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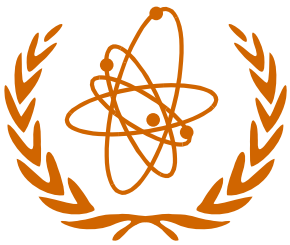

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SECTION A – NEWS

PROGRAMME AGAINST AFRICAN TRYPANOSOMIASIS

PAAT Adviser, Disease Diagnosis and Epidemiology

Dieter Mehlitz has had to withdraw from the position of PAAT Adviser, Disease Diagnosis and Epidemiology, now that he has assumed new, expanded responsibilities as Director General of ITC in The Gambia. His replacement is John McDermott (PhD/ MPVM/DVM), epidemiologist, International Livestock Research Institute, Kenya. John also holds a chair as Professor of Epidemiology at the University of Guelph, Canada, and has a broad ranging experience in veterinary epidemiology.

PAAT and FAO meetings to be held in conjunction with 25th ISCTRC Meeting

The *PAAT Advisory Group Co-ordinators Meeting* will take place in Mombasa on 23-24 September 1999. The co-ordinators provide technical expertise and advice to PAAT on all technical and scientific aspects in the fields of trypanosomiases, tsetse control and rural development in affected areas. Their recommendations, which are intended to guide research and field programmes, will be brought to the attention of the ISCTRC Meeting.

The *FAO Liaison Officers' Meeting* on African trypanosomiasis in Central and West Africa will be held in Mombasa, on 20-21 September 1999. Liaison officers deliberate on and review national programmes, regional and international reports including research priorities, policy issues, rural development and integrated vector and disease management. Country position papers from the Liaison Officers' Meeting are expected to be presented as posters during the ISCTRC Meeting. Representatives from 16 Central and West African Countries and from regional and international organisations and institutions will attend the meeting.

PAAT discussions with DG VIII

In May, Peter Holmes (PAAT Chairman), Jan Slingenbergh and Guy Freeland met officials in DG VIII in Brussels to discuss the future role which PAAT can play in the planning and policy research of EU control programmes in Africa. It was agreed that the expertise residing in PAAT is a unique resource which could make a major contribution to the success of future control programmes. In particular it is hoped that PAAT can assist in the planning and implementation of FITCA. To facilitate this, and in the light of recommendations arising out of the last meeting of the PAAT Programme Committee in late 1998, it is hoped that the Planning, Policy and Implementation Module of PAAT can be transferred to OAU-IBAR in the coming year.

NATURAL RESOURCES ANIMAL HEALTH PROGRAMME (UK)

New appointment

Professor Ian Maudlin has recently been appointed to the post of Programme Manager of DFID's Natural Resources Animal Health Programme, in succession to

Duncan Brown. The Programme will continue to be managed from the Centre for Tropical Veterinary Medicine, Edinburgh, on a part-time basis. Meanwhile, Professor Maudlin retains his position as Professor of Molecular Entomology at the University of Glasgow.

REGIONAL TSETSE AND TRYPANOSOMOSIS CONTROL PROGRAMME

Review of achievements and shortcomings of the RTTCP, 1986-1999

Background: The RTTCP of Malawi, Mozambique, Zambia and Zimbabwe began in 1986. Phase I of the Programme was preparatory. In addition to emergency tsetse control operations in Zambia and Zimbabwe, the Programme focused on the development of new, appropriate tsetse survey and control methods, the distribution of tsetse and bovine trypanosomosis in the fly-belt common to the four countries, and staff training. Other important activities included environmental monitoring of the impact of tsetse control measures, and Regional co-ordination. Phase II began in 1992. Its prime aim was to develop a comprehensive strategic plan to integrate tsetse and trypanosomosis control into sustainable rural development. During Phase II, the RTTCP also provided technical assistance to the Department of Veterinary Services of Namibia.

Management of the Programme: The EDF provided grants for Phases I and II of the RTTCP. In early 1998, an additional, bridging grant was made to enable the RTTCP to continue until a new, broader Regional Animal Health Programme for Southern Africa was launched. A Regional Standing Committee, comprising two representatives of each of the member countries and the SADC Livestock Production and Disease Control Sector Co-ordinator, has directed the RTTCP. On a day to day basis, the Regional Co-ordinator and his staff have implemented the decisions of the Regional Standing Committee. The Regional Co-ordinator provided technical and administrative advice to the Regional Authorising Officer of the EDF, and to the RTTCP National components.

The Regional Standing Committee held its thirteenth meeting between 15 and 17 June 1999 in Kariba, Zimbabwe. It reviewed the major achievements and the shortcomings of the RTTCP over its 14-year existence.

Achievements and successes of the RTTCP

- Environment friendly technologies for tsetse control developed
- New control technologies transferred and adopted in the RTTCP Region
- Effective Regional Co-ordination and collaboration achieved
- Standardised procedures developed and adopted in the Region
- Exchange of skills promoted effectively and widely
- Regional personnel trained
- Management skills improved
- Large volume of socio-economic data collected in the Region in a uniform format
- Information management systems developed and transferred to RTTCP countries
- Skills transferred throughout the RTTCP Region
- Knowledge of the distribution of tsetse and nagana reliably updated
- Tsetse eradication achieved in some areas
- Emergencies overcome

- Multi-disciplinary approach to tsetse control achieved through wide consultation of stakeholders
- Effective networking achieved in the RTTCP Region.
  [For a fuller account of achievements, see PAAT Newsletter no. 3.]

Weaknesses

- Environmental and land use issues not fully addressed
- Sustainability not fully achieved
- Strategic plans not finalised.

The Regional Standing Committee analysed the Programme's main weaknesses. It was agreed that it lies beyond the scope of one project to address such broad issues as land use and environmental protection. During Phase I, the RTTCP did address environmental monitoring effectively and, in Phase II, the issue of land use and natural resource management was vigorously pursued through National Co-ordinating Committees. The achievement of sustainability is, perhaps, an unattainable goal because of the rapidly changing conditions. The most effective approach to ensuring sustainability is, therefore, to develop and apply an appropriate process of strategic planning. Since strategic planning is continuous, strategic plans should not be regarded as final – they should always be subject to review.

Future outlook for trypanosomosis control in Southern Africa

The launch of a new Regional Animal Health Programme in Southern Africa has been delayed and the Regional Standing Committee has recognised the need for post-project support to ensure the orderly closure of the Programme. A major component of post-project support will be the establishment of a Regional reference centre for tsetse and trypanosomosis control, which will be based upon Zimbabwe's Tsetse and Trypanosomosis Control Branch in Harare.

The RTTCP has developed a Regional strategy, which the Regional Standing Committee has recommended SADC Governments to adopt.

Proposed Regional strategy for the control of tsetse-transmitted trypanosomosis in Southern Africa

The Regional strategy for tsetse and trypanosomosis control (T&TC) aims to promote the optimal use of resources to identify and address priorities (National, Bilateral and Regional) to achieve sustainable benefits by controlling tsetse-transmitted trypanosomosis.

Guiding principles of the Regional strategy

Through continued effective Regional co-operation and collaboration, affected SADC countries undertake to:

- Build capacity to plan, implement and monitor T&TC
- Pool and share skills in the Region to control tsetse-transmitted trypanosomosis
- Develop and apply common standards related to training, data collection and information management
- Share information

- Promote appropriate research and development related to T&TC in the context of sustainable rural development
- Collaborate with international organisations and all stakeholders
- Promote implementation of appropriate technologies for T&TC.

Resources available and required to develop and promote implementation/ implement the Regional strategy

The prime Regional resource required to develop and implement the Regional strategy is the Tsetse and Trypanosomosis Control Branch (TTCB), Zimbabwe, which shall be used as a reference centre and is recognised as the SADC Centre of Excellence for T&TC.

Affected countries and associates of the Centre undertake to promote and facilitate its development and maintenance. The Centre encourages the participation of all stakeholders in achieving sustainable T&TC.

Strategy formulation is dynamic. It is a continual process that requires considerably more facilitation and support than is generally recognised. Consequently, the member countries of the RTTCP will require external support to implement the proposed strategy, establish a Regional reference centre and develop and empower its veterinary and tsetse control institutions. An important challenge in the near future will be the establishment of mechanisms for effective partnerships between public sector and private sector stakeholders in the delivery of services to control tsetse-transmitted trypanosomosis.

Robert J. Connor (former Regional Co-ordinator)
and William Shereni (Regional Co-ordinator)

TRAINING COURSE

The Sterile Insect Technique as a Component for Integrated Area-wide Tsetse and Trypanosomosis Management

This FAO/IAEA Regional Training Course will be held in Tanga, Tanzania, from 20 March to 14 April 2000 and is open to senior tsetse control staff, with preference given to entomologists and veterinarians who are or will likely be involved in area-wide tsetse and trypanosomosis management campaigns. The course will last four weeks and will include lectures and practical work in the laboratory and in the field. More detailed information was given in PAAT Newsletter no. 3.

Applications should be made on the standard Nomination for Training Course form (TA-3E) through the official channel (National Atomic Energy Authority, Ministry of Agriculture, Ministry of Foreign Affairs or UNDP Office). Applications must be received by the IAEA *not later than 15 December 1999*.

For further information and application form, contact Andrew Parker, Insect and Pest Control Section, Joint FAO/IAEA Division, P.O. Box 100, A-1400 Vienna, Austria (tel. +43 1 2600 26062; fax +43 1 2600 7; e-mail a.parker@iaea.org or u.feldmann@iaea.org; http://www.iaea.org/programmes/nafa/d4/index.html).

CONTROL OPERATIONS

Community-based tsetse control in Beles valley, Ethiopia: preliminary results

Community-based tsetse control activities, financed by the Italian government, are being carried out in Beles valley, north-western Ethiopia, by CISP, an Italian NGO, with the support of ICIPE, Nairobi.

The area, woodland savanna, is about 1000 m above sea level. Heavy infestations exclusively of *Glossina tachinoides* exist alongside the tributaries of the Beles river. The main rainy season is from May/June to September/October. Tsetse control was needed in order to reduce the effect of trypanosomosis on draft animals introduced by settlers in the valley. Cattle are an important component of the area's evolving farming system which is based on the integration of crop and livestock production. Besides the risk of drug resistance, which has already been reported from other regions of Ethiopia, farmers could no longer sustain the increasing costs of treating sick animals. A revolving fund, managed by local veterinary services with the assistance of the project, is providing essential veterinary drugs to stock breeders.

The fly control scheme, started two years ago, includes 22 villages in an area of about 300 km^2. Community participation has been achieved alongside the implementation of other development activities and with local veterinary support. 1500 biconical traps were distributed to over 300 specially trained farmers and located in strategic areas of the valley. In one year (September 1997 to September 1998), characterised by standard precipitation patterns, the number of flies caught per trap per day dropped from about 87 to 1.6. The prevalence of trypanosomosis in monitored herds decreased from 58% to 18%, and average PCV rose from 17.5 to 25.4%. Annual trap losses are about 15%.

Farmers are very satisfied with the results and are willing to carry on the scheme and cover replacement costs of traps. Control and monitoring activities will be carried out also during the coming rainy season. In collaboration with ICIPE, the project is working to further improve the control strategy by determining the level of involvement of local services to be achieved, how to avoid re-infestation, where and how to focus activities, and how to reduce cost of and damage to traps.

For further information, contact M. Ghirotti, Central Technical Unit, DGCS, Ministry of Foreign Affairs, Rome (e-mail ghirotti@esteri.it).

NEW NETWORK

African Trypanosomosis Mechanically Transmitted (ATMT)

To enhance and facilitate collaboration between researchers working on mechanically transmitted trypanosomosis in Africa, OIE, CIRDES and CIRAD-EMVT have proposed establishing a network on 'African Trypanosomosis Mechanically Transmitted' (ATMT) which principally concerns trypanosomosis due to *Trypanosoma evansi* and *T. vivax*.

The initial network in Africa will include Mali, Mauritania, Niger, Chad and Burkina Faso, probably joined by Côte d'Ivoire, Ghana, Togo and Benin. National correspondants will be identified in each of these countries: some have already accepted this role, namely Dr O. Diall (LCV, Mali), Dr M. Dia (CNERV, Mauritania), and Dr A.

Bado (LCV, Burkina Faso). International consultants have also offered advice and/or expertise: Dr Steve Mihok on vector control and transmission dynamics, Dr Lane Foil on biology and control of biting flies, and Dr Stéphane de La Rocque on identification and cartography of transmission sites (including GIS and high resolution remote sensing data).

Conditions of transmission, clinical signs, medical and economic impacts, and improvement of diagnosis and control will be the main concerns, with other topics to be identified by participants.

Subscription to Tryplink-l and to the newsletter *Trypnews* is recommended.

For further information, contact the Project Co-ordinator, Marc Desquesnes, CIRAD-EMVT/CIRDES, B.P. 454, 01 Bobo-Dioulasso, Burkina Faso (tel. +226 97 22 87; fax +226 97 23 20; e-mail m.desquesnes@fasonet.bf).

SECTION B – ABSTRACTS

1. GENERAL (INCLUDING LAND USE)

10954 **Gardiner, A.J. and Reid, R.S., 1999.** Effects of land-use change after tsetse control on biological diversity: the case of northwestern Zimbabwe. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 543-554.

ILRI, P.O. Box 30709, Nairobi, Kenya.

It has been hypothesised that the presence of the tsetse fly has protected the biological diversity of the African continent by preventing over-use of ecosystems by people and their livestock. Our objective was to evaluate how changes in land-use, a likely impact of tsetse control, affect selected aspects of biological diversity in three vegetation types (alluvial, mopane, miombo 1) at two sites in north-western Zimbabwe (Busi Valley, Kanyati), selected to simulate possible ecosystem states before and after tsetse control. This is part of a continent-wide project designed to look at these issues. The taxonomic groups used were large mammals, small mammals, birds, butterflies, dung beetles, herbaceous plants and woody plants. The structure of the vegetation was also analysed. In both Busi Valley (tsetse control for 10 years) and Kanyati (no tsetse control), species numbers and abundances were compared in protected areas (used principally by indigenous megaherbivores) and nearby communal farmlands in the wet and dry seasons of 1995 and 1996. Additional information about the effect of land-use change on dung beetles was added from other studies conducted by the first author in western (Hwange and Matopos) and central (Wedza) Zimbabwe. A new sampling method was devised to study multiple taxonomic groups on the same transect at a landscape scale of resolution. The taxonomic groups differed in the way they responded to land-use, vegetation type, season and year. Data on both the number of species and the abundance of species provided valuable information on impacts. Some groups responded similarly while others did not, therefore one group is not necessarily a good indicator of other groups. The advantages and disadvantages of using each group or the combination of groups as indicators of changes in environmental quality are discussed.

10955 **Hendrickx, G., Slingenbergh, J.H.W., Dao, B., Bastiaensen, P. and Napala, A., 1999.** Systèmes d'information géographique (SIG), outil puissant de prise de décision. Définir des zones prioritaires de contrôle de la trypanosomose. [Geographic information systems (GIS), powerful tools in decision making. Defining priority areas for trypanosomosis control.] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 464-471.

Hendrickx: Projet GCP-TOG-013-BEL, c/o FAO, B.P. 4388, Lomé, Togo. [fao-tgo@field.fao.org]

Togo is used as an example to illustrate how georeferenced data on agriculture, animal husbandry and trypanosomosis may be analysed within a GIS framework to select priority areas for intervention. A countrywide analysis of sedentary animal husbandry

systems suggests a clear, geographic division into traditional and commercial livestock rearing and thus priority areas are defined for both systems. In a commercial system the aim is to improve professional herd health and production management. Defining the level of veterinary follow-up needed to achieve this qualitative goal requires knowledge of disease prevalence, general health status of the herds and cattle breeds. In a traditional system, on the other hand, the focus is on the integration of crop and livestock production as well as on rural development prospects improved by vector control. Priority areas for this quantitative goal are assigned comparing potential benefits, based on knowledge of land-use intensity and cattle densities, with estimated costs, i.e. disease impact. Both qualitative and quantitative approaches are described using simple spatial analysis techniques. Selected variables are combined stepwise with thresholds set according to field experience, allowing rational decision making. As a conclusion, a map is proposed showing selected priority areas including data on protected areas.

10956 **Herren, H.R. and Thiermann, A., 1999.** Privatization of tsetse/trypanosomiasis control in the tropics. (Abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), p. 476.

Herren: ICIPE, P.O. Box 30772, Nairobi, Kenya.

'Privatisation' may be interpreted in many ways, but in essence it has to do with the transfer of the 'means of production' and distribution of inputs from public to private ownership. Privatisation could be 'partial' in that joint ventures are created, or alternatively private enterprises could be allowed to compete with government agencies. This paper attempts to address the proposal that tsetse/trypanosomiasis control could be privatised. Certain constraints of the community-based approach to tsetse control, for example, suggest that there is a need to consider alternative approaches including privatisation. Basic requirements of private tsetse/trypanosomiasis control enterprises (e.g. the existence of a market, type and size) are discussed in order to determine if and how privatisation might be adopted within the service sector, based on the existing methods of control. Most importantly, the paper provides a number of potential options for privatisation, such as fully private, the Southern African model, the Ethiopian model, general government/community option, and donors/NGOs/communities option. Finally, suggestions are made about the way forward towards privatisation of tsetse/trypanosomiasis control.

10957 **Kabayo, J.P., 1999.** Proposal for a continental approach to tsetse and trypanosomosis control. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 462-463.

Department of Biochemistry, Makerere University, P.O. Box 8815, Kampala, Uganda.

Tsetse control operations throughout sub-Saharan Africa have greatly declined over the past two decades as a result of reduced national budgets, civil unrest or changed national priorities or levels of emphasis. A continental approach to tsetse control is proposed, with a central continental organisation managing, monitoring and co-ordinating all tsetse and trypanosomiasis control operations. Such an organisation would best be set

up under the auspices of OAU and/or the UN. On-going regional programmes and plans would be fused within the continental strategy and each affected country would be compelled to contribute to the central budget to sustain its programmes. It is suggested that FAO, IAEA, OAU, WHO or some such other likely institution should sponsor a 3- to 5-man team to carry out a feasibility study to determine (a) whether a continental approach to the management of tsetse control operations is viable, (b) the level of interest and political support for the proposal evident in endemic countries, and (c) what the proposal would cost and the manner and protocol in which it would be implemented.

10958 **Mugalla, C., Swallow, B. and Kamuanga, M., 1999.** The effects of trypanosomosis risk on farmers' livestock portfolios: evidence from The Gambia. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 472-473.

Mugalla: ITC, P.M.B. 14, Banjul, Gambia.

A study of the effects of trypanosomosis risk on livestock and crop production was undertaken in the Central River Division of The Gambia in 1995 by ILRI in collaboration with ITC. A stratified random sample of 368 households was chosen to represent four areas of different trypanosomosis risk (Lower Fulladu South – low risk; Bansang North Bank and Bansang South Bank – medium risk; Niamina East – high risk) and the four major ethnic groups in those areas (Mandinka, Fulani, Wollof, others). A household survey was implemented in four separate visits to each household. Large differences in the total number of livestock were observed across the three levels of trypanosomosis risk. The average number of tropical livestock units (TLUs) per household was 5 in the high risk area, 11-13 in the medium risk areas, and 26 in the low risk area. There were also large differences in the number of horses (known to be particularly susceptible to trypanosomosis) per household across the three levels of risk: average of 0.1 in high, 0.5-1 in medium and 1 in low risk areas. The average number of herd cattle per household was 3 in high, 10 in medium and 27 in low risk areas. There were no differences in the numbers of draft cattle, sheep, goats and donkeys per household across the risk levels. The results for draft cattle (many of which are zebu) and donkeys were unexpected since these animals are more susceptible to trypanosomosis than N'Dama herd cattle. Large differences in livestock holdings were also observed across the four ethnic groups. Average livestock ownership was unexpectedly highest for Wollof households (18 TLUs per household), although the difference between Wollof and Fulani households was not statistically significant. Wollof households had significantly more horses than any other ethnic group. The results suggest that the main impacts of trypanosomosis will be on beef and milk production, not on production of sheep, goats or animal traction, since farmers respond to the higher levels of risk by reducing the numbers of herd cattle that are most exposed to trypanosomosis and maintaining the numbers of animals that are managed in ways that minimise those risks.

10959 **Mullins, G., Allsopp, R., Nkhori, P., Kolanyane, M. and Phillemon-Motsu, T., 1999.** The effect of tsetse fly and tsetse control on tourism in the Okavango Delta of Botswana. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 555-562.

Mullins: Veterinary Epidemiology and Economics Unit, Department of Animal Health and Production, Ministry of Agriculture, Private Bag 0032, Gaborone, Botswana.

Each year thousands of foreign tourists visit the Okavango Delta, in 1996 injecting foreign exchange to the value of US $7.5-10.5 million into the local economy and assuring the employment of thousands of people. But the Okavango hosts not only a lucrative tourism industry; it also harbours Botswana's only population of tsetse (*Glossina morsitans centralis*). To ensure that the Okavango remains a safe tourist destination, the Government of Botswana spent over US $1 million on tsetse control in 1996 and there are an estimated 17,000 odour-baited targets (OBT) currently in the delta in an attempt to eradicate tsetse. Tour operators have, however, expressed considerable criticism about the targets and the presence of tsetse control teams in this renowned wilderness area. A study was undertaken with the following objectives: (i) to quantify the extent to which tsetse fly is a nuisance impinging on tourists' enjoyment of the delta, (ii) to determine the effect on tourists of tsetse control efforts, specifically the use of OBT, and (iii) to develop recommendations for the amelioration of any negative effects on tourists arising from the use of the OBT technology. With the co-operation of tour operators, a short questionnaire was issued to tourists via camp managers. Of the 88 respondents, 88% reported seeing targets but only 11% mentioned seeing tsetse control staff; 48% stated that they had been 'annoyed' by tsetse to some degree but over half of these found the fly either not a problem or only a mild annoyance. Of the 73 tourists who reported sighting OBT, 93% had only a mild reaction to them, as did those seeing tsetse control staff. A 'hunting objective' for the visit (as opposed to game-viewing or bird-watching) had a significant influence on the response to seeing OBT, interviewees expressing the view that the tsetse fly is the saviour of the wilderness. Having prior information on OBT technology, presented in the preface to the questionnaire, or being a member of a conservation society, mitigated tourist reaction to the targets. Certain measures, such as siting targets where tourists cannot easily see them, tsetse control teams organising their field activities to avoid encountering tourists, and education on OBT and less environmentally friendly options directed at all visitors to the delta, are recommended.

10960 **Muriuki, G., Olubai, W., Bourn, D. and Wilson, C., 1999.** Land use change and tsetse control in Lambwe Valley, Western Kenya. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 537-542.

Muriuki: KETRI, P.O. Box 362, Kikuyu, Kenya.

An account is presented of a retrospective case study investigating land use changes and the history of tsetse and trypanosomosis in the Lambwe Valley in South Nyanza region of western Kenya. Land use changes between 1948 and 1993 were assessed by means of comparative aerial photograph interpretation. These changes are interpreted in the context of documented population growth, immigration, agricultural expansion and tsetse fly control. Population growth has been shown to be driven by a combination of factors but the single most important contributing factor has been the control of tsetse and trypanosomosis. This population growth has led to a rapid expansion in cultivation around the Ruma National Park, while the trend inside the park has been one of bush

encroachment which maintains prime tsetse habitat and therefore a persistent focus of infection, despite numerous endeavours in the past to control tsetse and trypanosomosis in the valley. This paradoxical co-existence of conflicting interests and land use categories, including various forms of agriculture, wildlife conservation and forests, is presented as a demonstration of land use changes that may be driven directly or indirectly by tsetse control.

10961 **Odiit, M., Amulen, D., Kansiime, F., Enyaru, J.C.K. and Okitoi, D., 1999.** Comparison of the epidemiology of sleeping sickness and the environment profile in Tororo district. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 224-234.

Odiit: Sleeping Sickness Special Programme, LIRI, P.O. Box 96, Tororo, Uganda.

In order to ascertain the possible usefulness of GIS in the surveillance of sleeping sickness, a retrospective analysis of sleeping sickness case records and environmental data for Tororo district, Uganda, was undertaken. When transposed, maps of the known distribution of sleeping sickness and that of vegetation, land use and drainage fit closely. Trends in monthly sleeping sickness incidence, rainfall and normalised difference vegetational indices (NDVIs) are correlated. The epidemiology of sleeping sickness in Tororo appears to be closely associated with vegetation, land use, drainage and rainfall distribution. GIS may be very useful in precisely defining foci and therefore priority areas for control.

10962 **Okello, O.O., Kruska, R.L. and Reid, R.S., 1999.** Use of GIS to analyse the impacts of controlling trypanosomosis. (Abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), p. 587.

Okello: ILRI, P.O. Box 30709, Nairobi, Kenya.

Currently the quality of GIS analyses is constrained by poor data on the distribution of current tsetse populations, non-human and human trypanosomosis prevalence, livestock population densities, agricultural production, biodiversity, soil fertility, land-use, infrastructure, income, markets, etc. Most of the current focus is on the production of maps, with little use of powerful GIS analysis tools. Better use needs to be made of exploratory analysis techniques, statistical analyses and spatial data analysis. To date, GIS software does not incorporate tools to model system dynamics. GIS tools need to be better linked with other analysis tools to improve our understanding of system change after tsetse control.

10963 **Organization of African Unity/Scientific, Technical and Research Commission, 1999.** *Twenty-fourth Meeting of the International Scientific Council for Trypanosomiasis Research and Control, Maputo, Mozambique, [29 September – 3 October] 1997.* Nairobi; OAU/STRC. OAU/STRC publication no. 119. 607 pp.

OAU/STRC, P.O. Box 30786, Nairobi, Kenya.

The texts and/or abstracts of papers presented at the twenty-fourth ISCTRC meeting are published under the following headings: Diagnosis; Immunology; Human trypanosomiasis; Animal trypanosomiasis; *Glossina* biology: technology applications; Tsetse and trypanosomiasis control (Chemotherapy and pour-on, *Glossina* control, Community participation including planning for control, Impact of trypanosomiasis control). Introductory sections include reports of relevant work carried out by international and regional organisations (OAU/IBAR, EU, WHO, ILRI, ITC, CIRDES, IAEA, ICIPE, RTTCP, PAAT) and by countries (Burkina Faso, Botswana, Ethiopia, Ghana, Guinea Bissau, Kenya, Senegal, Tanzania, Togo, Uganda, Zambia). Summaries of the plenary sessions are also given, with recommendations. Abstracts of all presentations published in this report are included in this issue of *TTIQ*.

10964 **Reid, R.S., 1999.** Impacts of trypanosomosis on land-use and the environment in Africa: state of our knowledge and future directions. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 500-514.

ILRI, P.O. Box 30709, Nairobi, Kenya.

To understand the environmental impacts of controlling trypanosomosis, there are two principal questions to answer: (1) How does controlling trypanosomosis affect the pattern and rate of land-use/land cover change? (2) If these changes occur, how do they affect ecosystem structure and function? For more than half a century, natural history observations have led scientists and resource managers to speculate about the answers to these questions, but only recently have quantitative studies been conducted that rigorously assess impacts. Most of the impact studies have focused on the first rather than the second question because of its immediate nature. Even concerning land-use/land cover impacts, very few of these quantitative studies have been designed so that the impacts of trypanosomosis control can be distinguished from other factors that cause land-use/land cover change. Even when good comparative sites are available for study, establishing cause and effect is difficult. However, accumulating evidence shows that tsetse/trypanosomosis and land-use/land cover change are strongly linked in some locations in Africa and weakly linked in others. These changes in land-use/land cover can have unanticipated impacts on biological diversity and vegetative structure. These and other results are synthesised into a picture of our current knowledge and future directions about tsetse/trypanosomosis control, land use and the environment.

10965 **Reid, R.S., Kruska, R.L., Deichmann, U., Thornton, P.K. and Leak, S.G.A., 1999.** Will human population growth and land-use change control tsetse during our lifetimes? *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 563-577.

Reid: ILRI, P.O. Box 30709, Nairobi, Kenya.

For at least five decades, tsetse biologists have observed that the populations of some species of tsetse (particularly species in the *morsitans* group of flies) decline as fly habitat is converted into cultivated land and host populations are decimated by hunting. Some have even suggested that tsetse control is unnecessary because human population

growth and concomitant land-use change will eventually control the fly, even if no formal tsetse control is attempted. We tested this hypothesis for the African continent by first surveying the literature and establishing the levels of human population density at which populations for the three groups of tsetse flies (*morsitans, palpalis* and *fusca*) begin to decline and then disappear altogether. We then developed four human population scenarios showing likely levels of human populations in the years 1960, 1990, 2020 and 2040. These data layers were then overlaid with the distribution of each group of tsetse fly and areas of possible tsetse decline were identified. The resulting maps show that large areas of Africa will still have low human populations and thus intact tsetse habitat even 40 years from today. However, most people and livestock will inhabit areas of high human population density, where it is likely that *morsitans* group populations will have diminished. In these areas, other tsetse species in the *palpalis* group that are less affected by human population density, such as *Glossina palpalis, G. tachinoides* and *G. fuscipes*, will likely be the primary disease vectors. Thus, while it is certain that trypanosomosis will not disappear as a result of human population growth during our lifetimes, the epidemiological nature and the location of the problem will shift.

10966 **Swallow, B.M., 1999.** Impacts of trypanosomosis on African agriculture. (Presented as a PAAT position paper.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 515-536.

ILRI, P.O. Box 30709, Nairobi, Kenya.

African animal trypanosomosis constrains agricultural production in areas of Africa that hold the continent's greatest potential for expanded agricultural production. Previous studies indicate that the incidence of trypanosomosis: (i) reduces calving rates by 1-12% in tolerant breeds and by 11-20% in susceptible breeds of cattle; (ii) increases calf mortality by 0-10% in tolerant breeds and by 10-20% in susceptible breeds of cattle; (iii) reduces milk offtake from trypanotolerant cattle by 10-26%; and (iv) reduces lambing and kidding rates by 4-38%. At the herd level, it is estimated that the incidence of trypanosomosis reduces cattle offtake by 5-30%, milk offtake by 10-40%, and the work performance of oxen by 33%. The risk of trypanosomosis also shapes farmers' choices about livestock purchases, sales and overall herd size. The evidence from a small number of field studies suggests that farmers in areas of high trypanosomosis risk keep 25-60% as many cattle as farmers in nearby areas of low risk. Impacts on other livestock species vary greatly depending upon the management system and level of susceptibility. Overall it has been estimated that trypanosomosis reduces the density of cattle by 37% in the sub-humid zone and 70% in the humid zone. The indirect effects of trypanosomosis risk on land use and agricultural production can be inferred from focused field studies and aggregate-level studies that have examined the relationship between livestock and crop production more generally. In mixed farming systems where trypanosomosis is so severe that it constrains the number of oxen that farmers own, it can reduce the average area planted per household by as much as 50%. By generally constraining farmers from the overall benefits of livestock to farming – less efficient nutrient cycling, less access to animal traction, lower income from milk and meat sales, less access to liquid capital – trypanosomosis reduces both yields and area cultivated. It is estimated that the elasticity of livestock stock with respect to total agricultural production is about 0.20: a 50%

reduction in livestock population would reduce the total production of agricultural output by 10%.

10967 **Wangila, J., Swallow, B.M., Tesfaemichael, N., Okello, O. and Kruska, R., 1999.** Factors affecting farmer demand for pour-on treatments in Ethiopia. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 490-497.

Wangila: ILRI, P.O. Box 30709, Nairobi, Kenya.

Animal trypanosomosis is particularly important in Ethiopia where 7-10 million cattle are at risk. A geo-referenced census of over 5000 households was conducted between March and July 1996 to better understand factors affecting demand for the cypermethrin pour-ons used since January 1991 to control tsetse in Ghibe, Ethiopia. Since December 1992, farmers have paid 3 Ethiopian Birr (US $0.50) for each pour-on treatment offered once a month at nine supply centres. GIS and econometrics were used to identify and quantify effects of different economic, demographic and spatial factors on farmer demand for the pour-ons. Results show that household-level demand for the pour-on depends upon season, characteristics of the household head, structure of the cattle herd, distance to the nearest supply point and characteristics of the household's neighbours. Demand is highest in the wet season and lowest in the dry season. Female-headed households were more likely to treat their cattle than male-headed households, while households located farther from the treatment centres were less likely to treat. Households whose neighbours treated a large number of animals were more likely to treat, while households with a large number of cattle-owning neighbours were less likely to treat. These results suggest that there is a type of informal collective action occurring, supported by people's observation of their neighbours' behaviour.

10968 **Woudyalew Mulatu, Swallow, B.M., Rowlands, G.J., Leak, S.G.A., d'Ieteren, G.D.M. and Nagda, S.M., 1999.** Economic benefits to farmers of six years of application of an insecticidal 'pour-on' to control tsetse in Ghibe, southwest Ethiopia. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 578-586.

Woudyalew Mulatu: ILRI, P.O. Box 5689, Addis Ababa, Ethiopia.

A tsetse control campaign using cypermethrin pour-on applied monthly to village zebu cattle in Ghibe, south-west Ethiopia, has been in operation for over 6 years (1991-1997). Since 1993 farmers have paid a cost-recovery price for each animal given treatment. Relative densities of tsetse and biting flies fell by 95% during the second year of vector control. Mean trypanosomal prevalence in adult cattle has been reduced from 41% to 16% (a reduction of 61%) and the number of curative trypanocidal treatments per animal has been reduced by 50%. A 57% reduction in abortion rate and calf mortality, a 49% increase in calf:cow ratio and an 8% increase in adult male body weight occurred as a result of tsetse control. There was an increase in the density of cattle raised in the area during the course of the trial due to increased settlement and to purchase or movement of cattle into the area. The reduced expenditures on trypanocidal drugs more than offset the cost of the pour-on. The additional benefits of increased output of meat (41%) and milk (39%) led to an overall benefit:cost ratio of 8:1 spread over 5 years. When the above net

benefits are expressed in terms of average household income, they represent increases in annual income of between 10 and 34% per household.

2. TSETSE BIOLOGY

(a) REARING OF TSETSE FLIES

10969 **Kitwika, W.A., Msangi, A.R., Kiwia, N.E., Mramba, F., Malele, I.I., Kasilagila, G., Byamungu, M.B., Parker, A.G., Dyck, V.A. and Feldmann, U., 1999.** Production of *Glossina austeni* for the sterile insect technique in Tanzania. (Abstract only.) *In*: OAU/STRC, 1999 (see 22: no. 10963), pp. 357-358.

Kitwika: TTRI, P.O. Box 1026, Tanga, Tanzania.

A major component of the project to eradicate *G. austeni* from Unguja Island, Zanzibar, has been the establishment of a colony at TTRI to produce sterile male flies for release in the field, and this has now become the largest tsetse colony in the world. The flies are fed on whole defibrinated bovine blood through a silicone membrane warmed to 37°C. The environment is kept at 24 ± 1°C and 75-85% relative humidity, and the photoperiod is 12 h light per day. The performance of the colony is satisfactory, with an average mortality rate of 1.35% per day, fecundity of 0.05 pupae per female per day and average pupal weight of 19.8 mg. About 90% of pupae emerge. Surplus males (80% of all males produced) are fed two blood meals mixed with isometamidium chloride to reduce vectorial capacity, chilled and irradiated at a dose of 120 Gy before packing and shipping to Zanzibar by air twice a week. Regular quality assessment is carried out. Sterile male survival in the laboratory averages 66.33% after 25 days. In October 1996 the colony contained > 900,000 female flies, and in August 1996 it produced about 250,000 pupae per week and > 100,000 sterile males were shipped per week. From mid August 1994 to July 1997, more than 7.5 million sterile males were shipped. TTRI now has the facilities and capability to assist in the eradication of other tsetse species in other areas of Africa.

10970 **Nadel, D. and Mahamat, H., 1999.** Development of a new tsetse production system for use under field conditions by local communities based on the lethal insect technique. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 352-354.

Nadel: ICIPE, P.O. Box 30772, Nairobi, Kenya.

Large colonies of tsetse flies *Glossina fuscipes* (collected from Mbita area on the shore of Lake Victoria) and *G. austeni* (from Vienna) are being established at ICIPE to produce insects for use in an integrated control strategy based on the lethal insect technique (LIT). The LIT has been conceived in two versions: (i) continuous release of tsetse attracted to traps equipped with contaminating devices (CDs), and (ii) sequential repetitive releases of mass-reared and contaminated male and female flies. Freshly collected blood from donor cattle kept at ICIPE is defibrinated and fed to the flies through

a silicone membrane. A new integrated rearing and feeding system based on a tsetse cage holding 200 female and 24 male tsetse and fixed rack and feeding trolley has been designed and is being tested. Tsetse fed alternate days showed equally good performance as those fed daily; this will help to increase the interval at which donor cattle are bled. The possibility of using by-products (biogas, fertilisers, etc.) from donor cattle kept under zero-grazing conditions in a new integrated 'biovillage' approach to managing insects which could be exploited by resource-poor farmers is being considered.

10971 **Ngotho, J.M., Makumi, I.N. and Ndung'u, J.M., 1999.** *In vitro* laboratory colonisation of *Glossina pallidipes*. (Abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 355-356.

Ngotho: KETRI, P.O. Box 362, Kikuyu, Kenya.

Previous attempts at colonising *G. pallidipes* in the laboratory have not been successful, *in vivo* feeding on rabbits resulting in poor fecundity, low emergence rates and high mortality. In the present study, flies collected from Kibwezi forest, Kenya, were fed on defibrinated bovine blood collected aseptically from healthy cattle from the KETRI herd 6 days a week using the artificial membrane technique. The insectary environmental conditions were maintained at 25 ± 1°C and 80 ± 5% relative humidity. The flies were held in medium size PVC cages holding a maximum of 25 flies. The average longevity of the wild flies was between 60 and 80 days; mortality decreased from *c*. 70% in the first batch to under 10% in subsequent batches, indicating improvement in the handling and performance of the colony. The first batch of wild flies produced a high percentage of lower weight class pupae but the trend changed to more class B and C pupae (30-37 mg) with subsequent batches, and the emergence rate rose from 20% to over 90%. The F1 generation colony has grown steadily, with high quality pupae in classes B and C. It is envisaged that the technique can be adapted for collection of larger amounts of blood in a slaughterhouse for mass-rearing to produce sterile males for tsetse control by SIT.

10972 **Opiyo, E., Luger, D., Feldmann, U., Hendrichs, J. and Paral, A., 1999.** Developments in tsetse fly mass rearing at Seibersdorf Laboratories. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 359-361.

Opiyo: Entomology Unit, FAO/IAEA Agriculture and Biotechnology Laboratories, A-2444 Seibersdorf, Austria.

The feasibility of rearing tsetse flies in Africa for the sterile insect technique (SIT) was first demonstrated in Tanzania in 1972-1979. This was followed by projects in Burkina Faso (1976-1984) and Nigeria (1979-1986) and another project is currently nearing successful completion in Zanzibar. These projects were carried out in limited areas due to, among other considerations, the inability to produce adequate numbers of sterile flies for large area-wide compaigns. The incorporation of the SIT as a final component of integrated area-wide tsetse/trypanosomosis intervention programmes requires, as a pre-requisite, semi-industrial scale tsetse production. This involves the development of methods for standardisation of quality sensitive processes and of partial automation of labour intensive fly handling procedures. This communication describes

research that has been carried out to take care of the main bottlenecks of tsetse mass rearing. These are: (i) fly emergence, (ii) handling of young flies, and (iii) holding and feeding of the flies. The methods tested allow the emergence of adult flies directly into production cages in the correct sex ratio without chilling and manual separation of pupae (saving 23% of total time for tsetse rearing), thus eliminating the need for chilling and manual separation of sexes after mating (saving 17% of total time). The possibility of automating the holding, feeding and collection of pupae has been demonstrated and will be further evaluated.

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **22**: no. 10990.]

10973 **Kappmeier, K., 1999.** Target and odour-bait improvement for the tsetse species *Glossina brevipalpis* and *G. austeni* in South Africa (N.E. Kwazula-Natal). *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 337-342.

Onderstepoort Veterinary Institute, Private Bag X05, Onderstepoort 0110, South Africa. [karink@moon.ovi.ac.za]

An attractive target has been developed for the control of *G. brevipalpis* and *G. austeni* in north-east Kwazula-Natal. Baiting with a synthetic odour mixture greatly increases its effectiveness against *G. brevipalpis* but has no additional effect on *G. austeni.* Studies on various coloured targets showed that a 1.75-2.0 m black/pthalogen-blue/black target was most effective and practical for both species. For *G. brevipalpis* control, only the black parts of the 2 m target need to be treated with insecticide as opposed to the entire surface of a 1.75 m target. For *G. austeni* it was shown that the entire target should be treated since this species also settles on the blue section. For the attraction of *G. brevipalpis*, studies on the components of the synthetic ox odour used in Zimbabwe, namely 3-*n*-propylphenol, octenol, 4-methylphenol and acetone, showed that 3-*n*-propylphenol could be omitted. Octenol should be released at between 2.4 and 9.6 mg/h and 4-methylphenol at 12.8 mg/h. These doses together with acetone released at 350 mg/h increased the catches significantly 2.3-3.1 fold when compared to the Zimbabwe mixture and could be recommended for future use. Other phenols, namely 3- and 4-ethylphenol, 4-*n*-propylphenol, 3-methylphenol, and butanone were also tested at various doses but were unattractive. None of the odour treatments tested was found attractive for *G. austeni*. The addition of the recommended odour to a 1.75 m black/p.blue/black target was 3.5 times more effective for *G. brevipalpis* than the target system used in the *G. brevipalpis* control trial in the Hluhluwe Game Reserve in 1992.

10974 **Oloo, G.O., Muriuki, G., Wilson, C., Bourn, D., Okech, G., Stevenson, P., Makumi, J. and Ndung'u, J.M., 1999.** The tsetse distribution map of Kenya: current status. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 474-475.

Oloo: KETRI, P.O. Box 362, Kikuyu, Kenya.

A workshop held in April 1996 aimed to review the tsetse distribution map of Kenya, to recommend measures for maintaining and updating relevant databases, and to arrive at a consensus on the future surveillance of tsetse distribution in the country. The information obtained from the workshop confirmed tsetse presence in accordance with the 1967 tsetse distribution map but highlighted considerable changes. Kenya has eight species of tsetse distributed in six widely separated belts. *Glossina fuscipes fuscipes* is confined to the Lake Victoria basin and its rivers in Western and Nyanza provinces. *G. swynnertoni* and *G. fuscipleuris* are confined to Narok District and *G. austeni* to the coastal belt. *G. longipennis* and *G. brevipalpis* are found in the drier parts of the coastal hinterland and the forest relicts, in the Rift Valley, Eastern and North Eastern provinces. *G. pallidipes* is found in almost all the fly belts. The Lake Victoria and Tsavo National Park fly belts have expanded, and this needs verification on the ground. In the western Kenya fly belt, *G. pallidipes* was reported to have extended its range up the Turkwel river by over 120 km, whereas a lower arm was shown to be tsetse free. Bungoma district in western Kenya, the Thika and Murang'a districts, central Kenya, were reported as being newly infested with *G. pallidipes*. Also apparent is the expansion of tsetse belts and subsequent linking of the belts at the centre of the country and with the coastal belt. Recommendations included the need for surveys in areas where no recent information is available, general study of the impact of environmental and land use change on tsetse distribution, and updating the national Tsetse and Trypanosomosis Geographical Information Systems Database (TTGISD) so that it may be used as a planning and management tool. In due course, a revised map of tsetse distribution in Kenya will be printed and put into circulation.

10975 **Yao, Y., Green, C.H., Späth, J. and Traore, G., 1999.** Essais comparatifs de différents modèles de pièges et de substances olfactives pour la capture de *Glossina longipalpis*, Wiedemann, 1940 (Diptera: Glossinidae) en Côte d'Ivoire. [Comparison of different models of traps and olfactory attractants for *G. longipalpis* in Côte d'Ivoire.] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 329-336.

Yao: Service de Lutte contre la Trypanosomiase Animale et les Vecteurs, 01 B.P. 3301, Bouaké 01, Côte d'Ivoire.

The efficiency of different trap models used in different parts of Africa (biconical, monoconical Vavoua, pyramidal, Mérot, N'Gu (NG2G) and Epsilon) was tested for the capture of *G. longipalpis*. Results were analysed with reference to the biconical trap commonly used for tsetse monitoring in control operations in Côte d'Ivoire. The results showed that monoconical models were the most efficient for this fly, with the monoconical Vavoua trap being the best. It was 7 times more efficient than the biconical trap, and shortening the interior screens had no effect on its attractivity. The efficiency of the modified Vavoua trap (shorter screens) ranged from 21.9% to 35.8% compared with 13.8% to 15.5% for the biconical trap. Using the modified Vavoua trap, we tested olfactory attractants such as 4-methylphenol and 3-methylphenol, which are essential components of the phenolic fraction of ox urine, and also acetone and octenol. Results showed that the two phenols acting alone or together were not significantly different from

the control without attractants even though a mixture of 3-methylphenol and 4-methylphenol (1:5) increased the catches by 80%. The addition of octenol to the phenols gave no increased effect, but the association of acetone and phenols increased the catches three times, independently of the releasing rate of acetone. The best proportions of 3-methylphenol and 4-methylphenol in the presence of acetone at a release rate of 100 mg/h were 1:0.5 and 1:1. In conclusion, the modified Vavoua with shorter screens with a mixture of 3-methylphenol and 4-methylphenol in combination with acetone is much more efficient in catching *G. longipalpis* than the biconical trap which is commonly used for tsetse monitoring in Côte d'Ivoire and which can lead to under-estimation of populations of this species.

3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE-EFFECTS)

[See also **22**: nos. 10955-10957, 10959, 10960, 10967, 10968, 10973, 10990, 11007.]

10976 **Allsopp, R., 1999.** The implementation of odour bait techniques for the control of tsetse flies in eastern and southern Africa. (Presented as a PAAT position paper.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 411-426.

NRI, Central Avenue, Chatham Maritime, Chatham, Kent ME4 4TB, UK.

This position paper is in three parts. Part 1 summarises the methods which have recently been used to control tsetse. Of the various techniques available, cattle dipping is probably the least expensive. Although figures are not readily available, SIT is probably the most expensive but is environmentally benign. Both have advantages and disadvantages but are certainly viable options to control authorities. Residual applications of insecticide from the air and expensive thermal fogging would probably be discounted on environmental grounds. Depending on local situations and the strategic objective (control or eradication) there is probably little difference in the costs of the three most widely used chemical control methods, viz. discriminative ground spraying, aerial spraying and odour-bait techniques. Similarly, barring accidents or malpractice, all three have no long-term irreversible effects. Part 2 presents a case study on experience with targets in Botswana where tsetse occur almost exclusively in the Okavango Delta, a wildlife area with no cattle where tourism is the main activity. Targets have been used since 1992 and have kept large areas of the delta fly free and have prevented major invasion into areas earlier cleared by aerial spraying. Part 3 summarises and assesses the information provided in response to a questionnaire distributed to control authorities which use odour-bait techniques in eastern and southern Africa. The few questionnaires that have been returned do not provide a definitive assessment of the current tsetse control situation in the area but neither do they suggest that significant progress is being made. There is an indication that it is time to review objectives, assess performance, reconsider options, mobilise all available resources (including those in the private sector) and perhaps revise the strategies currently used.

10977 **Barrett, K. and Okali, C., 1999.** Partnerships for tsetse control: community participation and other options. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 451-461.

Barrett: Overseas Development Group, School of Development Studies, University of East Anglia, Norwich NR4 7TJ, UK.

The paper aims to stimulate debate and clarify issues relating to community involvement in tsetse control using traps and targets. A framework is provided to facilitate programme planning. By incorporating various levels and types of participation, including cash, labour, time and decision-making, and a range of possible partners, including local communities, private sector businesses, non-governmental organisations and government, the framework provides a range of options to be considered. The challenge for planners is to match the overall policy objective, eradication or suppression, with the social, institutional and economic parameters to arrive at a sustainable programme. Implications of the alternative policies of tsetse eradication or suppression for the composition of partnerships are discussed. Given the objective of suppression, greater levels of direct non-government participation will be possible and decisions about suppression levels will shift from government to its partners as their involvement increases. The potential for community participation is assessed in relation to human and livestock population density and distribution, the organisational capacity of communities and the proposed size of the control area. The potential for communities to adapt the technology to meet their own situations and requirements is also discussed. It is concluded that community participation is not appropriate as an overall strategy for tsetse control although it may be feasible in some contexts. A more sustainable strategy is likely to be one involving partnerships of different stakeholders. A clear understanding of how these partnerships can work is required: expected benefits as perceived by each partner and actual or potential conflicts must be identified.

10978 **Bastiaensen, P., Kouagou, N.T., Napala, A. and Hendrickx, G., 1999.** Le secteur privé peut-il mener à bien la lutte antivectorielle? Expériences au Togo. [Can the private sector handle tsetse control? Experiences in Togo.] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 477-479.

Bastiaensen: Projet ‘Lutte contre la Trypanosomose Animale au Togo’, B.P. 114, Sokodé, Togo. [Tryptogo@cafe.tg]

The FAO project GCP/TOG/013-BEL has succeeded in assessing the trypanosomosis problem based on geo-referenced data collection and has developed a grid-based national control programme, in which control methods and priority areas are defined. Whilst strategic chemotherapy and trypanotolerant livestock are the main established tools in Togo to reduce trypanosomosis losses, there are selected areas where tsetse control is likely to become economically beneficial and sustainable. In March 1997, sixteen areas were selected for tsetse control primarily on the basis of a severe prevailing trypanosomosis problem, a relatively high cattle density and a fair number of commercial production units. The underlying rationale is that trypanosomosis control, likewise any animal production or health campaign, should be approached economically and become

financially sustained by the beneficiaries. In the selected sixteen tsetse control areas the cattle owners themselves undertake the tsetse control operations. Elected representatives are coached by project field personnel and private veterinarians so as to ensure timely and correct block treatment of all cattle in their area with insecticide. Zootechnical, socio-economic, parasitological and entomological monitoring is in place to evaluate the results. Pilot schemes conducted by the project show that, under the conditions present in Togo, livestock bait technology appears superior to stationary baits in terms of acceptability and ease of cost-recovery. With privatisation of the veterinary sector in West Africa becoming commonplace, Togo pursues the establishment of an autonomous distribution circuit for pour-on insecticides, encompassing arrangements for import, distribution and retail.

10979 **Bauer, B., Kabore, I., Lefrançois, T. and Solano, P., 1999.** Impact du triflumuron, inhibiteur de la synthèse de la chitine, sur deux espèces de mouches tsétsé dans la zone subhumide du Burkina Faso (Afrique de l'Ouest). [Impact of the chitin synthesis inhibitor, triflumuron, on two tsetse species in the sub-humid zone of Burkina Faso, West Africa.] (Abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), p. 348.

Bauer: CIRDES, 01 B.P. 454, Bobo Dioulasso 01, Burkina Faso.

A control trial using 1667 triflumuron-impregnated targets was conducted in an area of high density of *Glossina morsitans submorsitans* and *G. tachinoides*. The targets were deployed along drainage lines, dams and dirt roads covering approximately 400 km^2 of a 900 km^2 game ranch, where the typical West African wildlife was still present apart from eland (*Tragelaphus derbianus*) and hippopotamus (*Hippopotamus amphibius*). After target deployment in November 1996, five entomological surveys were conducted in January, February, April, May and July 1997. These showed a significant shift in the age structure of the *G. tachinoides* population, with the disappearance in July 1997 of the 1-19 days age group. This shift in the age structure was less pronounced in the *G. m. submorsitans* population. Mature infection rates, i.e. infections of the proboscis alone and simultaneous infections of both proboscis and midgut, increased from 22.0% and 14.9% in January and February 1997, respectively, to reach a peak of 42.4% in July in *G. m. submorsitans*. For *G. tachinoides* the initial mature infection rates of 7.1% and 4.2% in the first two months of 1997 rose to reach 17.5% in April and 23.8% in July 1997.

10980 **Chamisa, A. and Mweempwa, C., 1999.** Control of tsetse flies *G. pallidipes* Austen and *G. morsitans morsitans* Westwood in the Kariba Hills, an area common to Zambia and Zimbabwe. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 432-437.

Chamisa: Tsetse and Trypanosomosis Control Branch, Department of Veterinary Services, P.O. Box CY52, Causeway, Harare, Zimbabwe.

Control of tsetse flies *Glossina morsitans morsitans* and *G. pallidipes* in Kariba Hills, an area of 450 km^2 spanning the Zambia/Zimbabwe international border, was achieved to 99.68% using odour-baited targets after both countries had instituted control operations in 1994. Initial control efforts on the Zambian side alone from 1991 to 1994 did not yield desired results as there was continuous re-invasion from Zimbabwe where

control activities were not being done during the same period. Control on the Zambian side would not have taken so long or used so many resources if activities had been started at the same time on both sides of the border. This work therefore highlights the importance of international joint operations in border areas.

10981 **Langley, P.A., 1999.** Autosterilization as a means of tsetse control: a role for insect growth regulators (IGRs). *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 343-347.

School of Pure and Applied Biology, University of Wales, P.O. Box 915, Cardiff CF1 3TL, UK.

A population of insects can be reduced by regularly eliminating a given proportion of the population, which in the case of tsetse may be as low as 1% per day. Traps and targets impregnated with synthetic pyrethroids, to which tsetse are attracted by appropriate visual and olfactory stimuli, have been very successful but ways of increasing efficiency are still being sought. One approach is to replace the insecticide with an insect growth regulator (IGR). These are of two kinds: juvenile hormone mimics or analogues (JHA) such as pyriproxyphen which disrupt the moulting cycle of the *in utero* larva, and chitin synthesis inhibitors (CSI) such as triflumuron which disrupt cuticle formation. Both these substances penetrate the adult female tsetse cuticle on contact and are transferred to the larval gut, preventing completion of metamorphosis (JHA) or formation of a puparium (CSI). Contaminated males are unaffected by these compounds but can transfer effective doses to females when they mate. Preliminary field trials of specially designed contaminating devices (CDs) on top of odour-baited traps or targets have been carried out in Zimbabwe against *Glossina morsitans morsitans* and *G. pallidipes*, in Kenya against *G. pallidipes* and in Côte d'Ivoire against *G. tachinoides*, and have given promising results although the formulations of these compounds used on targets appear not to be as persistent (weatherproof) as deltamethrin and their use on targets may not therefore be economically favourable. IGR-treated CDs may be particularly useful for pre-release population suppression in SIT programmes and a project to test this concept is under way on Buvuma Island, Lake Victoria, Uganda, against *G. fuscipes fuscipes* using triflumuron-treated CDs on pyramidal traps.

10982 **Lumamba, D.N., Mweempwa, C., Mubanga, J. and Leroy, E., 1999.** Eradication of *Glossina morsitans morsitans* and *Glossina pallidipes* in the Kariba Hills of Siavonga, southern Zambia. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 427-431.

Lumamba: RTTCP Project, P.O. Box 350001, Chilanga, Zambia.

Eradication of *G. m. morsitans* and *G. pallidipes* in the Kariba Hills of Siavonga, southern Zambia was achieved when similar and complementary control operations were carried out in Zimbabwe. Initial efforts were made to control tsetse flies on the Zambian side without doing so on the neighbouring Zimbabwe side during a period of 36 months (November 1991 to November 1994), using odour-baited insecticide-impregnated screens or targets. In 1991, an initial 3.6 targets/km^2 were deployed in an area of 90 km^2. This

figure was increased to 6.8 targets/km^2 in 1993 and the area was expanded to 165 km^2. However, these changes made to the density of targets did not reduce the apparent density of the tsetse population. Instead, an opposite trend was observed so that apparent density increased with increase in target density. Tsetse fly density rose from 0.005 flies/trap/day prior to control in July 1991 to a maximum of 0.238 flies/trap/day in April 1994. This gradual increase in fly population was consistent with that of trypanosomiasis disease incidence. Four months after the start of complementary control efforts in the adjacent area of Zimbabwe, the apparent fly density dropped to zero. No tsetse or trypanosomiasis disease cases have been reported (on the Zambian side) since then.

10983 **Mahamat, H. and Okech, M., 1999.** The lethal insect technique (LIT): a new concept for the control of *Glossina* spp. in field and laboratory. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 349-351.

Mahamat: ICIPE, P.O. Box 30772, Nairobi, Kenya.

It has been reported that *Beauveria bassiana* and *Metarhizium anisopliae* are capable of inducing mortality of tsetse populations in the laboratory. The aim of the present investigation was to test the usefulness of entomopathogenic fungi in contaminating tsetse flies in semi field conditions. Two different contaminating devices (CDs) were used, the old ICIPE CD and a new improved CD. Traps fitted with CDs contaminated with 1 g and 2 g of *B. bassiana* and *M. anisopliae* were placed in Rusinga Island at different sites. Field-trapped *Glossina fuscipes*, which had passed through the contaminated CDs, and the control were caught in fly cages so that they could not escape. These flies (donors) were kept singly and allowed to mate 24 h later with clean field-collected flies (recipients). Between 70 and 100% of tsetse which had passed through traps fitted with fungus contaminated CDs picked up the fungus and later succumbed to it. Furthermore, these flies were also able to transmit the fungus to clean flies. Females were better donors than males. The material (plastic bottle) used in the old CD deteriorated within a month whereas the new CD was not affected by environmental factors. Studies are under way to determine the transmission of the fungus under real field conditions using mark-release-recapture.

10984 **Makumi, J.N., Greene, C., Stevenson, P. and Ndung'u, J.M., 1999.** Dynamics of re-invasion by *Glossina longipennis* Corti in a controlled area. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 446-448.

Makumi: KETRI, P.O. Box 362, Kikuyu, Kenya.

One of the most important requirements for tsetse control in areas which form part of an extensive tsetse belt is to prevent re-invasion of tsetse from uncontrolled areas. This is particularly important in community-based tsetse control programmes, where sustainability is likely to be low. This study evaluated re-invasion of *G. longipennis* in Galana Ranch, south-east Kenya, using baited impregnated targets to understand the mechanisms and rate of re-invasion, including the effect of rainfall. Targets impregnated with deltamethrin were deployed for a year to suppress the tsetse population. Tsetse monitoring was carried out before, during and after control operations using 16 baited F3

and Epsilon traps in a transect in the area for 48 h every fortnight. Installation of the targets reduced the tsetse population by 99% between June 1992 and July 1993. After removal of the targets in July 1993, the population remained low with an average of *c.* 0.1 flies/trap/day for the first 3 months but increased to *c.* 2 flies/trap/day in November 1993 (× 20 increase). Tsetse numbers then decreased to *c.* 1 fly/trap/day until July 1994 when numbers started to increase, reaching highest numbers in November 1994 with an average of 12 flies/trap/day (× 120 increase). The population stabilised at *c.* 4 flies/trap/day with seasonal fluctuations for the rest of the trial period until October 1996 when the population re-established to the peak of 12 flies/trap/day. There was a close correlation between the monthly mean tsetse numbers and the monthly rainfall totals in the suppression area, the highest tsetse numbers being recorded during periods of highest rainfall in November. Significantly more females were caught than males. Ovarian dissection and wing fray ageing methods showed that they were predominantly older females, over 80% being in age categories above 2. This suggests re-invasion rather than an increase in the residual population. Mark-release-recapture of flies caught in the area showed a high dispersal of marked flies: none were recaptured in 30 days either within or outside the trial area.

10985 **Okoth, J.O., Omare-Okurut, A. and Eboyu, F., 1999.** The use of theatre to mobilise and sensitise rural communities to participate in tsetse control in Bugiri district, Uganda: a case study. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 480-483.

Okoth: LIRI, P.O. Box 96, Tororo, Uganda.

Busoga region of Uganda, in which Bugiri district is situated, has been hit by epidemics of sleeping sickness many times in history. Various methods of tsetse control have been tried, mainly by personnel from outside the community, with resultant lack of sustainability. The use of theatre was conceived as an effective way to encourage community participation in tsetse control, providing entertainment while carrying messages and involving many people, literate and illiterate. The specific objectives of the theatre approach were: (a) to create awareness among the community about the dangers of tsetse; (b) to establish and strengthen community-based organisations' ability to mobilise communities to participate in tsetse control; (c) to provide the community leaders and primary health care personnel with messages about the need to support tsetse control in their communities; and (d) to identify and integrate existing activities with the control of sleeping sickness in the community. Information was collected using focus group discussions. The people were then asked to form stories, using the traditional folklore approach. Various issues, such as the dangers of tsetse, the need to work together, the need to have accurate information, and the need to control tsetse by general cleanliness and trapping, were eventually, after further discussion, woven into a story which formed the basis of a play called '*Ekiriita Omwana*' ('Your child will die because of your own negligence'). A sleeping sickness song was also created. As a result of the performance of the play, civic leaders contributed money for tsetse traps and community members started making inquiries as to how they could participate in tsetse control. Theatre thus appears to be an effective tool to entertain people while they learn things useful to their survival.

10986 **Olubai, W.A., Kuloba, R., Oloo, F.P. and Lako, G.T., 1999.** Community participation in tsetse and trypanosomosis control in Transmara District, Kenya: a preliminary study. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 484-489.

Olubai: KETRI, P.O. Box 362, Kikuyu, Kenya.

Animal trypanosomosis is a major constraint to livestock productivity in Transmara District. Past tsetse and trypanosomosis control programmes have shown that for tsetse and trypanosomosis control to be cost-effective and sustainable, there is need to involve the community. Transmara Development Programme (TDP) in conjunction with GTZ have adopted a community-managed tsetse and trypanosomosis control programme in the Olopikidong'oe area. Participatory rural appraisal (PRA) tools were used to assist in identifying the community's constraints and opportunities. Animal diseases featured as the most important impediment to livestock productivity in all the *elatias* (villages) involved in the study. The community was sensitised to trypanosomosis and tsetse control issues to enable them to make informed choices. Poster presentations were used to convey information that people needed to select the catalytic farmers to be trained. The training covered the following topics: (a) understanding tsetse and its related problems, (b) bovine trypanosomosis, (c) tsetse control methods, (d) evaluation and costs of available solutions with emphasis on tsetse control, (e) community involvement in tsetse and trypanosomosis control and (f) environmental considerations relating to community-based tsetse control. Since December 1996, these *elatias* have been engaged in a participatory process of education and mobilisation for tsetse and trypanosomosis control. Community organisations are being formed and decisions taken at *elatia* meetings. There has been a commitment to contribute money to buy traps in readiness for control activities.

10987 **Saleh, K.M., Vreysen, M.J.B., Kassim, S.S., Suleiman, F.W., Juma, K.G., Zhu, Z.-R., Pan, H., Dyck, V.A. and Feldmann, U., 1999.** The successful application of the sterile insect technique (SIT) for the eradication of *Glossina austeni* (Diptera: Glossinidae) from Unguja Island (Zanzibar). *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 438-445.

Saleh: Commission of Agriculture and Livestock, P.O. Box 159, Zanzibar, Tanzania.

In 1994, the governments of Tanzania and Zanzibar, with the technical assistance of the IAEA, embarked on a programme to eradicate *G. austeni* from Unguja Island of Zanzibar. Initially the fly population was suppressed by application of persistent insecticides on cattle and by deployment of blue insecticide-impregnated screens. This was followed by the dispersal of gamma-sterilised male flies by light aircraft, initially over the southern half of the island, later (from July 1996) over the entire island. Monitoring of the eradication effort was done with more than 500 sticky panels, positioned in strategic areas, and by sequential screening of the disease incidence in 38 sentinel herds. More than 7.8 million sterile male flies were dispersed by aircraft over the island from August 1994 to September 1997, reaching an average of more than 70,000 males released per week in 1996. Ratios of sterile: wild male flies remained below 10:1

until mid 1995. Thereafter, ratios of > 100:1 were obtained over the entire southern part of the island. This resulted in a rapid increase in the proportion of female flies showing evidence of mating with a sterile male fly, i.e. from < 25% in the last quarter of 1994 to > 70% by the end of 1995. The apparent density of the indigenous male and female fly population declined rapidly by the end of 1995, followed by a population crash in the beginning of 1996. The last wild male and female flies were trapped in 1996 in weeks 32 and 36, respectively. The disease incidence in the sentinel animals, as measured by the buffy coat technique, was < 1% in January 1997 and limited to *Trypanosoma vivax*. Fly releases will continue until the end of 1997, i.e. ± 6 fly generations after the last wild fly has been trapped.

4. EPIDEMIOLOGY: VECTOR-HOST AND VECTOR-PARASITE INTERACTIONS

[See also **22**: nos. 10961, 11026.]

10988 **Duvallet, G., Reifenberg, J.M., Solano, P., Sidibé, I., La Roque, S. de, Lefrançois, T., Cuisance, D., Touré, S.M. and Cuny, G., 1999.** Epidémiologie moléculaire des trypanosomoses animales: premier bilan des recherches menées en Afrique de l'Ouest. [Molecular epidemiology of animal trypanosomiasis: first results of research conducted in West Africa.] *In*: OAU/STRC, 1999 (see 22: no. 10963), pp. 277-285.

Duvallet: CIRAD-EMVT, Montpellier, France.

The epidemiology of the trypanosomoses has benefited greatly in recent years from the development of molecular biology tools which have facilitated research on the characterisation and genetic variability of the parasites and their vectors. This is essential for the development of more focused and efficient control programmes. Epidemiological research carried out in recent years using PCR in the field in West Africa and in laboratories in France, in particular at CIRAD-EMVT, CIRDES and ORSTOM, is reviewed. An analysis of the variability of the trypanosome species, especially *Trypanosoma congolense*, and the accurate characterisation of the parasites in the host and in the vector have helped to provide a better understanding of epidemiological cycles. The hypothesis of preferential parasite-vector pairs has been tested. In addition, the vectorial capacity of various tsetse species has been studied in the laboratory and in the field. It is noteworthy that many trypanosomes detected by microscopical examination, especially in vectors, are not recognised by available molecular probes. More research is needed in order to identify all the trypanosomes in disease epidemic areas. Finally, efforts have to be made to simplify these tools and to facilitate their transfer to national or regional laboratories.

10989 **Herder, S., Grebaut, P., Eouzan, J.P., Morlais, I., Djoha, S. and Cuny, G., 1999.** De nouveaux marqueurs moléculaires pour l'étude de la variabilité génétique de *T. brucei* s.l. [New molecular markers to study genetic variability of *T. brucei* s.l.] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 176-178.

Herder: Laboratoire de Recherche sur les Trypanosomoses, OCEAC, B.P. 288 Yaoundé, Cameroon.

New molecular markers that are able to discriminate between the different subspecies of *T. brucei* s.l. are essential in the comprehension of the epidemiology of human African trypanosomiasis and particularly its reappearance in foci where it was considered extinct. The genetic markers currently used are laborious and require a good level of biochemical expertise. New molecular markers capable of distinguishing between *T. b. brucei*, *T. b. gambiense* and *T. b. rhodesiense* were isolated in the OCEAC trypanosomiasis laboratory. They consist of microsatellite DNA sequences extracted from the *T. brucei* genome. These markers, based on amplifications by PCR of these sequences, are easy to use and can be carried out in a relatively simply equipped laboratory.

10990 **Kiragu, J.M., Green, C.H., Stevenson, P.G. and Makumi, J.N., 1999.** *Glossina brevipalpis* Newstead 1910, another *fusca* species giving cause for concern. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 362-368.

Kiragu: KETRI, P.O. Box 362, Kikuyu, Kenya.

Increasing land pressure in the tsetse infested areas is leading to utilisation of forest lands for grazing. This inevitably promotes contact between livestock and forest dwelling tsetse such as *G. brevipalpis*. Studies were carried out in Kibwezi, Kenya, to assess whether this species could be important as a vector of livestock trypanosomiasis. Dissections and microscopy indicated that flies had trypanosome infections in the proboscis and midgut. Infection rates varied seasonally from zero to 5.4%, and were comparable to those found in many other tsetse flies. Two Boran steers kept in tsetse-free conditions away fom Kibwezi developed mixed infections of *Trypanosoma congolense* and *T. vivax* after being experimentally fed upon by field-collected *G. brevipalpis*. In the absence of a suitable trap among those conventionally in use for other tsetse species, mobile vehicle fly rounds offer an appropriate technology for sampling. Landing responses on a cloth-only target were low. Consequently, stationary electrified screens for research or insecticide-impregnated targets for control purposes require side panels of mosquito netting. The optimum design was a 1 × 1 m blue cloth target with a 0.5 × 1 m mosquito netting side panel.

10991 **Morlais, I., Grebaut, P., Bodo, J.M., Djoha, S., Cuny, G. and Herder, S., 1999.** Detection and identification of trypanosomes by polymerase chain reaction (PCR) in wild tsetse flies in Cameroon. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 170-175.

Morlais: Laboratoire d'Epidémiologie des Maladies à Vecteurs, Centre ORSTOM, B.P. 5045, 34032 Montpellier, France. [cuny@orstom.rio.net]

The prevalence of various species and subgroups of trypanosomes in infected flies from three sleeping sickness foci (Mbam, Fontem and Campo) in Cameroon was determined using the PCR method. The predominant tsetse species was *Glossina palpalis*

palpalis. Microscopical examination of 943 non-teneral tsetse flies revealed an average infection rate of 10.4%, the majority (55.6%) being infected only in the proboscis. Ninety of the infected flies were analysed using primer sets specific for *Trypanosoma (Trypanozoon) brucei* s.l., *T. (Duttonella) vivax*, *T. (Nannomonas) simiae* and forest type *T. (Nannomonas) congolense.* PCR succeeded in identifying the trypanosomes in 52 of the 90 infected flies. Only one-third of the proboscis infections (4/12) were identified as *T. vivax*. Forest type *T. congolense* was the most prevalent species (28/52; 53.8%); the majority of these (17/28; 60.7%) were mixed infections with other species (*T. brucei*, *T. simiae*, *T. vivax*). *T. brucei* occurred in half the flies (26/52). PCR amplification thus allowed identification of immature infections and revealed an overall prevalence of mixed infections of 40.4%. The PCR technique failed to identify 42.2% (38/90) of the parasitologically positive flies and the reasons for this failure are discussed. Other primers were tested on microscope-positive/PCR-negative infections and detected 3 Kilifi type and 1 savanna type *T. congolense* infections.

10992 **Okoth, J.O., 1999.** Natural hosts of *Glossina fuscipes fuscipes* and epidemiological implications for sleeping sickness outbreak in S.E. Uganda. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 238-241.

LIRI, P.O. Box 96, Tororo, Uganda.

This paper examines the opportunistic feeding behaviour of *G. f. fuscipes* in relation to the changing habitat and its implications for sleeping sickness outbreaks in south-east Uganda. A total of 575 blood meal samples from tsetse were collected from Kapyanga and Nabukalu in Iganga District, of which 265 were analysed. The results show that 57% of the flies fed on cattle and 26% on man. Only 5% fed on reptiles. The peridomestic behaviour of *G. f. fuscipes* and its preference for man and cattle has turned it into a dangerous vector of sleeping sickness. Even at a low fly apparent density, active transmission can take place with cattle as reservoir. Sometimes a whole household becomes infected. It is postulated that in several years *G. f. fuscipes* may acquire an even higher degree of peridomesticity, like house flies and *Stomoxys*, making necessary a new control strategy if eradication is to be contemplated.

10993 **Ouma, J.O., Masake, R.A., Masiga, D.K., Moloo, S.K., Minja, S.H., Njuguna, J.T., Olaho-Mukani, W. and Ndung'u, J.M., 1999.** Comparative sensitivity of dot-enzyme linked immunosorbent assay (dot-ELISA) and the polymerase chain reaction (PCR) in the detection of trypanosome infection in tsetse flies (*Glossina* spp.). *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 160-165.

Ouma: KETRI, P.O. Box 362, Kikuyu, Kenya.

The dot-ELISA, developed for the detection and identification of trypanosome species in tsetse flies, was validated in the laboratory by comparing its sensitivity to that of the PCR. *Glossina morsitans centralis* were experimentally infected with different stocks of *Trypanosoma brucei* and *T. congolense.* The flies were dissected and midgut samples tested using the two techniques alongside each other. Dot-ELISA detected 98.4% of *T. brucei* and 71% of *T. congolense* infections in tsetse midguts and was shown to detect up to a minimum of 10^3 trypanosomes per dot. PCR detected 97.6% of *T. brucei*-

infected and 96% of *T. congolense*-infected tsetse midgut samples. These results show both the dot-ELISA and PCR as sensitive, species-specific tests for revealing trypanosome infections in tsetse flies. A limitation of the dot-ELISA is that it can detect a minimum of 10^3 parasites as compared to PCR which detects fewer numbers of trypanosomes. However, the dot-ELISA reported in the present study utilises material that can easily be transported to the field and can be performed without the need for electricity. It will be a useful tool in the generation of field data on the infection rates and prevalence of trypanosome infection in the tsetse population.

10994 **Penchenier, L., Herder, S., Bodo, J.M., Grebaut, P. and Wang Sonne, 1999.** Dynamique de la ré-émergence de la trypanosomiase humaine en Afrique centrale, dans les pays de la zone OCEAC. [Dynamics of re-emerging human trypanosomiasis in Central Africa (OCEAC countries).] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 217-223.

Penchenier: Laboratoire de Recherche sur les Trypanosomoses, OCEAC, B.P. 288 Yaoundé, Cameroon. [pencheni@oceac.orstom.cm]

Since the late sixties, the incidence of human African trypanosomiasis has been rising gradually. The epidemics in the OCEAC area during the last few years have all occurred at known endemic foci which had been sites of pandemics at the end of the 19th century and the beginning of the 20th century. To determine the causes of epidemics in these foci and their endemicity, it is necessary to analyse the history and dynamics of these endemic areas in the regional context and not at the national level. Their origin needs to be studied in order to determine whether these foci existed before human colonisation (primary foci) or if they are the result of population movement. One may ask whether in each endemic focus a particular strain of trypanosomes is present. If this hypothesis is correct, the endemic focus may follow its evolutionary course independently, and epidemics may be due to a re-emergence of the local strain (possibly related to the absence or decrease in acquired immunity of the new generation of hosts). It may also be possible that epidemics are associated with the introduction of new strains of trypanosomes from another endemic region. In this case, the evolution of the epidemiological situation should be analysed at the regional level, and its implications for the trypanosomiasis control programme considered.

10995 **Truc, P., Merriweather, A., Diallo, P.B. and Unnasch, T.R., 1999.** L'isoenzyme et l'ACP pour identifier les repas de sang chez les glossines. [Isoenzyme and PCR for identifying blood meals in tsetse flies.] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 166-169.

Truc: Laboratoire de Biologie des Parasites et Vecteurs, IPR/OCCGE, 01 B.P. 1500, Bouaké, Côte d'Ivoire. [truc@bouake.orstom.ci]

Two techniques for distinguishing between human and other mammalian blood meals of tsetse are described. The qualitative analysis of superoxide dismutase (SOD), an enzyme contained in large quantities in blood cells, showed practically no variability within human and tsetse populations but large variability between different species of

mammals (man, pig, cattle, sheep, rodents, horse). An analysis carried out in Côte d'Ivoire found 30% of tsetse blood meals of human origin and 60% of animal origin, while only 10% were unidentifiable, probably because of enzyme degradation during digestion. The second technique, based on PCR and heteroduplexes (HDA), found slight variability in the human population, and two human types, A and B, were kept as controls. Using this technique, it was possible to distinguish between human and non-human hosts up to 72 h following the blood meal. The HDA technique was successfully used to distinguish blood meals taken on pigs and humans in the Sinfra region of Côte d'Ivoire. Although further trials of HDA on other tsetse in other foci should be carried out, these two techniques are promising and complementary. SOD is cheap and quick and can be used to calculate the index of risk but requires the dissection of tsetse to remove the digestive tract, while PCR/HDA can be used on crushed, non-dissected tsetse.

5. HUMAN TRYPANOSOMIASIS

(a) SURVEILLANCE

[See also **22**: nos. 10961, 10989.]

10996 **Akol, M.N., Schmid, C., Enyaru, J.C.K., Odiit, M., Brun, R. and Kaminsky, R., 1999.** Serodiagnosis of *Trypanosoma brucei gambiense* sleeping sickness in Northern West Uganda by immunofluorescent antibody test. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 117-121.

Akol: LIRI, P.O. Box 96, Tororo, Uganda.

Serological testing depends on the suitability of the antigen used. This study attempted to adapt four *T. b. gambiense* isolates from north-western Uganda for the production of specific antigens for use in IFAT and other serological tests, and to test them for their sensitivity and specificity in the diagnosis of *gambiense* sleeping sickness. One of the four trypanosome isolates was successfully adapted to *Mastomys natalensis* and subsequently bloodstream form culture. The trypanosomes were suspended in 5% FCS in PSG. Smears were prepared from this suspension, fixed in acetone/chloroform and stored in silica gel at 4°C until used. One hundred and twenty blood samples, 20 from confirmed sleeping sickness cases, 20 from non-infected persons and 80 from persons infected with other parasitic diseases, were collected on filter paper and each tested against this antigen and three others using IFAT. Preliminary results showed that the antigen prepared from UTRO 270396A had a sensitivity of 95%, specificity of 98.9% and positive predictive value of 73%, compared to two other antigens from West African *T. b. gambiense* (STIB 754B and DAL 1402) which gave values of 90% sensitivity (both), 97.8% and 92.0% specificity and 66.6% and 69.2% positive predictive value, respectively. Antigen Utat 4.1 (Ugandan *T. b rhodesiense*) gave values of 85%, 96.7% and 60.7%, respectively.

10997 **Arbyn, M., Boelaert, M. and Miaka-Mia-Bilenge, C., 1999.** The potential utility of EPIMAP in the surveillance of sleeping sickness in the Democratic Republic of Congo. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 235-237.

Arbyn: Department of Epidemiology, Scientific Institute of Public Health Louis-Pasteur, J. Sytsmanstraat 14, 1050 Brussels, Belgium.

Sleeping sickness control has been the subject of a major debate between advocates of active case finding by specialised mobile teams (vertical approach) and proponents of a control strategy implemented through the district health service (horizontal approach). In Congo D.R., where there have been some major epidemic outbreaks in several historical foci in recent years, well equipped mobile teams have in the past operated independently of the local health authorities. Today, the consensus is that no control strategy should be run outside the health service, but that the decision on active or passive screening will depend on the local epidemiological conditions and available resources. The use of EPIMAP, a simple and free GIS software package which allows cartographic presentation of epidemiological or other spatial referenced data, as a common surveillance mapping system could facilitate strategic decision-making and furthermore enhance collaboration between health professionals. District Medical Officers should be involved in planning of itineraries of the mobile teams for which printed maps can be a useful tool. Health centre nurses can invite the target population, assist the mobile teams in active screening and can assure compliance with treatment and follow-up of diagnosed cases. In the past, mobile teams produced epidemiological reports on the areas visited but these often did not correspond to administrative boundaries and changed over time, making longitudinal analysis of trends impossible. An information system based on the health district and its subdivisions will enable the use of fixed topographic denominators which provide more relevant data for impact evaluation. New cases detected in health centres or district hospitals can be easily integrated into the same statistical system. Feedback with easily interpretable maps can further motivate all concerned peripheral health workers.

10998 **Enyaru, J.C.K., Matovu, E., Akol, M., Sebikali, C., Schmid, C., Brun, R., Kaminsky, R., Ogwal, L.M., Kansiime, F. and Maiso, F., 1999.** Re-evaluation of Card Agglutination Test for Trypanosomiasis (CATT) for the diagnosis of *Trypanosoma brucei gambiense* in North West Uganda. *In*: OAU/STRC, 1999 (see 22: no. 10963), pp. 129-133.

Enyaru: LIRI, P.O. Box 96, Tororo, Uganda.

A total of 45 parasitologically confirmed cases of sleeping sickness were diagnosed in north-west Uganda of which 40 were positive by CATT and four were negative, while one was not screened by CATT. The four sleeping sickness cases which gave negative CATT results have very important implications in the diagnosis of *T. b. gambiense* using CATT because it implies that the CATT misses out some patients who remain as human reservoirs for continuous infection of the population. Trypanosomes isolated from these CATT-negative but parasitologically positive sleeping sickness patients were propagated for detailed biochemical genetic analysis in order to demonstrate whether these trypanosomes lack the LiTat 1.3 gene used in the CATT. Some of these 45 sleeping

sickness cases were detected by a combination of two or three techniques. All the DNA extracts isolated from the 10 *T. b. gambiense* stocks so far prepared were targeted for amplification by the three variable surface glycoprotein genes thought to be ubiquitous in *T. b. gambiense*. The LiTat 1.3 gene which encodes the antigen chosen for the CATT was shown to be present in the 10 isolates including the four isolated from CATT-negative patients. The extent of false CATT-negative individuals (due to non-expressor LiTat 1.3 populations or low sensitivity of the CATT) is unknown because CATT-negative individuals are rarely examined further. This study demonstrates the value of a co-ordinated use of serological and parasitological techniques in the diagnosis of *T. b. gambiense* sleeping sickness.

10999 **Legros, D., Hutin, Y., Brown, V., Lee, E., Owini, V. and Paquet, C., 1999.** Evaluation de la prévalence de la trypanosomose à *Trypanosoma brucei gambiense* avec la méthode LQAS: résultats d'une étude réalisée dans le comté de Terego en Ouganda. [Estimation of the prevalence of *T. b. gambiense* trypanosomosis using the LQAS method: results of a survey conducted in Terego County, Uganda.] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 268-270.

Legros: Epicentre, P.O. Box 2362, Kampala, Uganda.

Lot Quality Assurance Sampling (LQAS), a method which can be applied when the sample may consist of several subgroups, was used to estimate the overall prevalence of sleeping sickness in Terego County in north-west Uganda. The 100,000 inhabitants of the county are divided into 24 parishes (lots) of which only 14 were accessible to the survey; one person in each of 59 randomly chosen households was selected randomly to make up a sample of 59 persons per parish. Cases of sleeping sickness were defined parasitologically or serologically. A fixed threshold of 2 cases per sample of 59 was used which allowed upper and lower threshold prevalences of 10% and 2% respectively to be defined. When the number of cases diagnosed in a parish was below the threshold, the parish was accepted; in other words the prevalence in this parish was estimated at below 10%. When the number diagnosed was above the threshold of 2 cases, the parish was rejected and the prevalence estimated at above 2%. Altogether 826 individuals were tested for sleeping sickness, of which 16 cases were confirmed parasitologically, giving a prevalence for the whole county of 2.2% (95% CI, 1.1-3.2). As the population of the 14 parishes was 53,000, the number of cases could be estimated at between 584 and 1698, or between 1093 and 3180 for the whole county. Using the serological case definition, 4 parishes had an estimated prevalence of more than 2%. LQAS not only allowed estimation of overall prevalence but also permitted identification of potential areas of high transmission in the focus.

11000 **Lejon, V., Büscher, P., Magnus, E., Meirvenne, N. van, Doua, F. and Sema, N., 1999.** Further evaluation of a LATEX/IgM assay for IgM quantification in cerebrospinal fluid of sleeping sickness patients. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 122-128.

Lejon: Department of Parasitology, Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium.

Optimal treatment of *Trypanosoma brucei gambiense* sleeping sickness, with minimal risk for the patient, depends on correct determination of stage. This is currently carried out by examining the CSF for cell number, protein concentration and presence of trypanosomes. IgM concentration in CSF is a helpful alternative parameter for stage determination as second stage patients can have abnormally high CSF IgM concentrations. A latex agglutination test, LATEX/IgM, for detection of IgM in CSF of sleeping sickness patients under field conditions was developed. The reagent consists of IgM-specific antibodies covalently coupled to latex particles. The test takes only 10 minutes, is performed on serial dilutions of CSF and results are comparable to those obtained by nephelometry. In its freeze-dried form, the reagent remains stable for at least 12 months, even at 45°C. Results obtained with CSF samples from 142 parasitologically confirmed *T. b. gambiense* patients (34 from Congo D.R., 108 from Côte d'Ivoire) before treatment are reported. End titres showed that the group of second stage patients, determined by CSF cell concentration of > 5 cells/µl, was heterogeneous. When a limit of 20 cells/µl was used to subdivide the second stage patients, end titres of early second stage samples were grouped around a median of 4, approaching the first stage median of 2, while the advanced second stage sample group was more or less separated from the early group with a median of 256. This strengthens the hypothesis that an upper limit of 20 cells/µl might be more appropriate for stage determination.

11001 **Penchenier, L., Djoha, S., Grebaut, P. and Herder, S., 1999.** Utilisation d'une nouvelle technique de préparation du sang pour le diagnostic par PCR des trypanosomiases humaines et animales: premiers résultats. [Use of a new method of blood preparation for PCR diagnosis of human and animal trypanosomiasis: first results.] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 147-151.

Penchenier: Laboratoire de Recherche sur les Trypanosomoses, OCEAC, B.P. 288 Yaoundé, Cameroon. [pencheni@oceac.orstom.cm]

Detecting trypanosomes in blood is difficult. Compared to classical parasitological methods, PCR is more sensitive and often more specific. However, direct amplification in blood is hindered by haemoglobin-derived products. We overcame this problem by developing a simple and efficient method of blood preparation which enables blood samples to be taken under field conditions. PCR applied to blood samples is then able to detect one trypanosome in 1 ml of blood. We have tested the technique first on human blood in the laboratory, then in Cameroon on pigs living in their natural environment in a village without *gambiense* trypanosomiasis and in a village in an endemic area. PCR results accorded with parasitological results but PCR had the advantage of greater sensitivity and specificity. This technique, though not suitable for mass screening nor for hospital diagnosis, can be used under field conditions to facilitate epidemiological studies, especially in determining the residual reservoir of the disease (animal reservoir, human trypanotolerance), and also in veterinary research.

(b) PATHOLOGY AND IMMUNOLOGY

(c) TREATMENT

[See also **22**: no. 11000.]

11002 **Boa, Y.F., Dja N'Goran, N. and Doua, F., 1999.** La qualité de la vie après le traitement de la trypanosomiase humaine africaine (THA) à *T. b. gambiense*. Etude prospective portant sur 424 patients traités et suivis au PRCT de Daloa, Côte d'Ivoire. [The quality of life after treatment of *T. b. gambiense* human African trypanosomiasis (HAT). A prospective study on 424 patients treated and followed up at PRCT, Daloa, Côte d'Ivoire.] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 271-273.

Boa: Ministère de la Santé Publique, Abidjan, Côte d'Ivoire.

Over a 10-year period, 1284 cases of trypanosomiasis were diagnosed and treated at PRCT, Daloa, Côte d'Ivoire. A field study to discover their physical, mental, biological and social state traced 424 patients (33%) with a follow-up period of more than 24 months. While 310 (73.1%) of the patients presented neuro-endocrine disorders at diagnosis, only 8 (1.9%) still had such disorders (including 4 with lowered libido). Only 34 (8%) had CSF abnormalities compared with 322 (75.9%) at the outset. Social integration of all these former patients was excellent. This study confirmed the effectiveness of current treatments in the mesenchymatous phase of meningo-encephalitic trypanosomiasis.

11003 **Legros, D., Evans, S., Maiso, F., Enyaru, J.C.K. and Mbulamberi, D., 1999.** Une épidémie de rechutes chez des patients traités pour la trypanosomose à *Trypanosoma brucei gambiense* dans le district d'Arua en Ouganda: novembre 1996 – avril 1997. [An outbreak of relapses among patients treated for *T. b. gambiense* trypanosomiasis in Arua District, Uganda, November 1996 – April 1997.] *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 264-267.

Legros: Epicentre, P.O. Box 2362, Kampala, Uganda.

A new treatment programme, started by Médecins sans Frontières (MSF) in Arua, north-west Uganda, in September 1995, admitted more than 900 trypanosomiasis patients in 2 years. At the beginning of 1997, the centre's monitoring data showed an apparent epidemic of relapses following melarsoprol treatment. Retrospective studies showed that age and the occurrence of complications during initial hospital treatment were associated with a reduction in risk of relapse in the year following treatment, while risk was higher in men than in women, and in patients diagnosed with trypanosome(s) in the CSF (× 2). The risk of relapse was 6.8 times higher in patients admitted for retreatment than in patients admitted for a first treatment. Case-control studies indicated that doses of melarsoprol received by relapse cases were consistently lower than those received by controls but the differences were not significant. Possible reasons for these results (biases of selection or over-diagnosis, poor application of treatment protocol, degraded melarsoprol because of

poor storage conditions) are discussed and discounted. Development of resistance by the *T. b. gambiense* strains in the Arua district is put forward as the most likely hypothesis, possibly as a result of underdosing with melarsoprol before the MSF programme was started. The need for other drugs to provide a second line of defence, and for simpler techniques for testing trypanosome strains for resistance is stressed.

11004 **Maiso, F., 1999.** Adverse effects of pentamidine in *T. b. gambiense* sleeping sickness in North Western Uganda. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 242-247.

National Sleeping Sickness Control Programme, P.O. Box 1241, Jinja, Uganda.

In this study the author investigated the adverse effects of pentamidine in *T. b. gambiense* sleeping sickness patients in Adjumani sleeping sickness centre in north-western Uganda. A total of 92 patients were monitored during treatment with pentamidine, 29 (31.5%) being in the early stage and 63 (68.5%) in the late stage. The early-stage patients each received a total of 10 injections of pentamidine i.m., while the late-stage patients each received a single i.m. injection of pentamidine 2 days before commencement of melarsoprol. Thirty-three (35.9%) of the patients developed adverse effects: 14 (42.4%) early-stage patients and 19 (57.6%) late-stage. Fever (axillary temperature of 38°C or more) was the most frequent adverse effect overall (10.9%) and among the late-stage patients (14.3%), while induration at the injection site was the most frequent in early-stage patients (27.6%). Other adverse effects were tachycardia (9.8%), vomiting (8.7%), hypoglyceamia (7.6%), injection pain/abscess (6.5%), proteinuria (3.3%), hypotension (2.2%) and abdominal pain (1.1%). Among the patient characteristics studied, none was a predisposing factor to the development of adverse effects except that patients in poor general condition stood a higher risk of developing an adverse effect ($P < 0.05$). The prevalence of adverse effects in this study was found to be much lower than that described in AIDS patients, indicating that pentamidine is a relatively safe drug in *T. b. gambiense* sleeping sickness patients.

6. ANIMAL TRYPANOSOMIASIS

(a) SURVEY AND DISTRIBUTION

[See also **22**: no. 11001.]

11005 **Bengaly, Z., Ganaba, R., Sidibe, I. and Duvallet, G., 1999.** Prévalence des infections trypanosomiennes chez les bovins de la zone sud-soudanienne du Burkina Faso. [Prevalence of bovine trypanosomiasis in the south sudanese zone of Burkina Faso.] (Abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), p. 295.

Bengaly: CIRDES, 01 B.P. 454, Bobo Dioulasso 01, Burkina Faso.

A total of 1796 cattle from the south sudanese zone of Burkina Faso, a trypanosomosis endemic area, were examined for the presence of trypanosomal infection using the buffy coat/dark ground and the stained thin smear methods. The aim was to assess the prevalence of trypanosomosis and the factors affecting its variation. In four provinces where the investigations were done during the rainy season (July-August), the prevalence varied between 7.6% and 12.2%. In the fifth province where the survey was carried out during the dry season (March), the prevalence was estimated at 4.9%. Only the breeding zone and the age class showed a significant effect on the prevalence of trypanosomosis out of the factors investigated (province, breeding zone, animal race and age). In particular, a decrease in the prevalence of *Trypanosoma vivax* with age was observed, the reverse of the situation with *T. congolense*. *T. vivax* was the predominant species (64% of total infections), followed by *T. congolense* (46.6%), then *T. brucei* (2.5%). Mixed infections represented 13%. The presence of *T. vivax* was frequently associated with the presence of *T. congolense*.

11006 **Eisler, M.C., Lessard, P., Moloo, D., Masake, R.A. and Peregrine, A.S., 1999.** Sensitivity and specificity of antigen-capture ELISAs for diagnosis of *Trypanosoma congolense* and *Trypanosoma vivax* infections in cattle. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 179-193.

Eisler: Department of Veterinary Physiology, University of Glasgow Veterinary School, Bearsden Road, Glasgow G61 1QH, UK.

The sensitivity and specificity of the FAO/IAEA Trypanosomiasis Direct Antigen-ELISA was tested on samples of serum taken from cattle experimentally infected with cloned populations of *T. congolense* (three) or *T. vivax* (one) by tsetse bite. Experiments were conducted using a double-blind system. Ten cattle in each of four groups were infected with a single trypanosome population, four other cattle remaining as non-infected controls. Parasitological examination was conducted daily for 3 weeks and bi-weekly thereafter, for at least 60 days, by the phase-contrast buffy coat technique, and blood samples for separation of serum were collected on the same days. Although the ELISAs had good diagnostic specificity for trypanosome infections, trypanosome species specificity was poor. The sensitivity and specificity of the ELISA depended on the choice of negative and positive threshholds expressed as percentage positivity. For example, at a 5% positivity cut-off, the sensitivity was 11% for samples from cattle infected with *T. congolense* and 24% for *T. vivax*. Corresponding values for specificity were 95% and 79% respectively. Lowering the cut-off to 2.5% positivity gave sensitivities of 25% for *T. congolense* and 35% for *T. vivax*, while the respective specificities were 85% and 63%. There was no value for the cut-off at which both sensitivity and specificity were satisfactory. Restricting analysis to only those samples collected 14 days or more after tsetse challenge had little effect on sensitivity. In contrast, the sensitivity of the buffy-coat technique for *T. congolense* infections was reasonably high (67%) for all samples, and very high (96%) for those collected 14 days or more after tsetse challenge. The sensitivity for *T. vivax* was lower (60%), but reasonably high (76%) for ≥ 14 day samples.

11007 **Hopkins, J.S., Chitambo, H., Machila, N., Luckins, A.G., Rae, P.F. and Eisler, M.C., 1999.** Adaptation and validation of the antibody trapping ELISA, using

dried blood spots on filter paper, for epidemiological surveys of tsetse transmitted trypanosomosis in cattle. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 138-146.

Hopkins: FITCA (Kenya) Project, OAU/IBAR, P.O. Box 30786, Nairobi, Kenya.

An indirect antibody ELISA for bovine trypanosomosis was adapted for use with either serum samples or dried blood spots on filter paper. As a component of the validation of this assay, studies were conducted to assess its sensitivity and specificity using samples of known provenance: from populations of cattle in the tsetse-free area around Lusaka (sera, n = 209; bloodspots, n = 466) and from parasitologically positive, naturally infected cattle in Eastern Province, Zambia (sera, n = 367; bloodspots, n = 278) (parasitological examination by buffy-coat/phase contrast technique and thick and thin Giemsa-stained blood films). The antigen for coating ELISA plates was prepared as a soluble fraction of *Trypanosoma congolense* purified by DEAE anion-exchange chromatography of parasites from whole blood of infected rats. Sera were diluted 1/400 in phosphate buffered saline (PBS) containing 0.05% Tween 20 (PBST). Six millimetre disks punched from dried bloodspots on filter papers were eluted in 2.0 ml PBST. Antibody detection used rabbit anti-bovine IgG peroxidase conjugate (Sigma) optimally diluted in PBST. The percentage positivity (PP) method of data expression and quality assurance was used. Strong positive, weak positive and negative reference sera and conjugate control were included in every ELISA plate. Excellent sensitivity and specificity were obtained. The assay worked well using either conventional serum samples or eluates of dried bloodspots on filter paper. The best results were obtained with bloodspots, for which values of sensitivity and specificity of 93.7% and 98.1% respectively were obtained by fitting appropriate distributions to the observed data. Ab-ELISA is potentially useful to establish seroprevalence of trypanosomosis in a region for the purposes of targeting tsetse and trypanosomosis control operations. Seropositivity does not necessarily indicate current infections in individual animals and should not be used as a basis for chemotherapy.

11008 **Magona, J.W., Kakaire, D. and Mayende, J.S.P., 1999.** Animal trypanosomosis survey on Buvuma Island, Uganda. (Abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), p. 294.

Magona: LIRI, P.O. Box 96, Tororo, Uganda.

Whereas numerous studies had been carried out on tsetse on Buvuma Island, the animal trypanosomosis situation was not known. Therefore, a survey to determine the prevalence of animal trypanosomosis was carried out in March 1997. A total of 59 cattle, 127 goats, 16 pigs and 30 dogs were examined for trypanosomosis using the buffy coat technique. Trypanosomes were detected in 18.6 ± 5.0% of the cattle, 3.1 ± 1.5% of the goats, 50 ± 12.5% of the pigs and 3.3 ± 3.2% of the dogs; 10% of cattle were infected with *Trypanosoma brucei*, 5.2% with *T. vivax*, 1.7% with *T. congolense* and 1.7% with *T. vivax/T. brucei* mixed infection; 1.5% of the goats were infected with *T .brucei* and another 1.5% with *T. vivax*; 43.8% of the pigs were infected with *T. brucei* and 6.2% with

T. congolense/T. vivax mixed infection; all infected dogs had *T. brucei*. There exists an eminent risk of animal trypanosomosis to livestock on Buvuma Island. In addition, a high prevalence of *T. brucei* in domestic animals on the island indirectly implies existence of a significant animal reservoir for human trypanosomosis given that the area is highly infested with *Glossina fuscipes fuscipes*. The current animal trypanosomosis situation clearly justifies the planned implementation of SIT and other tsetse and trypanosomosis control measures on Buvuma Island.

11009 **Mwemdia, C.M.T., James, A., Roderick, S. and Stevenson, P., 1999.** Trypanosomosis in sheep and goats under a pastoral management system in Kenya. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 286-293.

KETRI, P.O. Box 362, Kikuyu, Kenya.

The presence of small ruminants in areas with trypanosomosis has been used to suggest that these animals are not susceptible to the disease. These animals are mainly kept by small-scale farmers and their low infection rates may be related to management rather than innate trypanotolerance. To investigate the effect of management on trypanosome incidence, four mixed flocks of sheep and goats (two sedentary, two transhumant) were monitored in Olkiramatian Group Ranch in Kajiado district, Kenya, for a period of 3 years. The study also assessed trypanosomosis related losses in productivity among small ruminants under the pastoral livestock management system. The overall annual incidence of trypanosomosis caused by *Trypanosoma vivax* and *T. congolense* among breeding sheep and goats was 13% and 6.8% respectively. Lambs and kids had few infections as they were not much exposed due to the management system. Sheep had significantly more infections than goats ($P < 0.05$). There were seasonal differences in the occurrence of trypanosome species in that most of the *T. vivax* cases were observed during the dry season, while most *T. congolense* infections were observed in the wet season. PCV and body weight gains were significantly affected by trypanosomosis ($P < 0.05$). The study showed that trypanosomosis was well controlled by the pastoral management system. The disease incidence increased with the tsetse challenge and locational management of the animals. Future disease control will only be worthwhile after the management system changes from transhumant to sedentary.

11010 **Ndamkou, C.N. and Nchare, A., 1999.** Bovine trypanosomosis in northern Cameroon: sensitivity and specificity of diagnostic techniques used. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 197-198.

Ndamkou: Laboratoire National Vétérinaire (LANAVET), P.O. Box 503, Garoua, Cameroon.

The sensitivity and specificity of various diagnostic techniques were determined in a prevalence study of bovine trypanosomosis (*Trypanosoma brucei*, *T. congolense* and *T. vivax*) in northern Cameroon. A total of 4932 cattle were examined between November 1994 and July 1995. Three parasitological techniques, the buffy coat technique (BCT), the microhaematocrit centrifugation technique (mHCT) and Giemsa-stained smears, were used together with a direct sandwich antigen-ELISA provided by the Joint FAO/IAEA Division. The BCT was the most sensitive technique (68.9% for *T. brucei*; 89.39% for *T.*

congolense; 92.95% for *T. vivax*). The antigen-ELISA showed a low sensitivity (6.76% for *T. brucei*; 25.76% for *T. congolense*; 21.14% for *T. vivax*) but a good specificity (91.09-92.79% for the three species).

11011 **Ngaira, J.M., Karanja, S.M. and Stevenson, P., 1999.** Evaluation of CATT/*Trypanosoma evansi* for the diagnosis of *Trypanosoma evansi* infection in dromedary camels in Kenya. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 134-137.

Ngaira: KETRI, P.O. Box 362, Kikuyu, Kenya.

The card agglutination test for trypanosomiasis for *T. evansi* (CATT/*T. evansi*) is an experimental direct agglutination test for the detection of antibodies to *T. evans*i in serum or plasma of infected animals. The objective of the present survey was to evaluate the performance of the test as a diagnostic tool for *T. evansi* (surra) in camels. A total of 254 camels in 10 herds were tested. CATT/*T. evansi* showed an overall prevalence of 46.0% as compared to 3.1% by parasite detection. Out of the 8 cases with detectable trypanosomes, only 4 were positive by direct microscopy using the buffy coat technique, while the rest were detected by mouse inoculation. CATT/*T. evansi* detected antibodies in 7 of the 8 positive cases. Prevalence was highest in a herd of 18 camels, all of which showed symptoms of surra. CATT/*T. evansi* detected antibodies in 16 of the 18 camels (88.9%), while parasite detection revealed 5 positive (27.8%). This positive correlation between clinical diagnosis, CATT/*T. evansi* and parasite detection was also observed in other herds. All 35 control sera from a *T. evansi*-free herd were negative by CATT/*T. evansi*. Results of this study indicate that detection of anti-trypanosome antibodies by CATT/*T. evansi* is an effective method of screening to assess prevalence of *T. evansi* in dromedary camels in the field and may contribute to control programmes.

11012 **Waiswa, C., Clausen, P.H., Greiner, M., Katunguka-R[wakishaya], E. and Mehlitz, D., 1999.** Comparison of polymerase chain reaction (PCR) and antigen ELISA as diagnostic tools for *Trypanosoma brucei* infection. (Abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 194-195.

Waiswa: Faculty of Veterinary Medicine, Makerere University, P.O. Box 7062, Kampala, Uganda.

The objective of this study was to assess the usefulness of the PCR and Ag-ELISA techniques in the diagnosis of *T. brucei* infection. Three groups of four calves each were used: (1) infected and treated, (2) infected and non-treated, and (3) uninfected controls. Calves in groups 1 and 2 were infected with 1.0×10^3 *T. brucei*. Eleven weeks p.i., group 1 animals were treated with diminazene aceturate at a dose of 7.0 mg/kg body weight. Blood samples were taken three times a week for 23 weeks p.i. PCR and Ag-ELISA were negative for all the samples collected before infection. DNA amplification revealed the specific 177 bp band as soon as 1 day p.i. PCR was positive for all the tested samples collected from the infected animals before treatment. The animals that responded clinically well to treatment showed negative results with PCR beginning on the 4th day after treatment and remained negative thereafter, while two other treated animals remained

PCR-positive and later died. Ag-ELISA showed no antigens in circulation before infection and for the first 5 days p.i. Circulating antigens declined after institution of effective chemotherapy and were detected for up to 3 weeks in animals that responded clinically well to treatment. Unexpectedly, the *T. vivax* and *T. congolense* Ag-ELISAs were positive in this study, suggesting a need for more Ag-ELISA evaluation studies. However, this technique has been shown to have great potential for use in the assessment of the effectiveness of chemotherapy of trypanosomiasis. The PCR primers used in this study were able to differentiate between infected and non-infected animals so PCR is also a useful technique for assessment of the effectiveness of therapy.

11013 **Waiswa, C., Katunguka-Rwakishaya, E. and Mehlitz, D., 1999.** Clinical observation and use of parasitological techniques (HCT and mAECT) in monitoring the success of trypanocidal therapy in cattle after experimental infection with *Trypanosoma brucei.* (English abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), p. 196.

Waiswa: Faculty of Veterinary Medicine, Makerere University, P.O. Box 7062, Kampala, Uganda.

Trypanocidal drugs are widely used to control African bovine trypanosomiasis and resistance has been reported. The objective of this study was to assess the utility of parasitological techniques, the haematocrit centrifugation technique (HCT) and the miniature anion exchange centrifugation technique (mAECT), for the demonstration of therapeutic success. Three groups of Ankole long horn (Sanga) cattle each containing four male one-year-old castrate calves were used in this study. Calves in groups 1 and 2 were infected with *T. brucei*. Eleven weeks p.i. calves in group 1 were treated with diminazene aceturate. Blood and serum samples were taken three times a week for 23 weeks p.i. Trypanosomes were detected in circulation on the fifth day p.i. by both HCT and mAECT. None of the four treated animals showed a relapse of trypanosome infection as determined by the two techniques. Parasites could not be detected in the blood of even non-treated animals from the 18th week p.i. up to termination of the experiment. There was a progressive decrease in PCV values starting when parasitaemia developed, followed by a rise in all treated animals. Five of the infected calves developed nervous signs which resulted in death. This study has shown that parasitaemia in chronic *T. brucei* in cattle may be undetected by parasitological methods and that treatment of infected animals at 72 days p.i. does not prevent brain involvement. While it is necessary to demonstrate the presence of trypanosomes in circulation by use of parasitological methods before confirming that the animal has current infection, the results of this study show that this is not always possible. It is therefore important to combine parasitological, serological and DNA techniques for the diagnosis of trypanosomiasis.

(b) PATHOLOGY AND IMMUNOLOGY

[See also **22**: no. 11025.]

11014 **Anosa, V.O., 1999.** Bone marrow functions and pathology in trypanosomiasis. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 298-300.

EC Trypanosomiasis Project, c/o Department of Veterinary Pathology, University of Ibadan, Ibadan, Nigeria.

Bone marrow functions and pathology in trypanosomiasis have been studied in ruminants infected with *Trypanosoma vivax* and *T. congolense*. There is a marked consistency of changes observed, with variations associated with breed. Changes in bone marrow are consistent with: gross expansion of red bone marrow in long bones, increased cellularity of haemopoietic tissue, selective proliferation of some cell lineages and hypoplasia of others, marked proliferation of macrophages with phagocytosis of cells. Although bone marrow attempts to replace lost cells, anaemia and leucopenia persist because of phagocytosis of their precursors and mature forms in bone marrow; mature cells are also phagocytosed in spleen and liver, and there is selective hyperplasia of granulocyte precursors. N'Dama cattle, with greater cellularity of bone marrow, apparently replace lost cells better than Borans, which is presumably a major characteristic of trypanotolerance. Questions which still need answers are: (i) How do the selective changes in proportions of cell lineages occur? (ii) What causes macrophage activation? (iii) Why do the macrophages destroy haemopoietic cells selectively (mostly erythrocytes, granulocytes, thrombocytes, seldom lymphocytes)? (iv) What is the significance of contacts between macrophages and haemopoietic cells (more marked in N'Dama than Borans)?

11015 **Katunguka-Rwakishaya, E., Fishwick, G., Parkins, G., Mubanga, J., Holmes, P.H. and Murray, M., 1999.** Influence of plane of nutrition on the pathophysiology of *Trypanosoma congolense* infection and on isometamidium prophylaxis in sheep. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 400-402.

Katunguka-Rwakishaya: Department of Veterinary Medicine, Makerere University, P.O. Box 7062, Kampala, Uganda.

Two experiments were conducted to investigate the influence of plane of nutrition (i) on the pathophysiology of *T. congolense* infection and (ii) on isometamidium prophylaxis in sheep. In the first experiment, 18 castrated male lambs were divided into two groups and fed either a high protein (HP) diet (176 g digestive crude protein (DCP)/kg dry matter (DM) or a low protein (LP) diet (81 g DCP/kg DM). Four weeks later, 6 animals in each group were infected with *T. congolense*. Animals on the HP diet tended to develop higher intensities of parasitaemia but these differences were not significant. Infected animals on the HP diet grew at similar rates to their uninfected controls but infected animals on the LP diet experienced marked retardation of growth compared with their uninfected controls. Nutrition had no effect on the degree of anaemia in either infected group. In the second experiment, 10 twin pairs of lambs were divided into two groups and put on a high plane (HP) (98.6 g DCP per day) or a low plane (LP) (47.6 g DCP per day) diet. Four weeks later, 6 lambs in each group were injected with isometamidium chloride at a dose rate of 0.5 mg/kg body weight and challenged every 4 weeks with *T. congolense*. The prophylactic period conferred by isometamidium chloride was 121 ± 11 days in the HP group and 117 ± 11 days in the LP group. The prepatent period after 4th challenge was 13 ± 3 days in the HP group and 12 ± 4 days in the LP

group. The mean serum isometamidium concentrations reached a maximum at 4 and 2 h post injection in the HP and LP groups respectively, and after 6 weeks were below the detection limit of 0.2 ng/ml in both groups. It was concluded that, while the plane of nutrition influences rate of growth, it does not affect rate of development and degree of anaemia, isometamidium pharmacokinetics and duration of prophylaxis.

11016 **Njiru, Z.K., Olaho-Mukani, W., Ochieng, R.S., Khaemba, B.M., Guya, S.O., and Omukuba, J., 1999.** *In vitro* phagocytic function of dromedary polymorphonuclear (PMN) cells during experimental infection with *Trypanosoma evansi*. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 205-207.

Njiru: KETRI, P.O. Box 362, Kikuyu, Kenya.

Glass wool adherence, phagocytosis of zymosan and trypanosomes, and cytochrome C reduction test were used to study the effect of *T. evansi* infection on the function of camel polymorphonuclear (PMN) cells. The aim was to investigate the role of the polymorphonuclear system in immunosuppression observed in sick camels. Following infection of five camels with *T. evansi*, there was a significant decrease in the ability of the PMN cells to adhere to glass wool ($P < 0.001$) and reduce cytochrome C ($P < 0.001$), enhanced phagocytosis of zymosan ($P < 0.01$) and increased binding of trypanosomes to PMN cells ($P < 0.05$). The observed alterations of PMN functions were restored following the elimination of trypanosomes with melarsomine treatment. It is concluded that *T. evansi* infection in camels inhibits some PMN cell activities which contribute to the observed immune suppression. These findings call for a mixed treatment with trypanocides and antibiotics in trypanosomosis-infected camels.

11017 **Ouma, J.O., Olaho-Mukani, W., Mutani, A., Wishitemi, B.E.L., Guya, S.O. and Ndung'u, J.M., 1999.** Complement (C_3): purification, characterization and quantitation in sera of *Trypanosoma evansi* infected dromedary camels. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 208-214.

Ouma: KETRI, P.O. Box 362, Kikuyu, Kenya.

The third component of the dromedary complement system (C_3) is known to have important effector functions in immune responses, but its role in camel trypanosomosis has not been determined. The present study aimed at isolating, characterising and evaluating the levels of C_3 in *T. evansi*-infected camels. C_3 was isolated from camel serum by polyethylene glycol precipitation and chromatography. Molecular characterisation on SDS-PAGE revealed that the protein has a molecular weight of 185 kDa. Monospecific antiserum prepared in goats produced single precipitin lines with both the purified form of C_3 and normal camel serum. Following experimental infection of camels with *T. evansi*, serum C_3 levels showed a slight initial increase. The levels dropped 1 week p.i., continued to drop as the infection progressed and correlated negatively with parasitaemia levels. The mean C_3 level of infected animals was significantly lower than that of controls ($P < 0.05$) and only recovered following treatment. The hypocomplementaemia in *T. evansi*-infected camels was attributed to the presence of the trypanosomes, which may be responsible for releasing complement-activating factors. It is concluded that camel C_3 is a

high molecular weight protein and that its depletion occurs in trypanosome-infected camels. In addition, complement may be responsible for the *in vivo* control of parasitaemia, and the hypocomplementaemia reported in the present study could lead to immunosuppression widely reported in animal trypanosomoses.

11018 **Stevenson, P. and Okech, G., 1999.** Haemorrhagic *Trypanosoma vivax* on Galana Ranch in Kenya. (Abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 296-297.

Stevenson: Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK.

Trypanosomosis is commonly diagnosed in cattle on Galana Ranch in Kenya. The ranch includes a large area infested with *Glossina pallidipes* and *G. longipennis*. The recorded annual mortality rate in cattle on the ranch is usually around 4%, less than a quarter of which is ascribed to trypanosomosis. The disease is generally successfully controlled by the use of prophylactic drugs or the treatment of clinically affected animals with diminazene aceturate. In herds grazing in areas with high numbers of tsetse flies, however, the mortality rate can increase greatly if the haemorrhagic form of *T. vivax* infection appears. A profound drop in PCV can occur within a few days and treatment with diminazene aceturate will not always result in cure. In three outbreaks of the disease which were closely monitored on the ranch, 30-60% of the cattle showed a rapid drop in PCV within 1 or 2 weeks and the mortality rate was 5% or more despite prompt treatment with diminazene. Cases of haemorrhagic *T. vivax* are seen after the rains when tsetse numbers are high. The haemorrhagic form of the disease rarely occurs at other times of year when the incidence of trypanosomosis is lower. With the existence of *T. vivax* strains on the ranch which are resistant to isometamidium, prophylactic treatment cannot always be relied upon to prevent the occurrence of trypanosomosis. Removing cattle from areas of the ranch where large numbers of tsetse flies will occur after the rains is the only means at present whereby a high mortality rate from trypanosomosis can be confidently avoided. Some recent trials with a pour-on formulation of deltamethrin indicate, however, that the incidence of haemorrhagic *T. vivax* cases is much lower than expected in treated cattle.

(c) TRYPANOTOLERANCE

[See also **22**: nos. 11014, 11038.]

11019 **d'Ieteren, G., Wissocq, N., Trail, J.C.M., Nantulya, V. and Masake, R., 1999.** Parasite control and assessment of trypanotolerance. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 301-305.

d'Ieteren: ILRI, P.O. Box 30709, Nairobi, Kenya.

The two most widely accepted features characterising trypanotolerance are the control of the intensity, prevalence and duration of parasitaemia and the ability to resist the development of severe anaemia as measured by PCV. Although major progress has been made in research on criteria estimating anaemia control capabilities, it has not been possible to indicate criteria by which an animal would be reliably categorised in terms of

parasite control capability. This is complicated by the fact that, with the buffy coat technique, many infections in trypanotolerant livestock go undetected because parasitaemia is transient, fluctuates widely or is below the limit of detection. Initial work to evaluate the possible contribution of antigen detection tests to more accurately defining infection status has been followed by further research on 568 post-weaner N'Dama cattle in a high natural challenge situation (see **22**: no. 11021). The results suggest that the serial antigen test can contribute to a more accurate determination of an animal's infection status.

11020 **Mwangi, E.K., Stevenson, P., Ndung'u, J.M., Stear, M.J., Reid, S.W.J., Gettinby, G. and Murray, M., 1999.** Studies on host resistance to tick infestations among trypanotolerant *Bos indicus*. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 315-325.

Mwangi: KETRI, P.O. Box 362, Kikuyu, Kenya.

Recent epidemiological studies carried out in East Africa have indicated that some *Bos indicus* cattle breeds such as the Orma Boran and Maasai Zebu have a degree of trypanotolerance worth exploitation by their introduction into trypanosomosis endemic areas where other cattle breeds cannot survive. However, in most areas of East Africa, trypanosomosis, ticks and tick-borne diseases occur together. It is therefore important to obtain information on the susceptibility of these breeds to tick infestation and tick-borne diseases. This study was therefore designed to determine the susceptibility of these cattle breeds to tick infestations. They were compared with the Galana Boran (trypano-susceptible) and the Friesian (susceptible to tick infestations, tick-borne diseases and trypanosomosis). The four breeds of cattle were exposed to natural tick challenge for a period of 7 months and whole body weekly tick counts were done on each animal. Significant differences to tick infestations among the four breeds were observed. For both *Rhipicephalus appendiculatus* and *Boophilus decoloratus*, susceptibility to infestation increased in the order, Maasai Zebu, Orma Boran, Galana Boran and Friesian. The results generated by this pilot study so far suggest that variation to tick infestation exists among the four breeds. The Orma Boran and Maasai Zebu showed greater resistance to tick infestations than the Galana Boran and Friesian. This suggests that utilisation of these trypanotolerant cattle breeds could be feasible even in the face of tick challenge and should therefore be considered when planning integrated trypanosomosis and tick control strategies.

11021 **Wissocq, N., d'Ieteren, G., Trail, J.C.M., Masake, R., Nantulya, V. and Monsengo, B., 1999.** Trypanosome antigen test to characterise infection status in N'Dama cattle. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 310-314.

Wissocq: ILRI, P.O. Box 30709, Nairobi, Kenya.

Practical indicators of the parasite control capability of trypanotolerant animals have still to be identified as they rely on the availability of more precise diagnostic techniques that could be carried out at the farm level. To evaluate the contribution that trypanosome antigen detection techniques, used in conjunction with parasite detection techniques, can

make to improved assessment of trypanotolerance components under natural challenge, 568 post-weaner N'Dama cattle were monitored weekly over a 21 week period for parasitaemia (BCT), antigenaemia (ELISA), PCV, trypanocidal treatment required, and weight. The antigen test was positive in 89.5% of parasitologically positive samples, but not in 10.5%, while 66.9% found parasitologically negative were antigen positive. 69.7% of the animals were detected parasitaemic at least once whereas nearly all were detected antigenaemic at least once. The mean proportion of time an animal had parasitaemia was 11% compared to 69% for antigenaemia. Detected parasitaemia had very significant direct effects on both PCV and growth: on average, animals never infected had 2.3% units higher PCV and gained 64 g more per day than those infected. Antigen test index also significantly affected PCV and weight change: animals with an above-average antigenaemia index had a 2.5% units higher PCV and gained 38 g more per day than those with a below-average antigenaemia index. The effect of infection status characterised by the combination of both diagnostic techniques was then evaluated and significant effects were shown on both PCV and growth: a reduction of 0.18% units in average PCV and of 3.5 g/day in daily live weight change were observed for each unit increase in antigenaemia index in animals not detected parasitaemic, compared to a reduction of 0.33% units in average PCV and of 5.3 g/day in daily live weight change in animals detected parasitaemic. These results suggest that antigen test information can contribute to more accurately defining an animal's infection status and help in assessing trypanotolerance criteria.

11022 **Wissocq, N., d'Ieteren, G., Trail, J.C.M., Minengu, M. and Monsengo, B., 1999.** Ability to acquire resistance to trypanosome infections and growth of N'Dama cattle. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 306-309.

Wissocq: ILRI, P.O. Box 30709, Nairobi, Kenya.

Earlier research had shown that N'Dama cattle can acquire, over time, some control of the development of parasitaemia following a *Trypanosoma vivax* infection but not, apparently, following a *T. congolense* infection. This ability was further assessed in 464 post-weaner N'Dama cattle aged from 12 to 45 months in three herds exposed to different levels of risk which were monitored weekly for 21 weeks. The levels of risk ranged from 28.8% of animals detected parasitaemic at Lebaka, through 54.2% at Mbuli to 90.6% at Ndwe. There were significant decreases in the proportion of time detected parasitaemic with *T. vivax* per monthly increase in animal age in the two higher trypanosomiasis risk herds, with no corresponding significant decrease in proportion of time detected parasitaemic with *T. congolense*. Major differences in the proportions of *T. vivax* and *T. congolense* were found at 45 months of age compared to 12 months, the change being most marked at Ndwe where the *T. vivax*:*T. congolense* ratio was 1:0.5 at 12 months and 1:3.6 at 45 months. With increasing age, the effect of *T. vivax* parasitaemia on animal growth was significantly reduced, compared to the effect of *T. congolense* parasitaemia. These results not only confirm the ability of N'Dama cattle to acquire over time some control of the development of parasitaemia following a *T. vivax* infection, but suggest that its deleterious influence on animal performance is also reduced.

(d) TREATMENT

[See also **22**: nos. 11012, 11013, 11015, 11016, 11018, 11059.]

11023 **Geerts, S. and Holmes, P.H., 1999.** Drug management and parasite resistance in animal trypanosomiasis in Africa. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 371-385.

Geerts: Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp 1, Belgium.

Trypanocidal drugs remain the principal method of animal trypanosomiasis control in most African countries. However, there is growing concern that their future effectiveness may be severely curtailed by widespread drug resistance. An overview is presented of the current situation of resistance to drugs for the chemotherapy of trypanosomiasis in African livestock. Although the number of case reports on drug resistance is increasing, there is a lack of reliable data at the regional or national level on the true prevalence and impact of drug resistance. In order to compare data on a temporal and spatial basis across Africa there is an urgent need for better standardisation of tests for the detection of drug resistance. The advantages and disadvantages of the currently available assays are briefly reviewed and measures suggested to improve the situation. Finally, some guidelines are proposed to delay the development of drug resistance and measures which may be adopted to control drug resistance when it occurs are recommended. Although there is still a lack of knowledge about the mechanisms of resistance and the factors responsible for the development of drug resistance, urgent measures need to be taken to maintain the efficacy of the existing drugs. Based on experiences of the control of resistance to other drugs such as antimalarials, antibiotics and anthelmintics it is suggested that reliance on the 'sanative pair' guideline might not be sufficient to control resistance to trypanocides. This guideline needs to be accompanied by other measures, i.e.: (i) Avoidance of under-dosing. Under-dosing is an important cause of resistance development and commonly occurs in the field. Measures should be adopted to minimise the risks of under-dosing. Better formulations of the existing prophylactic drugs may help to avoid subtherapeutic concentrations, which exert a strong selection pressure for resistant clones. (ii) Reduction in the number of treatments. The most efficient way to delay the development of drug resistance is to reduce the selection pressure caused by these drugs. Exclusive reliance on drugs for the control of trypanosomiasis, especially in areas of high challenge, and mass treatments at short intervals should be avoided. More attention should be given to integrated control measures involving the vector as well as the parasite. (iii) Quinapyramine should no longer be used in cattle. Cross-resistance with the other available trypanocides has now been clearly demonstrated at the level of individual trypanosomes. The use of this drug in cattle is therefore contra-indicated.

11024 **Kageruka, P., Geerts, S., Deken, R. de, Diall, O., Diarra, B., Brandt, J.R.A., Eisler, M.C., Lemmouchi, Y., Schacht, E. and Holmes, P.H., 1999.** Laboratory and field evaluation of sustained release devices for the chemoprophylaxis of African trypanosomiasis in cattle. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 403-405.

Kageruka: Institute of Tropical Medicine, 2000 Antwerp 1, Belgium.

Trials were carried out in cattle in order to evaluate the prophylactic effect of sustained release devices (SRD) containing polymers loaded with isometamidium (ISMM) or homidium bromide (HBr) at a dose of 0.5-1.0 mg/kg body weight. Under laboratory conditions, poly(D,L-lactide)-SRDs were compared with i.m. injection of the same drugs. From 1 month post treatment, cattle were challenged monthly by at least 8 *Glossina morsitans morsitans* infected with *Trypanosoma congolense* clone IL 1180. Parasitological examination was carried out weekly using the buffy coat technique. The average protection period using the ISMM and HBr SRDs was 20 and 8.3 months which was respectively 3.2 and 2.8 times longer than with i.m. injection. After i.m. injection, the serum concentration of both drugs peaked immediately after administration followed by a relatively rapid decline, while after implantation of the SRDs peak concentrations were reached only after a few weeks but levels remained stable and higher for a longer period. Field trials were carried out at the Madina Diassa ranch in Mali, a high tsetse challenge area, on cattle which were first treated with Berenil (7 mg/kg). In the first trial, at 8 months post-treatment the cumulated infection rate (CIR) was significantly lower in the ISMM-SRD-implanted group (27.7%) than in the ISMM-i.m.-injected group (58.5%). In the second trial, two types of implants were used: poly(caprolactone-co-L-lactide) for the ISMM-SRD and poly(D,L-lactide) for the HBr-SRD. Although a clear-cut difference was observed 8 months post-treatment between the CIR of the ISMM-SRD group (26%) and that of the ISMM-i.m. group (41.6%), this difference was not statistically significant. For HBr the difference between the implanted group (49%) and the i.m. group (57.1%) was very small. Preliminary results indicated that there was no difference in drug sensitivity between breakthrough isolates from implanted and i.m.-injected cattle.

11025 **Lopes Pereira, C.M., Lopes Pereira, D., Escrivão, R.A., Schwalbach, L.J. and Pinto, F.G., 1999.** Chemoprophylaxis of trypanosomiasis in dogs. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 386-389.

C.M. Lopes Pereira: Veterinary Faculty, P.O. Box 257, Maputo, Mozambique.

Thirty-four dogs of the Malinois and German Shepherd breeds were introduced in January 1994 into tsetse-infested areas of Mozambique where there was a high prevalence of trypanosome infection in cattle (*Trypanosoma congolense*, *T. vivax* and *T. brucei*). The dogs were treated at 4 month intervals until June 1997 with 1 mg/kg of 1% isometamidium chloride (many dogs experienced a local reaction to the i.m. injection) and checked for the presence of trypanosomes using the HCT and buffy coat methods. Only one dog was infected with *T. brucei* and was treated with diminazene aceturate at 7 mg/kg. Relapses occurred 30 and 14 days after the first and second treatments, respectively. Clinical signs included depression, anaemia, dilated abdomen, inspiratory dispnoea, corneal opacity, fever, CNS disturbances affecting behaviour, vomiting, inflammation of retropharyngeal lymph nodes, ocular lesions and loss of vision. Blood biochemical tests detected hypo-proteinaemia with hypoalbuminaemia, and increases in creatinin, alanine aminotransferase and total bilirubin. After a third treatment with diminazene aceturate at

14 mg/kg the dog's general condition improved and no trypanosomes were found up to 31 days later (when the dog was euthanised due to loss of vision), suggesting that this dose might be an effective treatment.

11026 **Matovu, E., Enyaru, J.C.K., Lubega, G.W., Brun, R. and Kaminsky, R., 1999.** *Trypanosoma brucei rhodesiense* response to Berenil® and implications for control of the domestic animal reservoir in South Eastern Uganda. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 254-259.

Matovu: LIRI, P.O. Box 96, Tororo, Uganda.

Twelve *T. brucei* isolates from domestic animals were human serum-resistant. They were considered potentially human infective and denoted as *T. b. rhodesiense*, while 17 serum-sensitive stocks were denoted as *T. b. brucei*. The former were detected in dogs, pigs and cattle which emphasised that animals harbour human-infective trypanosomes and act as reservoirs in south-eastern Uganda. The above stocks and 9 *T. b. rhodesiense* stocks isolated from sleeping sickness patients were studied for susceptibility to diminazene aceturate *in vitro*. One *T. b. rhodesiense* stock isolated from a sleeping sickness patient showed a reduced susceptibility to the drug: after 10 days drug exposure, more than 100 ng/ml diminazene aceturate was required to eliminate the stock. Treatment of mice which were infected 72 h earlier with the stock revealed that it was refractory to 3.5, 7.0 and 14.0 mg/kg diminazene aceturate, with 80%, 60% and 26% of the mice, respectively, becoming patent. In contrast, treatment of mice infected with *T. b. brucei* which was shown to be drug-sensitive *in vitro* practically effected permanent cure at all doses. However, when cattle infected with the refractory stock, the sensitive stock or a mixture of the two were treated with 7.0 mg/kg, the dose currently employed in south-eastern Uganda, the infection was cleared in all the animals.

11027 **Murilla, G.A., Peregrine, A.S., Holmes, P.H., Eisler, M.C. and Ndung'u, J.M., 1999.** Investigation into the effects of *Trypanosoma congolense* infections on the pharmacokinetics of homidium in Boran cattle. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 398-399.

Murilla: KETRI, P.O. Box 362, Kikuyu, Kenya.

The chemotherapeutic activity of homidium against *T. congolense* infections in cattle was investigated. Two groups of five Boran cattle were infected with two populations of *T. congolense*, one drug-sensitive (IL 1180) and one drug-resistant (IL 3330). Parasitaemia, serum drug levels and pharmacokinetic parameters were estimated. The animals were treated i.m. with homidium bromide at a dose rate of 1.0 mg/kg body weight 7 days after the last animal in each group was detected positive. In cattle infected with drug-sensitive trypanosomes, no parasites were detected in the bloodstream of four out of five cattle within 24 h of treatment, the fifth within 48 h. During this period and for the next 10 days, acceleration in the rate of drug elimination was observed, after which the rate reverted back to that in non-infected cattle. This was accompanied by an elevation in PCV to pre-infection levels. The animals remained aparasitaemic up to the end of the 90 days observation period, with low serum drug concentrations of between 0.1 and 0.3 ng/ml

in circulation. However, following similar treatment of cattle infected with drug-resistant trypanosomes, parasites did not clear from the bloodstream. An acceleration in the rate of drug elimination was also observed following treatment which persisted until the drug was no longer detectable within 20 days of treatment. Non-compartmental pharmacokinetic analysis showed that values for biological half life, area under the curve and mean residence time were significantly higher in cattle infected with the drug-sensitive trypanosome population (423.7 ± 145.6 h; 1667 ± 233 ng.h/ml; 296.7 ± 158.8 h) than in cattle infected with the drug-resistant population (75.5 ± 16.9 h; 1329 ± 156 ng.h/ml; 32.78 ± 4.45 h). The presence of *T. congolense* infection thus significantly alters homidium pharmaco-kinetics in Boran cattle.

11028 **Okech, G., Masinde, A., Stevenson, P. and Ndung'u, J.M., 1999.** The role of isometamidium chloride in chemoprophylaxis against trypanosomosis of small ruminants in Kenya. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 390-397.

Okech: KETRI, P.O. Box 362, Kikuyu, Kenya.

A study was designed to determine the prevalence and impact of trypanosomosis on the performance of sheep and goats in an endemic area, and the most effective regime for isometamidium chloride prophylaxis. This study was conducted at Galana Ranch in the Coast Province of Kenya, on the fringes of a permanent tsetse fly belt, predominantly infested with *Glossina pallidipes*. Ninety-six male weaner Dorper sheep and 83 East African male weaner goats were divided into four experimental groups and given isometamidium at a dose rate of 0.5 mg/kg body weight every 2, 3 and 6 months, while one group remained as an untreated control. The trial lasted for one year. Both sheep and goats suffered from trypanosomosis, resulting in anaemia and weight loss. However, the anaemia and weight loss was more pronounced in sheep and death from trypanosomosis occurred. Taken as a group, the untreated goats gained weight and improved their haematocrit levels in a similar pattern to the treated groups, suggesting a degree of tolerance to the disease by this breed. The first breakthrough infections appeared 4 weeks after isometamidium treatment in sheep and 9 weeks in goats. The present study has shown that trypanosomosis can be a major constraint to small stock productivity in tsetse-infested areas. Chemoprophylaxis has an impact on the performance of sheep, and treatment with isometamidum at 0.5 mg/kg body weight every 3 months may be an appropriate control method under the conditions existing at Galana Ranch. It is concluded, however, that indigenous goats can be kept in this area under minimal prophylaxis.

11029 **Rowlands, G.J., Nagda, S.M., Leak, S.G.A., Woudyalew Mulatu, d'Ieteren, G.D.M. and Peregrine, A.S., 1999.** Epidemiological analyses of trypanocidal drug resistance in zebu cattle in Ghibe, Southwest Ethiopia. (Abstract only.) *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 406-407.

Rowlands: ILRI, P.O. Box 30709, Nairobi, Kenya.

Approximately 750 Ethiopian Highland village zebu cattle were monitored monthly in the Ghibe valley from 1986 to 1997. All isolates obtained from these cattle were found

to be resistant to diminazene aceturate when inoculated into Boran calves. Throughout the period of monitoring, all cases of parasitaemia detected when the PCV was < 26% were treated with diminazene at 3.5 mg/kg body weight. When trypanosomes had been detected in an animal following two months with no parasitaemia detected and with a PCV ≥ 26%, the infection was assumed to be a new one. Using this definition, the mean incidence of *Trypanosoma congolense* infections in cattle over the study period was 13.7% and the overall prevalence of such infections was 22.6%. The difference between these two figures gives a measure of the apparent prevalence of recurrent infections. In contrast, *T. vivax* infections appeared to be drug-sensitive since the incidence and prevalence were both 4.0%. In general the overall incidence correlated better than prevalence with tsetse relative density, which gives credence to our definition of new infections in cattle. This method for defining new infections was used to investigate the effect of tsetse control using cypermethrin 'pour-on', applied over a period of 5 years, on the incidence of trypanosomal infections and prevalence of recurrent infections in one of the herds. Tsetse control resulted in a 72% reduction in the incidence of new infections and a 58% reduction in the apparent prevalence of recurrent infections. In view of the very high prevalence of drug resistant trypanosomes, it would appear, from the apparent reduction in prevalence of recurrent infections, that the cattle at Ghibe were able to develop a better immune response to infection when the tsetse challenge was reduced. A combination of tsetse control and chemotherapy was thus able to reduce the negative effects of trypanosomosis on the health and productivity of the cattle.

7. EXPERIMENTAL TRYPANOSOMIASIS

(a) DIAGNOSTICS

11030 **Verloo, D., Meirvenne, N. van, Lejon, V., Magnus, E. and Büscher, P., 1999.** Evaluation of serological tests in rabbits, experimentally infected with *T. evansi* stocks and clones from different origin. *In*: OAU/STRC, 1999 (see **22**: no. 10963), pp. 152-159.

Verloo: Department of Parasitology, Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium. [dverloo@itg.be]

To evaluate various antigens in antibody detection assays for their diagnostic potential for *T. evansi* infections, rabbits were experimentally infected with *T. evansi* clones and stocks originating from various parts of the world and from different host species. Immune trypanolysis, ELISA, Western blot, direct agglutination (CATT) and indirect agglutination (LATEX) tests were performed on serum samples. Blood samples were collected for parasitological diagnosis. Overall sensitivity was 100% for all test systems on days 29-32 p.i. On days 6-10 sensitivity varied depending on the antigen and the test system. All pre-infection sera yielded negative results.

11031 **Wang, Y.-F., Zhou, Y.-Z., Zhong, S.-M., Song, B. and Shen, J., 1998.** [Detection of *Trypanosoma evansi* by PCR.] [Mice.] (In Chinese with English summary.) *Acta Veterinaria et Zootechnica Sinica,* **29** (2): 168-173.

Shanghai Institute of Animal Parasitology, Chinese Academy of Agricultural Sciences, Shanghai 200232, China.

(b) PATHOLOGY AND IMMUNOLOGY

11032 **Brochu, S., Olivier, M. and Rivest, S., 1998.** Neuronal activity and transcription of proinflammatory cytokines in the brain of acutely- and chronically-infected mice with *Trypanosoma brucei brucei*. (Meeting abstract.) *Society for Neuroscience Abstracts*, **24** (1-2): 1858.

Laboratory of Molecular Endocrinology and Infectious Diseases, CHUL Research Centre, Laval, PQ G1V 4G2, Canada.

11033 **Coetzer, T.H.T., 1998.** Proteases and phosphatases as possible pathogenesis factors in African trypanosomiasis. [*T. b. brucei.*] *South African Journal of Science*, **94** (6): 279-280.

Coetzer: Department of Biochemistry, University of Natal, Private Bag X01, Scotsville, 3209 Pietermaritzburg, South Africa.

11034 **Eltayeb, R., Mustafa, M., Lycke, N., Meide, P.H. van der and Bakhiet, M., 1998.** Cytokines and anti-cytokine autoantibodies during experimental African trypanosomiasis in mice with disrupted interferon-γ and interferon-γ receptor genes. [*T. b. brucei.*] *International Journal of Molecular Medicine*, **1** (1): 177-183.

Bakhiet: Division of Neurology, Karolinska Institute, Huddinge University Hospital R54, S-14186 Huddinge, Sweden.

11035 **Enwezor, F.N.C. and Ekejindu, G.O.C., 1998.** Suppression of antibody response to sheep red blood cells in murine trypanosomiasis. [*T. brucei*, *T. congolense*; rats.] *Biomedical Letters*, **58** (230): 175-181.

Enwezor: NITR, P.M.B. 2077, Kaduna, Nigeria.

11036 **Ghorui, S.K., Srivastava, R.V.N., Bansal, G.C. and Bansal, M.P., 1998.** Humoral immune response in rabbits experimentally infected with *Trypanosoma evansi*. *Indian Journal of Animal Sciences*, **68** (6): 515-517.

Ghorui: Division of Parasitology, Indian Veterinary Research Institute, Izatnagar 243122, UP, India.

11037 **Igbokwe, I.O., Isa, S., Aliyu, U.K., Hamza, H.G. and Egbe-Nwiyi, T., 1998.** Increased severity of acute *Trypanosoma brucei brucei* infection in rats with alloxan-induced diabetes. *Veterinary Research*, **29** (6): 573-578.

Igbokwe: Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria.

11038 **Iraqi, F., Kemp, S. and Teale, A., 1998.** Fine mapping of trypanosomiasis resistance QTLs in mice using advanced intercross lines. [*T. congolense.*] (Meeting abstract.) *Animal Genetics*, **29** (Suppl. 1): 45.

Iraqi: ILRI, P.O. Box 30709, Nairobi, Kenya.

11039 **John, M.C., Nedunchelliyan, S. and Venkataraman, K.S., 1997.** Infectivity of different strains of *Trypanosoma evansi* in rabbits. *Cheiron*, **26** (5/6): 103-104.

Department of Preventive Medicine, Madras Veterinary College, Chennai 600 007, India.

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The production of nitric oxide in trypanosomosis was studied in the vervet monkey (*Cercopithecus aethiops*) model of *rhodesiense* sleeping sickness. Sera and CSF samples were obtained from monkeys infected with *T. b. rhodesiense* (KETRI 2537) and assayed

for nitrate. Nitrate is the stable oxidation product of nitric oxide *in vivo* and a direct indicator of nitric oxide synthesis in the respective tissues. Prior to infection, no nitrate was detected in CSF as compared to 39.5 µM ± 1.84 detected in the sera. Following infection, the sera nitrate concentrations increased rapidly with a peak at day 28 (216 µM ± 3.92), thereafter decreasing to pre-infection levels by day 42. In the CSF, the trend was similar although the values were lower. The nitric oxide peak corresponded to peak parasitaemia, low PCV and high body temperature.

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(c) CHEMOTHERAPEUTICS

[See also **22**: nos. 11080, 11085.]

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Atouguia: Centro de Malária e Outras Doenças Tropicais, Instituto de Higiene e Medicina Tropical, R. da Junqueira 96, 1400 Lisbon, Portugal.

Side-effects, resistance, problems of availability and price of currently approved drugs for late-stage human trypanosomiasis have prompted various new approaches: synthesis of new compounds, combination therapy, different dosage regimens and new methods of administration. Nitroimidazoles have been shown to have good trypanocidal activity but developmental work has been suspended because of their potential mutagenic and teratogenic properties. Good results have been obtained with some drug combinations but those shown to be most effective include either eflornithine, which is not widely available due to its price and production problems, or nitroimidazoles. This paper reviews experiments undertaken on the CNS-trypanosomiasis mouse model using topically applied gels containing melarsoprol combined with nitrofuranes (nitrofurazone and nifurtimox) or with nitroimidazoles (MK-436, fexinidazole and megazol). These showed that (a) melarsoprol/nitrofurazone and melarsoprol/nifurtimox produced permanent cures which were superior to melarsoprol monotherapy; (b) melarsoprol/nitroimidazole combinations could cure CNS-trypanosomiasis in a single application; (c) melarsoprol/MK-436 resolved hind-leg paralysis and post-treatment reactive encephalopathy caused by non-curative treatment of CNS-trypanosomiasis.

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Karanja: KETRI, P.O. Box 362, Kikuyu, Kenya.

This study was designed to investigate PCV profiles with trypanosome infection and following curative and subcurative treatments. Two groups of four vervet monkeys were infected with *T. b. rhodesiense* KETRI 2537 or KETRI 2772. When signs of late-stage disease were observed, the monkeys were treated either curatively with melarsoprol (MelB) or subcuratively with difluoromethylornithine (DFMO). PCV dropped by over 25% within the first 15 days of infection with both trypanosome strains. By day 42 there was a drop in PCV of up to 45% in 90% of the monkeys. Clinically, the monkeys were

dull and could not perch, there was stiffness of the hind limbs, reduced appetite, splenomegaly and enlarged lymph nodes. During the period of DFMO therapy, there was recovery of PCV to pre-infection values. When DFMO therapy was discontinued, PCVs dropped, with monkeys infected with KETRI 2537 showing a faster decline than those infected with KETRI 2772. Curative treatment with MelB resulted in full recovery of PCV to pre-infection values within 4 weeks post treatment. These results show that PCV decline during trypanosome infection is dependent on the strain of the infecting parasite and its rise after treatment may be a good indicator of cure.

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8. TRYPANOSOME RESEARCH

(a) CULTIVATION OF TRYPANOSOMES

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(b) TAXONOMY, CHARACTERISATION OF ISOLATES

(c) LIFE CYCLE, MORPHOLOGY, BIOCHEMICAL AND MOLECULAR STUDIES

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