) 1150-1156 [the entire issue is devoted to this topic]

A PRIORI or PLANNED COMPARISONS are explained in statistical textbooks, e.g. on Page 243 in Sokal, R.R. & F.J. Rohlf (1981) Biometry, 2nd Edition, W.H. Freeman and Company, San Francisco. Comparisons in the database are based on a two-tailed test at P=0.05.

Conversion of mean log catches to a Response Ratio for geometric means is simply a mathematical manipulation.

log(a) - log(b) = log(a / b), see the statistical paper below:

http://bmj.bmjjournals.com/cgi/content/full/312/7039/1153

Bland, J.M. & Altman, D.G. (1996) Statistics Notes: The use of transformation when comparing two means. *British Medical Journal*, **312**, 1153.

The response ratio is simply a visual representation of the ANOVA & LSD tests. When 95% confidence intervals of response ratios do not overlap, the two traps are significantly different. For most situations with large N, the Index of Increase and the Response Ratio are nearly identical. In contrast, the ratio of untransformed raw catches may not accurately represent the results of a Latin Square experiment. This is explained with a hypothetical example in the FAO Training Manual.

Species Crosstabulation

The database contains entries by family/subfamily, genus, species and sex with ANOVAs repeated at each level of detail. Each entry provides statistics for catches in an experimental trap (both standard biting fly and tsetse traps, and experimental Nzi traps in various fabrics or formats) relative to a standard trap (here always a phthalogen blue cotton or NZI-COT trap).

Care must be taken in filtering and summarizing raw information as ALL DATA have been included in the database regardless of sample sizes or coefficients of variation.

Ancala	8
Ancala africana	3
Ancala necopina	3
Atylotus	48
Atylotus agrestis	39
Atylotus albipalpus	3
Atylotus fuscipes	7
Chrysops	21
Chrysops aberrans	1
Chrysops distinctipennis	9
Chrysops univittatus	1
Glossina austeni	14
Glossina austeni female	14
Glossina austeni male	7
Glossina brevipalpis	16
Glossina brevipalpis female	16
Glossina brevipalpis male	16
Glossina fuscipes	16
Glossina fuscipes female	16
Glossina fuscipes male	16
Glossina longipennis	26
Glossina longipennis female	26
Glossina longipennis male	26
Glossina morsitans centralis	4
Glossina morsitans centralis female	4
Glossina morsitans centralis male	4
Glossina morsitans morsitans	4
Glossina morsitans morsitans female	4
Glossina morsitans morsitans male	4
Glossina morsitans submorsitans	18
Glossina morsitans submorsitans female	18
Glossina morsitans submorsitans male	18
Glossina pallidipes	76
Glossina pallidipes female	71
Glossina pallidipes male	71

Glossina palpalis gambiensis	11
Glossina palpalis gambiensis female	5
Glossina palpalis gambiensis male	5
Glossina swynnertoni	9
Glossina swynnertoni female	7
Glossina swynnertoni male	7
Glossina tachinoides	2
Glossina tachinoides female	2
Glossina tachinoides male	2
Haematobia	2
Haematobia stimulans	2
Haematobosca	42
Haematobosca latifrons	38
Haematobosca latifrons female	12
Haematobosca latifrons male	12
Haematopota	27
Haematopota pluvialis	2
Hybomitra	2
Hybomitra expullicata	2
Leucotabanus	2
Leucotabanus annulatus	2
Mosquitoes	10
Muscinae	98
Philoliche	4
Philoliche makueni	4
Prostomoxys	2
Prostomoxys saegerae	2
Rhinomusca	2
Rhinomusca dutoiti	2
Stomoxyinae	111
Stomoxys	105
Stomoxys boueti	9
Stomoxys boueti female	9
Stomoxys boueti male	9
Stomoxys calcitrans	46
Stomoxys calcitrans female	41
Stomoxys calcitrans male	42
Stomoxys inornatus	6

Stomoxys inornatus female	6
Stomoxys inornatus male	6
Stomoxys niger bilineatus	26
Stomoxys niger bilineatus female	19
Stomoxys niger bilineatus male	19
Stomoxys niger niger	52
Stomoxys niger niger female	44
Stomoxys niger niger male	44
Stomoxys pallidus	4
Stomoxys pallidus female	2
Stomoxys pallidus male	2
Stomoxys taeniatus	30
Stomoxys taeniatus brunnipes	7
Stomoxys taeniatus brunnipes female	7
Stomoxys taeniatus brunnipes male	7
Stomoxys taeniatus female	28
Stomoxys taeniatus male	28
Stomoxys varipes	2
Stomoxys varipes female	2
Stomoxys varipes male	2
Tabanidae	108
Tabanus	73
Tabanus coniformis	4
Tabanus copemani	2
Tabanus fraternus	2
Tabanus fuscicostatus	2
Tabanus gratus	13
Tabanus insignis	2
Tabanus laverani	3
Tabanus leucostomus	2
Tabanus limbatinervis	2
Tabanus lineola	2
Tabanus par	6
Tabanus pullulus	2
Tabanus quinquevittatus	1
Tabanus similis	1
Tabanus sufis	6
Tabanus taeniola	49
Tabanus thoracinus	5

Guide to Raw Data Files

All key trials include a **NZI-COT** standard trap (phthalogen blue cotton, Ethiopian or Kenyan fabric), and most also include a **NZI-POL** standard trap (Vestergaard Frandsen's original "pongee 2" pure blue 100% polyester from the mid-1990's). The original goal of this research was to test Nzi traps made from blue fabrics #105 and #101 in 3-times replicated 3 x 3 Latin squares relative to a "local" standard trap. Fabrics #105 and #101 are simply large lots of the equivalent fabrics #60 and #65 that did well when tested in Expt 23 of Mihok (2002).

Experiments where arithmetic means have not yet been collated
in the **Response Ratio** database are highlighted in BLUE

Fabric codes refer to the original codes in the ACCESS Database FABRICS.MDB
Cross references to the codes in Mihok (2002) are in SPECTRA REFERENCE.XLS

Country	Area	Season	Summary	Data File	Commands	Catches	Fabrics
			WORD	*SYSTAT*	*TEXT*	*EXCEL*	*EXCEL*
3 x 3 Latin Squares - Ethiopian Phthalogen Blue Cotton #105 & Vestergaard Frandsen Polyester #101							
Kenya	**Nguruman**	**Wet**	TrNguWet	NguWet	6k	3,265k	310k
Kenya	**Kibwezi**	**Wet**	TrKib	Kib	5k	2,900k	308k
Kenya	**Mbita Point**	**Wet**	TrMbita	Mbita	3k	2,113k	308k
Ethiopia	**Didesa**	**Wet**	TrDidesa	Didesa	6k	3,626k	308k
Ethiopia	**Arba Minch**	**Wet**	TrMinchWet	MinchWet	6k	3,254k	308k
Tanzania	**Naitolya**	**Dry**	TrTPRI	TPRI	2k	2,151k	240k
Uganda	**Busoga**	**Dry**	TrUganda	Uganda	3k	2,145k	274k
Zambia	**Kafue**	**Wet**	TrZambWet	ZambWet	3k	2,167k	308k
Zambia	**Kafue**	**Dry**	TrZambDry	ZambDry	3k	2,167k	308k
Gambia	**Niamina East**	**Wet**	TrGambia	Gambia	4k	2,476k	340k
Denmark	**Copenhagen**	**Wet**	TrDenmark	Denmark	2k	2,006k	206k
USA*	**Iowa**	**Dry**	TrIowa	Iowa	3k	1,894k	307k
USA*	**Louisiana**	**Dry**	TrLouisiana	Louisiana	2k	2,075k	275k
Japan	**Hokkaido**	**Dry**	TrJapan	Japan	1k	1,811k	173k

*** Brief results published in:** **Mihok, S., Carlson, D.A., Krafsur, E.S. & Foil, L.D.** (2006) Performance of the Nzi and other traps for biting flies in North America. *Bulletin of Entomological Research*, (in press).

Minor Methodological Variations - Cotton and polyester both tested							
Phthalogen Blue Cotton from Mountex, Kenya #184 & Opaque VF Polyester #161							
Ethiopia	**Kombo**	**Wet**	TrKombo	Kombo	5k	2,807k	274k
Mozambique	**Quelimane**	**Dry**	TrMozam	Mozam	2k	2,182k	308k
Phthalogen Blue Cotton from Bonar Industries, Zimbabwe #171 Cotton trap with geometric frame, Standard VF Polyester #101							
Zimbabwe	**Zambezi**	**Wet**	TrZimbWet	ZimbWet	2k	2,301k	240k
ROYAL BLUE Cotton from Awassa Textiles, Ethiopia #127, Standard VF Polyester #101							
Mali	**Tienfala-Baguineda**	**Wet**	TrMaliWet	MaliWet	3k	2,511k	239k
Mali	**Madina-Diassa (Savanna)**	**Dry**	TrMaliDryA	MaliDryA	2k	2,264k	**As Above**
Complex Fabric Trials - Large Latin Squares with many special fabrics							
Experiment 23 from Mihok (2002) in Bulletin of Entomological Research Ethiopian #60, Kenyan #62 Phthalogen Blue & VF Polyesters #64, 65 and some size/netting variations							
Kenya	**Nguruman**	**Dry**	TrNguDry	NguDry	5k	4,794k	343k
Initial fabric trial to scope causes of polyester/cotton catch differences - various cotton/polyester fabrics ROYAL BLUE Cotton from Awassa Textiles, Ethiopia #127 tested							
Ethiopia	**Arba Minch**	**Dry**	TrMinchDry	MinchDry	3k	3,046k	587k
Three sequential experiments using the same set of traps in minor variations on cotton/polyester fabrics Comparing many possible sources of catch differences in fabric features							
Ethiopia	**Chanka1**	**Wet**	TrChanka1	Chanka1	4k	3,630k	773k
Ethiopia	**Chanka2**	**Wet**	TrChanka2	Chanka2	6K	4,681k	**As Above**
Kenya	**Shimba**	**Wet**	TrShimba	Shimba	4k	3,731k	773k

Various Experiments - ONLY Cotton Nzi traps being compared to other traps							
Mihok et al. (in preparation MVE) - 7 x 7 Latin Squares - Phthalogen Blue Cotton from Mountex, Kenya #184							
Ethiopia	**Chanka**	**Wet**	TrTrapEth	TrapEth	6k	3,986k	137k
Phthalogen Blue Cotton from Bonar Industries, Zimbabwe #171 Tested dark versus light netting - traps made with geometric frames							
Zimbabwe	**Zambezi**	**Dry**	TrZimDry	ZimDry	3k	2,324k	240k
Standard Phthalogen Blue Cotton from Awassa Textiles, Ethiopia #105							
Burkina Faso	**Lahirasso**	**Dry**	TrBFLah	BFLah	3k	2,437k	171k
Burkina Faso	**Kimini**	**Dry**	TRBFKimini	BFKimini	2k	2,488k	**As Above**
Burkina Faso	**Banwali**	**Dry**	TrBFBanwali	BFBanwali	2k	2,340k	**As Above**

Experimental Summary

Published trials are listed below. Unpublished data are on the following page.

Expt$	Country$	Person$	Odours$	Habitat$	Season$	Weather$	Area$	Location$	Zone$	ELEVATION	Latitude$	Longitude$	Date$
Mihok et al. (2006)													
Ber06Canopy	CANADA	MIHOK	OCTENOL	GARDEN	DRY		RUSSELL	ONTARIO VILLAGE	CONTROL	24	45 15 N	75 21 W	12-Jul-04
Ber06Dyes5	CANADA	MIHOK	OCTENOL	GARDEN	DRY		RUSSELL	ONTARIO VILLAGE	CONTROL	24	45 15 N	75 21 W	10-Sep-04
Ber06Net2	CANADA	MIHOK	OCTENOL	GARDEN	DRY		RUSSELL	ONTARIO VILLAGE	CONTROL	24	45 15 N	75 21 W	02-Sep-03
TRIOWA	USA	KRAFSUR	UNBAIT	FARM	DRY	RAINY	AMES	DAIRY FARM	AGRICULTURAL	280	41 59 26 N	93 37 08 W	19-Jul-96
TRLOUISIANA	USA	FOIL	SACHET	FOREST EDGE	DRY	SUNNY	LOUISIANA	PARK ROAD	THISTLEWAITE	23	30 39 00 N	92 00 00 W	09-Jun-96
Mihok (2002)													
BERMIH12	KENYA	MIHOK	AUO	SAVANNA	WET		NGURUMAN	SHOMPOLE	CONTROL	550	02 00 S	36 10 E	24-May-95
BERMIH13	KENYA	MIHOK	UNBAIT	FARM	WET		NAIROBI	ICIPE	CONTROL	1500	01 20 S	36 50 E	09-Jun-95
BERMIH14	KENYA	MIHOK	OCTENOL	FOREST	DRY		NAIROBI	PARK	CONTROL	1500	01 20 S	36 50 E	19-Jul-95
BERMIH15	KENYA	MIHOK	OCTENOL	GARDEN	DRY	SUNNY	NAIROBI	LORESHO SUBURB	CONTROL	1500	01 20 S	36 50 E	01-Aug-95
BERMIH16	KENYA	MIHOK	AUO	SAVANNA	DRY	SUNNY	MARALAL	KIRIMUN	CONTROL	1450	00 40 N	36 50 E	14-Jun-95
BERMIH17	KENYA	MIHOK	AUO	SAVANNA	DRY	SUNNY	NGURUMAN	SHOMPOLE	CONTROL	550	02 00 S	36 10 E	25-Jul-95
BERMIH18	KENYA	MIHOK	AUO	THICKET	DRY	SUNNY	LAMBWE VALLEY	RUMA PARK	SUPPRESSION	1200	00 20 N	34 10 E	22-Aug-95
BERMIH19	KENYA	MIHOK	A+SACHET	THICKET	DRY		MBITA	NYAMANGA	CONTROL	1200	00 25 S	34 15 E	29-Aug-95
BERMIH20	KENYA	MIHOK	AUO	FOREST	WET		SHIMBA	AIRSTRIP	CONTROL	350	04 17 S	39 25 E	22-Nov-95
TRNGUDRY	KENYA	MIHOK	AUO	SAVANNA	DRY	SUNNY	NGURUMAN	SHOMPOLE	CONTROL	550	02 00 S	36 10 E	11-Jan-96
Ndegwa & Mihok (1999)													
BERNDE02	TANZANIA	NDEGWA	AO	WOODLAND	DRY		MAKUYUNI	NAITOLYA-8	CONTROL	1000	03 40 00 S	36 03 00 E	01-Aug-96
BERNDE03	TANZANIA	NDEGWA	AO	WOODLAND	DRY	SUNNY	MAKUYUNI	NAITOLYA-8	CONTROL	1000	03 40 00 S	36 03 00 E	20-Sep-96

Expt$	Country$	Person$	Odours$	Habitat$	Season$	Weather$	Area$	Location$	Zone$	ELEVATION	Latitude$	Longitude$	Date$
TRBFBANWALI	BURKINA FASO	RAYAISSE	UNBAIT	RIVERINE FOREST	DRY		BANWALI	TRIBUTARIES	MAHOUN RIVER	288	11.88 N	4.22 W	01-Nov-97
TRBFKIMINI	BURKINA FASO	RAYAISSE	UNBAIT	RIVERINE FOREST	DRY		KIMINI	TRIBUTARIES	MAHOUN RIVER	288	11.88 N	4.22 W	01-Nov-97
TRBFLAH	BURKINA FASO	RAYAISSE	UNBAIT	OPEN	DRY		LAHIRASSO	TRIBUTARIES	MAHOUN RIVER	281	11.85 N	4.07 W	01-Nov-97
TRCHANKA1	ETHIOPIA	MIHOK	AUO	WOODLAND	WET		KETTO	KETTO RIVER	CONTROL	1289	08 46.32 N	35 3.12 E	11-Sep-97
TRCHANKA2	ETHIOPIA	MIHOK	AUO	WOODLAND	WET		KETTO	VILLAGE 12	CONTROL	1223	08 43.12 N	35 07.74 E	01-Oct-97
TRDENMARK	DENMARK	SOMMER	OCTENOL	OPEN	WET	RAINY	COPENHAGEN	ISLE OF AMAGER	CONTROL	0	55 36 00 N	12 28 00 E	23-Jul-98
TRDIDESA	ETHIOPIA	MIHOK	UO	RIVERINE FOREST	WET		BEDELE	BRIDGE	DIDESA VALLEY	1083	08 41 36 N	36 24 52 E	31-Aug-96
TRGAMBIA	GAMBIA	CEESAY	AO	WOODLAND	WET	SUNNY	NIAMINA-EAST	MISSIRA	SUBHUMID	25	13 37 00 N	15 00 00 W	23-Jul-96
TRJAPAN	JAPAN	SASAKI	UNBAIT	FARM	DRY	SUNNY	HOKKAIDO	SHIZUNAI		69	42.33 N	142.37 E	20-Aug-96
TRKIB	KENYA	KIRAGU	AO+CRESOL	RIVERINE FOREST	WET	RAINY	KIBWEZI	UNBI STATION		700	2 S	38 E	20-May-96
TRKOMBO	ETHIOPIA	MIHOK	AUO	FOREST	WET		KETTO	KOMBO STREAM	CONTROL	1312	08 51.32 N	35 05.13 E	30-Aug-97
TRMALIDRYA	MALI	DJITEYE	UNBAIT	SAVANNA	DRY	SUNNY	MALI	MADINA DIASSA RANCH	SUDANO-GUINEAN	400	10 45 N	07 45 W	19-Mar-98
TRMALIWET	MALI	DJITEYE	UNBAIT	RIVERINE FOREST	WET		MALI	TIENFALA-BAGUINEDA	SUDANESE	375	12 35 N	07 45 W	30-Sep-97
TRMBITA	KENYA	MOHAMED	UNBAIT	THICKET	WET	RAINY	MBITA	KISSIWI	LAKESHORE	1200	00 25 S	34 15 E	02-Oct-96
TRMINCHDRY	ETHIOPIA	MIHOK	AU	SAVANNA	DRY	SUNNY	ARBA MINCH	LAKE CHAMO	NECH SAR PARK	1283	06 00 N	37 40 e	27-Dec-96
TRMINCHWET	ETHIOPIA	MIHOK	AUO	SAVANNA	WET		ARBA MINCH	NEAR HQ BY FOREST	NECH SAR PARK	1100	05 59 19 N	37 34 12 E	09-Aug-96
TRMOZAM	MOZAMBIQUE	MIHOK	A+SACHET	OPEN	DRY	SUNNY	QUELIMANE	MUNGAMA EAST	GRUPO MADAL	10	17 53 S	36 58 E	21-Sep-97
TRNGUWET	KENYA	MIHOK	AUO	SAVANNA	WET	RAINY	NGURUMAN	SHOMPOLE	CONTROL	550	02 00 S	36 10 E	18-May-96
TRSHIMBA	KENYA	MIHOK	AUO	FOREST	WET		SHIMBA	MWELE MDOGO	CONTROL	350	04 17 00 S	39 23 00 E	26-Nov-97
TRTPRI	TANZANIA	MUANGIRWA	AO	WOODLAND	DRY	RAINY	MAKUYUNI	NAITOLYA	CONTROL	1000	03 40 00 S	36 03 00 E	13-Feb-97
TRTRAPETH	ETHIOPIA	NDEGWA	AUO	WOODLAND	WET		KETTO	VILLAGE 11 & 12	WEST WOLLEGA	1223	8 43.12 N	35 7.74 E	24-Sep-97
TRUGANDA	UGANDA	OKOTH	UNBAIT	THICKET	DRY		BUSOGA		CONTROL	1000	00 30 00 N	33 40 00 E	01-Jul-97
TRZAMBDRY	ZAMBIA	MWANGELWA	MEK+OCTENOL	WOODLAND	DRY	SUNNY	KAFUE PARK	CHUNGA	MUMBWA DISTRICT	1017	15 02 63 S	26 00 35 E	14-Apr-97
TRZAMBWET	ZAMBIA	MWANGELWA	MEK+OCTENOL	WOODLAND	WET	SUNNY	KAFUE PARK	CHUNGA	MUMBWA DISTRICT	1017	15 02 63 S	26 00 35 E	08-Dec-96
TRZIMBDRY	ZIMBABWE	HARGROVE	A+SACHET	WOODLAND	DRY		ZAMBEZI VALLEY	BIGSQU		500	16 10 S	29 25 E	01-Feb-97
TRZIMBWET	ZIMBABWE	HARGROVE	A+SACHET	WOODLAND	WET		ZAMBEZI VALLEY	BIGSQU		500	16 10 S	29 25 E	17-Mar-97