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Numbers 13466–13600

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TSETSE AND TRYPANOSOMIASIS INFORMATION

The Tsetse and Trypanosomiasis Information periodical has been established to disseminate current information on all aspects of tsetse and trypanosomiasis research and control to institutions and individuals involved in the problems of African trypanosomiasis. This service forms an integral part of the Programme Against African Trypanosomiasis (PAAT) and is jointly sponsored by the Food and Agriculture Organization of the United Nations (FAO), the International Atomic Energy Agency (IAEA), the Inter-African Bureau for Animal Resources of the African Union (AU-IBAR), the World Health Organization (WHO), the Research Department for Livestock Production and Veterinary Medicine of the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD-EMVT), the British Government's Department for International Development (DFID) and the Institute of Tropical Medicine (ITM), Antwerp.

The half-yearly periodical is prepared for publication, in both English and French editions, by the Food and Agriculture Organization of the United Nations. Each annual volume consists of two parts and an index. Subscription is free for all recipients engaged in trypanosomiasis research and control, and requests for enrolment may be sent to: Ms Maria Grazia Solari, AGAH, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy (fax +39 06 5705 5749; e-mail MariaGrazia.Solari@fao.org).

Since the value of this information service depends to a great extent on the receipt of relevant material from research workers, campaign planners and organizers and field workers themselves, readers are requested to submit news items and copies of scientific papers and reports to the Editor: Dr James Dargie, Brunnstubengasse 43, 2102 Bisamberg, Austria (tel. +43 2262 61735; e-mail j.dargie@aon.at).

We regret that we are unable to supply photocopies of the papers quoted in the periodical.

Distribution dates and copy deadlines

	Copy deadline for news items	Distribution (English and French editions)
Part 1	15 April	July/August
Part 2	15 October	January/February

The Index will be distributed as soon as possible after the completion of each volume.

ABBREVIATIONS USED IN *TTI*

a.i.	active ingredient
ACTH	adrenocorticotrophic hormone
ALAT	alanine aminotransaminase
ASAT	aspartic acid aminotransaminase
b.w.	body weight
BIIT	blood incubation infectivity test
CATT	card agglutination test for trypanosomiasis
CD_{50}	median curative dose
CNS	central nervous system
CSF	cerebrospinal fluid
DNA	deoxyribonucleic acid
ELISA	enzyme linked immunosorbent assay
HAT	human African trypanosomiasis
HCT	haematocrit centrifugation technique
GIS	geographic information system(s)
GPS	global positioning system(s)
i.m.	intramuscular(ly)
i.p.	intraperitoneal(ly)
i.v.	intravenous(ly)
IFAT	indirect fluorescent antibody test
KIVI	kit for *in vitro* isolation of trypanosomes
LC_{50}	median lethal concentration
LD_{50}	median lethal dose
M	molar
mAEC	miniature anion-exchange centrifugation technique
McAb	monoclonal antibody
MW	molecular weight
NARS	National Agricultural Research Services/Systems
p.i.	post-infection
PCR	polymerase chain reaction
PCV	packed cell volume
ppb	parts per billion (10^9)
ppm	parts per million
r.h.	relative humidity
RNA	ribonucleic acid
SIT	sterile insect technique
sp(p).	species (plural)
ssp(p).	subspecies (plural)
UV	ultra-violet
VAT	variable antigen type
VSG	variant surface glycoprotein
WBC	white blood cell

Organizations

ANDE	Agence Nationale de Développement de l'Elevage
AU	African Union
AU/STRC	African Union/Scientific, Technical and Research Commission
BICOT	Biological Control of Tsetse by the Sterile Insect Technique
CEBV	Communauté Economique du Bétail et de la Viande
CEMV	Centre Universitaire de Formation en Entomologie Médicale et Vétérinaire
CGIAR	Consultative Group on International Agricultural Research
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
CIRAD-EMVT	Département d'Elevage et de Médecine Vétérinaire des Pays Tropicaux du CIRAD
CIRDES	Centre International de Recherche-Développement sur l'Elevage en Zone Subhumide
CNERV	Centre National d'Elevage et de Recherches Vétérinaires
CNRS	Centre National de Recherche Scientifique
CREAT	Centre de Recherche et d'Elevage, Avétonou, Togo
CRSSA	Centre de Recherches du Service de Santé des Armées Emile Pardé
CTVM	Centre for Tropical Veterinary Medicine
DFID	Department for International Development (UK)
DSE	German Foundation for International Development
EC/EU	European Community/European Union
EDF	European Development Fund
FAO	Food and Agriculture Organization of the United Nations

FITCA	Farming in Tsetse Control Areas of Eastern Africa
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IAEA	International Atomic Energy Agency
IBAR	Interafrican Bureau for Animal Resources
ICIPE	International Centre of Insect Physiology and Ecology
ICPTV	Integrated Control of Pathogenic Trypanosomes and their Vectors
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
INRA	Institut National de Recherche Agronomique
IPR	Institut Pierre Richet
IRD	Institut de Recherche et de Développement (formerly ORSTOM)
ISCTRC	International Scientific Council for Trypanosomiasis Research and Control
ISRA	Institut Sénégalais de Recherches Agricoles
ITC	International Trypanotolerance Centre
ITM	Institute of Tropical Medicine
KARI	Kenya Agricultural Research Institute
KETRI	Kenya Trypanosomiasis Research Institute
LCV	Laboratoire Central Vétérinaire
LNERV	Laboratoire National de l'Elevage et de Recherches Vétérinaires
LSHTM	London School of Hygiene and Tropical Medicine
MRC	Medical Research Council
MRU	Mano River Union
NITR	Nigerian Institute for Trypanosomiasis Research
NRI	Natural Resources Institute
OCCGE	Organisation de Coopération et de Coordination pour la Lutte contre les Grande Endémies
OCEAC	Organisation de Coordination pour la Lutte contre les Endémies en Afrique Centrale
OGAPROV	Office Gabonais pour l'Amélioration de la Production de la Viande
OIE	Office International des Epizooties
OMVG	Organisation pour la Mise en Valeur du Fleuve Gambie
PAAT	Programme against African Trypanosomiasis
PATTEC	Pan-African Tsetse and Trypanosomiasis Eradication Campaign
PRCT	Projet de Recherches Cliniques sur la Trypanosomiase
RDI	Rural Development International
RUCA	Rijksuniversitair Centrum Antwerpen
SADC	Southern African Development Community
SIDA	Swedish International Development Authority
SODEPRA	Société pour le Développement des Productions Animales
TDR	UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases
TDRC	Tropical Diseases Research Centre
TPRI	Tropical Pesticides Research Institute
TTRI	Tsetse and Trypanosomiasis Research Institute
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
UTRO	Uganda Trypanosomiasis Research Organisation
WHO	World Health Organization

CONTENTS

SECTION A – NEWS

FROM THE EDITOR

Dear Reader,

As you can see from the inside cover of this issue, I am the new Editor of TTI, having taken over from John Pollock towards the end of 2005 (details of John's career and the great contributions he has made to tsetse research and control and to international development are described in the section that follows). Before saying anything about myself and the content of TTI, on behalf of the PAAT Secretariat, I want to thank John for all he has done over so many years to make TTI what it is now. As a regular reader of this publication, and now more particularly in going through the process of preparing this issue, I have come to realize that even with the modern tools of electronic communication and while both extremely interesting and rewarding, the task of producing TTI is far from straightforward. John not only succeeded in covering the subject matter of TTI in a most comprehensive manner, but did so with great care and attention to detail, ensuring accuracy in both the technical content and layout of each issue for which he was responsible. He also helped me greatly to prepare this issue by providing thorough hand-over notes and by answering my many questions. These are all the hallmarks of a really competent and dedicated professional for which we are all truly grateful, and we wish John all the very best for the future.

As for myself, I graduated with BSc (Hons) and PhD degrees in Agricultural Science and Veterinary Parasitology from the University of Glasgow, UK. From 1966-1978, I taught Veterinary Physiology to under-graduate students at Glasgow University, while also conducting research on the pathogenesis and immunology of helminth and protozoal diseases, and supervising post-graduate students. During that period I worked in Kenya, the Sudan and the Gambia for around 3 years and published around 100 papers and book chapters on animal parasitology that included work on trypanosomiasis and trypanotolerance. I left Glasgow University in 1978 as a Reader in Veterinary Physiology to become a Technical Officer in the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture – a joint undertaking between the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations that was set up to foster research and technology transfer on nuclear and biotechnology methods in food and agriculture. In 1980, I became Head of the Animal Production and Health Section of this Division, responsible for its scientific and technical direction and overall management in the fields of animal nutrition, reproduction and disease diagnosis and surveillance.

In 1995, I was appointed Director of the Joint FAO/IAEA Division, responsible then for the overall management of a Programme that in addition to livestock, encompassed, the areas of soil and water management, plant breeding and genetics, insect pest control and food and environmental protection. Between 2002 and mid-2005 when I retired from FAO, I Chaired FAO's Inter-Departmental Working Group on Biotechnology with overall responsibility for overseeing the planning and implementation of an inter-disciplinary and cross-sectoral programme on biotechnology applications in Agriculture, Forestry and Fisheries. In 2005, I joined the Board of Trustees of the International Livestock Research Institute (ILRI) which has its headquarters in Nairobi but also has a major site in Addis Ababa, and in 2006 became Chair of the Programme Committee of its Board of Trustees.

This issue of TTI essentially follows the long-established scope and format of its predecessors, except that due to its longer than normal News Section and large number of

General abstracts and those dealing with Tsetse, Human and Animal Trypanosomiasis, it has unfortunately not been possible to include abstracts of the many publications that have appeared over the past 6 months covering Experimental Trypanosomiasis and Trypanosome Research. These will, however, be included in the next issue. Otherwise, the issue - as usual - describes through its News and Abstracts Sections the policy, institutional and scientific developments that are taking place at national, regional and global levels to tackle the principal vectors, parasites and diseases affecting humans and farmed animals. As such, its orientation is very much on the African trypanosomiases, and while issues surrounding non-tsetse transmitted trypanosomiases (even within Africa when related to camels) and trypanosomiases of host species like household pets are not excluded completely, in the interests of maintaining focus, meeting the needs of the vast majority of readers and minimizing costs, the coverage given to these topics is minimal.

Both Sections attest to the enormous progress being made with respect to the planning and implementation of national programmes to eliminate the constraints caused by tsetse and the trypanosomiases in Africa. They also illustrate the quite extraordinary effort that is going in from all corners of the world to apply both modern and more traditional science to improve our understanding of essentially all aspects of tsetse, trypanosomes and trypanosomiasis – efforts that have already and hopefully more so in the near future, will pay off in terms of bringing improvements to the lives of so many.

The purpose of bringing this information together and disseminating it widely is to keep scientists, field personnel and decision-makers at all levels abreast with what is going on in relation to tsetse and trypanosomiasis. In this way, it hopefully serves to encourage contacts between individuals and institutions, and to stimulate discussion, new ideas and innovation with respect to science, institutional arrangements, policies and investments. However, the content of TTI is really only as interesting and comprehensive as you - The Readers - are prepared to make it. As Editor, I have certain responsibilities, but I do rely on you to provide information relevant to both of its main Sections. While anything new that falls within the scope outlined earlier will be considered, it's already clear that what needs most strengthening is input from the staff of national institutions and field programmes within Africa and from people conducting research or other activities related to tsetse and trypanosomiasis in France or elsewhere who publish or report their work in the French language. Greater input from these sources would go a long way to helping TTI better achieve its objectives and I therefore appeal to all concerned to help us in this way. However, any ideas or comments on this or any other aspect of TTI are very welcome, so please get in touch.

With best wishes,

James Dargie

JOHN N. POLLOCK: OUTSTANDING SERVICES TO TSETSE RESEARCH, CONTROL AND THE INTERNATIONAL COMMUNITY

As a post-graduate student at Imperial College, London, and as Research Fellow in Brunel University, John studied the mating process in the tsetse and during this work discovered the spermatophore. This finding, that the tsetse retained such a primitive method of sperm transfer, prompted a study of the systematic position of the tsetse in respect of other flies. He investigated the status of Glossinidae from the comparative anatomical approach; the first conclusion being that the family links up with Hippoboscidae, the louse flies, and Gasterophilidae, the horse and rhino bot family. This work was carried out in the 1970s. Later, this group of three families was seen as the sister group of Oestridae (warble flies and their allies), and the whole complex as deriving from the base of Ephydroidea, the superfamily that includes *Drosophila*. This last finding (published in 2002) opened the door to a comparison of the genomics of *Glossina* with that of *Drosophila*, which from the genetics viewpoint is much better known. From 1975 to 1978, John worked with the government tsetse control team in Zambia, in charge of Northern Province. There, he saw the need for a training manual in this field. FAO had also identified such a need for Africa as a whole, and the Organisation sponsored his writing/editing of their three-volume "*Tsetse Control Training Manual for Middle-level Personnel*", which was published in 1980. From 1980, he worked for FAO on a research and training project based in Lusaka, Zambia, which led directly to the formation the SADC Regional Training Centre for Middle-level Personnel for the Control of African Animal Trypanosomiasis, of which he was the Project Manager. Much of the work consisted of transferring the new technologies worked out in Zimbabwe to the rest of Africa, by means of long courses (i.e. seven- month, later four-month courses) in Lusaka, or short courses held in various sub-Saharan countries. After ten years there, John switched to the RTTCP, based in Harare, Zimbabwe. He supervised the ongoing Angwa-Manyame Large Scale Target Trial Project in its concluding stages, and wrote the final report of this major enterprise. He returned to Lusaka to lead a new phase of the SADC Regional Training Centre, for three years. John retired from FAO in 1995, but continued to work in the area of education. After returning to UK in 2000, he was appointed Editor, TTIQ (later TTI) in 2001, retiring in 2005. He put into effect the change from four issues per year, to two, and the submission of the drafts in electronic form, instead of as camera-ready copies. He is now a writer and training as a water colourist.

PROGRAMME AGAINST AFRICAN TRYPANOSOMIASIS: 9TH MEETING OF THE PROGRAMME COMMITTEE

Foreword

The ninth meeting of the PAAT Programme Committee was convened at the Headquarters of the International Atomic Energy Agency (IAEA), Vienna, Austria, 3-4 May 2005. The meeting focused on (i) achievements of PAAT mandated organizations (i.e. FAO, IAEA, WHO) and AU-PATTEC, (ii) the new AfDB-PATTEC initiative in support of tsetse intervention in six sub-Saharan countries (Burkina Faso, Ghana, Mali in West Africa and Ethiopia, Kenya, Uganda in East Africa), (iii) current knowledge of tsetse population fragmentation in West Africa and the new Wellcome Trust funded project, and (iv) linking

Sustainable Agriculture and Rural Development (SARD) strategies with sleeping sickness control.

The meeting was officially opened by Dr J. Dargie, Director of the Joint FAO/IAEA Division, who on behalf of FAO and IAEA welcomed the participants. He underpinned the importance of embedding tsetse and trypanosomiasis (T&T) intervention within SARD, national development strategies, plans and programmes for poverty alleviation. There are two strategies to attack both the causes and consequences of poverty and hunger. Strategy one is to make interventions that improve food availability and incomes for the poor by enhancing their productive activities, while track two involves targeting programmes that give the neediest people direct and immediate access to food. Both are needed and moreover they are clearly closely interrelated because at their very foundation lies the need to invest in programmes that not only promote agriculture and rural development on which the great majority of the hungry and poor depend for their livelihoods, but do so in a sustainable manner.

He also stressed the role of PAAT as a knowledge and global public goods-based international alliance that treats the T&T problem as an integral part of SARD, providing countries with science-based information and guidance on their technological, policy and institutional options. Mr Dargie welcomed the commitment of AfDB to provide substantial funding support to assist a number of T&T affected countries to embark on intervention. He recognized the contribution and role that the Pan African T&T Eradication Campaign (PATTEC) can play on area-wide tsetse fly intervention.

The meeting was chaired by Prof. A.A. Ilemobade.

Reports from UN and Regional Organizations and Institutions

Representatives of AU-PATTEC, AfDB, FAO, IAEA and WHO reported on progress, priorities and planned activities.

***AU-PATTEC – J. Kabayo*:** The African Heads of State and Government were committed to support PATTEC in its endeavour to liberate the African continent from tsetse fly and trypanosomiasis and, thus, contribute to reduce hunger and poverty through concerted and sustained actions. PATTEC seeks to address the transboundary nature of the T&T problem using a step-wise and sustainable approach until tsetse fly eradication will be achieved. The mandate of PATTEC enables the coordinator to address directly AU Member States for their respective support with PATTEC Coordination Office ensuring that efforts focus on tsetse eradication activities. The meeting was informed that AfDB supports the tsetse eradication philosophy. The initial AfDB support concentrates on six countries: Burkina Faso, Ghana, Mali in West Africa and Ethiopia, Kenya, Uganda in East Africa. Other countries in the "southern front" (Angola, Botswana, Namibia, Rwanda and Zambia) expressed the wish to initiate activities with the coordination offered by PATTEC.

***AfDB - S.K. Moussa*:** The AfDB recognized that complexity and magnitude of the T&T problem in sub-Saharan Africa require international cooperation and co-funding. In this regard, he called for the preparation of bankable projects for submission to other donor/financial partners, like the World Bank. For the formulation of project documents, AfDB requires assistance and technical advice from international organizations (e.g. FAO, IAEA, WHO and their PAAT International Alliance). It was noted that the achievements of

the six countries benefiting of AfDB support should be consolidated by a continuation of the programme in other countries. However, delay in the identification of additional candidate countries to receive AfDB support may reduce and/or fragment the benefits derived from the initial support.

During the discussion concern was expressed about the care taken in the selection of priority areas for intervention in West and East Africa. In this regard, it was strongly recommended to adopt and use PAAT-PATTEC agreed criteria and guiding principles. Additionally, before embarking in further T&T interventions in other sub-Saharan countries, there is the need to conduct socio-economic analysis (and define socio-economic indicators to be monitored) in those six countries supposed to initiate T&T removal campaigns. Lessons learned from FITCA could be used to guide the current AfDB-PATTEC initiative.

FAO/PAAT – R.C. Mattioli: FAO/PAAT activities and progress on the implementation of recommendations since the 8th PAAT-PC meeting were presented. As introduction, it was reported that efforts in raising the profile of T&T and ensuring that related interventions aiming at SARD were reflected in the national Poverty Reduction Strategy Papers (PRSPs) of some selected countries. The importance of this issue was reiterated by the PAAT Secretariat at the 4th PATTEC Policy and Mobilization Committee meeting held in Addis Ababa, Ethiopia, February 2005. The high level of commitment by AfDB to assist six African countries (Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Uganda) to deal with T&T is testimony to the increased awareness of the donor community on the problem.

In relation to the recommendation that concerned the involvement of other stakeholders, it was noted that the partnership between FAO and the International Federation of Animal Health (IFAH) is a good example of public-private sector partnership. The main objective of this collaboration is the establishment of Quality Control/Quality Assurance (QC/QA) Standards of trypanocidal drugs used to treat animals against the disease. A spin-off of this partnership is expected to be extended to other drugs and chemicals of veterinary importance, such as antibiotics, anthelmintic and insecticides. It was however noted that the implementation of this activity requires appropriate funding. In addition, it was proposed that drug companies provide chemicals at a reduced cost as has been made by Aventis for treatments against sleeping sickness. Another example of the increased involvement of stakeholders brought to the attention of the audience was the comprehensive socio-economic survey conducted in the Southern Rift Valley (SRV) of Ethiopia which concerned more than 7,000 households and which sought to involve all stakeholders in T&T field intervention activities.

Concerning the recommendation on the application of PAAT developed policies and strategies for T&T intervention by Member Countries, these have been used by AfDB and PATTEC in the preparation of field programmes and by the Ethiopian Government, assisted by FAO and IAEA, for the formulation of a project document submitted to the Japanese Trust Fund in support of T&T activities in the SRV.

With reference to the recommendation on the development of new drugs and diagnostic tools, the meeting was informed that NEPAD-CAADP has identified the development of improved diagnostic methods as research priority. Similarly, scientific work is in progress on the development of new drugs and diagnostic techniques in Europe and by African NARS. The contribution of the Bill Gates Foundation and the Wellcome Trust are significant developments towards diagnosis and treatment of trypanosomiasis.

On the recommendation that called for the use of standard and independent process for the evaluation of T&T technologies and interventions it was agreed that the PAAT-PATTEC developed criteria and guidelines are to serve as basis and refinement is necessary. The meeting expressed the need to produce guidelines for declaring areas free of tsetse-trypanosomiasis.

The audience was informed that the PAAT Technical and Scientific Series publications are the normative and policy support provided by PAAT and mandated organizations to member countries and serve to guide policy makers, policy advisors, planners, technical and field staff in the formulation of T&T intervention aiming at achieving positive SARD. It was emphasised the leading role of member countries to define research priorities and to use PAAT and ISCTRC as platforms to inform the international scientific community on research needs.

***IAEA – U. Feldmann*:** Between 1993 and 2003, US$ 9.3 million was made available by the Regular Budget of IAEA to support normative activities, R&D and consultancies. The Agency also funded Technical Cooperation activities mainly in the areas of capacity building and training for a total sum of USD 14 million. The successful elimination of tsetse fly from Zanzibar created high expectations in countries of sub-Saharan Africa affected by the T&T problem. The creation of PATTEC symbolizes the political will of African countries in solving the problem posed by T&T to the sub-continent. Emphasis was on the necessity of regional coordination in T&T intervention. PAAT serves as a forum for the mandated organizations to avoid duplication and harmonize their contributions to Member States' efforts against T&T, and offers science-based advice and objective quality assurance of interventions. In addition to the PAAT-PATTEC developed criteria and guidelines for selection of priority areas for intervention, PAAT and PATTEC have also defined roles and responsibilities of partners in their assistance to the programmes of Member States.

The meeting was informed that a major review of the Agency's Tsetse Programme was undertaken in 2003 - 2004. Outcomes of the review recommended member states to 'own" their project with IAEA acting as a facilitator and/or advisor. The IAEA mandate has to focus and limit on the application of nuclear technology, i.e. developing and transferring the sterile insect technique (SIT) to countries that need it. This objective necessitates the collaboration with other specialized partners. Agency's support will concentrate on SIT feasibility assessment and capacity building. IAEA will also continue to assist member states in operational intervention.

The meeting was briefed on ongoing planned activities: one regional Technical Cooperation Project and nine national projects are implemented and concern SIT assessment and capacity building, with the Southern Tsetse Eradication Project in Ethiopia as the most advanced. Funds from the Regular Budget are (or will be) devoted to support R&D mainly on quality assurance and increased efficiency of SIT. Manuals and field guides are also being developed.

In relation to capacity building, the meeting stressed the importance to devote special attention to assess training needs with T&T affected countries taking the leading role in defining human resource development strategies.

WHO – J. Jannin: WHO reported the advances made through the Human African Trypanosomiasis Network, a forum established to meet the specific objectives defined by the PAAT. This forum has allowed bringing together everyone concerned in research,

surveillance and control of sleeping sickness. The crosscutting working groups established within the framework of the Network has allowed defining a number of research issues concerning drugs, drug resistance and drug development as well as surveillance systems, disease economic impact, advocacy and vector control. Through strong advocacy, WHO has established public-private partnerships and collected the necessary funds to provide seeding money to implement Network recommendations. Through the networking concept, WHO has identified and mobilized the necessary human resources to get research projects to move forward. WHO partners are now numerous and diversified, looking at all aspects of disease surveillance and control, thus limiting that any particular issue would impede progress towards the ultimate aim of eliminating the disease as a public health problem.

WHO also reported that over the last years some 80 high level decision makers were trained through high level international training courses. In addition, several technical workshops were implemented at regional level and delivered by its special team in Yaoundé on subjects such as diagnosis, treatment, surveillance methodologies and programme planning and management.

The most outstanding result is certainly the development of a short melarsoprol protocol which has undergone full clinical trials and is now recommended as the most appropriate treatment for advanced stage patients. A multicentre clinical trial is ongoing to evaluate the safety and efficacy of a combination treatment using eflornithine and nifurtimox in order to simplify the cumbersome administration of eflornithine which jeopardizes the access of patients to this less toxic drug. The work being done on DB289 is also worth mentioning; it will provide a new effective and safe molecule for the treatment of first stage patients. Although further research is still required, there are promises that in a near future DB group of drugs will also lead to the development of an alternative treatment for second stage patients.

New diagnostic tests are being validated: one is a highly specific and sensitive serological test and another is an agglutination test to assess CNS involvement. Thus, networking has allowed developing, validating and introducing in a timely fashion these new techniques in the field. National programmes have received the support of WHO to enhance surveillance and control. In parallel training was provided to develop local competence. The original goal of WHO to have 100 percent of the endemic countries having a clear plan of action, identifying individual programme strengths and weaknesses, is well underway. Modular training is now being implemented to find specific solutions to individual problems and improve performance.

The time is gone when some 45,000 cases were diagnosed and treated while only 10 to 15 percent of the population at risk were under some kind of surveillance or protection. Since the year 2000 there has been a regular decline in the number of new cases and a noticeable increase in the number of individuals placed under surveillance. In 2004 less than 18,000 cases were identified throughout the countries endemic for the disease.

It is important to note that the awareness of sleeping sickness has been considerably raised among decision makers and the population at risk. With the willingness of public agencies and private partners coherent actions can now be implemented. It is conceivable, and there is great hope, that sleeping sickness elimination will be achieved sooner than later.

Certainly there are still countries where surveillance and/or control are still weak but improvements are constantly being made. Undoubtedly, time will come when cases will be as rare as they will be irritating. It is doubtful that the disease will ever be eradicated due to its zoonotic character but it will undoubtedly be eliminated as a public health problem. By then,

it will be time to look for new approaches and develop new tools that can be integrated into national health delivery systems to ensure sustained surveillance.

Sleeping sickness has been and still is today an obstacle to rural development, but progress in reducing the burden is remarkable. This 9th PAAT PC meeting should certainly take note of recent success in removing the sleeping sickness "stumbling stone" to the advancement of social and economic status of the rural population and the poor. This success is the result of organized and coordinated determination, strong collaboration and networking. WHO is convinced that each contribution of individual PAAT partners will lead to better health and more productive agriculture. This will ultimately enhance rural development and ensure food security. The combined action will eventually achieve the ultimate goal of the PAAT: an improved economical and social status of the African population.

AfDB Supported T&T Interventions: Country Reports

Reports from countries benefiting from AfDB-PATTEC support for T&T interventions were presented by representatives of Burkina Faso, Ethiopia, Ghana, Kenya, Mali and Uganda. In all six countries, the projects envisage four major components:

- tsetse suppression and elimination;
- capacity building and human capital development;
- sustainable land use and management of natural resources; and
- coordination.

Loan agreements have been signed by the countries and AfDB; in some cases parliamentary approval is pending. Project implementation should start simultaneously by the end of 2005 – beginning 2006.

Ethiopia – Temesgen Alemu

The presenter indicated that although formalities for loan agreement between AfDB and the Ethiopian Government were at an advanced stage of finalisation, field and laboratory activities have not started yet. The expected AfDB funded project focuses on an area of 25,000 km^2 in the Southern Rift Valley of Ethiopia where, at the end of the project cycle, tsetse-trypanosomiasis problem is expected to be eliminated. In order to ensure continuity of support, a donors' conference is planned to deliberate on the sustainability of the programme in Ethiopia. Previous work on tsetse in the area selected for T&T intervention 80 percent of fly suppression was achieved through the use of insecticide impregnated targets and the use of live baits (i.e. epicutaneous use of insecticides on cattle). However, to achieve tsetse elimination in the remaining target area integration of various techniques (e.g. sequential insecticide aerosol technique, SAT) should be considered. In addition to T&T intervention, flanking measures targeting land use, management of natural resources, human and animal health packages need to be incorporated in a comprehensive socio-economic development scheme to lead towards positive SARD.

Kenya – P. Olet

Due to its potential for livestock production, the Lambwe Valley in Kenya was selected as pilot area for intervention. However, the tsetse distribution map is not accurate enough. Therefore, prior to the implementation of T&T activities, there is the need to undertake investigations to provide evidence that the fly population is isolated. ICIPE, ILRI and NARS (e.g. KARI) in Kenya will assist the Government to carry out entomological studies to assess the isolation status of the fly population in the selected area. An essential component for project success is the involvement of the local communities in T&T intervention activities. To ensure full commitment and participation of communities, adequate technical training needs to be provided.

Uganda – L. Semakula

The Uganda Government has almost completed the financial and administrative procedures required by AfDB to receive the financial contribution for T&T intervention. The support provided by AfDB allows consolidating work and achievements obtained during the execution of the FITCA project. To suppress the tsetse population, the Uganda Government strategy envisages to integrate various techniques, i.e. insecticides impregnated targets, live baits and SAT. In relation to the use of this latter technique, special attention should be paid to inform and convince policy makers about the safety of SAT in view of the notions that it is environmentally unfriendly. Community participation is also seen as an essential component of T&T intervention and related activities. Like for Kenya, more accurate study needs to be carried out on tsetse distribution in order to identify isolated fly populations and select priority areas for intervention.

Burkina Faso and Mali – I. Sidibe, S. Maiga

Since 2001, Burkina Faso and Mali have collaborated in joint T&T intervention projects, with financial and technical assistance provided by IAEA. In Mali, the zone initially targeted for intervention comprises the peri-urban area of Bamako in the northern Niger River basin. Significant success has been obtained in tsetse suppression involving community based approach; the fly population has been reduced by more than 99 percent. However, despite this impressive result, fly elimination has not been achieved due to lack of effective natural (and temporary artificial) barrier systems. Within the AfDB supported project an area of approximately 15,000 km^2 has been identified for tsetse elimination.

Burkina Faso has a long standing experience in tsetse control and elimination activities and structures are in place to provide the technical assistance in the implementation of the AfDB financially supported T&T intervention. These structures include ELAT, CIRDES and various NARS. In addition, the Government of Burkina Faso was committed to building a tsetse mass-rearing facility which will be shared with Ghana and Mali. Lessons learned from the past taught that the active community participation is the driving force for achieving T&T intervention project objectives. Additional key components ensuring project success are proper planning of land use and natural resource management.

Ghana – C. Mahama

In Ghana, the selected area for the first phase of T&T intervention (about 20,000 km^2) is located in the Upper West Region and contiguous with the southern limit of the Burkina Faso and Mali zone. Major objectives of the intervention targets are crop/livestock integration and improved agricultural production. The AfDB financial contribution allows expansion of initiated activities of tsetse suppression (with ultimate goal of fly elimination) which have received the support of other development partners. Rural communities and farmers ensured their support and contribution (in kind) to the implementation of project activities. The project has also received full commitment by the National authorities (Ministry of Food and Agriculture, Ghana Atomic Energy Commission, Ministry of Finance and Ministry of Health). The meeting was informed that the AfDB project document has been approved by the Cabinet of the President; still pending is the endorsement of the Parliament. A request was addressed to PAAT to assist the Government in developing training modules, terms of reference for consultancies and establishment of data base, its use and maintenance.

General Discussion

During the round-table discussion which followed the country reports the need was stressed to strengthen national and regional capacity building and human resources development as key elements for successful project implementation. The meeting expressed additional concerns on:

- the necessity to refine current guidelines for the selection of priority areas;
- duly including national, political interests, besides technical and economic consideration, in the selection of priority T&T intervention areas;
- integrating land use and optimal utilisation of natural resources in the planning process of T&T projects;
- considering the role of trypanotolerant livestock as a valid option to be integrated in T&T intervention strategies;
- involving the private sector in activities against T&T;
- the preparation of simple training material for rural and farmers communities involved in T&T field operations;
- urging T&T affected countries to be pro active in the preparation and submission of T&T control projects; and
- establishment of a mechanism for supervising co-financed projects.

Recommendations

The following recommendations were formulated:

1. The meeting was informed of the increasing number of countries that have expressed interest in soliciting for loans and grants from AfDB to initiate activities for the elimination of the tsetse and trypanosomiasis (T&T) problem. While acknowledging the high level of commitment shown by these countries, the meeting recommends:

- The importance of applying the PAAT-PATTEC criteria in the selection of new candidate countries; and

- To member countries, PATTEC and AfDB to work together to ensure that the criteria are applied.

Action: AfDB, beneficiary countries, PATTEC, PAAT.

2. The meeting recognized that the successful implementation of T&T interventions would depend on the quality and quantity of human resources available in concerned countries. The meeting noted with concern the general deficiency in trained personnel for field operations, especially at middle-level. The meeting recommends:

- To consider the establishment of a task force that would work in partnership with countries concerned to comprehensively address the problem of human resource development.

Action: PATTEC, PAAT and mandated organizations, AfDB beneficiary countries.

3. The meeting recognized the importance of establishing standardized guides and procedures for field and laboratory operations and welcomes the presentation by the Joint FAO/IAEA Division on Generic Guidelines and Optimal Location of Tsetse Fly mass-rearing facilities. The meeting recommends to PAAT and PATTEC:

- To contribute in accordance to their respective mandate.

Action: PAAT and mandated organizations, PATTEC.

4. The meeting re-affirms its support to the PATTEC initiative and acknowledges the presence of other diseases and constraints to SARD in T&T intervention areas. The meeting recommends:

- To bring on board other relevant partners in the management of other diseases and constraints to SARD in intervention areas.

Action: Member countries, PATTEC, PAAT.

5. The meeting lauded the intention of countries to employ integrate approach to achieve effective area-wide tsetse suppression and recognizes that under appropriate situations SAT may be the optimal method. The meeting also notes with appreciation recent reports of progress in aerial spraying technology for vector suppression. The meeting recommends:

- To consider the use of SAT in situations where this method is the most cost effective and environmentally friendly;
- To allow flexibility for the integrated use of vector suppression methods; and
- To consider the possibility of producing in the PAAT Technical and Scientific series a paper on SAT.

Action: Member countries, PATTEC, PAAT, AfDB.

6. The meeting noted with concern the inadequacy of advocacy material available for T&T interventions and the lack of a focal institution for the preparation and dissemination of effective message packages. The meeting recommends:

- To collate, produce and disseminate objective messages on T&T interventions.

Action: PAAT Secretariat.

7. The meeting endorses the use of SIT as a tool for mopping up residual tsetse populations after fly suppression. The meeting recognizes that capacities for tsetse mass-rearing are still underdeveloped, that time is of essence in the current AfDB-PATTEC initiative and other projects. The meeting recommends:

- To put emphasis on the use of conventional methods to suppress tsetse populations to levels that would considerably reduce the number of sterile males required for tsetse elimination; and
- To form a task force that would assess progress made so far in tsetse mass rearing for elimination activities and report to the next PAAT PC meeting.

Action: Member countries, PATTEC.

Closing

The meeting was declared closed by Mr Werner Burkhart, Deputy Director General, IAEA Department of Nuclear Sciences and Applications. Mr Burkhart expressed his appreciation of the commitment of AfDB in funding T&T intervention activities in sub-Saharan Africa. He stressed the importance of now moving forward jointly to assist in the implementation of projects. In the past, the sterile insect technique (SIT) for tsetse eradication SIT was over sold and presented as the magic silver bullet to solve the T&T problem in Africa. Hence, emphasis now is on the judicious use of this technique and its technical feasibility which should consider the species of fly involved, agro-ecological and climatic conditions of the area to be free from tsetse and relative costs-benefits derived from the operation. Mr Burkhart re-affirmed the support of the IAEA to PAAT and to African countries affected by the T&T problem.

ACTIONS TAKEN ON THE RECOMMENDATIONS OF THE 9TH PAAT PROGRAMME COMMITTEE MEETING (VIENNA, MAY 2005)

Recommendation 1*:* FAO/PAAT: This issue was re-emphasised at the PAAT Advisory Group Coordinators meeting, Addis Ababa, September, 2005; the six countries (Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Uganda) benefiting from AfDB loans and grants agreed to use the PAAT-PATTEC criteria and guidelines to select national/regional priority areas for the implementation of T&T interventions.

- The 28th meeting of the ISCTRC in Addis Ababa, Ethiopia, 26–30 September 2005, recommended to the national PATTEC projects the adoption of a phased, conditional planning and implementation approach. In particular national PATTEC projects should only enter the operational intervention phase, after having appropriately

addressed the key components in earlier phases (i.e. feasibility assessment, capacity building, efficient management structures).

- FAO/IAEA/WHO/PAAT: Developed a document which included Terms of Reference for an "Assistance Formulation Team" for livestock-agriculture and human health in T&T intervention areas under the current six national AfDB-AU/PATTEC projects. The document, which outlines possible assistance of the mandated UN organizations along a phased, conditional approach, was presented at the PATTEC Regional Harmonization Meeting, held in Nairobi, Kenya. 24–28 October 2005. Participants in the workshop involved the representatives (including the coordinators) of the six national PATTEC projects and of several envisaged "phase-2" PATTEC project countries, as well as, technical and management staff of international institutes based in Nairobi.
- Agreed PAAT/PATTEC criteria for selection of priority areas were presented at the workshop "Improving decision support for T&T intervention in Uganda". This country has requested further assistance to FAO in planning strategic T&T field programmes. At that workshop it was noted that the approach adopted by Uganda is to intervene first in T&T affected areas having high potential for livestock-agriculture production/expansion, and where rural poverty is severe and sleeping sickness is spreading.
- IAEA organized in Vienna, 7–9 December 2005, a regional meeting of national coordinators. Member States participants included the national counterparts of IAEA-TC projects. Additional participants included the PATTEC Coordinator and the Chairman of PAAT, who made presentations on behalf of PAAT, FAO and WHO. The meeting discussed the status of the national PATTEC projects along the proposed phased conditional approach for international assistance and two working groups for West and East/Southern Africa aimed at identifying where the mandated UN agencies may provide specific contributions.
- The importance of the collaboration between PAAT and PATTEC and the support of FAO/PAAT to PATTEC was emphasised at the high level FAO-AU meeting, January 2006, FAO HQs. The AU Commissioner of Rural Economy and Agriculture, Ms Kurwijila, agreed to re-examine and to reply positively to the request made previously by FAO that the AU reconsider its position on collaboration within PAAT.
- A representative of FAO/IAEA participated in the first Technical Advisory Group meeting for STEP, which was held on 24 January 2006.
- FAO and IAEA sent representatives at the Director level to the inaugural meeting of the STEP National Steering Committee, Addis Ababa, 9 February 2006.

Recommendation 2: FAO/PAAT: This point is addressed by the project "Strengthening the PAAT-IS" (funded by IFAD) which includes among its activities the assessment of training needs and requirements of national technical staff and the development of human resources using a concerted, consultative approach. In this regard, missions were undertaken in Burkina Faso, Ghana, Mali, Ethiopia, Kenya and Uganda. Opportunities of training have been also been explored with other PAAT partners (e.g. IAEA, WHO, CIRAD, CIRDES, ICIPE, ILRI, ITM, etc). This information will be collated and made available to officials of T&T affected countries and PAAT stakeholders (including donors, research institutes, etc.) through the PAAT website. FAO has already contacted IFAD for an extension of, and broadening the context of the FAO/PAAT-IFAD collaboration and financial support. Achievements and

future plans of FAO/PAAT-IFAD collaboration were reported to the IFAD Governing Council at its 29th Session, February 2006.

- WHO organized an international course on African Trypanosomiasis in Tunisia 10-28 October 2005. Sixteen participants came from HAT endemic countries and 4 from Research laboratories.
- WHO trained on the spot 10 staff from Ministry of Health and Veterinary Services Department on HAT control methods. WHO supported MoH in their presentation of PoW during the *Inter Ministerial Steering Committee Meeting of the Ghana PATTEC project*
- IAEA organized a FAO/IAEA Regional Training Course on Standardized Baseline Data Collection for Area-wide Tsetse and Trypanosomosis Management, Nairobi, 13 March – 7 April 2006, in collaboration with the Kenya authorities and with substantial coordinative assistance from ICIPE and valuable support from ILRI and AU-PATTEC. Twenty-six participants from T&T affected countries, including four Kenyan participants participated in the course.
- In the period between the 9th and the 10th meeting of the PAAT-PC, i.e. May 2005 – April 2006, IAEA funded 54 person-months fellowships for collaborators from seven T&T affected countries.
- Suggested action: within the activities of the project "Strengthening the PAAT-IS" to create an e-concertation to collect information on training needs and requirements of T&T affected countries.

Recommendation 3*:* FAO/PAAT: *Technical and normative contribution to T&T field and laboratory operations* - Standardized guidelines and procedures for T&T interventions (including laboratory and field work/procedures) have been generated over the years [e.g. Training manual for tsetse control personnel (5 volumes); Field guide for the diagnosis, treatment and prevention of African animal trypanosomiasis (revised edition 1998); Drug management and parasite resistance in animal trypanosomiasis in Africa (PAAT T&S No. 1); Integrating the sterile insect technique as a key component of area-wide tsetse and trypanosomiasis intervention (PAAT T&S No. 3); Economic guidelines for strategic planning of T&T control in West Africa (PAAT T&S No. 5); Long-term T&T management options in West Africa (PAAT T&S No. 6); T&T intervention policies supporting SARD]. All this information has been widely distributed and is downloadable from the PAAT website. Additional work is in progress to produce "Guidelines for declaring areas free of tsetse flies and tsetse-transmitted trypanosomiasis", and to develop a new tool guiding in the economic decision process for field T&T interventions ("Mapping the benefits").

- In addition, a paper dealing in particular with SIT was published under the title "Potential impact of tsetse fly control involving the sterile insect technique" in "Sterile Insect Technique – Principles and management in area-wide integrated pest management" (Eds V.A. Dyck, J. Hendrichs, A.S. Robinson), Springer, The Netherlands, pp. 701-723.
- Consultants were recruited to draft the "FAO/IAEA Guidelines for Conducting Baseline Tsetse Surveys for Area-Wide Integrated Pest Management Programmes". The draft was distributed to the coordinators of the six national PATTEC programmes to obtain feed-back, and the draft guidelines also served as the basis for the above mentioned FAO/IAEA regional training course, Nairobi, 13 March – 7 April 2006.

Recommendation 4: FAO/PAAT: Contribution to the management of other diseases is foreseen within the FAO-IFAH partnership on QC/QA of trypanocides and other veterinary drugs. This partnership includes, *inter alia*, the development of good practices for laboratory tests for drug quality, delivery of quality drugs, and drug use and administration. UNIDO has shown positive interest in participating in this initiative.

- FAO/PAAT: concerning other constraints, FAO/PAAT will take advantage and make good use of the agreed collaboration with World Bank/ALIVE on T&T interventions. In particular, it was agreed that (i) all matters related to T&T and addressed to ALIVE be dealt through PAAT in support to the PATTEC initiative, and that (ii) FAO provides the policy, strategy and technical and scientific support to WB policy and investment in sub-Saharan Africa for all matters related to T&T.
- FAO/PAAT – FAO/IGAD-LPI (Inter-Governmental Authority on Development-Livestock Policy Initiative) project collaboration.

Recommendation 5: FAO/PAAT: In its T&T intervention policies aiming at positive SARD, PAAT promotes a flexible, adaptive strategy which considers the optimization of the spectrum of tsetse suppression technologies complying with the prevailing agro-ecological conditions, targeted vector species and orographic characteristic of the area.

- The integrated use of methods for vector suppression has been duly considered in the joint Ethiopian Government/FAO/IAEA project for T&T intervention and related SARD submitted to the Government of Japan.
- Cost-benefit analysis of the use of SAT and other tsetse suppression techniques has been duly considered in a paper dealing with an analysis of costs of alternative tsetse control approaches in Uganda. The paper is produced by A. Shaw for the FAO/PPLPI project, with the contribution of FAO/PAAT. FAO/PAAT and FAO/IGAD-LPI project have recently agree to collaborate to develop "A new decision support tool for policy and advocacy: mapping and analysing both estimated costs and potential benefits of T&T control in the Greater Horn of Africa (including, *inter alia*, Ethiopia, Kenya, Sudan, Uganda). The cost-benefit analysis of the use of SAT is included in this study. The study proposal has been submitted for funding to the Wellcome Trust. Part of this study could be considered for developing a PAAT T&S paper on the comparative cost-benefit analysis of various methods for T&T control/elimination.

Recommendation 6: The various documents and publications produced by the PAAT Secretariat and PAAT mandated organizations (see documents/publications mentioned in Recommendation 3, Actions Taken) are regarded as a collation of objective technical and scientific information. This generated, collated information is widely distributed in form of hard copies or through the PAAT and other linked websites.

- A PAAT Secretariat paper dealing with "International assistance to intervention policies and implementation of area-wide tsetse and animal trypanosomiasis programmes" was presented at the International Conference on "Area-wide Control of Insect Pests: Integrating the Sterile Insect and Related Nuclear and Other Techniques", Vienna, Austria, May 2005. Worldwide attendance, more than 400 participants.

Recommendation 7: FAO/PAAT: the first point of this recommendation is dealt under in Actions Taken of Recommendation 3.

- A working group at the PATTEC Regional Harmonization Meeting, held in Nairobi, Kenya, 24–28 October 2005, analysed the tsetse fly mass-rearing situation in Eastern Africa and the prospected needs for sterile flies for possible SIT components as part of integrated area wide T&T interventions in East African national PATTEC projects. The discrepancy between plans for near-future SIT operations in some of the PATTEC countries and concrete action underway to secure the timely availability of sterile tsetse fly males remains obvious.

Further Actions Related to and/or Supporting the Above Recommendations

- Technical and scientific support to advance the planning process for intervention and support to planners, policy makers, researchers, technical and development community;
- Two issues annually of Tsetse and Trypanosomiasis Information (TTI).
- PAAT T&S papers and other papers in the pipeline:

  -Linking sustainable agriculture and rural development strategies with sleeping sickness control (Cattand et al.);

  -Mapping the benefits: developing a new decision tool for T&T interventions (Shaw *et al.*), in English and French (an FAO-DFID publication);

  -Guidelines for declaring areas free of tsetse flies and tsetse-transmitted trypanosomiasis (Barclay et al.).

- Regular updating of the PAAT website, new website features, maps, pages, etc.

28TH CONFERENCE OF THE INTERNATIONAL SCIENTIFIC COUNCIL FOR TRYPANOSOMIASIS RESEARCH AND CONTROL (ISCTRC)

Report of the Secretary – Dr. Solomon Haile Mariam, AU/IBAR

The 28th ISCTRC Conference was held from 26th to 30th September, 2005 at AU Conference Hall in Addis Ababa, Ethiopia. The conference was attended by delegates from more than 35 AU Member States and over 20 International Organizations and was officially opened by H.E. Mr. Girma Wolde Giogis, the President of the Federal Democratic Republic of Ethiopia.

The following invited guests of honour made speeches at the opening ceremony:-

H.E Prof. Alpha Oumar Konaré – Chairperson of the Commission of the African Union.

Hon. Mr. Ato Belay Edjigu – Minister of State for Agriculture and Rural Development in the Federal Democratic Republic of Ethiopia.

H. E. Madam Rosebud Kurwijila – Commissioner for Rural Economy and Agriculture for the AU. Madam Rosebud gave the keynote address.

During the ceremony Prof. Alpha Oumar Konaré presented the PATTEC uniform and flag to the President of Ethiopia as a symbol of launching that uniform.

After the opening speeches, Dr. John Kabayo, the PATTEC Coordinator, presented a progress report on the implementation of the PATTEC Project in Africa. He said that the African Development Bank (ADB) had given a soft loan for PATTEC projects to six (6) AU Member States, namely Burkina Faso, Ghana, Mali from West Africa and Ethiopia, Kenya and Uganda from East Africa. The total amount allocated for the six countries was over USD 70 million to be spent over a 5 year period. Related to these developments, the following declaration was made at the Conference:

"Noting with appreciation the progress PATTEC has made since the declaration by African Heads of States and Governments in Lome in the year 2000, Member Countries and PATTEC Coordination Office are urged to initiate Eradication Campaign Projects against Tsetse and Trypanosomiasis in all the affected 37 African countries by the year 2015 in line with the Global Fund for HIV/AIDS, Malaria and other diseases."

The presentation and statements by International Organizations took place before the opening ceremony. During that session the ISCTRC Executive Committee Chairman, Dr. Rob Bagnall of South Africa, presented his speech and the ISCTRC Secretary, Dr. Solomon Haile Mariam, his report. Other International Organizations making statements included, EU, ICIPE, FAO, WHO, ILRI, PAAT, USAID, DFID, AARANET, CIRDES, CIRAD etc.; these were all supportive of the ISCTRC Conference.

The five day 28th ISCTRC conference was divided into 18 plenary sessions, covering country reports, biology, protozoology, immunology and diagnosis; human trypanosomiasis; animal trypanosomiasis; vector control and environment and socio-economics. A total of 60 papers were presented orally and there 40 poster presentations. Satellite and round table meetings were also held. These included: the PAAT Advisory Group Meeting; the 30th ISCTRC Executive Committee meeting; and round table meetings on PATTEC, non-tsetse transmitted trypanosomiases, tsetse control with integrated community development, and sleeping sickness in Uganda.

Field trips for conference participants were organised on Friday, 30th September to the insectory in Kaliti, the Addis Ababa Disease Investigation Centre at Sebata, and the Biofarm Centre in Addis Ababa.

The proceedings of the 27th ISCTRC (Pretoria) Conference which had been dedicated to the memory of Prof. Thomas Odhiambo, the former Director General of ICIPE, were distributed to participants in both hard and CD Rom copies.

In the closing session it was announced that the Republic of Angola had offered to host the next (29th) ISCTRC Conference. It was also announced that in view of the ongoing restructuring process at AU, the present ISCTRC Executive Committee would remain in office for another term, but a representative of North African countries would be nominated to join. Dr. Miressa Keno of Ethiopia was to be the new Chairman.

Presentations by International Organizations and Programmes

EU

The European Union has supported tsetse and trypanosomosis intervention in the context of rural development for more than 25 years. In the early 1980s the European Commission

initiated the Regional Tsetse and Trypanosomiasis Control Programme (RTTCP) in Malawi, Mozambique, Zambia and Malawi. The RTTCP focused on a community-based approach and aimed at covering an area of more than 300,000 km². This programme, financed over a period of 15 years (1986-2000), had somewhat mixed results, which was partially due to the magnitude of the programme. One lesson learned was that an approach towards T&T should focus on regional, national and local capacity building and, particularly, at empowering local communities.

Building on the experience of the RTTCP, in 1986 the Commission formed the regional programme FITCA (Farming in Tsetse Controlled Areas) in five Eastern African countries (Ethiopia, Kenya, Rwanda, Uganda and the United Republic of Tanzania). The programme initially was scheduled to last for 4 years (through 2000) but delays caused by bureaucratic and other problems made it necessary to extend the programme through 2004. FITCA established that Tsetse and Trypanosomiasis was best based on active partnerships, embedding control measures in full community involvement and aiming at generating resources for the development of sustainable rural incomes. In early 2005 an evaluation of FITCA concluded that although the results of the programme were different in the five countries it had led to many innovative and positive approaches.

The presenter highlighted the fact that this 28th meeting of the ISCTRC was taking place at an auspicious time, as the European Commission is currently developing a new overall vision on how best to address Africa's development needs. A proposal regarding this vision is expected to be approved by the European Commission in October and is anticipated to be a key discussion point at a high level meeting between the AU and the AU Commissions later this year.

ADB

The African Development Bank Group is committed to being a partner in the suppression, control and eradication of Tsetse and Trypanosomiasis in Africa. As mentioned earlier, the Bank is currently funding a multinational project covering 6 countries (Ethiopia, Kenya and Uganda in East Africa and Burkina Faso, Ghana and Mali in West Africa) and so far, the Bank and Regional Member Countries involved in phase I have committed about USD 82 million.

The goal of the Tsetse and Trypanosomiasis Control Programme is to contribute to poverty reduction, food security and sustainable development in Africa. This would be achieved through the creation of sustainable Tsetse and Trypanosomiasis free countries in Africa by integrating suppression, control and eradication technologies while ensuring that reclaimed areas are equitably, sustainably and economically exploited in an environmentally friendly manner.

The Bank is committed to continuing support for Tsetse and Trypanosomiasis suppression, control and eradication by making available more resources to cover more countries. This will depend on the preparedness and commitment of the beneficiary countries. The Bank's participation in this conference is to show its commitment and willingness to provide more resources to Regional Member Countries to address the problems of Tsetse and Trypanosomiasis. Its delegation aims to benefit from the discussions aimed at helping in the design and execution of an expanded Bank funded programme and it is open to collaborate with other development partners in the fight against Tsetse and Trypanosomiasis.

FAO

FAO's 2004 report on "State of Food Insecurity in the World" specifies the scale of economic costs of hunger at USD 30 billion and about USD 0.5-1 trillion per year in terms of direct costs and lost productivity and incomes, respectively. Countries in sub-Saharan Africa are most severely affected. Two broad strategies can be implemented to address the causes and the consequences of hunger and poverty: a) improving food availability and income of the poor through enhancing food productivity; and b)providing direct and immediate access to food for those most in need.

The UN and internationally established Millennium Development Goals (MDGs), which are reflected in the objectives of the Programme Against African Trypanosomiasis (PAAT), aim at halving the number of hungry and poor by 2015 and at rolling back environmental degradation. This can only be attained through sustainable agriculture and rural development, which is severely constrained by and necessitates the removal of the tsetse and trypanosomosis problem. The response of FAO Member Countries to this interdependent problem is reflected in the formation of PAAT, which produces relevant technical and scientific information for policy makers, planners, the public and private sector and various other stakeholders concerned with Tsetse and Trypanosomiasis research and control. FAO also provides direct assistance in the formulation of field programmes that focus on area-wide intervention against the tsetse fly and the disease in areas where there is significant potential for sustainable agricultural development. An example of this is the assistance by FAO and IAEA to Ethiopian efforts in developing and the submitting a proposal to the Japan "security fund" (United Nations Trust Fund for Human Security) for supporting Tsetse and Trypanosomiasis intervention and rural development in the Southern Rift Valley of Ethiopia. A similar initiative is anticipated to be undertaken in collaboration with colleagues in Burkina Faso and Mali for the "cotton belt zone".

FAO also supports efforts to assess the impact of the disease burden and the benefits of intervention. An FAO/IFAD initiative seeks to assess the overall development constraints posed by various human, animal and plant diseases. Furthermore, an initiative by FAO, the United Nations Industrial Development Organization (UNIDO) and the International Federation of Animal Health (IFAH) aims at the development of systems and establishment of national capacities for quality control / quality assurance for trypanocidal and other veterinary drugs.

FAO and The World Bank's Africa Partnership for Livestock Development (ALive) are seeking an enhanced cooperation, aiming at field interventions and respective investments. The presenter emphasized the importance of consensus between FAO/PAAT and AU/PATTEC regarding integrated area-wide approaches against the Tsetse and Trypanosomiasis problem and he welcomed the approved AfDB support.

WHO

In 1999 an overall strategy, based on full access to health systems, diagnosis and treatment, was established to address the particularly difficult situation that HAT control efforts were facing: Epidemics were flaring-up in major affected countries, existing diagnostics were not widely used, availability of drugs was jeopardized, and there was very poor support from the international community for HAT control. Today, considering a) that the number of new cases is decreasing constantly, combined with lowered estimates regarding unknown cases; b) an increasing portion of the population being screened; c) the total availability of drugs; d) the increasing number of trained technicians in the countries concerned; and e) the

commitment of the international community; it is reasonable to regard sleeping sickness under control. This has been accomplished with partners that enabled WHO to establish, develop, and lead a coherent control programme, which has covered the entire spectrum of activities needed for controlling the disease. It has been enhanced by a successful approach to expand access to drugs including drug donations, targeted distribution, training and restoration of treatment centres. Therefore, it appears possible to propose launching an elimination programme of HAT.

Today the elimination of sleeping sickness must be considered a goal that is achievable by making use of existing diagnostic tools and drugs. However, due to the complexity of applying some of the tools, it is impossible to integrate them together with the required drugs into the peripheral health capacities. Under such conditions there is a risk that elimination may not be sustainable. Consequently, simple diagnostic tools and oral/safe drug(s) are needed for both stages of HAT to ensure a cost effective and sustainable elimination.

The future of sleeping sickness control currently faces a critical and decisive period. As the disease may no longer be considered a major and widely distributed public health problem, NGOs are about to leave, countries are giving lower priority to the disease, the international community is less and less interested, trained technicians are at risk of being lost, and no incentives exist for drug and diagnostic development. As a consequence, although we may be close to the elimination of the disease, there is a real risk of creating conditions for major re-emergences of HAT.

On 26th August 2005 the regional committee for Africa urged WHO to implement a strategy aiming to eliminate the disease as a public health problem.

IAEA

In addition to its key role as the UN's nuclear 'watchdog', the IAEA also seeks to contribute nuclear and related techniques to poverty reduction and sustainable rural and agricultural development.

In 2004 a major internal and external review of the Agency's tsetse "programme" confirmed that the SIT can, in some situations, make a decisive difference as part of an integrated area-wide campaign. However, SIT should not be regarded as the panacea for all tsetse and trypanosomosis problem scenarios. The review emphasised that ownership and development of an overall roadmap for the creation of tsetse-free zones is formally a matter for the Member States concerned. The Agency's support activities will largely be restricted to the SIT component of area wide integrated pest management, i.e. the "SIT-package". Other activities such as conventional suppression activities using insecticides on livestock or artificial baits need to be conducted by the Member States and/or other partners / stakeholders. The Agency will support Member States' efforts in four phases, whereby advancement from one phase to the next will be subject to achieving pre-agreed milestones. The four phases are: a) existence of a national / sub-regional policy and strategy and level of Member State commitment; b) feasibility assessment; c) capacity building; and d) support to operational area-wide intervention against Tsetse and Trypanosomiasis. In all phases the Agency would provide support on aspects that are relevant to the "SIT-package". Enhanced partnerships with other mandated UN agencies and other organizations, institutions and stakeholders will be essential to attain the overall development objective.

Relevant services to Member States will continue to be conducted using both the Agency's Regular Budget resources and the IAEA Technical Cooperation Fund. Support to

Member Stares will continue to be provided through three main mechanisms, namely "normative" activities, research and methods development and technical cooperation.

"Normative" activities include the development of standards, guidelines, manuals, etc. A recent example is a draft report on "Criteria for Declaring a Zone Free of Tsetse Flies Tsetse-Transmitted (Animal) Trypanosomosis". Another, ongoing, effort aims at drafting a manual on the "Principles of Entomological Baseline Data Collection" in preparation of area-wide integrated PATTEC programmes.

Research and methods development is the second of three major pillars of the Agency's tsetse "programme". This includes in-house research at the FAO/IAEA Agriculture Laboratory and Coordinated Research Projects (CRPs) and technical contracts.

With regards to IAEA-TC supported activities in Member States, the Agency currently provides technical assistance through nine national projects in Botswana, Burkina Faso, Ethiopia, Kenya, Mali, Senegal, South Africa, Uganda and the United Republic of Tanzania. All national projects are in different phases of feasibility assessment, capacity building and pre-operational support, with the Ethiopian project currently being the most advanced. In addition one regional project supports the overall objectives of the AU-PATTEC initiative, under which one regional training course on the Principles of Baseline Data Collection and two sub-regional workshops in East and West Africa on standardized sampling and processing of flies for subsequent DNA-based population genetic investigations will be organized in 2006.

ICIPE

ICIPE has a long history as a centre of excellence for research and capacity building in insect science and its applications. ICIPE has multidisciplinary teams of scientists – biologists, ecologists, molecular biologists, social scientists, etc. – working on its 4-'H' paradigm, involving human, plant, animal and environmental health.

In the Animal Health Division the objective is to increase livestock productivity by effectively managing tsetse and ticks. In this connection ICIPE's work on the development of baits – olfactory and visual – is well known. ICIPE identified two repellents for savannah tsetse, one a synthetic repellent and the other being the repellent blend from un-preferred animals like waterbucks. Work is in progress to field test the repellents in large field trials and to optimize the dispensers. Work is also in progress at ICIPE to identify the molecular basis for parasite survival in the flies and factors important in vector competence. Adaptive management of tsetse populations is also being undertaken in the lake region of Ethiopia by identifying hot-spots of high tsetse densities using GIS for strategic placement of traps. Work is in progress on developing simple on-farm integrated tick management methods using botanicals and behaviour-modifying semiochemicals.

ICIPE's work in capacity building at all levels is well known and the institute has trained farmers, communities and a cadre of vector control specialists and researchers in large numbers.

ICIPE supports the area-wide projects in which integrated vector and disease management strategies are employed for control / eradication of T&T, and is willing to assist these countries by undertaking ecological studies (dispersal / distribution of vectors), vector suppression, barrier development, tsetse mass-rearing, backstopping R&D, socio-economic studies and capacity building at all levels.

WHO/TDR

The Tropical Disease Research programme (TDR), established in 1974/75, has two objectives: a) undertake research and development of new and improved tools for the control of major groups of tropical diseases; and b) strengthen research capabilities in countries, where these diseases are endemic, through training in biomedical and social sciences research, and through institutional support. TDR-funded research involves various disciplines, including parasitology, entomology, molecular biology and molecular pathology. The work aims at the discovery of new or improved drugs or diagnostic techniques and it supports drug development and evaluation, as well as, vector control research. A TDR initiative to strengthen research capacity resulted in the formation of a consortium of African research institutions, with one coordinating institution, i.e. KETRI / KARI-TRC. At a recent meeting the consortium developed a strategy for training, to which all member institutions will contribute their competences. TDR is supporting the coordination of an IGGI research group for *Glossina* genome sequencing. Activities of the research group so far include the estimation of genome size for *G. m. morsitans* (613 Mbp) and *G. p. palpalis* (479 Mbp), and the construction of ESTs and BAC libraries.

With regards to new opportunities for funding vector research on Human African Trypanosomiasis (HAT), the TDR Molecular Entomology Committee will begin in May 2006 screening proposals for research on HAT vectors for possible funding. The presenter highlighted that the deadline for receipt of research proposals applications is 17 February 2006. Funding proposals for research projects should focus on the following areas:

- Generation of knowledge and development of tools for tsetse fly control. The work would include analysis of population bionomics, genetics and vectorial capacity, and would explore possible occurrence of insecticide resistance in tsetse flies.
- Development of 'post-genomics studies' of tsetse flies. The work would include functional genomic analysis for better characterizing the vectors (biology, vector competence) and for assessing tsetse-trypanosome interactions.
- Development of novel approaches for interrupting trypanosome transmission. The work would include efforts to develop methods for devising refractory tsetse phenotypes and to explore gene-driving mechanisms (into natural populations), such as symbiont-mediated cytoplasmic incompatibility.

PAAT

The Programme Against African Trypanosomiasis (PAAT) is a consortium of mandated organizations within the UN family, namely FAO, IAEA and WHO, along with AU-IBAR and other international agencies and institutions working in the field of Tsetse and Trypanosomosis (T&T). Through harmonious interactions of the partners, PAAT aims at fostering focused research and investments to remove the constraint of T&T, particularly in the rural population, improve human and animal welfare and livelihoods, promote sustainable agriculture and rural development, ensure food security and poverty alleviation and facilitate achievement of rural cash economy. The PAAT secretariat is hosted by FAO Rome.

PAAT supports the overall objectives of the AU-PATTEC initiative. At the last meeting of the ISCTRC a report on the harmonization of activities of PAAT and PATTEC was reported. This effort generated guidelines/criteria for the selection of priority areas for joint international activities against T&T. Six countries, namely Burkina Faso, Ethiopia, Ghana, Kenya, Mali and Uganda, benefited from this PAAT–PATTEC harmonization effort

and were successful in obtaining grants and loans from the ADB to fight T&T under the PATTEC initiative. PAAT will continue to provide expertise to Member States in the context of the objectives of the PATTEC initiative.

A major activity of PAAT is the provision of relevant information, publications and access to required expertise through the PAAT information system (PAAT-IS). PAAT urges its mandated institutions as well as other stakeholders to maintain the momentum of the PATTEC programme by assisting the current activities in Member States and contributing to the design of concrete support strategies, evaluating programme needs, assisting in capacity building, standardizing preparatory and operational techniques, such as baseline data collection, progress monitoring and land use planning and rural development.

ILRI

Over the past few years ILRI expanded its geographical reach from Africa into Asia and Latin America. ILRI's focus is on livestock research that contributes to improving the livelihoods of poor people, including livestock keepers, market agents and consumers. ILRI's livestock research, including research in trypanosomiasis, addresses five thematic areas of a) market opportunities, b) biotechnology and c) livestock systems (i.e. people, livestock and the environment), as well as two cross-cutting themes on d) targeting research and development activities and e) enabling innovations. National, regional and international research institutions have been ILRI's main partners, and there is increasing collaboration with civil society organizations, NGOs and the private sector.

Trypanosomosis research at ILRI covers the areas of molecular genetics, breeding for trypanotolerance, diagnostics and molecular biology, epidemiology, socio-economics, environmental monitoring, the decision support tools and delivery of services in the field. With regards to trypanotolerance, a focus is on the mechanisms and degree of tolerance through field and laboratory studies, particularly in N'Dama cattle. Shorter-term goals are to identify health and production traits for selection and to understand the mechanisms that confer tolerance. Currently there is research in Ethiopia to assess trypanotolerance in indigenous Ethiopian breeds. Efforts for exploiting genes from indigenous breeds for improving livestock production in West Africa, (supported by Global Environment Facility and the African Development Bank) are scheduled to commence in 2006.

ILRI is in the process of developing the Bioscience east and central Africa (BecA) research platform, which is a joint venture of African research institutions with a research hub at ILRI and nodes to be established in different national institutions. Construction activities will be initiated in 2006. BecA will provide a state-of-the-art shared research facility for genomics, functional genomics and plant and animal biosciences.

Epidemiological research has focussed on three areas, assessment of alternative control options, drug resistance and cattle-human transmission of *rhodesiense* sleeping sickness. Diagnostic research has focused on developing tools for epidemiological field studies.

Socio-economic research addresses economic impact (cost-benefit). Some efforts in this field aim at better delivery systems, estimate transaction costs and assess the economic issues associated with collective action in tsetse and trypanosomiasis control. One important project in recent years has investigated options for reducing the impact of resistance to trypanocidal drugs in Mali, Burkina Faso and Guinea in collaboration with national and regional institutions.

Increasing importance is being placed on environmental monitoring and impact assessment, including ecological impacts of disease control programmes and changes in agricultural activity. Site-specific assessments have been made in West and East Africa and are being integrated as impact assessment tools for national PATTEC programmes.

Over the years ILRI's research focus has evolved with an increased emphasis on the broader epidemiological, socio-economic and environmental impacts of trypanosomiasis in sub-Saharan Africa. The presenter highlighted that laboratory research is more targeted, that there is an increasing number of field-based studies, and that there is a greater reliance on collaborations and linkages with national, regional and international partners.

CIRDES

Since the 27th meeting of ISCTRC, CIRDES has pursued research on a) improved diagnostics; b) regional aspects of epidemiology; c) improved chemotherapy while minimizing the risk of chemo-resistance; d) improved techniques and strategies for vector control; e) vector ecology; and f) genetic markers to investigate resistance to trypanocidal drugs.

CIRDES aims at putting in place a system for disseminating scientific results that permits reaching all relevant stakeholders in the field. For this a package of awareness generation was produced, and a series of national workshops held in Benin, Burkina Faso, Ghana, Mali, Niger and Togo between September 2004 and February 2005.

Under a regional CORAF/WECARD project on awareness generation and dissemination of improved livestock rearing techniques, CIRDES and various regional partners aim at developing a) new tick control techniques; b) ELISA based diagnostics for trypanosomiasis; c) innovative techniques for *Glossina* control; d) integrated livestock / cropping systems; and e) livestock breed characterization and selection. Furthermore, CIRDES produced a series of relevant technical files and manuals.

Using flies from the CIRDES tsetse colonies, which currently are maintained at a level between 100,000 and 150,000 female flies, CIRDES has also been providing assistance to pre-operational tsetse intervention activities in Mali. The work included mating competitiveness studies between the mass-reared strain of *G. palpalis gambiensis* from the CIRDES tsetse colony and flies from the target area in Mali, irradiation studies and experiments aiming at the provision of high-quality male flies for future SIT operations, as well as, the provision of marked sterile males for a series of test releases in Mali.

Under a Wellcome Trust project on tsetse habitat fragmentation and resulting consequences for epidemiology and tsetse control, CIRDES aims at contributing to the development of improved control strategies. The project involves GIS-supported ecological and molecular genetic studies, which compare different tsetse populations in separate fragmented habitats. Other newly initiated activities at CIRDES include work on immunization and on markers for disease resistance.

EANETT

The Eastern Africa Network for Trypanosomiasis (EANETT) is a joint effort by countries in Eastern Africa and aims at effective management and control of sleeping sickness. EANETT is comprised of national institutes that are directly involved in research and control of trypanosomiasis. EANETT is supported by the Swiss Agency for Development and Cooperation (SDC) and started its activities in 2000. The first phase of EANETT ended in March 2004, phase II currently runs though end 2006.

Members of EANETT include the a) the Swiss Tropical Institute (STI), Basel, Switzerland; b) the Tropical Medicine Research Institute (TMRI), Khartoum, Sudan; c) Livestock Health Research Institute (LIRI), Tororo, Uganda; d) the Kenya Trypanosomiasis Research Institute (KETRI), Kikuyu, Kenya; e) National Institute of Medical Research (NIMR) Tabora, Research Station, Tabora, Tanzania; f) Tsetse and Trypanosomiasis Research Institute (TTRI), Tanga, Tanzania; and g) the Ministry of Health, Malawi. Neighbouring countries with endemic HAT are invited to join the Network.

The research collaboration addressed under EANETT includes a) active surveillance of humans (and livestock); b) identification of the most endemic areas (villages); c) treatment of HAT patients; d) Geo-referencing of endemic villages and human cases; e) updating tsetse distribution and density in endemic areas; f) establishing colonies of *G. swynertoni* and *G. fuscipes* for studies on vectorial capacity and transmission; g) characterising tsetse flies genetically; h) improving techniques for the isolation of *T. b. gambiense* from patients; i) collecting new *T. b. gambiense* isolates; and j) establishing of a *T. b. gambiense* monkey model at KARI-TRC.

EANETT contributed to the improvement of laboratory facilities for research and diagnosis and provided information exchange channels (internet access; establishment of a homepage www.eanett.org; new flyer). The Network provides support to selected MSc and PhD fellowships and it organised training events / workshops on the following themes: geographical information system (10 participants); molecular biology and entomology (10 participants); and scientific writing and presentation (15 participants). EANETT maintains close links with WHO's "Sleeping Sickness Treatment and Drug Resistance Network", PAAT, MSF, the Institute of Tropical Medicine, Antwerp, Belgium, Yale University, School of Medicine, New Haven, USA, and the Royal Tropical Institute, Amsterdam, The Netherlands.

EANETT's planned near-future events include the Annual Conference 2005 in Mombasa, Kenya, November 16-18 and a workshop on "Standardisation" in Mombasa, Kenya, November 14-16, aiming at the cryo-preservation, propagation, isolation, drug sensitivity of *T. b. gambiense*, sampling / collecting field samples, application of GIS and reflecting socio-economic considerations.

ITC

As an autonomous, non-profit oriented regional livestock-based agricultural research institution the International Trypanotolerant Centre (ITC), located in Banjul, The Gambia, initially fostered research and multiplication of trypanotolerant cattle, namely the unique N'Dama. This is done in an effort to contribute to increasing livestock productivity and utilisation in the West African region through optimal and sustainable exploitation of genetic resistance of indigenous breeds of livestock for the welfare of the human populations. With the aim to impact on poverty reduction and food security, ITC targets the formulation, implementation and introduction of sustainable socio-economically and environmentally acceptable integrated packages at farmer level, for improved livestock health, production and exploitation. Immediate partner countries include The Gambia, Guinea Bissau, Guinea Conakry, Senegal and Sierra Leone.

Current ITC R&D takes place through three projects: a) low-input systems programme; b) market-oriented systems improvement programme; and c) systems overlap and linkages programme. The outputs from these three institutional projects in turn strengthen the four pillars that support the centre's R&D agenda: a) improving local

resources including animal and feed resources; b) introducing innovative changes including exploitation of local and exotic crossbreeds and the deployment of improved diagnostic techniques; c) collaborating and networking; and d) human resources development and institutional capacity building. Recent R&D advances included work on trypanocide drug resistance among trypanotolerant cattle, which revealed that drug resistance in the test areas in Mandiana region and Haute Guinée may not be existent. Furthermore, genetic characterisation was undertaken among goat populations in West Africa.

In consultation with national partners, the Centre has developed a 12 year long term strategic plan, in which strategic alliances will be sought with NARS and CG Centres in undertaking research in applied, strategic and adaptive domains to tackle the problems associated with tsetse and trypanosomosis with the view to reducing poverty among people living in tsetse infested areas.

Recommendations

National PATTEC projects

Ongoing efforts by several tsetse and trypanosomosis affected countries aim at generating further financial support from the African Development Bank Group for national PATTEC projects. The meeting welcomes these efforts. The meeting also underlines that in several countries major technical and other issues should be resolved, before the national projects become operational. The meeting proposes to the national PATTEC projects the adoption of a phased, conditional planning and implementation approach. In particular, national PATTEC projects should only enter the operational intervention phase, after having appropriately addressed the key components in earlier phases (i.e. feasibility assessment, capacity building, efficient management structures). The meeting further proposes that the Council offers its scientific assistance to the national PATTEC projects in advancing along the phased, conditional approach towards the objective of the PATTEC initiative.

Human African Trypanosomiasis

Considering the achievements made in the area of control of sleeping sickness, leading to a current reduction of new cases and increase of surveillance activities, the ISCTRC:

recommends WHO to launch an elimination programme of sleeping sickness, to adapt control strategies towards this goal and advocate partners which have permanently provided support to maintain their efforts and assistance.

encourages countries to sustain and coordinate their efforts, develop studies aimed to update epidemiological status of the disease and look for additional resources.

urges R&D groups to develop new diagnostic tools and drugs to ensure a cost effective sustainable elimination of sleeping sickness.

Standards, manuals and field guides

Manuals like the one being developed by IAEA on “Principles of Entomological Baseline Data Collection” are expected to provide useful contributions to national and sub-regional efforts under the PATTEC initiative. The meeting encourages specialized institutions to contribute similar standards / manuals for the collection of relevant veterinary, environmental and socio-economic data. It is, furthermore, recommended that additional guidelines or manuals be developed that may target, for example, at area-wide tsetse suppression or standardized entomological and veterinary monitoring and respective data assessment,

reporting routines and facilitation of day-to-day decision making in operational intervention programmes.

Country Reports

Ten papers were presented by representatives of the following countries, Sudan, Mali, Ethiopia, Uganda, Kenya, the Democratic Republic of Congo, Cote D'Ivoire, Angola, Nigeria and Tanzania.

Sudan

The Tsetse and Trypanosomiasis situation in the Sudan was outlined. About 12 percent of the total land surface of Sudan is tsetse infested and trypanosomiasis presents a major constraint to the pastoralists who own more that 80 percent of the livestock. About 8 million cattle and 5 million humans are at risk of contracting trypanosomiasis in Southern Sudan.

Currently tsetse and trypanosomiasis control activities in the Sudan include the collection of base-line data, all cattle rearing areas inside and outside the tsetse belts are endemic to trypanosomiasis, only one species of Trypanosome (*T.vivax*) was found to be pathogenic to cattle and goats. Tsetse surveys were carried out in the Bhar Al Arab tsetse belt. Tsetse survey has been initiated in the Sudan–Ethiopia border area. Only one tsetse fly species namely *G. m. submorsitans* occurs in the Sudan. It was demonstrated in that there was resistance against all trypanocides available. Trypanosomiasis prevalence in camels in Eastern Sudan is 4 percent in Kordofan and 42 percent in South Darfur. Local communities were trained in 2002 in tsetse control techniques under an FAO Technical Co-operation project in South Darfur. Political support for tsetse and trypanosomiasis is high in the Sudan.

Mali

A paper was presented on the experimental releases of sterile male tsetse flies in the peri-urban areas of Bamako. Trypanosomiasis is a major constraint in that area, limiting the full exploitation of the natural resources in this area and hinders agricultural development, and vector control is perceived in Mali as the most efficient way to control trypanosomiasis. Baseline data was collected and a decision was taken to integrate tsetse suppression techniques using baits with the release of sterile flies. The releases gave crucial information on the survival, dispersal and mating success of the flies. Sterilised flies were flown from Bobo-Dioulasso to Bamako for release. Survival of the flies was good and 5,000 flies were released at 59 sites on either side of the Niger River. The flies survived in the natural environment for 35.5 days and could fly for 6 km. Mortality of sterilized flies was caused by high humidity within the container.

Uganda

The contribution of FITCA Uganda to tsetse and trypanosomiasis control in Uganda was outlined. The project had generated comprehensive data on tsetse, sleeping sickness, Nagana and on socio-economics. Zones of low, medium and high risk to trypanosomiasis were delineated and control programmes were implemented to support appropriate farming practices. Livestock figures for cattle, goats, sheep, pigs and chicken were presented. About

3,124,474 cattle are at risk to trypanosomiasis, and 300,000 cases of trypanosomiasis were diagnosed and treated. There was some reduction in the prevalence and incidence of trypanosomiasis following the implementation of tsetse control intervention. A 75-90 percent reduction in the number of flies caught in a trap per day was recorded.

In North West Uganda tsetse control activities were undertaken to reduce *T. b. gambiense* infections in humans. Over 1,000 cases were diagnosed and treated. Tsetse control activities were also undertaken in the *T. b. rhodesiense* area in Eastern Uganda where 793 new cases were reported and treated although 52 deaths were reported between years 2000 to 2004. There was a northward expansion of the human trypanosomiasis belt towards the *T. b. gambiense* area to the north.

The need to re-centralise and harmonise tsetse control programmes was emphasised as the current decentralisation of services was hampering implementation. Uganda supports the implementation of area-wide tsetse and trypanosomiasis control programmes.

A request for the extension of FITCA Uganda has been approved and the second phase of the project will therefore run for 42 months from 2005 – 2007 for the consolidation of achievements in the past. A suggestion was made to expedite the launching of PATTEC in Uganda.

Democratic Republic of Congo (DRC)

The presentation highlighted past and present efforts to reduce the incidence of Human African Trypanosomiasis (HAT). The paper examined recent records of HAT in DRC and evaluated control efforts undertaken including epidemiological and financial data from previous operations during the period 1993 to 2003.

The DRC has a human population of 60 million people and 12.5 million are at risk to Human sleeping sickness (HSS).

Financial support was received from the Belgium Government, WHO, and from the French and Danish Co-operation. WHO is supporting by providing trypanocides. Some additional support has also been obtained from Non-Governmental Organisations.

During the last 5 years, 70,000 new cases were diagnosed. There was, however, a drastic decrease from 26,000 new cases in 1998 to 11,000 new cases in 2001. In 2004, the prevalence of trypanosomiasis was on the increase. Cessation of control efforts will result in a further deterioration of the situation with tsetse populations increasing to pre-control levels. Trypanosomiasis is prevalent in most areas which were affected by the war. The distribution includes the capital Kinshasa as well as the Kasai Province, which is recording one of the highest number of cases.

The problem in the DRC is that the budget is too small compared to the problem to be solved.

Cote D'Ivoire

Results of studies on the Human Animal Trypanosomiasis (HAT) situation in Cote d'Ivoire from 2000 to 2004 were discussed. It was noted that the war which took place since September 2002 resulted in an upsurge of trypanosomiasis infections in humans. A total of 65,897 people were screened and 284 were diagnosed as HAT positive during the period 2000 to 2004. The survey showed that 51 percent of patients were infected in the Western and South Eastern areas.

It was recommended to strengthen surveillance programmes, and the need to raise awareness among the communities and stakeholders was emphasised.

Angola

Human African Trypanosomiasis was reported to have been detected in 1871 in Angola and was controlled towards the end of the colonial era. The detection rate was reduced to 0.001 percent in 1974 when only 3 new cases were diagnosed in both *T. b. gambiense* and *T. b. rhodesiense* endemic areas. The situation has continued to deteriorate in the post independence period. A national strategy has been put in place to address the situation. Researchers have looked into issues of low rates of parasitological confirmations, treatment failures and relapses.

Angola has agreed to collaborate with regional neighbours to strengthen the existing national strategy.

Operational and logistical problems including insufficient staff were highlighted. The Trypanosomiasis Research Centre (ICCT) has 20 centres for screening and treating HAT and has 23 mobile teams. Financial support needed includes USD 700,000 for expenses of staff, 20 vehicles and USD 1,320,000 for equipment.

Kenya

The development of the livestock industry in Kenya is severely constrained by ticks and tsetse flies. Tsetse control therefore is a care function of the Ministry of Livestock and Fisheries Development.

Tsetse occur at an altitude of 200m above sea level in Kenya. All three groups of tsetse are present in Kenya and are represented by eight (8) species of tsetse. These are *G. pallidipes, G. morsitans, G. austeni, G. swynnertoni, G. longipennis, G. brevipalpis, G. fuscipleuris, G. fuscipes fuscipes. G. pallidipes* is the most widely distributed species. About 67 percent of Kenya is under tsetse infestation causing huge losses and reduced livestock productivity. The major trypanosomes in Kenya are *T. congolense, T. vivax, T. simiae* and *T. evansi*. Cattle have been found to be reservoir hosts of T**.** *b. rhodesiense* in sleeping sickness endemic areas of Nyanza and the Western Province. At one time, sleeping sickness cases in Kenya exceeded 500 in a year but since 1968 there have been less than 100 cases reported each year. Sleeping sickness areas are around Lake Victoria, Busia and the disease does not occur anywhere else in Kenya.

The ultimate objective in tsetse control in Kenya is to eradicate tsetse from the entire country in order to promote agricultural and rural development. The decision has been taken to undertake tsetse control using environmentally accepted techniques. Control programmes are to involve the component of community participation. The PATTEC programme has already been launched in Kenya and the initial phase of the project will focus on the Lambwe Valley tsetse belt where eradication is envisaged. The project will also cover the Lake Bogoria fly belt and Embu – Mwea tsetse belt.

Nigeria

Trypanosomiasis has a severe impact on livestock, humans and other agricultural production system in Nigeria. Economic losses due to tsetse and trypanosomiasis are enormous and have

never been fully quantified. It has been estimated that USD 70 million is lost annually in cattle alone in six northern states

There are 11 tsetse fly species in Nigeria. Four of these (*G. p. palpalis, G. tachinoides, G. m submorsitans and G. longipennis*) are of great economic importance. The limits of distribution of the fly species were discussed. The report also covered the historical aspects of tsetse control in Nigeria.

Previous methods of tsetse control included, game elimination, bush clearing and ground spraying. More recently bait technology, involving the use of traps and insecticide impregnated screens, has been used as well as cattle dipped in pyrethroids. SIT was also used in the past.

The use of curative and prophylactic drugs are the most widely accepted means of controlling the disease and reducing losses in livestock. Trypanotolerant cattle have also been used.

Research into tsetse and trypanosomiasis has been undertaken by the Nigerian Institute for Trypanosomiasis Research (NITR). The plan of action and strategy for the eradication of tsetse and trypanosomiasis was recently approved following the inauguration of PATTEC.

Tanzania

An overview of tsetse & trypanosomiasis management in Tanzania was presented. There are seven (7) species of tsetse flies in Tanzania namely *G. morsitans, G. pallidipes, G. longipennis, G. swynnertoni, G. brevipalpis, G. austeni and G. fuscipes*.
Trypanosomiasis is a major constraint to livestock and crop production in Tanzania. Tsetse control could lead to improved food security, increased income to farmers and reduced poverty in rural areas. About 4 million people and 7 million cattle are at risk. Livestock population figures were presented and the human population is 34.5 million. Three trypanosome species are more commonly reported. These are *T. congolense, T. vivax* and *T. brucei.*

The strategy and policy for tsetse control was presented. Control is based on co-ordinated and integrated approach involving stakeholders.

On-going control activities include the deployment of 3226 targets at Serengeti, Mikumi, Katavi and Ruaha National Parks. Awareness campaigns and training of communities have been undertaken and communities have been involved with the development of targets.

Tsetse surveys were undertaken in six (6) regions namely; Tanga, Kilimanjaro, Arusha, Manyara, Mara and Shinyanga. Trypanosomiasis survey indicated that the disease incidence had increased drastically in 2004.

Research is continuing in Tanzania on trypanosomiasis prevalence in cattle on Majia Island and on drug resistance. Further plans include range development through land use plans, community participation for sustainability of tsetse and trypanosomiasis control, use of SIT for eradication and implementation of PATTEC programmes.

Ethiopia

Tsetse flies infest up to 200,000 km^2 of Ethiopia. Five tsetse fly species are present and these are; *G. m. submorsitans, G. tachinoides, G. f. fuscipes, G. pallidipes and G. longipennis*.

About 88 percent of the human population and 70 percent of livestock are found on highland areas which constitute 36.6 percent of the total area of 1.2 million km^2. There are 44 million cattle in Ethiopia.

National objectives in tsetse control are designed to ensure sustainable development and poverty reduction, to facilitate resettlement of people in low lying areas and to ensure food security and rural development. The problem caused by tsetse and trypanosomiasis was outlined.

Surveys are one of the major activities in order to update records on the distribution of both the vector and parasite. Some of the problems encountered include, lack of co-ordination and duplication of efforts, shortage of skilled personnel and infrastructure, inadequate budget and lack of sustainability.

Recommendations

- Recognizing the shortage of well trained and experienced staff in the region, PATTEC is requested to urgently co-ordinate the assessment of training needs at the middle and senior staff levels, develop training curricula and implement training courses.
- Recognizing the need to expedite the implementation of PATTEC programmes Regional/PATTEC Co-ordination offices should draft national and regional action plans.

Two major issues dominated this session, namely: the refinement of techniques for diagnosis of both human and animal trypanosomiasis based on molecular and serological approaches; and genetic markers as tools for determining genetic diversity between and within tsetse fly species.

Previous work assumed the potential of PCR-based techniques for improved trypanosome detection. A paper presented showed the value of PCR in the detection of isometamidium resistant *T. congolense*. While this approach promises to be more sensitive, less laborious and less expensive than conventional methods, questions still remain on its applicability to diminazene-resistant *T.congolense* and the mechanism of resistance.

A modified PCR-based technique (Amplified Fragment Length Polymorphism) was used to study the population structure of *T. brucei gambiense* as a means to understand upsurge and clinical evaluation of sleeping sickness. This method though did not meet the desired objective; therefore there is a need for further studies.

During discussion it became clear that these studies can only be beneficial in the field if they provide more reliable epidemiological information for addressing field and clinical interventions, both for humans and animals, and supporting the formulation of disease management policies and strategies.

The work on tsetse genetics is at the root of our understanding of fly ecology and strategies for its elimination. The papers presented indicated that the ongoing work is promising and emphasises the need for identification of additional specific molecular and morphometric markers. They also underlined the need for additional studies since most results are of preliminary nature. The establishment of a network should facilitate progress in this area.

Recommendations

This session recommended:

- Further refinement of the molecular based techniques for diagnosis, both for human and animal trypanosomiasis;
- Further work on using PCR-based technology for detecting drug resistance strains of trypanosomes;
- To consider the application of laboratory-based studies (both on diagnosis and tsetse genetics) to field situations for tsetse and trypanosomiasis intervention, and explore the possibility of private sector participation on diagnosis;
- It was noted that ongoing research on African trypanosomiasis has generated numerous data and compounds with potential for application in diagnostics. This knowledge has remained in the academic/research environment. Subsequent development into diagnostic tests is seldom achieved due to lack of appropriate technology among researchers. The ISCTRC encourages the establishment of collaboration between researchers and the industry, such as public-private-partnership, to translate the available research data and candidate compounds into validated diagnostic tools for application in the field.

Human African Trypanosomiasis

Fourteen papers were presented during three sessions. Two papers described epidemiological findings. Two papers described diagnostic test sequences. Four papers were related to encephalopatic reaction following melarsoprol or genetic mutation related to melarsoprol resistance treatment. Three papers discussed new drugs development or combination of drugs. Two referred to genetic predisposition to the disease or the role of cytokines. Finally one was related to human infection by *T. evansi*.

In the papers on epidemiological findings, one described the achievements of a control programme in Yei (South Sudan). After three years continuous decrease of prevalence has been observed in most endemic areas. However these achievements are hampered by the weak local system that is unable at the moment to take over the control activities. The second one described the network set-up to monitor drug resistance based on 9 hospital-sentinel network in 5 countries. Treatment failures have been reported in many hospitals ranging from 16 percent to 30 percent with a significant risk in patient showing more than 100 cells in CSF. The treatment failure rate that should prompt a change and which alternative first line therapy should be adopted was discussed.

In the papers describing diagnostic test sequences, one was performed in South Sudan. In a low endemic area CATT performed on diluted blood was found the most cost-efficient method. In DRC, CATT as screening method was found to be most efficient compared to lymph node palpation.

Among the papers about melarsoprol-related encephalopathy, a comprehensive study of risk factors and HLA association was performed in 6 HAT treatment centres in Angola and DRC between June 2002 and November 2003. A total of 69 cases of encephalopathy syndrome and 207 controls were analysed. Whereas oedema, bone pain, apathy and depressed humour were associated to risk of developing an encephalopathy syndrome when present in anamnesis, abdominal pain and diarrhoea were associated with higher mortality.

The haplotype C 14/B15 was significantly associated with the encephalopathy syndrome. In the Centro de Viana in Angola, the encephalopathy syndromes that occurred between January 2001 and December 2004 were retrospectively studied. A total of 78 cases of encephalopathy syndrome were observed among the 1353 patients treated. Encephalopathy syndrome appeared after day six of treatment and was preceded with intense pruritus, urticaria, hyperthermia, severe headaches and vomiting. In two studies undertaken in South Sudan and Uganda, the role of P2 nucleotide transporters, coded by TbATI gene, on the resistance of trypanosomes to melarsoprol when mutations occur was discussed. It seems that other genes could be involved in refractoriness of trypanosomes to melarsoprol.

Of the papers concerning drugs, one provided an update on the development of DB289 for the treatment of the first stage *T. b. gambiense* sleeping sickness. After dose adaptation in phase IIb, the results obtained will allow initiation of phase III, which will involve 250 patients and will be developed in Angola, DRC and South Sudan. One paper provided preliminary data regarding the results obtained treating 52 patients combining nifurtimox 15mg/kg/day 8-hourly for 10 days with eflornithine 400mg/kg/day 12 hourly for seven days. This regimen was compared with 51 patients treated with the standard eflornithine regime 400mg/kg/day 6 hourly for fourteen days. Preliminary pharmacokinetics, and follow-up results indicate that the combination regimen of nifurtimox-eflornithine which is shorter and less cumbersome than standard eflornitine, appears as safe and effective as the standard eflornitine one is. One last paper was presented in this section showing pharmacokinetics of ¼ and ½ of standard oral eflornithine-nifurtimox dose in African green monkeys.

The paper on the genetic predisposition to HAT did not find the same risk effects of TNF_{α} IL10 in Ivory Coast and DRC. However it found an association between IL6 polymorphism and HAT. Six cytokines were studied in confirmed sleeping sickness cases, seropositive individuals and controls. All sleeping sickness cases showed significantly higher plasma levels of six cytokines whereas IL-2 and IL-10 were significantly lower in plasma of seropositive than in the controls. Immunity is suggested to play a role.

Finally a presentation was made of the first human case of trypanosomiasis by *T. evansi*. A 45 years old male Indian farmer living in Shivani village (Central India) without history of travelling out of the country was admitted in the hospital presenting with intermittent fever and altered consciousness. Several assays, including parasitological, serological and molecular biological tests confirmed *Trypanosoma (Trypanozoon) evansi* HIV test were negative. Tangier' Disease was discarded. CSF analysis clearly indicated no CNS invasion by trypanosomes. The patient was successful treated with 5 doses of Suramin.

Recommendations

- *Gambiense* endemic countries are recommended to strength active case-finding detection in order to detect cases as soon as possible and to avoid toxicity and relapses risk when melarsoprol is the first line option to treat second stage
- Countries are encouraged to prefer eflornithine for treatment of late stage *T. b. gambiense* sleeping sickness where feasible, and until combination treatments have been adequately validated
- Countries where NGO's undertake HAT control should make efforts to ensure the capacity to take over NGO's activities.

- Countries are encouraged to give full support to clinical trials aimed at finding new tools for the improvement of diagnostic and treatment.
- Countries are encouraged to develop protocols for the diagnosis and treatment of melarsoprol-related encephalopahic syndrome. In addition further research is needed to understand factors acting in the pathogenesis of HAT.

Animal Trypanosomiasis

Thirteen presentations were made which addressed issues relating to the epidemiology of animal trypanosomiasis, chemotherapy, animal reservoirs of HAT and haematological changes in trypanosomiasis infection.

Cross-sectional and longitudinal studies of animal trypanosomiasis and its vectors in different zones showed that the prevalence of the disease varied according to tsetse challenge. Mechanical vectors were incriminated as the vectors of trypanosomiasis in tsetse-free areas. Management was also shown to be an important determinant of disease prevalence. Another paper showed that productivity in sheep was adversely affected by trypanosomiasis but that there were other parasitic diseases of equal importance in the environment including helminthiasis and heart water.

Standard parasitological diagnostic methods and the use of molecular techniques showed the occurrence of *T. brucei gambiense* in domestic animals. Other studies showed the occurrence of *T. b rhodesiense* in livestock. This observation has implications for the control of HAT

A paper was presented on the development of a rapid diagnostic test for the assessment of drug resistance in the cotton belt zone of Guinea, Burkina Faso and Mali. The test which was based on a modification of a previous test developed by other workers was able to confirm the presence of the phenomenon and showed that there were variations in its occurrence across the area. The test has prospects for use as a relatively inexpensive pen-side test for the diagnosis of drug resistance.

Two papers presented on the assessment of the efficacy and local tolerance of Cymelarsan® in horses and the efficacy of the drug in experimentally infected cattle, showed that at the recommended dosage, the drug is capable of curing both early and chronic infections.

A novel method for tsetse suppression using protein extracts from the midgut of tsetse flies for the vaccination of rabbits was described. Mortality in tsetse flies feeding on vaccinated rabbits indicates that this approach could be used for tsetse suppression. The vaccine also elicited immune responses that impeded the development of trypanosome infection in tsetse that fed on the rabbits.

Haematological changes observed in monkeys and horses after infection with *T.b.rhodesiense* and *T. evansi* respectively, revealed patterns that could serve as indicators for diagnosing infections due to these species of trypanosomes.

Recommendations

Noting with concern the reported occurrence of trypanosome species infective for man in domestic animals and recognising the role domestic animals may play in the transmission of HAT, the ISCTRC recommends to research institutions:

- to conduct detailed studies in order to characterise and determine the pathological significance, in man, of *T. brucei gambiense* and *T. brucei rhodesiense* found in livestock;
- to assess the epidemiological significance of the occurrence of human-infective trypanosomes in livestock using a multi-disciplinary approach involving AAT and HAT specialists;
- to encourage the sampling of a wide range of domestic animals in epidemiological investigations.

Noting with concern the widespread reporting of drug resistant trypanosomes and the absence of new molecules for the treatment of trypanosomiasis, and with appreciation both the efficacy of new formulations of some existing trypanocides and the progress made in diagnostic tests (pen-side and molecular) for detecting drug resistance, the ISCTRC recommends to pharmaceutical companies and research institutions:

- to encourage further work on the development of new formulation of existing trypanocides;
- to implement previous recommendations made on the development of new trypanocidal drugs.

Noting with appreciation the long term objective of PATTEC that seeks to eliminate tsetse flies and trypanosomiasis and with concern the high incidence/prevalence of *T. vivax* infections in tsetse-free areas, the ISCTRC recommends to Research Institutions and PATTEC:

- To support and/or conduct research to determine the role of mechanical vectors in the maintenance of trypanosomiasis in the eventual eradication of tsetse flies.

Vector Control

Nine papers were presented on Vector Control. Three of the papers were on different aspects of the Sterile Insect Technique, two on the vectorial capacity and on tsetse suppression. One paper was on modelling and planning of tsetse control operations.

The models (tsetse plan and tsetse muse) that can be used to predict outcome of tsetse eradication programmes was presented. The paper cautioned against the use of SIT as it was considered to be too costly. This paper generated some controversy and was criticized for what was perceived as a bias against SIT. It was suggested that the tools box be 'keep open' and techniques should be used as feasible. The model was considered to be unrealistic as it assumed even populations of tsetse population and even cattle distributions.

A paper was presented on community-based programmes to control tsetse flies. The reasons for the failure of tsetse control programmes were discussed. Different tsetse control methods used by farmers were discussed. These included the scarecrow target, sackcloth screen, painted tree trunk and the modified mono-screen trap. Information was disseminated to villages in Uganda through workshops, video shows, radios, farmer-to-farmer contacts.

The different methods used were ranked in the order of effectiveness. The use of scarecrows was considered to be more sustainable as it constitutes a tool that farmers would normally use for the protection of their crops.

Results of tsetse suppression in the South Tsetse Eradication Project (STEP) were presented for discussion. The objectives of the project were outlined and these included capacity building, eradication of tsetse from 25,000 km^2 of the Rift Valley and to contribute to the National Poverty Eradication Programme.

Pre-suppression base-line data collection was done on the distribution and density of tsetse using baited traps, parasitology, socio-economic impact and on environmental effects. The suppression programme was undertaken using blue-black-blue targets and deployed 30,000 targets using local communities on a voluntary basis. Cattle (1.4 million) treated with insecticides were also used for tsetse suppression. A 92 percent reduction in the tsetse density and a 60 percent reduction in the disease prevalence were achieved.

Prospects of future work in the project area were good as the project was receiving political support and was supported by the communities. These were however drawbacks which included inaccessibility to some areas.

The distribution of tsetse (*G. austeni* and *G. brevipalpis*) in the Kwazulu Natal area was examined. This study looked at the relationship between tsetse species and the environment and the suppression of those species using targets. *G. brevipalpis* has a wider distribution in forest and open grassland than *G. austeni* which was confined to a shaded areas and at the edges of forest. The increase in the numbers of targets resulted in a 98 percent reduction in the population of *G. austeni.*

The vectorial capacity of tsetse was influenced by the age of the fly and the nutritional status. Younger flies appeared to be more susceptible to infection by trypanosomes than older flies. Multiple infections of trypanosomes were more common in younger flies. After starving tsetse flies for 7 days there were very high infection rates detected. In general starvation increased susceptibility of adult flies to infection with trypanosomes. There was a correlation between the fat level and infection rate. Infection rates were higher when the fat levels were low and vice versa.

A report was made as a study to determine the effects of seasonal variation on the quality of blood and to establish other factors that influence blood quality from local abattoirs. Blood was from Tanga, Arusha and from Dar-es-Salaam. The blood was sterilized by drying in an oven at 80^{o}C for plastics and at 120^{o}C for heat resistant equipment. The bacteria screening procedure of pouring blood on sterilized petri-dishes with nutrient to identify pathogenic bacteria to tsetse flies was followed. The quality values (QF) of the samples tested were above one (1) except the one sample from Arusha. The *Bacillus* group was more common followed by the staphylococcus bacteria. Other minor mortalities in tsetse depended on the type of bacteria. The need to collaborate with other institutions such as Universities in establishing infections in blood samples was emphasized. The need to sex tsetse flies before sterilization was noted so that females can be kept in a colony. It is preferred to release only sterile males and sterile females live longer than males and will increase the risk of becoming infected and transmitting disease. There were advantages in sexing in the pupal stage than at the adult stage. A separate calibration was required for different age pupae. Whilst most of the work has so far been on *G. pallidipes* tests have indicated that multiple species can be sorted with a single calibration, simplifying the set up of the system.

The role of symbionts in the vectorial competence of *Glossina* was elucidated in a study to determine the presence/absence of *Sodalis glossinidius* in *T. congolense* infected and non infected larvae of *G. palpalis gambiensis* and *G. m. morsitans*, respectively poor and major vectors of the parasite. *S. glossinidius* was detected in all infected or not, for both *Glossina* species. It was also detected in all proboscis from the *G. p. gambiensis* displaying mature and immature infection but never in the proboscis of *G. m. morsitans*, the major vector of the parasite. The results suggest that *S. glossinidius* might not be involved in the *T. congolense* maturation process. The symbiont covered may, however, participate in parasite establishment.

The Government of Ethiopia came into agreement with the International Atomic Energy Agency (IAEA) to formulate an SIT project in the Rift Valley. The total area of the project is 25,000km^2 and the first suppression block was 10,500 km^2 . Progress has been made including establishment of the insectory (fly mass rearing and eradication facility) and the collection of blood and processing. Tsetse suppression in the project area has already commenced. There is need for good baseline data. Several challenges have been encountered including delays in colony build up, presence of inaccessible pockets of infestation, management efficiency and lack of financial flexibility. Future steps will focus on technical activities and involve human resources development, enhancement of national and international partnerships and the implementation of land use plans.

Recommendations

- Following the launching of National and Regional PATTEC Programmes after a long time of in inactivity in many countries and noting the need for standardized or harmonized baseline data collection and operational procedures, it is recommended that gaps be filled in the area of data collection, tsetse suppression, sterile insect techniques (SIT) and capacity building including private sector participation;
- Community participation should be considered for integration during the initial stages of tsetse suppression in PATTEC programmes. However, due to problems experienced with sustainability, the meeting recommended that specialized and effective strategies be considered for the eradication of low tsetse densities beyond the community's capability;
- Considering the variety of tsetse eradication technologies available for use under different field conditions, it is recommended that appropriate techniques including SIT, be integrated in order to achieve the desired results and use predictive models to assess progress and outcomes where and when necessary.

Environment (GIS)

There were five oral presentations and one poster covering this topic. The papers were of very high quality science relating to environments under which tsetse and trypanosomiasis control is carried out. It was noted that to have a separate session dedicated to environmental matters alone was a big improvement from the previous ISCTRC Conference where papers on environment were presented alongside the socio-economics and have never been more than three. The improved number of papers may be a reflection of the growing importance of environment in tsetse intervention issues. This may be due to the recent focus in diversification of objectives of tsetse and trypanosomiasis control to embrace aspects of

promoting agriculture and rural development. As a result of this change in focus environmental impacts of tsetse and trypanosomiasis control are more and more addressing the indirect/ secondary effects that may be triggered by changes in land use after the disease constraint to livestock production is removed. This focus is highly welcome as there is a need to enhance agricultural productivity in the project areas and protect the environment.

The papers presented ranged from application of environmental monitoring methodologies, environmental surveys in tsetse infested areas to show how tsetse distribution matches habitat structures, and development of a framework for environmental impacts assessment. An interesting presentation was made that discussed environmental affinities important in the transmission of human trypanosomiasis. The paper on mapping of benefits generated a lot of interest as there were a number of questions as to how to apply the model.

There were many questions following each presentation which showed the interest the audience had on issues of environment in Tsetse and Trypanosomiasis interventions. Environmental monitoring and sustainable land management in PATTEC projects is critical to achieving the desired goals and objectives of rural development. Despite this session being on the last day of paper presentations, it was encouraging to find that participants of the previous three days were still attentive and participating even though most of them were from as distant disciplines as parasitology and immunology.

Recommendations

Recommendations drawn from the discussions were:

- There is a need to promote environmental considerations in Tsetse and Trypanosomiasis interventions in order ensure sustainability of agricultural practices;
- There is need to standardize methodologies used in environmental monitoring impact assessments and make them available to all countries;
- There is also a need for capacity building among countries to develop adequate manpower with appropriate skills to conduct environmental studies in Tsetse and Trypanosomiasis project areas;
- It was recommended that PATTEC or PAAT undertakes a coordination exercise to ensure that a standard terms of reference for baseline data collection among countries are developed to ensure that data collected are of high quality and is similar in all sites;
- It was also recommended that a standard framework or guides for environmental data collection is developed to ensure that data from different sites and countries are comparable;
- That studies including GIS work should be encouraged in human and animal trypanosomiasis for spatial risk and impact assessment.

Socio-Economic and Rural Development

Recommendations

- Manufacturers should be encouraged provide sachets of trypanocidal drugs available in a variety sizes for a range of animal weights;
- For sustainability, animal trypanosomosis control interventions should be targeted towards communities committed to controlling tryponosomosis;

- Primary school teachers should be included in campaigns to raise awareness of tsetse and trypanosomosis and be provided with appropriate information and materials;
- Technology delivery should be targeted at the appropriate gender group and policy formulation and implementation should be gender balanced;
- Continued support for the Orma Boran breeding programme is required to maintain the genetic qualities of this indigenous breed and maximise benefits from previous investments.

Poster Presentations

A total of 31 posters were presented during the 28th ISCTRC meeting. Highlights of these are as follows:

- Detection of trypanosome-specific antibodies in saliva for non-intrusive diagnosis of sleeping sickness. Saliva, serum and whole blood were used to measure specific antibodies using direct ELISA, indirect ELISA and CATT. Result indicates that the best test format for saliva testing is the indirect ELISA on sample dilution 1:20.
- Highlights the importance of benefits from improved diagnostics for farmers by reducing losses from morbidity and mortality and cost of unnecessary drug. More accurate diagnosis would allow more rational drug use and slow the development and progression of drug resistance.
- Veterinary measures against animal trypanosomosis suppress the incidence of human sleeping sickness in southern Uganda.
- Assess the impact of one dose ISMM treatment in cattle on the incidence of human sleeping sickness due to *T. b. rhodesiense.*
- Highlights the importance of genetic host parasite interaction for the diagnosis, treatment and control of human sleeping sickness.
- Stage determination of human sleeping sickness using LATEX/IgM and LATEX/*T. b. gambiense* agglutination tests in CSF.
- Evaluation of various diagnostic techniques indicated that CTC and mAECT are better tests for field application.
- Pathogenesis of T. *b. gambiense* in vervet monkey with particular emphasis on clinical and haematological parameters.
- DMFO-nifurtimox combination treatment against *T. b. g.* in African Green Monkey and the use of Megazol in relapse cases.
- Describes drug resistance of *T. congolense* field isolates from cattle in relation to drug use practices in Mozambique.
- Variation in virulence of *T. congolense* field isolates tested in mice in Eastern Zambia.
- Spatial distribution of drug resistant animal trypanosomes in Mali and Guinea.
- Nkedi zebu cattle are more tolerant to tsetse-transmitted trypanosomiasis compared to Ankole cattle under the same tsetse challenge in Uganda.
- Highlights the importance of haemorrhagic *T. vivax* in Uganda.
- Tsetse blood meal analysis and its relation to the transmission of *T. b. g*. to human in southern Cameroon.

- Cross sectional and longitudinal studies on bovine trypanosomiasis indicated high risk in the lowlands compared to the plateau in Cameroon. Drug treatment in the buffer zone will reduce the incidence on the plateau.
- Use of insecticide to kill tsetse and ticks reduce the incidence of trypanosomiasis and tick-borne diseases in cattle in Bugiri and Busia districts of Uganda.
- F1 (Orma Boran x Tseso Zebu) showed low prevalence of trypanosome infection with better PCV in Teso district, western Kenya.
- ILRI/EARO. Sheko breed of cattle showed relatively high tolerance to trypanosomosis compared to Gurage, Horro and Abigar breeds of cattle in Ethiopia.
- Highlights the association between *Glossina fuscipes fuscipes* and *T. brucei gambiense*. and the river basins in Uganda.
- *Glossina fuscipes fuscipes on* Lake Victoria islands feed predominantly on *Varnidae*. Blue-black insect targets are more effective in suppressing *G. f. f.* than pour-ons/sprays.
- Toxicological effects of synthetic repellents were tested on rabbits and showed mild irritation on the skin and eyes of the rabbits.
- "Push-Pull" technology gave a 70 percent reduction in trypanosome infection in 6 months time.
- Describes vector and rodent holding devices during parasite transmission experiment in the laboratory.
- New tsetse mass rearing and research facility in Slovakia with present female colony of 33,000 *G. pallidipes*, 45,000 *G. fuscipes* and 12,000 *G. m. morsitans.*
- Assess the prevalence of trypanosomosis in cattle, pig, sheep and goats using PCR in Busia, Kenya. Individual homesteads with *T. brucei* were mapped.
- In western Kenya, community beliefs about the cause of human sleeping sickness attributed the cause to witchcrafts (34.7 percent), HIV/AIDS (33 percent) and tsetse flies (21 percent) and recommend awareness creation and education among others.

THE WHO/TDR PROGRAMME

Sequencing the Tsetse Fly Genome

Malaria, dengue and dengue haemorrhagic fever, and human African trypanosomiasis (HAT) are on the increase. Although vector control methods are available to interrupt transmission of these diseases, their effectiveness has been limited by logistics problems, development of resistance to insecticides, and high cost. Novel, sustainable approaches to control are urgently needed. Much work remains to be done to identify at the molecular level the role of insect vectors in disease transmission, and the mechanisms for interfering with vector competence. The ultimate goal is to use this knowledge to develop new controls of the diseases.
Toward this, TDR convened the third meeting of the Executive Committee of the International Glossina Genomics Initiative (IGGI) to assess progress on generating a Whole Genome Sequence (WGS) for *Glossina*. About 15 members met 15-17 December 2005 at The Institute for Genomics Research (TIGR) in Rockville, Maryland, USA.

Achievements since the last two meetings include the genome size estimates (550 Mbp in average) of four *Glossina* species (*G. palpalis palpalis, G. fuscipes, G. morsitans*

morsitans, G. pallidipes), and the generation of cDNAs and bacterial artificial chromosomes (BACs) libraries, which would facilitate the assembly and annotation of the genome.

During this meeting, the Consortium adopted the phase III sequencing-related activities. The activities comprise the Whole Genome Sequencing of *Glossina m. morsitans* by Sanger Centre (UK) with funding support from Wellcome Trust. They also include the sequencing of several thousands of full-length cDNAs of *Glossina p. gambiensis* by French Genoscope in collaboration with Institut de Recherche pour le Développement (IRD). Moreover, they involve the generation and normalization of the Expressed Sequenced Tags (ESTs) and BAC libraries by Yale University School of Medicine (USA), Liverpool School of Tropical Medicine (UK), IRD (France), Laboratory for Genomic Information (Japan) and South African National Bioinformatics Institute (South Africa). In addition to the institutes directly involved in the genomics activities, research institutes from Kenya, Uganda, and Tanzania along with WHO/AFRO are also contributing to the global effort of the consortium by facilitating the mobilization of the tsetse research community and the future use of the genome data.

A first draft of the *Glossina* genome sequence is expected by the end of 2006, followed by annotation in 2007. With the crucial importance of vector control for African trypanosomiasis, the availability of a fully sequenced *Glossina* genome should make a significant contribution to vector control efforts and the regeneration of a supporting scientific base.

Trypanosomatids: Genomes and Biology

A special two-disc set of CD-ROMs has been produced to mark the publication of the completed genome sequences of three pathogenic trypanosomatids: *Trypanosoma brucei, T. cruzi* and *Leishmania major*.

The CDs are targeted at researchers in trypanosomiasis and leishmaniasis, other parasitologists and relevant molecular biologists, particularly in disease endemic countries.

The two CDs contain:

- the completed genomic sequences for *T. brucei, T. cruzi* and *L. major* ;
- software for analysis of, and navigation around, these sequences, through genome browsing and keyword searching ;
- the genome papers - reproduced with permission from Science;
- introductory interactive tutorials on disease biology ;
- a collection of over 100 annotated images ; and
- additional resources - reports and articles, videos, animations and research grant information

Development of these CDs has been co-funded by the UNICEF/UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (TDR), the Wellcome Trust and GeneDB on behalf of the 'TriTryp' sequencing consortium, which comprises the Sanger Institute, The Institute for Genomic Research, Seattle Biomedical Research Institute and the Karolinska Institute.

To obtain a free copy of the CD set, please contact: WHO/TDR, 20 Avenue Appia, 1211 Geneva 27, Switzerland; Tel.: +41 22 791 3725; Fax: +41 22 791 4854; E-mail: tdr@who.int

THE FAO/IAEA PROGRAMME

Meeting of Participants in Coordinated Research Project on Improved and Harmonized Quality Control for Expanded Tsetse Production, Sterilization and Field Application, Vienna, 4-7 May, 2005.

This meeting brought together 11 contract holders, two agreement holders and two observers from the following countries: Austria, Burkina Faso, Costa Rica, Ethiopia, Kenya, Slovakia, Uganda, United Republic of Tanzania, Republic of South Africa, Belgium and Mali. The presen- tations covered three main areas: fly quality measurement both in the colony and after release, blood diet collection, processing and decontamination, and control of vectorial capacity.

The fly quality measurements that were covered ranged from colony performance characteristics such as fecundity, survival and pupal size, to a detailed video analysis of mating behaviour and recording and analysis of sound production. These latter two indicated that the behaviour of tsetse during mating is much more complex than previously thought, and the studies will continue to try to determine which components are critical to mating success of released sterile flies in the wild. A study of flight muscle development looked at the rate of muscle development, changes in the proportion of actin to myosin and enzyme activity, and will look at methods to enhance muscle development in the males destined for irradiation and release.

Under blood diet, presentations were made on the effect of season and host condition on blood quality, and the potential of high temperature, short time pasteurization for bacterial decontamination of blood. Whilst variation in blood quality could be observed with season, the effect was small. The influence of donor condition is likely to be more important, and the method for assessing this was discussed. Pasteurization was shown to be feasible, at a temperature in excess of 70°C for 1-3 seconds, but difficulties were experienced in controlling the conditions to achieve the correct holding time and post-treatment cooling rate.

In the final group of presentations, the control of vectorial capacity through feeding trypanocidal drugs in the blood diet of sterile males was presented. Two contract holders have been working on this issue, and presented very similar results in two different tsetse species with different trypanosome isolates. Both showed that isometamidium chloride (Samorin®) at 10ug/ml substantially reduced the rate of establishment and of maturation of trypanosome infections, particularly of *Trypanosoma brucei* over a period of 7-10 days. The mode of action of the isometamidium chloride was discussed, and two possible mechanisms were identified: direct toxicity of the drug with residual action, and persistent modification of the midgut environment influencing the parasites ability to invade the host. Further work to elucidate this was planned.

Developments at the FAO/IAEA Agriculture and Biotechnology Laboratory, Seibersdorf, Austria.

The envisaged reorganization of the tsetse colonies has now been completed with the transfer of the *Glossina morsitans morsitans* colony to the Slovak Academy of Sciences (SAS); Institute of Zoology in Bratislava, Slovakia and the return of the *G. m. centralis* colony to the FAO/IAEA Laboratory in Seibersdorf. This latter colony is now held at about 3,000 females. Following the expiration of the initial three year contract with the SAS in Bratislava, a new contract has now been issued to supply pupae to the rearing facility in Ethiopia.

Testing of the semi-automated tsetse feeding and holding system TPU3.2 (Tsetse Production Unit) has continued, with alternate week's units being set up on the TPU3.2 and the conventional trolley system. Problems encountered with the alignment and levelling of the cages, caused in large part by the irregularity of the cages are being addressed by the development of an improved cage-holding system using new foam- core PVC pipe cages.

Work is continuing on alternative blood decontamination procedures using UV treatment. One of the UV treatment machines has been installed in Seibersdorf, and tests have been carried out to assess the effect of UV irradiation on the nutritional quality of the blood, and to assess the effect of the UV irradiation on the bacteria normally encountered during blood collection.

Work on the effect of freeze-dried blood on tsetse quality and reproduction, has recommenced. Freeze-dried blood has been dialysed through a 6-8000 k Dalton membrane and the dialysate collected and concentrated by freeze-drying to isolate a compound, named yellow factor (YF), due to its light yellow to orange appearance. Freeze-dried blood that has been dialysed does not support reproduction in tsetse, and the females show various reproductive abnormalities. Work is continuing to demonstrate the necessity of YF for tsetse reproduction, and to identify the components of YF.

Work is also just starting to look at the effect of storage on blood quality, and various additives to minimize the effect of storage. This will continue earlier work on citrate as an anticoagulant reported in the 2002 Annual Report.

As reported earlier, some tsetse species carry a virus that, in a certain proportion of individuals, leads to hyperplasia of the salivary gland and these individuals also show reproductive abnormalities. This virus is present in natural tsetse populations at a low level (0.5- 5 percent), but in the Seibersdorf colonies the virus is widespread and can result in some of them in significant decrease in colony production. The problem seems to be most serious in *G. pallidipes.*

PCR analysis detected the virus in 100 percent of the *G. pallidipes* colony that originated from Uganda and in 93 percent of the *G. pallidipes* colony that was established in Ethiopia. Due to the negative impact of the virus on colony productivity under certain stressful condition it is important to understand more about the virus with the goal to develop a management strategy for the virus. The most effective way to begin this study is to obtain the nucleotide sequence of this virus as recommended during a consultancy by Max Bergoin (University of Montpellier II, France). Last July Drion Boucias (University of Florida, Gainesville) visited the Entomology Unit of the Seibersdorf laboratory to develop collaborative work on this topic as he is working on a very similar virus in house fly.

To obtain the nucleotide sequence of this virus, it was necessary to obtain sufficient quantity of the purified virus. This was done by injecting the virus into 3rd instar larvae as previously described in the literature. Using this approach sufficient virus could be purified and confirmed under the electron microscope.

Due to the long life span of tsetse, attempts to produce this virus in an alternative host such as house fly are being undertaken. The small quantity of viral DNA prepared from hypertrophied salivary gland by Francois Cousserans (University of Montpellier II, France) in 2003 was used to construct two viral genome libraries. The first uses small insert fragments as these can be easily cloned and sequenced. The second is construction of a library from large insert fragments in order to facilitate sequence assembly. Using the first approach we obtained more than 800 recombinant colonies and 681 colonies were analysed to estimate the insert length and 415 colonies were sequenced totalling 60-90 thousand bases. The attempts to assemble this sequence and to compare it with the data bank and to complete the genome sequence are ongoing. Whole viral DNA has also been sequenced commercially; the results are still being analysed.

Study of this virus would be simplified if it could be grown in cell culture, but attempts to establish a cell line from tsetse salivary gland have so far proved unsuccessful. Attempts to establish a cell line are continuing, concentrating on controlling bacterial contamination of the culture. Another important aspect to study is the impact of cell culture media and we will also try to establish cell culture from other tissues such as ovaries and imaginal discs.

For more detailed information on the R&D activities conducted by the Entomology Unit, Seibersdorf, see the Annual Report for 2005 which has recently been published at: http://www-naweb.iaea.org/nafa/ipc/index.html

ILRI

Coordinated Regional Project on Improving the Management of Trypanocide Resistance in the Cotton Zone of West Africa

Over the past four years (2002-2006), ILRI has been leading a project in the cotton belt of West Africa to address the threat of resistance to trypanocidal drugs used to control trypanosomosis, a major constraint to agricultural livelihoods in that region. The project, funded by German development assistance, represents a collaborative effort bringing together a consortium of partners comprising international and regional research centres (ILRI, Centre International de Recherche-Développement sur l'Elevage en Zone subhumide (CIRDES), International Trypanotolerance Centre (ITC)), German universities (Freie Universität Berlin, University of Hanover), and national institutions of research and development from Burkina Faso (Direction Provinciale des Ressources Animales), Mali (Laboratoire Central Vétérinaire, Centre Régional de la Recherche Agricole de Sikasso, Unité de Lutte contre la Trypanosomose) and Guinea (Direction Nationale de l'Elevage, Institut de Recherche Agronomique de Guinée).

Trypanosomosis is one of the most important livestock diseases in the cotton zone of West Africa and farmers rely mainly on trypanocidal drugs to control it. After many years of chemotherapy, the efficacy of trypanocidal drugs in cattle appears to be threatened by the development of resistance in trypanosomes. Cases of resistance were already being reported in the cotton zone of Burkina Faso in early 80s. Resistance can jeopardize the ability of people to keep livestock to provide food, income and, just as important, power to cultivate cotton, one of their main sources of income.

Together, the partners have conducted a series of field studies in southwest Burkina Faso (2004), southern Mali (2002-2004), and northeast Guinea (2002-2003), during which

protocols for national agencies for rapid evaluation of trypanocide resistance were developed and tested. The surveys established a clearer picture of the geographical distribution of drug resistance and its association with determinants related to cattle breed and drug use.

Two field studies were conducted in sequence in each site. The first collected data on livestock numbers and breeds, trypanosomosis prevalence, tsetse densities, and drug use levels in a random sample of villages in the study zone. The second estimated the proportion of infections in cattle due to resistant trypanosome strains in villages identified as exhibiting high trypanosome prevalence (>10 percent) during the first study. Isometamidium resistance was assessed by block treatment of 50 randomly selected cattle in each village, and monitoring trypanosome infections every two weeks over a period of 56 or 28 days. Diminazene resistance was assessed by curative treatments of infections in another sample of 50 cattle and monitoring relapses occurring 2 weeks after treatment over the same period. This second group served also as a control for the Isometamidium-treated group. At the end of experiment, a statistical test of relative risk reduction (RRR) was used to estimate (i) the level of Isometamidium resistance in the first group of cattle and (ii) the proportion of curatively treated cattle which became positive 14 days after diminazene treatment in the second group as an indicator of resistance to diminazene.

The project has confirmed the presence of drug resistance in Mali and Burkina Faso and concluded that it is probably not present in north-east Guinea. It has also generated baseline data on the distribution of trypanosomosis and its risk factors as well as tsetse across a zone from northeastern Guinea, through southern Mali, to southwestern Burkina Faso.

Having confirmed the problem, the partners then developed and tested strategies to reduce the risk of the problem emerging and spreading. In doing so, the project demonstrated the utility and feasibility of integrated trypanosomosis control strategies that rely on promoting Rational Drug Use as the core component, complemented by community-based vector control and use of trypanotolerant breeds of cattle.

The project has also studied policies at national and regional levels which might influence the potential for drug resistance to emerge and which would best support appropriate delivery systems for drugs and related veterinary services.

Through its implementation, the project has created the capacity, both in terms of human resources and appropriately adapted methodologies, to ensure sustained monitoring and control of drug resistance in the region. This has been achieved not only through conventional student and on-the-job training by direct participation in project activities, but also by enabling peer-to-peer training and backstopping across countries.

This phase of the collaborative effort is ending. A number of prototype dissemination and training media have been developed. The partnership is therefore seeking to evolve and adapt accordingly by linking to new partners, such as NGOs and regional bodies, who are best suited to up-scaling and disseminating these materials and strategies to the various targeted stakeholders across West Africa.

A major challenge also remains on the scientific side; the work undertaken to date has focused on reducing the risk of developing new resistance, and now the partners have agreed to address the issue of containing drug resistance once it is established in a given area. A proposal to support this expanded partnership and the research on means and ways to contain drug resistance has been approved by the donor partner, BMZ.

Targeting Tsetse and Trypanosomiasis Eradication to Improve Food Security and Reduce Poverty in sub-Saharan Africa

Tsetse fly control has been carried out in many parts of sub-Saharan Africa since the beginning 20th century to reduce the disease trypanosomiasis that severely affects both livestock production and human health. The disease has prevented millions of hectares from being used for grazing or cultivation in Africa. The driving force of tsetse control was to make this land available for human utilization. The main assumption has been that once freed from tsetse flies, people would move to this land to raise livestock and thus improve their livelihoods with improved nutrition, income and draught power. Presence of livestock also provides animal manure to fertilize the farms therefore enhancing agricultural intensification as well.

However, due to how tsetse and trypanosomiasis (T&T) operations have been organized in the past, these noble objectives have been rarely realized. In most cases T&T interventions have succeeded in controlling both the flies and the disease but due to the failure of integrating these successes into local production systems the overall objective of improving livelihoods in the long term has rarely been realized. The controlled areas have therefore been characterized by recurrence of the flies and disease once the control operations were over. Trypanosomiasis has therefore re-emerged as one of the most limiting factors to livestock production in many areas of sub-Saharan Africa, and one of most important limiting factors to economic utilization of vast savannas lands thus contributing to poverty and food insecurity in these areas. It is for this reason that African heads of state decided to focus on eradicating the disease from the continent and thus established the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) housed within the African Union's secretariat.

The framework for environmental and social economic impacts monitoring and assessment on T&T interventions

With financial assistance of the United States State Department Regional Environmental Office for Eastern Africa, the International Livestock Research Institute in partnership with the PATTEC regional office and the six countries participating in the first phase of PATTEC project, is preparing a framework for T&T environmental and socio-economic assessment and monitoring. This support is also assisting in preparation of a methodological guide to assist in implementing the framework. The aim of the framework is to provide PATTEC and the participating countries with a tool to monitor progress and evaluate changes associated with T&T eradication activities. This monitoring and evaluation will enable project managers to identify areas where their operations need to target in order to achieve the overall goal of improving the livelihoods of the poor.

The framework is based on five key questions: Impacts of what?, Impact on what?, Impact on whom?, Impact how? and Impact if? Based on these basic questions and baseline natural and social data, the pressures under which these systems operate and how the interventions influence and alter the state of these pressures and the system will be determined. The questions will address the issue of direct and indirect impacts of the T&T interventions in order to inform the project implementers and policy makers on necessary mitigation measures to enhance environmental sustainability and achieve socio-economic benefits. The framework will assist the evaluators to follow societal responses to the

interventions and how the systems evolve. The framework will help planners and policy makers generate scenarios of possible system outcomes based on sets of likely alternatives including policy interventions.

Methodological Guide

Based on a thorough literature survey on past studies, this document will provide methodological advice to guide the monitoring and assessment of T&T interventions. This document will describe methods for assessing different components of each system and how to measure changes in each. The guide will identify indicators for measuring impacts at different scales.

Enhancing Outcomes

Both the framework and the methodological guide are intended to increase the possibility of T&T interventions leading to fulfilment of the expected outcomes of increasing food production and improving the livelihoods of local people. The extent to which these tools influence the outcome, however, depends on the ability of individual countries to implement them, and their ability and willingness to adapt their programmes based on the results.

Biotechnology

ILRI is participating in a three year capacity building project for HAT funded by TDR/WHO. Thirty five students originating from countries in the endemic regions participated in the initial workshop held during January and February 2006. This was designed to introduce promising young scientists to HAT research. Key outputs were draft concept notes developed by the participants with input from the course tutors. It envisaged that TDR will probably fund one or more of these projects. One Draft CN of particular interest would be a search for potential livestock reservoirs of *T. brucei gambiense* using high resolution genotyping techniques, particularly Multi Locus Sequence Typing (MLST) to confirm the genetic identity of trypanosomes from humans and livestock.

ILRI has developed an indirect antibody ELISA test for *T. brucei* detection in cattle based on a defined recombinant antigen. This has good specificity for *brucei* and the closely related *T. evansi* relative to *T.congolense* and *T. vivax* when evaluated using defined experimental cattle sera from the ILRI collection. This now requires wider validation with field sera.

On the tsetse fly front, and in collaboration with Sue Welburn's group at Edinburgh, a storage method was developed for *Glossina* from the field that maintains the DNA intact and allows extraction for PCR amplification after long term storage at room temperature. A genotyping system based on genome-wide, amplified fragment length polymorphism (AFLP) has been successfully applied to differentiate individual flies from both laboratory and field populations. This will be useful in the future for evaluating gene flow.

ITC

Introduction and Management of Crossbred Dairy Cattle in Peri-urban Areas in The Gambia under Persistent Tsetse Challenge

Despite the agro-ecological changes over the last decades, most regions in The Gambia remain affected by the presence of tsetse flies, either *Glossina m. submorsitans* or *G. p. gambiensis*. Consequently, the livestock industry still relies to a large extent on trypanotolerant breeds, namely N'Dama cattle, West African Dwarf goats and Djallonke sheep. Efforts since the mid-1990s to develop the small-scale dairy sector in the peri-urban settings of Greater Banjul Area (GBA) have led to the implementation of a crossbreeding programme using N'Dama and exotic dairy breeds (Holstein-Friesian) that was more recently complemented by the introduction of improved dairy technologies. These efforts were supported by the donor-community (AfDB, GTZ, EU, FAO) and implemented under the guidance of ITC and the Department of Livestock Services (DLS) of The Gambia.

The past and current epidemiological information has been used to develop appropriate management strategies and guidelines for the production, distribution and management of crossbred dairy cattle kept under varying trypanosomosis risk. Information on the tsetse distribution and trypanosomosis risk in the GBA has been recently updated. The findings of 2004 and 2005 showed that GBA is generally a low risk area (apparent density of less than 3 tsetse flies/trap/day), which is, however, interspersed with some remaining locations where tsetse density and trypanosome infection rates in the flies remain high. Monthly fly infection rates up to 8.6 percent were recorded of *T. congolense* and *T. vivax*.

In crossbred cattle kept predominantly under traditional management systems, the annual trypanosomosis prevalence rates ranged between 2 and 20 percent. Generally, most infections occurred during the rains and the early dry season around the locations identified as hot-spots. Crossbred cattle in such hot spot areas are still living under high trypanosomosis risk, especially when grazed on natural pastures. Cattle kept under more intensive or semi-intensive conditions around built-up areas with less suitable tsetse habitat are under low trypanosomosis risk. However, high numbers of *Stomoxys* spp. and some tabanide species, which are incriminated of mechanical transmission of trypanosomes, were recorded during the wet season in many areas. The increased use of pour-on insecticides reduced their numbers.

A zero-grazing system applied to crossbred animals was tested for high disease risk situations and integrated with feed supplementation and health management measures including helminth, trypanosomosis, tsetse and tick control. Experimentally, insecticide-impregnated netting fences were constructed around stabled crossbred cattle intended to protect them from tsetse fly attacks. While there were no trypanosome infections recorded in the experimental animals in the medium-risk areas where prophylactic treatment with isometamidium was employed, the animals in the high-risk areas had high mean trypanosome prevalence rates (7.4 percent), despite protection by insecticide netting fences. This was mainly due to the low compliance of farmers to keep their animals permanently stabled. Animals in the low-risk areas with no intervention had low trypanosome prevalent rate (1.2 percent).

The results indicate that the use of chemoprophylaxis, vector control and feed supplementation at various levels had reduced trypanosomosis prevalence, increased weight gains and kept these animals productive. This could be a step towards solving the constraints to the production of trypanosensitive crossbred dairy cattle in tsetse-infested areas.

FROM THE TSETSE INFORMATION CENTRE, BOTSWANA

In August 2002 aerial spraying for tsetse control over the entire Okavango Delta ended successfully and over a two year period tsetse flies were eradicated from the area. Surveys to find surviving or reinvading flies have continued for the past 4 years but none were found. There have been occasions when people working in the Delta reported seeing tsetse but on all such occasions these were subsequently shown to be other species of fly – mostly tabanids which are very similar and easily misidentified.

The operation was the first to eradicate tsetse flies from any infestation on mainland Africa -the only other being a sterile male release programme over a relatively small infestation on the island of Zanzibar. It was a timely reminder that aerial spraying can be effective for controlling tsetse because in 2001 the African Union announced a programme to attempt to eradicate tsetse flies from the whole of Africa and in 2002 they instigated the Pan African Tsetse & Trypanosomiasis Eradication Campaign (PATTEC). That programme recognised the significance of the Botswana operation in its stated objective of progressively achieving area-wide control and large scale tsetse-free zones. PATTEC has been instrumental in instigating a regional programme to begin rolling back tsetse flies from their southern distribution limits and as part of that programme Botswana, Namibia, Angola and Zambia have agreed a regional initiative to remove tsetse completely from northern Botswana and the Caprivi – then progressively roll back the limits in Angola and Zambia. From a Botswana perspective, this programme will make Botswana the first tsetse infested country in mainland Africa to become tsetse free. By overlapping into Caprivi and Angola it will ensure that the likelihood of reinvasion is virtually eliminated – thus protecting Botswana's considerable investment in their eradication campaign.

2006 Aerial Spraying Operation

Tsetse Control Division's (TCD) 2006 aerial spraying operation is currently scheduled to start 28 May. It will cover the remaining tsetse infestations in Botswana which are along the Kwando and Linyanti river systems. This distribution is continuous with that north of the rivers in the Caprivi – hence the importance of a regional approach. Although little is known of the fly distribution and continuity further north i.e. in southern Angola and Zambia the spraying will overlap these areas to prevent reinvasion into the Caprivi until such time as PATTEC take their programme forward.

The spray block will cover 10,000km^2 making it the largest area ever treated by aerial spraying to remove tsetse flies. A map is attached to show the area. On completion of the aerial spraying in late August, there will be no further need for blue/black cloth targets to be deployed in Botswana and these will all be removed by TCD. The largest area where targets are currently deployed is NE of the Selinda Spillway to prevent reinvasion from the Kwando/Linyanti infestation back into the Okavango. This appears to have been effective but will become redundant.

The insecticide to be used is exactly the same as that used in 2001 and 2002 i.e. a ulv formulation of deltamethrin called Deltanex. It will be applied over the entire area 5 times with the dosage rate for cycles 1 and 2 at 0.3 g/ha and for cycles 3, 4 and 5 at 0.26 g/ha. As explained in the previous operations, this insecticide has a very low toxicity to people and

mammals and according to the Harry Oppenheimer Okavango Research Centre (HOORC) which monitored both previous operations for environmental impact the non-target effects on all species are minimal and short lived.

The Department of Animal Health & Production has again commissioned the HOORC to monitor this years' spray programme and a Reference Group which first met on 18 May 2006 endorsed their initial monitoring protocol.

Some Safari Camps are located within the spray block – in Botswana and Namibia. HATAB has been notified and a representative attended the Reference Group meeting. Orsmond Aviation from Bethlehem in South Africa has again been awarded the spraying contract and they will be using 5 aircraft fitted with SATLOC GPS navigation equipment etc. As before, every effort will be made to minimize disruption of tourist activities and each camp will be notified as accurately and as far in advance as possible when the aircraft will overfly. As in previous operations, all spraying will be at night and the aircraft will leave the Katima airstrip no earlier than 1700h. At this point we only anticipate two sorties per night so spraying should be finished by about midnight.

BOOK PUBLICATION

Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.

As announced in the previous issue of TTI, this book – edited by V. A. Dyck, J. Hendrichs and A. S. Robinson - was published by Springer (ISBN: 1-4020-4050-4) at the end of 2005 and has now become available to provide further information than was available when first announced.

The book is organized into 8 Parts, providing respectively an Introduction, followed by 5 papers dealing with the Principles of the Sterile Insect Technique (SIT). Part 3 with its constituent 7 chapters then covers the Technical Components of the SIT and this is followed by 4 chapters that describe Supportive Technologies for improving the SIT. Part 5 covers Economic, Environmental and Management Considerations in 4 chapters. Parts 6 and 7 deal respectively with Applications of SIT (2 chapters) and the Impact of Area-Wide Integrated Pest Management Programmes that Integrate the SIT (4 chapters), while the last Part provides one chapter dealing with Future Development of the SIT.

For those concerned with African trypanosomiasis, the chapter by U. Feldman , V. A. Dyck, R. C. Mattioli and J. Jannin entitled Potential impact of tsetse fly control involving the SIT [**13516**]; is clearly of particular interest. However, since this book is almost as much about area-wide integrated pest management programmes as it is about the SIT *per se,* readers of TTI should also find the following chapters to be of considerable interest: History of the SIT by W. Klassen and C.F. Curtis [**13480**]; Area-wide integrated pest management and SIT by W. Klassen [**13479**]; Mass rearing for sterile insect release by A. G. Parker [**13498**]; Sterilizing insects with ionizing radiation by A. Bakri, K.Mehta and D.R. Lance [**13467**]; Sterile insect quality by C.O. Calkins and A.G. Parker [**13496**]; Monitoring sterile and wild insects in area-wide integrated pest management programmes by M.J.B. Vreysen;[**13546**] Procedures for declaring pest free status by H. J. Barclay, J. W. Hargrove, A. Clift and A. Meats [**13468**]; Use of GIS and spatial analysis in area-wide integrated pest management programmes that integrate the SIT by J. St. H. Cox and M. J. B. Vreysen

[**13528**]; Application of benefit/cost analysis to insect pest control using the SIT by J. D. Mumford [**13483**}; Environment and the SIT by P.Nagel and P. Peveling [**13481**]; Management of area wide integrated pest management programmes that integrate the SIT by V. A. Dyck et al [**13473**]; Public relations and political support in area-wide integrated pest management programmes that integrate the SIT by V. A. Dyck et al [**13472**]; Strategic options in using the SIT for area-wide integrated pest management by J. Hendrichs et al. [**13476**]; Misconceptions and constraints by M. Whitten and R. Mahon [**13495**]; and Prospects for the future development and application of the SIT by A.S. Robinson and J. Hendrichs [**13489**}. All these chapters are abstracted in this issue of TTI as indicated in bold in square brackets.

John Pollock has already given a commentary on this 787 - page book based on information provided by the publisher and from staff in the Joint FAO/IAEA Division who were responsible for its production, and as the former Director of this Division it would clearly be inappropriate for me to comment further on its technical scope, comprehensiveness and quality. That said, some comment on the price is warranted. At almost USD 400 this book comes at a high price and one that is certainly beyond the reach of many individuals and institutions- particularly in developing countries and all the more so for those in Africa. Noteworthy in this regard, is that the book entitled ***The Trypanosomiases*** by Ian Maudlin, Peter Holmes and Michael Miles which has 614 pages and published by CABI came in at around USD 185. Since this price difference cannot be explained by page numbers or quality of paper and print, I can only assume that it was due to the greater number of colour plates in the SIT book. While these unquestionably added to the "look" of the book and in most cases to understanding of the subject matter, perhaps greater consideration needs to be given in the future to the trade-off between appearance and access by developing countries. However, I understand that scientists and institutions in developing countries wishing a copy of the book may be able to get one free of charge by writing to the Joint FAO/IAEA Division.

OPPORTUNITIES FOR TRAINING AND FURTHER EDUCATION

Capacity Building in Tropical Animal Health

In February 2006 a new, primarily Web-based, part-time MSc degree programme (Veterinary Tropical Diseases) was introduced by the Department of Veterinary Tropical Diseases (DVTD), Faculty of Veterinary Science, University of Pretoria, South Africa. The programme comprises various modules that can also be taken for non-degree purposes in support of the Continuing Professional Development of a candidate. The programme is presented by the DVTD in collaboration with the Department of Animal Health of the Institute of Tropical Medicine, Antwerp, Belgium, and with the support of the Department of Production Animal Studies (UP) and the Department of Infectious Diseases and Immunology, Faculty of Veterinary Medicine, Utrecht University, the Netherlands.

The focus of the degree programme and the certificated modules is on animal health management issues of infectious and parasitic diseases (including tsetse and trypanosomiasis), particularly in the Afrotropical (sub-Saharan) Region. These modules will be of great value for candidates from developing countries where particularly transboundary diseases are often the biggest constraint to socio-economical development. The modules will also be very useful to candidates from the developed world from which many of these diseases have been eradicated, often at great cost, but nevertheless still pose a distinct threat because of increased international trade of animals and their products.

The tsetse and trypanosomiasis module aims at:

- training candidates in the identification, life cycle, biology, ecology, sampling methods, surveillance and control of tsetse flies and,
- training candidates in the epidemiology, clinical and pathological aspects, diagnosis and control of animal trypanosomosis

The candidate is the central focus of most of the opportunities for learning and skills development. Participation of the candidate in problem-solving and in the development of technical skills instead of the traditional mastering of subject content is a hallmark of the educational approach. By linking candidates and trainers from all over the world a training network is created that will promote an interchange of ideas.

The primary education mode is web-based supplemented by contact/practical sessions. The WebCT learning management system is used for curriculum presentation, scheduling and presentation of assignments, group discussions, quizzes, provision of additional educational information, submission of tasks, assessment, problem-solving and candidate administration. Experts from within and outside South Africa will be invited to take part in the group discussions. E-testing will allow regular testing and access to the results by the candidate.

Practical sessions (skills training) are a particular feature of the modules of the Laboratory Diagnostic theme and field work forms part of the practical sessions of the tick and tsetse modules. The Department and its partners have a range of audiovisual and other resources to complement the learning experience. Because band-width may not be sufficient for candidates in some geographical areas, high quality multimedia products (e.g. CD-ROMs, videos) will be provided to each candidate in instances where the course content includes many images, sound and video.

The minimum requirement for admission is a diploma in Veterinary or Medical Technology or an equivalent qualification or appropriate experience (approximately 2 years). The theory component of this course will be completed via the Internet - thus access to the Internet is a pre-requisite. Candidates who successfully complete a module will be awarded a certificate from the University of Pretoria. Credits for a module can be used towards obtaining a postgraduate degree.

Enquiries: Rina Serfontein; E-mail: rina.serfontein@up.ac.za; Tel :+27 125298384; Website http://www.up.ac.za/academic/veterinary/depts_vtd_teaching.htm

Scholarships for an Online Learning Masters in International Animal Health

A limited number of full scholarships are available for the online learning Masters in International Animal Health from the University of Edinburgh Centre for Tropical Veterinary Medicine. The Masters in International Animal Health is aimed at graduates with a degree in veterinary medicine, agricultural science, biology or a related science discipline. This online distance learning Masters course offers the opportunity to enhance the skills and knowledge of animal health professionals and others while they continue with their professional duties in their own countries.

Commencing in October 2006, the programme runs for 3 years part-time and allows students to study when it suits. Students will also join a supportive online community bringing together students and tutors from all over the world.

Those graduating from this programme will learn how to identify, control and manage diseases; based on a solid foundation based on the biological, pathological and immunological principles of both the host and pathogen. Courses on risk management and

surveillance will enable the student to rationalize the influence of transboundary diseases on, for example, international trade. Elements of nutrition and healthcare will reflect the methods of monitoring animal health in extensive and intensive livestock production. Students will also cover the principles of research methodologies and project planning.

Applications for the Scholarships must be received before 7 June 2006 to be considered by the Commonwealth Commission. The Commonwealth Commission have made the scholarships available to people from Botswana, Cameroon, Gambia, Ghana, Kenya, Lesotho, Malawi, Maldives, Mozambique, Namibia, Nigeria, Sierra Leone, South Africa, Swaziland, Tanzania, Uganda and Zambia.

Full details of the scholarships, the course and how to apply can be found at http://www.internationalanimalhealth.ed.ac.uk/ or by emailing mvmpg@ed.ac.uk

NEW PROJECTS

Wellcome Trust Funded Project on Tsetse Fragmentation

The epidemiology of tsetse-transmitted human and livestock trypanosomiasis is to a large extent determined by tsetse density, fly infection rate and host preference. All three contributing factors vary between tsetse populations and within a tsetse population may, often due to differences in well-being of the vector population, vary in time and space. A major factor contributing to fly population stress is human encroachment and concomitant fragmentation of tsetse habitat as a result of the introduction and expansion of mixed farming systems. Understanding the impact of habitat fragmentation on tsetse population dynamics contributes to the development of more effective control strategies.

Riparian and savannah tsetse species play a major role in disease transmission. Therefore, the project will identify study areas in West and southern Africa, where each group is predominant. In those study areas, the fragmentation of riparian vegetation and savannah woodland will be quantified and qualified using environmental and remotely sensed data. Study sites with different degrees of fragmentation will be identified and the tsetse and livestock populations will be monitored. Special attention will go to parameters that can be used to develop population dynamics and disease transmission models. The models will be used to determine:

- The well-being, dynamics and vulnerability of tsetse sub-populations in fragmented habitats; and
- The infection rate of hosts and vectors and the related disease transmission risk.

Furthermore, analyses of genetic diversity and gene flow between tsetse populations in habitat fragments will make it possible to determine the effect of different levels of fragmentation on tsetse's dispersal capacity. This will result in the identification of isolated tsetse populations. Using the findings of the field studies various control approaches will be tested and their appropriateness assessed. The outcomes of the study will be translated into practical guidelines that will facilitate the selection of priority areas for control and the most appropriate intervention method(s). The guidelines will be transferred to the beneficiaries.

The project, foreseen to last three years, is jointly executed by Avia-GIS, CIRAD-EMVT, CIRDES, ITM, Ministry of Agriculture and Co-operatives of Zambia, Oxford University, University of Pretoria.

FAO/IAEA Coordinated Research Project (CRP): Improving SIT for Tsetse Flies through Research on their Symbionts and Pathogens, 2007-2012

This CRP was approved following a Consultants Meeting held in Vienna in March 2006 involving major experts on arthropod and insect pathology with the objective of advising the FAO and the IAEA, in the context of SIT-based area-wide tsetse and trypanosomosis intervention, on: a) possible obstacles, as well as, synergistic or enhancing effects associated with pathogens and symbionts of tsetse flies; b) opportunities and priorities for research and methods development aiming at alleviating or eliminating problems and maximizing possible benefits linked to tsetse pathogens and symbionts; and c) possible collaborators to address identified research themes.

The consultants recommended, given the limited knowledge available to manage tsetse symbionts and pathogens, and the importance and current demand for improving the cost-effectiveness of SIT application against major tsetse species, to initiate a new CRP focused on: a) developing a better understanding of the biology of microorganisms related to tsetse, and b) addressing current constraints related to these organisms to allow enhancing the efficiency of the SIT for tsetse. The new CRP, harnessing the recent developments in tsetse, symbiont and pathogen genetics and genomics, will focus on the development of methods to manage the virus infection in tsetse colonies, an assessment of natural incompatibility related to the presence of *Wolbachia*, the development of improved population suppression methods using fungal pathogens, and the development of tsetse strains refractory to infection by trypanosomes.

Achieving the objectives of the CRP would be of direct benefit to the expansion of the SIT for tsetse through mass production of healthy colonies for production of sterile males, development of parasite resistant SIT lines that can be applied in disease endemic areas, and incorporation of natural incompatibilities for production of fitter sterile males. The beneficiaries would be: 1) livestock and people in the endemic areas through reduced disease from trypanosomosis; 2) livestock producers through increased profitability; 3) the environment through reduced insecticide use; 4) countries free of tsetse by greatly reducing, or possibly eliminating, the risk of introduction of these devastating pests and therefore, greatly improved farm productivity.

Researchers in the fields of microbiology and molecular biology and others with interest in the biology, manipulation or control of tsetse symbionts and pathogens are encouraged to apply for research contracts or agreements.

The first research coordination meeting is planned for March/April 2007 in Vienna, Austria, and the deadline to submit applications for research contracts and research agreements is October 2006. The application forms may be downloaded from the web at http://www-crp.iaea.org/html/forms.html, or by contacting the Joint Division in Vienna.

POINT OF VIEW

The following was provided by Dr. Justice Tettey of the Department of Pharmaceutical Sciences, Strathclyde Institute for Biomedical Sciences, UK. If you wish to contact him he can be reached at justice.tettey@strath.ac.uk

Veterinary Trypanocides: Time for a Standardized Approach to Formulation and Testing

Veterinary trypanosomiasis is one of the most important obstacles to sustainable agriculture and rural development in sub-Saharan Africa. It is estimated that the economic losses in terms of cattle production is approximately USD 1.2 billion/year. The prevention and treatment is achieved through chemotherapy and 35 million doses of trypanocides corresponding to USD 35-40 million are administered to domestic ruminants each year (source, FAO, UN). Despite the economic importance of this disease, the drug industry has been reluctant to invest in the development of newer trypanocides because of the exorbitant drug development costs and an expected low return on investment for this therapeutic category of medicines. Subsequently, it is imperative that the benefits from the existing trypanocides are exploited to the full in view of the rising accounts of trypanosome resistance to the existing trypanocides and also the incidence of substandard medicines in international commerce.

Substandard medicines are products whose composition and ingredients do not meet the correct scientific specifications and which are consequently ineffective and often dangerous to the patient (WHO Fact sheet N°275). These products may be a result of counterfeiting which is associated with mislabelling with respect to identity and the source of manufacture. The scenario expands to include products with the correct ingredients but fake packaging, products with the wrong ingredients and products without active ingredients or with insufficient active ingredients. This commentary looks at quality issues pertaining to two veterinary trypanocides, isometamidium and diminazene aceturate, in international commerce.

Isometamidium

Since its introduction in 1958, the mixture of related substances commonly called isometamidium has remained the only agent available for the chemoprophylaxis of trypanosomiasis in animals. Although the pharmacological action has been attributed to the major component (8-(3-m-amidinophenyl-2-triazeno)-3-amino-5-ethyl-6-phenylphenanthridinium chloride hydrochloride), the other isomers of which 7-(m-amidinophenyldiazo)-3,8-diamino-5-ethyl-6-phenylphenanthridinium chloride hydrochloride(M & B 4250, V) is the most abundant also possess trypanocidal properties. The composition of the final product is significantly affected by conditions such as pH and temperature used in the synthesis. In 1998, the effect of this synthetic problem on the chemical equivalence of two commercial brands of isometamidium, Veridium and Samorin was reported. The authors demonstrated significant variations in the composition of isometamidium between manufacturers and in batches from the same manufacturer. These variations have an impact on the quality, safety and efficacy of this important veterinary medicine. Ironically, almost a decade since these findings were made public, some new isometamidium products fail to address the important issue of chemical equivalence. A recent survey of some products in sub-Saharan Africa revealed a number of instances where the composition of isometamidium bore no similarity to the specifications of the innovator product.

Diminazene

Diminazene aceturate (4,4-diamidinodiazoaminobenzene diaceturate tetrahydrate) is an aromatic diamidine used extensively as a veterinary trypanocide in affected areas of the world. The product is usually presented in admixture with pyrazone (antipyrine). Despite its use for over four decades, there are no current pharmacopoeial specifications for the control of the quality of the product. In 2001, the author completed a pilot study commissioned by the Food and Agricultural Organisation of the United Nations to investigate the chemical equivalence of diminazene preparations in Africa. One hundred and four products, representing nineteen different brands were obtained from eleven participating countries in Africa. The study revealed that one out three products had a content of the active ingredient outside a ± 10 percent tolerance range (90 – 110 percent of label claim). In addition, physical examination of the contents showed marked differences in formulation of the product.

Veterinary medicines are subject to the same requirements of quality, safety and efficacy as those meant for human use. The lack (or the limitation) of resources available to medicines regulatory authorities in most developing economies has de-prioritised the control of veterinary pharmaceuticals. This situation has made affected regions a haven for counterfeit/substandard drug products. However, political will and resources are needed to guarantee that these trypanocides in international commerce are of the required quality. In order to act in a timely manner to protect users from sub-standard products, it is necessary to provide the relevant regulatory bodies in user countries with validated protocols, governed by achievable specifications, for use in quality control activities. Such protocols should produce identical results in the hands of different analysts in different countries. Also, the standardization of manufacturing processes of isometamidium in particular would go a long way in ensuring chemical equivalence of the finished product.

SECTION B - ABSTRACTS

1. GENERAL (INCLUDING LAND USE)

13466. **Aksoy, S., Berriman, M., Hall, N., Hattori, M., Hide, W. & Lehane, M.J., 2005.** A case for a *Glossina* genome project. *Trends in Parasitology,* **21** (3): 107-111.

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Given the medical and agricultural significance of *Glossina*, knowledge of the genomic aspects of the vector and vector-pathogen interactions are a high priority. In preparation for a full genome sequence initiative, an extensive set of expressed sequence tags (ESTs) has been generated from tissue-specific normalized libraries. In addition, bacterial artificial chromosome (BAC) libraries are being constructed, and information on the genome structure and size from different species has been obtained. An international consortium is now in place to further efforts to lead to a full genome project.

13467**. Bakri, A., Mehta, K. & Lance, D.R., 2005.** Sterilizing insects with ionizing radiation. In: *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management*. Springer, the Netherlands, pp. 233-268.

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Exposure to ionizing radiation is currently the method of choice for rendering insects reproductively sterile for area-wide integrated pest management (AW-IPM) programmes that integrate the sterile insect technique (SIT). Gamma radiation from isotopic sources (cobalt-60 or caesium-137) is most often used, but high-energy electrons and X-rays are other practical options. Insect irradiation is safe and reliable when established safety and quality-assurance guidelines are followed. The key processing parameter is absorbed dose, which must be tightly controlled to ensure that treated insects are sufficiently sterile in their reproductive cells and yet able to compete for mates with wild insects. To that end, accurate dosimetry (measurement of absorbed dose) is critical. Irradiation data generated since the 1950s, covering over 300 arthropod species, indicate that the dose needed for sterilization of arthropods varies from less than 5 Gy for blaberid cockroaches to 300 Gy or more for some arctiid and pyralid moths. Factors such as oxygen level, and insect age and stage during irradiation, and many others, influence both the absorbed dose required for sterilization and the viability of irradiated insects. Consideration of these factors in the design of irradiation protocols can help to find a balance between the sterility and competitiveness of insects produced for programmes that release sterile insects. Many programmes apply "precautionary" radiation doses to increase the security margin of sterilization, but this overdosing often lowers competitiveness to the point where the overall induced sterility in the wild population is reduced significantly.

13468**. Barclay, H.J., Hargrove, J.W., Clift, A. & Meats, A., 2005**. Procedures for declaring pest free status. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 363-386.

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Procedures are presented for declaring an area to be "pest free" following an area-wide eradication programme against a population of an insect pest. These involve two probability models to deal with null trapping results, and a growth model to help verify that pests were no longer present when control actions were stopped. The two probability models are presented for a situation in which trapping for an insect pest is ongoing, and for which the trapping results are all negative. The models calculate the probability of such negative results if in fact insects were present. If this probability is sufficiently low, then the hypothesis that insects are present is rejected. The models depend on knowledge of the efficiency of the traps, and also the area of attractiveness of the traps. The possibility of a rebound of an incipient but non-detectable population that remains after control measures are discontinued, is considered. Using a growth model, the rate of increase of an insect population that starts from one or two insects is examined. An example is given for tsetse flies — both means and

confidence limits are calculated for a period of 24 reproductive periods after control has been terminated. If insects are disease vectors, it is also suggested that the progress of the disease be monitored to detect continuing transmission. This should be done in conjunction with a disease transmission model.

13469. **Chibale, K., 2005**. Economic drug discovery and rational medicinal chemistry for tropical diseases. *Pure and Applied Chemistry,* **77** (11): 1957-1964.

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In order to fulfil research objectives around target-based drug discovery in the field of anti-infective agents that are prevalent mainly in poor Third World countries, selection of biological and chemical targets is guided by economic drug discovery and rational medicinal chemistry. Selection of biological targets of therapeutic relevance in multiple disease-causing organisms, as well as the use of natural products and existing drugs as chemical scaffolds for the discovery and design of novel therapeutics should be viable strategies underpinning drug discovery research in poor Third World countries. In this regard, biological targets of interest to our program include disulfide reductases and cysteine proteases (CPs), while chemical scaffolds include existing antimalarial agents and natural products.

13470. **Chretien, J.P. & Smoak, B.L., 2005**. African trypanosomiasis: changing epidemiology and consequences. *Current Infectious Disease Reports,* **7** (1):54-60.

Department of Defense Global Emerging Infections Surveillance & Response System (DoD-GEIS), Division of Preventive Medicine, Walter Reed Army Hospital, Washington.

Human African trypanosomiasis has re-emerged as a serious public health threat after near-elimination because of diminished investment in previously successful control programs. The continued, occasional importation of African trypanosomiasis to the United States can be expected as tourists and immigrants travel from high-risk areas. No vaccine or chemoprophylaxis is available for this disease, and travellers to affected areas should be counselled on tsetse fly avoidance. New diagnostic and staging tests are promising but have not replaced the classical method of examining body fluids for trypanosomes. Prompt diagnosis and staging is essential because if untreated, East African and West African sleeping sickness are fatal. Drug regimens are toxic and cumbersome, and short-term prospects for therapeutic advances are limited.

13471. **Cliff, A., Haggett, P. & Smallman-Raynor, M., 2004**. *World Atlas of Epidemic Diseases.* Arnold, Hodder Headline Group, London, UK. ISBN:0340761717.

A collection of maps (world, regional and local), illustrations and commentaries written by 3 leading experts provides an overview of the global distribution of 50 epidemic diseases which are acknowledged as responsible for the majority of global mortality and morbidity. The authors look at diseases both very old and very new, some limited to a very small geographical area and others near universal, some deadly killers and some just seasonal

causes of ill-health. The Atlas's twelve chapters are organised in a historical sequence beginning with the medieval Black Death and ending with "modern" diseases such as AIDS and Legionnaires' disease. 3 aspects of each disease are summarised: basic nature and impacts, origins and historical impact, and current global status/probability of control .Chapter 1 sets the scene by discussing global disease burden and the nature of epidemics, Chapters 2 & 3 deal with the "classic plagues": plague, cholera, leprosy, smallpox, measles, rabies. Chapter 4 "persistent scourges": tuberculosis, syphilis, typhus, relapsing fever. Chapter 5, "children's diseases": typhoid fever, diphtheria, scarlet fever, whooping cough, rubella, mumps and chickenpox. Chapter 6, "winter ailments": influenza and the common cold. Chapter 7 & 8, "tropical diseases": malaria, yellow fever, dengue and meningococcal disease, sleeping sickness, Chagas' disease, leishmaniasis, schistosomiasis, river blindness, other helminthic diseases. Chapter 9, "vaccine preventable disease": smallpox, measles, poliomyelitis. Chapter 10 & 11, "newly emergent diseases": AIDS, legionnaires' disease, Lyme disease, tropical haemorrhagic fevers such as Ebola-Marburg, kuru and CJD, hantavirus fevers, cryptosporidiosis, buruli ulcer. The final chapter, chapter 12, looks at changing patterns of disease related to changes in environment, increased global travel and trade and conflicts and also future surveillance/control. There are two appendices providing a review of useful websites and a technical term glossary. The atlas is aimed at those interested in the spread, control and eradication of epidemic disease and contains over 400 figures including 150 maps, micrographs, photographs, historical prints and changing incidence graphs.

13472. **Dyck, V.A., Regidor Fernandez, E.E., Reyes Flores, J., Teruya, T., Barnes, B., Gomez Riera, P., Lindquist, D. & Reuben, R., 2005**. Public relations and political support in area-wide integrated pest management programmes that integrate the sterile insect technique. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 547-559.

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The public relations component of area-wide integrated pest management (AW-IPM) programmes that integrate the sterile insect technique (SIT) has a large impact on programme success. Full-time professionals should direct public relations activities and secure vital political support from governments and community organizations. Good communication among programme staff, and between programme staff and the public, is required to maintain participation and support, and to keep the work goal-oriented even when some programme activities are controversial. The media can be valuable and effective partners by informing the public about the real facts and activities of a programme, especially if this is done in a non-technical and straightforward way. Ongoing research support improves the programme technology, provides technical credibility on contentious issues, and solves operational problems. Programme failure can result from poor public relations and inadequate public support.

13473. **Dyck, V.A., Reyes Flores, J., Vreysen, M. J. B., Regidor Fernandez, E.E., Teruya, T., Barnes, B., Gomez Riera, P., Lindquist, D. & Loosjes, M., 2005**. Management of area-wide integrated pest management programmes that integrate the sterile insect technique. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 525-545.

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Effective management of area-wide integrated pest management (AW-IPM) programmes that integrate the sterile insect technique (SIT) is key to success. Programme planning includes collection of baseline data and a feasibility assessment. The optimal management structure is where the programme can be implemented effectively and flexibly, independent of government politics, bureaucracy, and even corruption that impede timely goal achievement. Ideally, programmes include both public and private management, and require strong and steady financial support. Governments and donors are the most common sources of funds, but a mixture of public, community, and private funds is now the trend. Interrupted cash flow severely restrains programme performance. Physical support of programme operations must be reliable, and led by a maintenance professional. It is essential to have full-time, well-paid, and motivated staff led by a programme manager with technical and management experience. Programme failure is usually due to poor management and inadequate public support, and not to poor technology.

13474. **Haines, A., Kovats, R.S., Campbell-Lendrum, D. & Corvalan, C., 2006**. Climate change and human health: Impacts, vulnerability and public health. *Public Health,* **In Press, Corrected Proof**.

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It is now widely accepted that climate change is occurring as a result of the accumulation of greenhouse gases in the atmosphere arising from the combustion of fossil fuels. Climate change may affect health through a range of pathways, for example as a result of increased frequency and intensity of heat waves, reduction in cold related deaths, increased floods and droughts, changes in the distribution of vector-borne diseases and effects on the risk of disasters and malnutrition. The overall balance of effects on health is likely to be negative and populations in low-income countries are likely to be particularly vulnerable to the adverse effects. The experience of the 2003 heat wave in Europe shows that high-income countries may also be adversely affected. Adaptation to climate change requires public health strategies and improved surveillance. Mitigation of climate change by reducing use of fossil fuels and increasing use of renewable energy technologies should improve health in the near-term by reducing exposure to air pollution.

13475. **Harrus, S. & Baneth, G., 2005**. Drivers for the emergence and re-emergence of vector-borne protozoal and bacterial diseases. *International Journal for Parasitology,* **35** (11-12): 1309-1318.

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In recent years, vector-borne parasitic and bacterial diseases have emerged or re-emerged in many geographical regions causing global health and economic problems that involve humans, livestock, companion animals and wild life. The ecology and epidemiology of vector-borne diseases are affected by the interrelations between three major factors comprising the pathogen, the host (human, animal or vector) and the environment. Important drivers for the emergence and spread of vector-borne parasites include habitat changes, alterations in water storage and irrigation habits, atmospheric and climate changes, immunosuppression by HIV, pollution, development of insecticide and drug resistance, globalization and the significant increase in international trade, tourism and travel. War and civil unrest, and governmental or global management failure are also major contributors to the spread of infectious diseases. The improvement of epidemic understanding and planning together with the development of new diagnostic molecular techniques in the last few decades have allowed researchers to better diagnose and trace pathogens, their origin and routes of infection, and to develop preventive public health and intervention programs. Health care workers, physicians, veterinarians and biosecurity officers should play a key role in future prevention of vector-borne diseases. A coordinated global approach for the prevention of vector-borne diseases should be implemented by international organizations and governmental agencies in collaboration with research institutions.

13476**. Hendrichs, J., Vreysen, M.J.B., Enkerlin W.R. & Cayol, J.P., 2005**.Strategic options in using sterile insects for area-wide integrated pest management. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 563-600.

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The four strategic options, “suppression”, “eradication”, “containment” and “prevention”, in which the sterile insect technique (SIT) can be deployed as part of area-wide integrated pest management (AW-IPM) interventions, are defined and described in relation to the contexts in which they are applied against exotic or naturally occurring major insect pests. Advantages and disadvantages of these strategic options are analysed, and examples of successful programmes provided. Considerations of pest status, biology and distribution affecting decision-making in relation to strategy selection are reviewed and discussed in terms of feasibility assessment, and programme planning and implementation. Unrealistic expectations are often associated with applying the SIT, resulting in high political costs to change a strategy during implementation. The choice of strategy needs to be assessed carefully, and considerable baseline data obtained to prepare for the selected strategy, before embarking on an AW-IPM programme with an SIT component.

13477**. Holdsworth, P.A., Vercruysse, J., Rehbein, S., Peter, R.J., Bruin, C.D., Letonja, T. & Green, P., 2006**. World Association for the Advancement of Veterinary

Parasitology (WAAVP) guidelines for evaluating the efficacy of ectoparasiticides against biting and nuisance flies on ruminants. (Special issue: World Association for the Advancement of Veterinary Parasitology (WAAVP) guidelines for evaluating the efficacy of ectoparasiticides on ruminants.). *Veterinary Parasitology,* **136** (1): 3-13.

Avcare Limited, Locked Bag 916, Canberra, 2601 ACT, Australia.

These guidelines have been prepared to assist in the planning, conduct and interpretation of studies for the assessment of the efficacy of ectoparasiticides (excluding repellents) against the biting and nuisance Dipteran flies of ruminants. Information is provided on the selection of animals, dose determination and dose confirmation studies, field studies, record keeping and result interpretation. These guidelines advocate the use of pen facilities for dose determination and dose confirmation studies. These guidelines also are intended to assist investigators on how to conduct specific studies, to provide specific information for registration authorities involved in the decision-making process, to assist in the approval and registration of new ectoparasiticides, and to facilitate the worldwide adoption of standard procedures.

13478. **Jacobs, D.E. & Schnieder, T., 2006**. Application of molecular biology to the diagnosis of parasitic diseases. *Veterinary Parasitology* **136(**2) 67-68.

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This issue contains a compilation of articles from various experts dealing with the application of molecular techniques to the routine diagnosis of parasitic diseases and applied clinical research, and illustrates the enhancement in diagnostic ability possible with properly validated diagnostic techniques. Coverage includes: advances, opportunities and prospects in molecular diagnostic techniques; validation of molecular diagnostic techniques; molecular diagnosis of anthelmintic resistance; molecular extraction methods for *Trypanosoma vivax*; efficacy testing of praziquantel for *Anoplocephala perfoliata* using modified critical test; parasitological and immunodiagnosis of *Strongyloides stercoralis* in Brazilian dogs; and experimental infection of Beagle dogs with *Ehrlichia s*pecies.

13479**. Klassen, W., 2005.** Area-wide integrated pest management and the sterile insect technique. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 39-68.

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Area-wide integrated pest management (AW-IPM) focuses on the preventive management of pest populations throughout the ecosystem. It seeks to treat all habitats of the pest population so that none produces migrants to re-establish significant infestations in areas of concern. In contrast, the conventional strategy focuses narrowly on defending the valued

entity (crop, livestock, people, buildings, etc.) from direct attack by pests. AW-IPM requires multiyear planning, and an organization dedicated exclusively to its implementation, whereas conventional pest management involves minimal forward planning, tends to be reactive, and is implemented independently by individual producers, businesses, or households. AW-IPM tends to utilize advanced technologies, whereas the conventional strategy tends to rely on traditional tactics and tools. The sterile insect technique (SIT) is a species-specific form of birth control imposed on the pest population. It is a powerful tool for "mopping up" sparse pest populations, and is most efficient when applied as a tactic in a system deployed on an area-wide basis. On environmental, economic and biological grounds, the case for the SIT is compelling.

13480. **Klassen, W. & Curtis, C.F., 2005.** History of the sterile insect technique. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 3-36.

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During the 1930s and 1940s the idea of releasing insects of pest species to introduce sterility (sterile insect technique or SIT) into wild populations, and thus control them, was independently conceived in three extremely diverse intellectual environments. The key researchers were A. S. Serebrovskii at Moscow State University, F. L. Vanderplank at a tsetse field research station in rural Tanganyika (now Tanzania), and E. F. Knipling of the United States Department of Agriculture. Serebrovskii's work on chromosomal translocations for pest population suppression could not succeed in the catastrophic conditions in the USSR during World War II, after which he died. Vanderplank used hybrid sterility to suppress a tsetse population in a large field experiment, but lacked the resources to develop this method further. Knipling and his team exploited H. J. Muller's discovery that ionizing radiation can induce dominant lethal mutations, and after World War II this approach was applied on an area-wide basis to eradicate the New World screwworm *Cochliomyia hominivorax* (Coquerel) in the USA, Mexico, and Central America. Since then very effective programmes integrating the SIT have been mounted against tropical fruit flies, some species of tsetse flies *Glossina* spp., the pink bollworm *Pectinophora gossypiella* (Saunders), and the codling moth *Cydia pomonella* (L.). In non-isolated onion fields in the Netherlands, the onion maggot *Delia antiqua* (Meigen) has since 1981 been suppressed by the SIT. In the 1970s there was much research conducted on mosquito SIT, which then went into "eclipse", but now appears to be reviving. Development of the SIT for use against the boll weevil *Anthonomus grandis* grandis Boheman and the gypsy moth *Lymantria dispar* (L.) has ended, but it is in progress for two sweetpotato weevil species, *Cylas formicarius* (F.) and *Euscepes postfasciatus* (Fairmaire), the false codling moth *Cryptophlebia leucotreta* (Meyrick), the carob moth *Ectomyelois ceratoniae* (Zeller), the cactus moth *Cactoblastis cactorum* (Berg), the Old World screwworm *Chrysomya bezziana* (Villeneuve), additional *Glossina* spp., other *Anastrepha* spp. and *Bactrocera* spp. fruit flies, and other pest insects.

13481. **Nagel, P. & Peverling, R., 2005**. Environment and the sterile insect technique. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 499-524.

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The sterile insect technique (SIT) is an exceptionally promising pest control method in terms of efficacy and environmental compatibility. Assessments of environmental risks vary according to the status and origin of the target pests. The suppression or eradication of exotic pest populations with the SIT raises few environmental concerns, and these are related mainly to pre-release suppression techniques. However, the elimination of native species, or at least populations of native species, requires more detailed and complex assessments of ecological effects and consequences for biodiversity conservation. Eradication programmes provide opportunities to study these topics within the scope of both environmental impact assessments and operational monitoring programmes.

13482 **Mansfield, J.M. & Paulnock, D.M., 2005**. Regulation of innate and acquired immunity in African trypanosomiasis. *Parasite Immunology,* **27** (10-11): 361-371.

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African trypanosomes are well known for their ability to avoid immune elimination by switching the immunodominant variant surface glycoprotein (VSG) coat during infection. However, antigenic variation is only one of several means by which trypanosomes manipulate the immune system of their hosts. In this article, the role of parasite factors such as GPI anchor residues of the shed VSG molecule and the release of CpG DNA, in addition to host factors such as IFN-gamma, in regulating key aspects of innate and acquired immunity during infection is examined. The biological relevance of these immunoregulatory events is discussed in the context of host and parasite survival.

13483**. Mumford, J.D., 2005**. Application of benefit/cost analysis to insect pest control using the sterile insect technique. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 481-498.

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Before embarking on area-wide integrated pest management (AW-IPM) programmes involving eradication, exclusion, or suppression of insect pests using the sterile insect technique (SIT), and/or other area-wide control measures, not only their technical but also their economic feasibility needs to be assessed. They may require significant initial capital investments to achieve long-term returns in subsequent periods, and may raise questions about the distribution of benefits or the justification of public or private pest control efforts. A consistent and transparent system is needed to analyse the benefits and costs of such programmes and to demonstrate their value, or in some cases to assess appropriate contributions to the costs by the various stakeholders who gain the benefits. Benefit/cost

analysis (BCA) provides such a framework, and has been applied to many AW-IPM programmes that integrate the SIT, in which it has been used to demonstrate the expected value of area-wide eradication, exclusion or suppression. This chapter outlines the process of BCA in which itemized future costs and benefits are compared in terms of present values. It also provides a review and examples of the application of BCA to the SIT. A checklist of BCA inputs, and some examples of benefit/cost outputs, are also presented.

13484. **Nok, A., 2005**. Effective measures for controlling trypanosomiasis. *Expert Opinion on Pharmacotherapy,* **6** (15): 2645-2653.

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African trypanosomiasis, otherwise known as sleeping sickness in humans and 'Nagana' in cattle, is a disease that is resurgent in Africa. Research on the disease suggests that the development of a vaccine is still far away; even existing drugs are becoming ineffective on account of the emergence of drug-resistant trypanosomes. All this contributes to heavy economic losses and a sociopolitical crisis in the continent, thus underscoring the pressure to intensify research for inexpensive, less toxic and affordable trypanocides. This review discusses the current treatment of trypanosomiasis and the progress made towards the effective control of trypanosomiasis.

13485 **Pink, R., Hudson, A., Mouriès, M-A. & Bendig, M., 2005**. Opportunities and challenges in antiparasitic drug discovery. *Nature Reviews Drug Discovery* **4**(9): 727-740.

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New antiparasitic drugs are urgently needed to treat and control diseases such as malaria, leishmaniasis, sleeping sickness and filariasis, which affect millions of people each year. However, because the majority of those infected live in countries in which the prospects of any financial return on investment are too low to support market-driven drug discovery and development, alternative approaches are needed. In this article, challenges and opportunities for antiparasitic drug discovery are considered, highlighting some of the progress that has been made in recent years, partly through scientific advances, but also by more effective partnership between the public and private sectors.

13486. **Polley, L., 2005**. Navigating parasite webs and parasite flow: emerging and re-emerging parasitic zoonoses of wildlife origin. *International Journal for Parasitology,* **35** (11-12): 1279-1294.

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Wildlife are now recognised as an important source of emerging human pathogens, including parasites. This paper discusses the linkages between wildlife, people, zoonotic parasites and the ecosystems in which they co-exist, revisits definitions for 'emerging' and 're-emerging', and lists zoonotic parasites that can be acquired from wildlife including, for some, estimates of the associated global human health burdens. The paper also introduces the concepts of 'parasite webs' and 'parasite flow', provides a context for parasites, relative to other infectious agents, as causes of emerging human disease, and discusses drivers of disease emergence and re-emergence, especially changes in biodiversity and climate. *Angiostrongylus cantonensis* in the Caribbean and the southern United States, *Baylisascaris procyonis* in California and Georgia, *Plasmodium knowlesi* in Sarawak, Malaysia, Human African Trypanosomiasis, *Sarcoptes scabiei* in carnivores, and *Cryptosporidium, Giardia* and *Toxoplasma* in marine ecosystems are presented as examples of wildlife-derived zoonotic parasites of particular recent interest. An ecological approach to disease is promoted, as is a need for an increased profile for this approach in undergraduate and graduate education in the health sciences. Synergy among scientists and disciplines is identified as critical for the study of parasites and parasitic disease in wildlife populations. Recent advances in techniques for the investigation of parasite fauna of wildlife are presented and monitoring and surveillance systems for wildlife disease are discussed. Some of the limitations inherent in predictions for the emergence and re-emergence of infection and disease associated with zoonotic parasites of wildlife are identified. The importance of public awareness and public education in the prevention and control of emerging and re-emerging zoonotic infection and disease are emphasised. Finally, some thoughts for the future are presented.

13487. **Ratnieks, F.L**., **Foster, K.R**. & **Wenseleers T., (2006)** Conflict resolution in insect societies. *Annual Review of Entomology*, **51**:581-608.

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Although best known for cooperation, insect societies also manifest many potential conflicts among individuals. These conflicts involve both direct reproduction by individuals and manipulation of the reproduction of colony members. Here we review five major areas of reproductive conflict in insect societies: (a) sex allocation, (b) queen rearing, (c) male rearing, (d) queen-worker caste fate, and (e) breeding conflicts among totipotent adults. For each area we discuss the basis for conflict (potential conflict), whether conflict is expressed (actual conflict), whose interests prevail (conflict outcome), and the factors that reduce colony-level costs of conflict (conflict resolution), such as factors that cause workers to work rather than to lay eggs. Reproductive conflicts are widespread, sometimes having dramatic effects on the colony. However, three key factors (kinship, coercion, and constraint) typically combine to limit the effects of reproductive conflict and often lead to complete resolution.

13488. **Reesink, H.W., 2005**. European strategies against the parasite transfusion risk. *Transfusion Clinical Biology,* **12** (1): 1-4.

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Protozoal infections are endemic in mainly tropical low income countries, affecting millions of people. Malaria, American trypanosomiasis (*Trypanosoma cruzi*/Chagas disease) and protozoal tick-borne diseases (e.g. *Babesia*) can be efficiently transmitted by transfusion of cellular blood components. In non-endemic areas like Europe malaria, Chagas disease and *Babesia* are imported diseases resulting of travelling to endemic areas and migration of autochthons from these endemic areas. A recent International Forum showed that in Europe, as well as the USA, prevention of transfusion-associated protozoal infections depend mainly on selection of donors using questionnaires. Most countries divide donors at risk for malaria in two groups: individuals who have lived in the first 5 years of their life in malaria endemic areas and those who are borne and residing in non-endemic areas and visited the endemic area(s). The first category of donors is rejected for 3 years after their last visit to the endemic area, and in one country such donors are permanently rejected. In some countries such donors are accepted after 4 months-3 years, provided a test for malaria is non-reactive. Persons from non-endemic areas, who visited the malaria endemic area, are rejected for 4-12 months. Some countries reject these donors for 3 years or permanently when they resided for more than 6 months in the endemic area. The rejection rate of donors for malaria risk in the various countries was 0.003-0.43 percent of all donations. Over the last decade only a few cases of TT-malaria were reported in the various countries. In several countries donors are questioned for risk of *T. cruzi* infection. In some countries donors are excluded when they (or their mothers) were born in South or Central America, if they received a blood transfusion in these areas and if they lived in rural areas in these endemic countries for more than 4 weeks. In none of the countries donors are asked if they had *Babesia* or *Leishmania*. At present implemented measures to prevent TT-malaria in the European countries are probably highly effective. More research is needed to establish the theoretical risk of TT-*T. cruzi* and TT-*Leishmania* infection in Europe, before preventive measures may be considered.

13489**. Robinson, A.S. & Hendrichs, J., 2005**. Prospects for the future development and application of the sterile insect technique. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 727-760.

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Science-based modern agriculture and international trade in agricultural commodities have achieved that, even though the world population has doubled in the last 40 years, the absolute number of people in poverty and hunger has been falling steadily. The major challenge in the immediate future is to consolidate these positive gains, while simultaneously expanding environment-friendly agricultural practices. Within this context, the sterile insect technique (SIT), as part of area-wide integrated pest management (AW-IPM) programmes, will continue to gain momentum for application against certain key insect pests. This is in response to the demands for cleaner food and a better environment, the need to facilitate increasing international trade by overcoming pest related trade barriers to the movement of agricultural commodities, and the imperative of dealing with the increasing invasion of exotic pests. As the use of the technology increases, changes will continue to be made to improve the overall efficiency of the technique for those species where the SIT is already being used, and to expand the use of the technique to new key species. Modern biotechnology may also

contribute to improving efficiency and, even though there are as yet no transgenic strains of pest insects that could be used in AW-IPM programmes, transgenic technology may eventually benefit these programmes in terms of strain marking, genetic sexing, molecular sterilization, and disease refractoriness; however, first the regulatory hurdle to allow their use will have to be overcome. There appears to be much promise in improving sterile male performance by exposing male insects to hormonal, nutritional, microbial, and semiochemical supplements. Furthermore, the management of mother colonies will be significantly improved to reduce the effects of colonization and to slow down mass-rearing effects on key behavioural parameters that often result in rapid colony deterioration. Progress will also need to be made in the cost-effectiveness of all components of SIT implementation, from cage design to facility design, and from programme planning to evaluation. The trend of increasingly using sterile insects for routine pest suppression rather than eradication, particularly in commercially important commodities, will favour the involvement of the private sector and hence accelerate these improvements. Commercial producers of beneficial insects will probably be the natural investors, in view of the complementarities with sterile insects, experience in managing living organisms, and understanding the biological control market. As programme implementation is logistically complex, management will remain the key issue determining the success or failure of any area-wide approach to insect control. Thus, in spite of the many successes achieved and to be expected, in many least-developed countries the SIT may be a technology that is "ahead of its time" and beyond the animal and public health as well plant protection infrastructures. Failures in SIT application, mostly confined to such countries, have not been due to science but the implementation of systematic large-scale operations. Increased involvement of the private sector in such countries probably would assure effective implementation.

13490. **Rogers, D.J. 2006**. Models for vectors and vector-borne diseases. *Advances in Parasitology*, **62:** 1-35.

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The development of models for species' distributions is briefly reviewed, concentrating on logistic regression and discriminant analytical methods. Improvements in each type of modelling approach have led to increasingly accurate model predictions. This review addresses several key issues that now confront those wishing to choose the "right" sort of model for their own application. One major issue is the number of predictor variables to retain in the final model. Another is the problem of sparse datasets, or of data reported to administrative levels only, not to points. A third is the incorporation of spatial co-variance and auto-covariance in the modelling process. It is suggested that many of these problems can be resolved by adopting an information-theoretic approach whereby a group of reasonable potential models is specified in advance, and the "best" candidate model is selected among them. This approach of model selection and multi-model inference, using various derivatives of the Kullback-Leibler information or distance statistic, puts the biologist, with her or his insight, back in charge of the modelling process that is usually the domain of statisticians. Models are penalized when they contain too many variables; careful specification of the right set of candidate models may also be used to identify the importance of each predictor variable individually; and finally the degree to which the current "best" model improves on

all the other models in the candidate set may be quantified. The ability definitely to exclude some models from the realm of all possible models appropriate for any particular distribution problem may be as important as the ability to identify the best current model.

13491. **Rogers, D.J. & Randolph, S.E., 2006**. Climate change and vector-borne diseases. *Advances in Parasitology*, **62**: 345-381.

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In this review we examine formally the conditions under which vector-borne diseases are likely to change, and the directions of those changes, under various scenarios of climate change. We specify the criteria that must be met in order to conclude that climate change is having an effect on vector-borne diseases. We then take several examples from the literature and show how some of them meet these criteria, while others do not. For those that do not, there are alternative explanations that involve much more plausible drivers of the recorded changes in the diseases concerned.

13492. **Tarleton, R.L., 2005**. New approaches in vaccine development for parasitic infections. *Cellular Microbiology,* **7** (10): 1379-1386.

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Vaccines have had a tremendous impact on the control of infectious diseases. Not only are vaccines potentially the least expensive mechanism to combat infectious diseases, under optimal conditions, widespread vaccination can result in disease eradication - as in the case of smallpox. Despite this great potential, vaccines have had little impact on human parasitic infections. The reasons for this are many - these eukaryotic pathogens are genetically and biologically complex organisms, some with elaborate life cycles and well-honed immune evasion mechanisms. Additionally, our understanding of the mechanisms of immune control of many parasitic infections - of what constitutes an effective immune response and of how to induce high-quality immunological memory - is not fully developed. This review attempts to highlight recent advances that could impact vaccine discovery and development in parasitic infections and proposes areas where future studies may lead to breakthroughs in vaccines for the agents of parasitic diseases. There are several other recent reviews highlighting the results of vaccine trials, specifically in the malaria field.

13493. **Tatem, A.J., Rogers, D.J. & Hay, S.I., 2006**. Global transport networks and infectious disease spread. *Advances in Parasitology,* **62:** 293-343.

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Air, sea and land transport networks continue to expand in reach, speed of travel and volume of passengers and goods carried. Pathogens and their vectors can now move further, faster and in greater numbers than ever before. Three important consequences of global

transport network expansion are infectious disease pandemics, vector invasion events and vector-borne pathogen importation. This review briefly examines some of the important historical examples of these diseases and vector movements, such as the global influenza pandemics, the devastating *Anopheles gambiae* invasion of Brazil and the recent increases in imported *Plasmodium falciparum* malaria cases. We then outline potential approaches for future studies of disease movement, focussing on vector invasion and vector-borne disease importation. Such approaches allow us to explore the potential implications of international air travel, shipping routes and other methods of transport on global pathogen and vector traffic.

13494. **Tibayrenc, M., 2005**. Bridging the gap between molecular epidemiologists and evolutionists. *Trends in Microbiology,* **13**(12): 575-580.

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Molecular epidemiology designates the various molecular methods that aim to identify the relevant units of analysis of pathogens involved in transmissible diseases: species, subspecies, strains, clones and genes of interest. It is frequently based on an empirical approach. I advocate that evolutionary concepts enrich this discipline considerably and should be considered as an integral part. In turn, the experience and questioning of field experts are crucial to evolutionists who use transmissible diseases as models. A molecular epidemiology aim gives evolutionary studies a practical goal, putting a stop to approaches that are overly speculative.

13495**. Whitten, M. & Mahon, R., 2005**. Misconceptions and constraints. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 601-626.

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In theory, the sterile insect technique (SIT) is applicable to a wide variety of invertebrate pests. However, in practice, the approach has been successfully applied to only a few major pests. The shortfall between theory and practice is partly due to the persistence of some common misconceptions, but it is mainly due to one constraint, or a combination of constraints, that are biological, financial, social or political in nature. This chapter's goal is to dispel some major misconceptions, and view the constraints as challenges to overcome, seeing them as opportunities to exploit. Some of the common misconceptions include: (1) released insects retain residual radiation, (2) females must be monogamous, (3) released males must be fully sterile, (4) eradication is the only goal, (5) the SIT is too sophisticated for developing countries, and (6) the SIT is not a component of an area-wide integrated pest management (AW-IPM) strategy. The more obvious constraints are the perceived high costs of the SIT, and the low competitiveness of released sterile males. The perceived high up-front costs of the SIT, their visibility, and the lack of private investment (compared with alternative suppression measures) emerge as serious constraints. Failure to appreciate the true nature of genetic approaches, such as the SIT, may pose a significant constraint to the wider adoption of the SIT and other genetically-based tactics, e.g. transgenic genetically modified organisms

(GMOs). Lack of support for the necessary underpinning strategic research also appears to be an important constraint. Hence the case for extensive strategic research in ecology, population dynamics, genetics, and insect behaviour and nutrition is a compelling one. Raising the competitiveness of released sterile males remains the major research objective of the SIT.

2. TSETSE BIOLOGY

(a) REARING OF TSETSE FLIES

13496. **Calkins, C.O. & Parker, A.G., 2005** Sterile insect quality. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 269-296.

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The sterile insect technique (SIT) depends greatly on the production of good quality sterile male insects that are released into target wild populations. Quality is assured through a system of bioassays of quality parameters that reflect the insect's ability to survive, interact with its environment, and locate, mate and fertilize females of the target population. The system was developed by compartmentalizing the essential survival and mating behaviours of the species involved, and then developing a series of tests to confirm that these behavioural traits are present in the mass-reared insects. The system also has a feedback loop to correct problems in the production portion of the system before they become evident. Nevertheless, regular implementation of field or field-cage tests under semi-natural conditions, where sterile males have to compete with wild males for wild females, is required to provide the ultimate assurance that the sterile insects have the ability to fulfil their mission after release.

13497. **Mutika, G.N. & Parker, A.G., 2006**. Induced sterility of *Glossina pallidipes* Austen males after irradiation in a nitrogen atmosphere. *Entomological Science* **9**(1): 47-53.

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The sterile insect technique relies on sterilization of males using ionizing radiation. Life cycle stage, and the environmental conditions under which irradiation is carried out are crucial to the provision of good-quality insects. To identify an optimal radiation strategy for *Glossina pallidipes* Austen, 1903, 13-day-old males were irradiated at different doses in a nitrogen atmosphere. The following day the males were mated with 8-day-old virgin females. Pupal production of mated females was monitored for 6 weeks, and induced sterility was determined by probit analysis. Survival of the males that mated was also monitored. At least 95 percent sterility of irradiated males was achieved with a 158 Gy dose in nitrogen and a 125 Gy in air. Irradiation significantly lowered the probability of survival between 30 and 100 days of age (especially flies irradiated in air), but probabilities of survival were similar outside this period for irradiated and unirradiated flies. Exposure of 2- or 13-day-old males to sterilizing radiation induced similar levels of sterility in both air and nitrogen.

13498. **Parker, A.G., 2005.** Mass rearing for sterile insect release. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 209-232.

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As the sterile insect technique (SIT) relies upon released sterile male insects efficiently competing with wild males to mate with wild females, it follows that mass-rearing of insects is one of the principal steps in the process. Mass-rearing for the SIT presents both problems and opportunities due to the increased scale involved compared with rearing insects for most other purposes. This chapter discusses facility design, environmental concerns, strain management, quality control, automation, diet, sex separation, marking, and storage in relation to rearing for the SIT.

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

[See also **9**: 13466]

13499. **Carlson, D.M., Mramba, F., Sutton, B.D., Bernier, U.R., Geden, C.J. & Mori, K., 2005**. Sex pheromone of the tsetse species, *Glossina austeni*: isolation and identification of natural hydrocarbons, and bioassay of synthesized compounds. *Medical and Veterinary Entomology*, **19** (4): 470-479.

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Copulatory responses of male *Glossina austeni* (Newstead) (Diptera: Glossinidae), that were elicited after contact with frozen female tsetse, were not observed after solvent washing of cuticular lipids. Chromatographic analysis of extracts from laboratory-reared and field-collected *G. austeni* females yielded natural hydrocarbons that were highly stimulatory to males. Most of this activity was produced by compounds in the alkene fraction. Gas chromatograms (GC) contained five natural alkenes; these were separated by preparative GC for bioassays conducted in Tanzania. The two major alkenes were identified using gas chromatography-mass spectrometry (GC-MS) to be 13, 17-dimethyltritriacont- 1-ene and 13, 17-dimethylpentatriacont-1-ene, after the samples had undergone derivatization using dimethyl disulphide and saturation with deuterium. These alkenes and natural alkanes were quantified from *G. austeni* of both sexes from laboratory and field samples to confirm that their presence was consistent in this species. Trials of synthetic samples resulted in the order of biological activity for the stereoisomers of 13, 17-dimethyltritriacont-1-ene as follows: S, R-33:1 > R, S- 33:1 > S, S-33:1 > R, R-33:1. Dose-response data showed an ED50 at 5 mu g per treated, solvent-washed male decoy. Of the four stereoisomers of 13, 17-dimethylpentatriacont-1-ene, R, R-35:1 showed the most activity. This is the first report of alkene-induced sexual activity in males of the genus *Glossina.*

13500. **Hu, Y. & Aksoy, S., 2005**. An antimicrobial peptide with trypanocidal activity characterized from *Glossina morsitans morsitans*. *Insect Biochemistry and Molecular Biology*, **35** (2): 105-115.

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Tsetse flies (Diptera: Glossinidae*)* are vectors of African trypanosomes, the protozoan agents of devastating diseases in humans and animals. Prior studies in trypanosome infected *Glossina morsitans morsitans* have shown induced expression and synthesis of several antimicrobial peptides in fat body tissue. Here, we have expressed one of these peptides, Attacin (GmAttA1) in *Drosophila (*S2) cells *in vitro*. We show that the purified recombinant protein (recGmAttA1) has strong antimicrobial activity against *Escherichia coli*-K12, but not against the enteric gram-negative symbiont of tsetse, *Sodalis glossinidius*. The recGmAttA1 also demonstrated inhibitory effects against both the mammalian bloodstream form and the insect stage *Trypanosoma brucei in vitro* (minimal inhibitory concentration MIC50 0.075 [mu] M). When blood meals were supplemented with purified recGmAttA1 during the course of parasite infection, the prevalence of trypanosome infections in tsetse midgut was significantly reduced. Feeding fertile females GmAttA1 did not affect the fecundity or the longevity of mothers, nor did it affect the hatchability of their offspring. We discuss a paratransgenic strategy, which involves the expression of trypanocidal molecules such as recGmAttA1 in the midgut symbiont *Sodalis in vivo* to reduce trypanosome transmission.

13501. **Matthew, C.Z., Darby, A.C., Young, S.A., Hume, L.H. & Welburn, S.C., 2005**. The rapid isolation and growth dynamics of the tsetse symbiont *Sodalis glossinidius*. *FEMS Microbiology Letters*, **248** (1): 69-74.

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Sodalis glossinidius is known exclusively in endosymbiosis with tsetse flies (Genus: *Glossina*) and is one of the few insect bacterial symbionts that have been successfully cultured *in vitro*. This study details improved isolation and solid culture protocols that allow for a standardised and rapid preparation/maintenance of clonal material from individual flies. The isolation and culture of *S. glossinidius* were confirmed by partial sequencing of the 16S rDNA gene and specific PCR. In addition, the growth dynamics and changes in cell viability during liquid culture are described. The potential for culture of other endosymbiont taxa is discussed.

13502. **Nappi, A.J. & Christensen, B.M., 2005.** Melanogenesis and associated cytotoxic reactions: applications to insect innate immunity. *Insect Biochemistry and Molecular Biology*, **35** (5): 443-459.

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Insects transmit the causative agents for such debilitating diseases as malaria, lymphatic filariases, sleeping sickness, Chagas' disease, leishmaniasis, river blindness, dengue, and yellow fever. The persistence of these diseases provides testimony to the genetic capacity of parasites to evolve strategies that ensure their successful development in two genetically diverse host species: insects and mammals. Current efforts to address the problems posed by insect-borne diseases benefit from a growing understanding of insect and mammalian immunity. Of considerable interest are recent genomic investigations that show several similarities in the innate immune effector responses and associated regulatory mechanisms manifested by insects and mammals. One notable exception, however, is the nearly universal presence of a brown-black pigment accompanying cellular innate immunity in insects. This response, which is unique to arthropods and certain other invertebrates, has focused attention on the elements involved in pigment synthesis as causing or contributing to the death of the parasite, and has even prompted speculation that the enzyme cascade mediating melanogenesis constitutes an ill-defined recognition mechanism. Experimental evidence defining the role of melanin and its precursors in insect innate immunity is severely lacking. A great deal of what is known about melanogenesis comes from studies of the process occurring in mammalian systems, where the pigment is synthesized by such diverse cells as those comprising portions of the skin, hair, inner ear, brain, and retinal epithelium. Fortunately, many of the components in the metabolic pathways leading to the formation of melanin have been found to be common to both insects and mammals. This review examines some of the factors that influence enzyme-mediated melanogenic responses, and how these responses likely contribute to blood cell-mediated, target-specific cytotoxicity in immune challenged insects.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **29:** nos.13466, 13467, 13474, 13475, 13486, 13490, 13491, 13493]

13503**. Bouyer, J., Guerrini, L.G., Cesar, J., De La Rocque, S. & Cuisance, D., 2005**. A phyto-sociological analysis of the distribution of riverine tsetse flies in Burkina Faso. *Medical and Veterinary Entomology*, **19** (4): 372-378.

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In Burkina Faso, *Glossina palpalis gambiensis* Vanderplank and *G. tachinoides* Westwood (Diptera: Glossinidae) are the main cyclic vectors of trypanosomiasis. The vegetation type along river banks is an important factor determining the distribution and abundance of these tsetse. The following work investigated the relation between the plant species present (including the disturbance level) and tsetse distribution and abundance, using three ecotypes, described by P.C. Morel in 1978. These were the Guinean, Sudano-Guinean and Sudanese gallery forests. In the Mouhoun River basin, these three ecotypes are found successively from upstream to downstream. *Berlinia grandiflora*, *Syzygium guineense* and *Cola laurifolia* and finally *Acacia seyal* and *Mitragyna inermis* were the best indicators for the Guinean, Sudano-Guinean and Sudanese gallery forest ecotypes, respectively, as suggested by Morel. However, other species such as *Pterocarpus santalinoides* and *Mimosa pigra* were not ecotype specific. Trap catches confirmed that *G. palpalis* and *G. tachinoides* are predominant in Guinean and Sudanese gallery forests, respectively, and that both species

are well represented in the Sudano-Guinean ecotype. Tsetse densities dropped significantly in disturbed Sudano-Guinean and Sudanese gallery forest sites. However, this was not the case for both species in Guinean or for *G. tachinoides* in half-disturbed Sudanese gallery forest sites, confirming their high resilience to human-made changes. The importance of a detailed consideration of riverine ecotypes when predicting tsetse densities is discussed.

13504**. Esterhuizen, J., Kappmeier Green, K., Marcotty, T. & Van Den Bossche, P., (2005)** Abundance and distribution of the tsetse flies, *Glossina austeni* and *G. brevipalpis*, in different habitats in South Africa. *Medical and Veterinary Entomology,* **19**(4), 367-391.

P. Van den Bossche: Animal Health Department, Institute of Tropical Medicine, Nationalestraat 155, 2000 Antwerpen, Belgium.

The distribution and abundance of *Glossina austeni* Newstead and *Glossina brevipalpis* Newstead (Diptera: Glossinidae) were studied in the three main vegetation types in Zululand, KwaZulu-Natal, South Africa. During a period of 12 months, a trap transect consisting of 38 H-traps traversing the three vegetation types was monitored. The Index of Apparent Abundance (IAA) for *G. brevipalpis* was high in indigenous forest and open grassland but lower in exotic plantations. *Glossina austeni*, on the other hand, was captured mainly in or adjacent to indigenous forest. The seasonal trend in the IAA did not differ between vegetation types. The findings on the distribution of *G. brevipalpis* are in contrast with the historic records. Historically, this species was considered to be restricted to areas with a dense overhead canopy and high relative humidity. The repercussions of these findings for the epidemiology of livestock trypanosomiasis and the control of tsetse in Zululand are discussed.

13505. **Gooding, R.H. & Krafsur, E.S., 2005.** Tsetse genetics: contributions to biology, systematics, and control of tsetse flies. *Annual Review of Entomology*, **50**: 101-123.

Department of Biological Sciences, University of Alberta, Edmonton, Alberta, T6G 2E9, Canada.

Tsetse flies constitute a small, ancient taxon of exclusively haematophagous insects that reproduce slowly and viviparously. Because tsetse flies are the only vectors of pathogenic African trypanosomes, they are a potent and constant threat to humans and livestock over much of sub-Saharan Africa. Despite their low fecundity, tsetse flies demonstrate great resilience, which makes population suppression expensive, transient, and beyond the capacities of private and public sectors to accomplish, except over small areas. Nevertheless, control measures that include genetic methods are under consideration at national and supranational levels. There is a pressing need for sufficient laboratory cultures of tsetse flies and financial support to carry out genetic research. Here we review the genetics of tsetse flies from organismal and population points of view and identify some research needs.

13506. **Kubi, C., Van Den Abbeele, J., Dorny, P., Coosemans, M., Marcotty, T. & Van Den Bossche, P., 2005**. Ability of trypanosome-infected tsetse flies (Diptera:

Glossinidae) to acquire an infection with a second trypanosome species. *Journal of Medical Entomology*, **42**: 1035-1038.

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The epidemiology of human and animal trypanosomiasis is determined to a large extent by the number of infected tsetse flies in a specific area. In the field, a substantial proportion of infected flies carry mixed trypanosome infections. The way in which these tsetse flies acquire a mixed infection is not fully understood. In particular, the susceptibility of tsetse flies to sequential infection with trypanosomes is not well understood. Accordingly, laboratory studies were made of the effects of age and prior infection on the probability of *Glossina morsitans morsitans* (Westwood) developing an infection of *Trypanosoma congolense* and *Trypanosoma brucei brucei* after feeding on infected mice. Results of these experiments clearly showed that 20-30-d-old *G. m. morsitans* can still pick up and develop a mature infection in the mouthparts/hypopharynx for *T. congolense* or in the salivary glands for *T. b. brucei.* However, their ability to acquire infection was significantly lower compared with teneral flies. Furthermore, 20-30-d-old flies that already carry a mature *T. congolense* or *T. b. brucei* infection remained at least as susceptible to a secondary trypanosome infection compared with noninfected flies of the same age. The immunological and epidemiological repercussions of those findings are discussed.

13507. **Meireles-Filho, A.C.A., da S. Rivas, G.B., Gesto, J.S.M., Machado, R.C., Britto, C., de Souza, N.A. & Peixoto, A.A., 2006**. The biological clock of an hematophagous insect: Locomotor activity rhythms, circadian expression and downregulation after a blood meal. *FEBS Letters*, **580** (1): 2-8.

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Despite the importance of circadian rhythms in vector-borne disease transmission, very little is known about its molecular control in hematophagous insect vectors. In *Drosophila melanogaster*, a negative feedback loop of gene expression has been shown to contribute to the clock mechanism. Here, we describe some features of the circadian clock of the sandfly *Lutzomyia longipalpis*, a vector of visceral leishmaniasis. Compared to *D. melanogaster*, sandfly period and timeless, two negative elements of the feedback loop, show similar peaks of mRNA abundance. On the other hand, the expression of clock (a positive transcription factor) differs between the two species, raising the possibility that the different phases of clock expression could be associated with the observed differences in circadian activity rhythms. In addition, we show a reduction in locomotor activity after a blood meal, which is correlated with downregulation of period and timeless expression levels. Our results suggest that the circadian pacemaker and its control over the activity rhythms in this hematophagous insect are modulated by blood intake.

13508. **Ouma, J. O., Marquez J. G. & Krafsur E. S., 2006.** Microgeographical breeding structure of the tsetse fly, *Glossina pallidipes* in south-western Kenya. *Medical and Veterinary Entomology*, **20** (1): 138-149.

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The origins of extant *Glossina pallidipes* Austen (Diptera: Glossinidae) populations in the ecologically well-studied Lambwe and Nguruman valleys in Kenya are controversial because populations have recovered after seemingly effective attempts to achieve high levels of control. The microgeographical breeding structure of the tsetse fly, *G. pallidipes*, was investigated by analysing spatial and temporal variation at eight microsatellite loci to test hypotheses about endemism and immigration. Samples were obtained at seasonal intervals from trap sites separated by 200 m to 14 km and arranged into blocks. *G. pallidipes* populations nearest to Lambwe and Nguruman also were sampled. Spatial analysis indicated that genetic differentiation by genetic drift was much less among trapping sites within Lambwe and Nguruman (FST $\leq$ 0.049) than between them (FST = 0.232). FST between Serengeti and Nguruman was 0.16 and FST between Kodera Forest and Lambwe was 0.15. The genetic variance in *G. pallidipes* explained by dry and wet seasons (0.33 percent) was about one-fifth the variance among collection dates (1.6 percent), thereby indicating reasonable temporal stability of genetic variation. Gene frequencies in Kodera and Serengeti differed greatly from Lambwe and Nguruman, thereby falsifying the hypothesis that Lambwe and Nguruman were repopulated by immigrants. Harmonic mean effective (= breeding) population sizes were 180 in Lambwe and 551 in Nguruman. The genetic data suggest that *G. pallidipes* in Lambwe and Nguruman have been endemic for long intervals.

13509. **Schaub, G.A., 2006**. Parasitogenic alterations of vector behaviour. *International Journal of Medical Microbiology*, **In Press, Corrected Proof.**

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In many parasite-vector systems, alterations of the behaviour of the blood-sucking arthropods result in an increase of the transmission rate, but the underlying mechanisms are elucidated in only some systems. The more sluggish movements of the *Trypanosoma rangeli*-infected triatomine *Rhodnius prolixus* might increase the rate of predation by insectivorous mammals but also the transmission rate between the triatomines via cannibalism. Alterations of the feeding behaviour by which the number of attacks on hosts by blood-sucking arthropods can be increased seem to derive from two possible mechanisms. A competition for metabolites in the ingested blood induces an earlier starvation effect than in non-infected specimens and thus a new attempt by the insect to ingest blood. This may be relevant in *T. cruzi*-infected triatomines. Perhaps this is also the reason for the increased activity of ticks infected with the tick-borne encephalitis virus, resulting in a higher infection rate of ticks collected on humans than from the vegetation. The second, better elucidated mechanism is interference with the ingestion process, which causes a higher number of probings and low ingestion rates and is connected with disturbances of the digestive tract. Cells of the salivary glands are destroyed by the penetration of the parasites in *Plasmodium*-infected mosquitoes, *T. rangeli*-infected *Rhodnius*, and tsetse flies infected with salivarian *Trypanosoma* species. Some of the latter species attach to mechanoreceptive sensilla, which act as fluid flow meters and/or reduce the diameter of the foregut by a heavy colonization. This colonization effect is

even more evident in several *Leishmania*-sandfly systems and in *Yersinia pestis* infection of the rat flea.

13510. **Steuber, S.A., Abdel-Rady, A. & Clausen, P. H., 2005**. PCR-RFLP analysis: a promising technique for host species identification of blood meals from tsetse flies (Diptera: Glossinidae). *Parasitology Research*, **97** (3): 247-254.

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A polymerase chain reaction with the restriction fragment length polymorphism (PCR-RFLP) method using universal primers complementary to the conserved region of the cytochrome b gene (cyt b) of the mitochondrion DNA (mtDNA) of vertebrates was applied to the identification of the origin of blood meals in tsetse flies. Blood samples from ten potential tsetse hosts of the family bovidae (cattle, water buffalo, red buffalo, waterbuck, springbok, goat, sheep, sable antelope, oryx and dik-dik) were included in this study. Sites for appropriate restriction endonucleases cuts were chosen by pairwise alignment of the amplified 359 bp fragments. A flow chart of endonucleases digestion using three restriction enzymes (e.g. TaqI, AluI and HindII) for the unequivocal identification of the respective bovid species was developed. A number of additional non-specific DNA fragments attributed to the co-amplification of cytochrome b pseudogenes were observed in some species (e.g. in red buffalo and dik-dik after digestion with AluI) but did not hamper assignment of bovid species. The detection rate of host DNA in tsetse by PCR-RFLP was 100, 80, 60 and 40 percent at 24, 48, 72 and 96 h after *in vitro* feeding, respectively. Identification of the last blood meal was possible even when tsetse had previously fed on different hosts.

13511. **Toh, H.W., Weiss, B. L., Perkin, S.A.H., Yamashita, A., Oshima, K., Hattori, M. & Aksoy, S., 2006.** Massive genome erosion and functional adaptations provide insights into the symbiotic lifestyle of *Sodalis glossinidius* in the tsetse host. *Genome Research*, 16(2): 149-156.

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Sodalis glossinidius is a maternally transmitted endosymbiont of tsetse flies (*Glossina* spp.), an insect of medical and veterinary significance. Analysis of the complete sequence of *Sodalis'* chromosome (4,171,146 bp, encoding 2,432 protein coding sequences) indicates a reduced coding capacity of 51 percent. Furthermore, the chromosome contains 972 pseudogenes, an inordinately high number compared with that of other bacterial species. A high proportion of these pseudogenes are homologues of known protein function either in defense or in the transport and metabolism of carbohydrates and inorganic ions, suggesting *Sodalis'* degenerative adaptations to the immunity and restricted nutritional status of the host. *Sodalis* possesses three chromosomal symbiosis regions (SSR): SSR-1, SSR-2, and SSR-3, with gene inventories similar to the Type-III secretion system (TTSS) ysa from *Yersinia enterolitica* and SPI-1 and SPI-2 from *Salmonella*, respectively. While core components of the needle structure have been conserved, some of the effectors and regulators typically associated with these systems in pathogenic microbes are modified or eliminated in *Sodalis.*

Analysis of SSR-specific invA transcript abundance in *Sodalis* during host development indicates that the individual symbiosis regions may exhibit different temporal expression profiles. In addition, the *Sodalis* chromosome encodes a complete flagella structure, key components of which are expressed in immature host developmental stages. These features may be important for the transmission and establishment of symbiont infections in the intra-uterine progeny. The data suggest that *Sodalis* represents an evolutionary intermediate transitioning from a free-living to a mutualistic lifestyle.

13512. **Torr, S.M., Mangwiro, T.N., & Hall, D.R., 2006.** The effects of host physiology on the attraction of tsetse (Diptera: Glossinidae) and *Stomoxys* (Diptera : Muscidae) to cattle. *Bulletin of Entomological Research*, **96**(1): 71-84.

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In Zimbabwe, studies were made of the numbers of tsetse (*Glossina* spp.) and stable flies (*Stomoxys* spp.) attracted to cattle of different nutritional status, age and sex. Host odours were analysed to determine the physiological basis of these differences and improved methods are described for measuring rates of production of kairomones. Seasonal fluctuations in host weight, related to changes in pasture quality, had no significant effect on attraction of tsetse or *Stomoxys.* However, both attraction to different individuals and carbon dioxide production by these individuals were strongly correlated with weight, suggesting a possible link. Attraction to the odour from different types of cattle decreased in the order ox > cow > heifer > calf, and oxen were twice as attractive as calves of less than 12 months old. Lactation did not alter the relative attractiveness of cows. Calves less than six months old produced lower levels of carbon dioxide, acetone, octenol and phenols than oxen, but for older calves and cows, levels of production of known kairomones and repellents were similar to those of an ox. Carbon dioxide produced by cattle varied according to time of day and the animal's weight; cattle weighing 500 kg produced carbon dioxide at a mean rate of 2.0 1itres min^{-1} in the morning and 2.8 1itres min^{-1} in the afternoon compared to respective rates of 1 1itres and 1.9 litres min^{-1} for cattle weighing 250 kg. Artificially adjusting the doses of carbon dioxide produced by individual cattle to make them equivalent did not remove significant differences in attractiveness for tsetse but did for *Stomoxys.* Increasing the dose of carbon dioxide from 1 to 4 litres min^{-1} in a synthetic blend of identified kairomones simulating those produced by a single ox, increased attractiveness to tsetse but not to the level of an ox. The results suggest that the main sources of differences in the attractiveness of individual cattle are likely to be variation in the production of carbon dioxide and, for tsetse, other unidentified kairomone(s). The biological and practical implications of these findings are discussed.

3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE EFFECTS)

[See also **29**: nos. 13468, 13472, 13473, 13476, 13477, 13479, 13480, 13481, 13483, 13484, 13489, 13495]

13513. **Bauer, B.G., Gitau, D., Oloo, F.P. & Karanja, S.M., 2006**. Evaluation of a preliminary trial to protect zero-grazed dairy cattle with insecticide-treated

mosquito netting in Western Kenya. *Tropical Animal Health and Production*, **38** (1): 29-34.

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The incidence of trypanosome infection was monitored in dairy cattle during a 6-month trial in Busia and Teso districts, western Kenya, to assess the efficacy of insecticide-treated netting for protection against tsetse flies. Frequently, the fragile netting did not last longer than 2 months because of destruction by strong wind or animal movements. Also, many farmers let their cattle graze freely outside the units during the day, despite technical advice, resulting in exposure of the free-ranging animals to habitats suitable for tsetse and thereby an increased risk of trypanosome infections. The trial groups thus comprised 34 animals from 11 dairy units that were continuously protected, and 153 animals from 46 dairy units that were partially protected. The control group consisted of 162 animals in 42 unprotected units. The phase- contrast buffy-coat technique was used for parasitological monitoring. The mean hazard rate for trypanosomes was significantly lower in protected cows, with a value of 0.007 as opposed to 0.02 for the control animals. Mean packed cell volumes (PCV) were significantly higher in protected cattle (29.7 percent) than in unprotected ones (27.6 percent). Farmers with protected animals also reported fewer nuisance flies and mosquitoes in their compounds.

13514. **Bourn, D.G., Grant, I., Shaw, A., & Torr, S., 2005.** Cheap and safe tsetse control for livestock production and mixed farming in Africa. *Aspects of Applied Biology*, **75:** 81-92.

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Trypanosomosis remains a widespread constraint on animal production, human health and agricultural livelihoods in rural Africa. Methods of tsetse control are reviewed and recent developments in bait technology are highlighted as a cost-effective and environmentally benign means of increasing agricultural production and improving food security. It is concluded that the restricted application of insecticide to cattle to suppress and eliminate local tsetse populations should be promoted as one of the key, farmer-based, disease control measures to complement, or as an alternative to, the prevailing widespread use of trypanocides.

13515. **Clausen, P.-H., Maia, M., Kruppa, T., Garms, R., May, J., Mehlitz, D., Abonuusum, A., Osei, S. & Bauer, B.,2006**. A pilot study to measure the effectiveness of insecticide-treated nets for protecting cattle from insects of medical and veterinary importance in the Ashani region in Ghana. *Scientific Report of the Bernhard Nocht Institute for Tropical Medicine, Hamburg, Germany.*

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The efficacy of deltamethrin-treated mosquito netting (polyester, 150 denier) in protecting cattle against nuisance insects and mosquitoes was evaluated in Kumasi, Ghana. A previous trial conducted in western Kenya had shown a significant reduction in cases of tsetse-transmitted trypanosomosis and a concomitant increase in the packed cell volumes of the protected animals. Protecting two zebu bulls with a pyrethroid-treated net at a height of 100cm above ground proved effective in reducing nuisance or biting insects (*Stomoxys* and *Musca* spp.) as well as Culicidae (including *Anopheles* spp.). In comparison to two other pens – each containing two zebu bulls and a negative control the reductions were more than 90 percent in- and outside the pen for *Stomoxys* and *Musca* spp. Culicidae (including *Anopheles* spp.) were as well affected with about 50 percent reduction in- and outside the pen. Further investigations are intended to study the effects of insecticide-treated fences in mixed agricultural and livestock production systems, simultaneously analyzing externalities for human health.

13516**. Feldmann, U., Dyck, V.A., Mattioli, R.C. & Jannin, J., 2005.** Potential impact of tsetse fly control involving the sterile insect technique. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 701-723.

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Hunger and poverty persist in rural sub-Saharan Africa. Many affected communities could produce enough food for themselves, and even for sale, if they had the basics — livestock and crops. In most of these communities, the presence of tsetse flies and the disease they vector, trypanosomosis, prevents optimal productive livestock-keeping and mixed farming, resulting in inadequate local food production. Since a vast majority of the rural communities depends on agriculture, the removal of a key development problem like tsetse and trypanosomosis (T and T) will permit increased local agricultural production, socio-economic and market development, and alleviate hunger and poverty. A sustained alleviation, if possible a complete, lasting removal of the T and T problem, is therefore considered a prerequisite to rural self-sufficient agriculture, in which productive livestock can provide milk, meat, draught power to cultivate the land, and eventually generate higher income and market opportunities. Hence the removal of such a key problem would catalyse overall development in rural areas. However, the poverty and food security status of communities in Africa is rather heterogeneous, and reflects the impact of various constraining factors, including T and T on the current agricultural production process and human well-being, as well as on the overall development potential. Correspondingly, the benefits to sustainable agriculture and rural development (SARD), resulting from an elimination of the T and T problem, will also vary from area to area. In view of the substantial funding required over the next decades to address this key problem, and the need for early "success stories" that show tangible benefits, it is important that the initial T and T control areas are carefully selected according to technical feasibility, and to the predicted potential in the context of SARD. Trypanosomosis is a major, but technically solvable, development problem, and the effectiveness of the sterile insect technique (SIT), as a component of area-wide integrated pest management (AW-IPM) programmes to create tsetse-free zones, has been demonstrated

in Zanzibar and other locations. This chapter (1) outlines the causal relationship between the T and T problem and food insecurity, malnutrition, poverty, and related disease and development constraints, (2) describes the impact of the problem on African rural communities and the overall economy, and (3) indicates the potential benefits of a reduced T and T burden, or even of its zonal elimination from selected priority areas in support of sustainable rural development.

13517. **Kamuanga, M. & Kabore, I., 2005**. Tsetse control in the Yale agropastoral zone (Burkina Faso): results of socio-economic surveys. *Tropicultura,* **23**: 146-153.

International Livestock Research Institute, Nairobi, Kenya.

The study examines the impact of a tsetse campaign (1994-97) in southern Burkina Faso. In the absence of health-productivity monitoring, data were collected in cross sectional surveys to generate quantitative estimates of relevant productivity traits for cattle. The results showed a 25 percent increase in herd size, a reduction in mortality from 63.1 to 7.1 percent and an increase in live births of 57.6 percent. Milk yield increased from 0.2 to 2.2 litres /cow /day in the dry season. These results show the impacts trypanosomosis control can have on zebu cattle exposed to a high tsetse challenge. The study underscores the importance of well-designed surveys as a cost effective way of generating estimates of productivity impacts. These estimates can be a useful alternative to subjective assessments in modelling the economic benefits.

13518. **Maniania, N.E., Odulaja, A., Okech, M.A. & Nadel, D.J., 2006**. Prospects of a fungus-contamination device for the control of tsetse fly *Glossina fuscipes fuscipes. Biocontrol Science and Technology*, **16** (2): 129-139.

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The prospect of the fungus *Metarhizium anisopliae* (Metsch.) Sorok. applied in contamination devices (Cds) to control tsetse fly *Glossina fuscipes fuscipes* Newstead was tested in a field experiment in Lake Victoria from 2 March 1999 to 31 August 2000. One hundred and sixty pyramidal traps mounted with Cds were deployed along the lakeshore and rivers on Mfangano Island. Contamination devices were loaded with 1.5 - 2.0 g of dry conidia/Cd. On the second island, Nzenze Island, four pyramidal traps fitted with plastic bags were deployed and served as the conventional 'trap and kill' population suppression method. A third island, Ngodhe Island, remained untreated and served as a control. Cds were recharged monthly with fresh conidia; plastic bags were also changed monthly. The apparent changes in population density were monitored weekly using biconical traps set at random on the three islands. To assess the incidence of *M. anisopliae* in tsetse flies on Mfangano Island, flies captured during monitoring were maintained in the laboratory and their mortality recorded. Fly population was reduced to 82.4 and 95.8 percent relative to untreated control on Mfangano and Nzenze Islands, respectively, during the experimental period. Compared to the fungus-treated island, the number of flies caught in monitoring traps increased considerably in 'trap kill' treatment at 5 months after the treatments were removed. The incidence of *M. anisopliae* in fly populations was low during the 12 weeks following the initiation of the

experiment but increased afterward until termination of the treatment. *M. anisopliae* could still be recovered from fly populations at 3 months after termination of the treatment, although the incidence was low. The results of this study have shown that application of *M. anisopliae* in a contamination device can suppress the population of *G. fuscipes fuscipes* comparable to the 'trap and kill' technology.

13519. **Muriuki, G.W., Njoka, T.J., Reid, R.S. & Nyariki, D.M., 2005**. Tsetse control and land-use change in Lambwe valley, south-western Kenya. *Agriculture, Ecosystems & Environment*, **106** (1): 99-107.

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For a long time, trypanosomosis, spread by the tsetse fly *Glossina*, constrained human settlement in the Lambwe Valley, a south-western Kenya rangeland. After lengthy efforts to control tsetse over many years, the valley is currently experiencing an increase in human population growth rate, and rapid changes in land-use and cover are taking place. Using time-series aerial photograph interpretation, social survey methods, and a review of human population trends over five decades, a three-fold expansion in cultivation in the settled areas over a 50-year period, with a consequent decrease in woody vegetation cover was identified. In the Ruma National Park, occupying a third of the valley floor, shrublands and thickets have expanded while open grasslands have decreased. The sudden increase of land under cultivation adjacent to prime agricultural land designated for wildlife conservation, exacerbated by bush encroachment and dwindling resources for tsetse control could provide a situation suitable for land-use conflicts. Sustainability of this unique rangeland is dependent on how judiciously the resources are shared among all stakeholders in the valley. This study suggests continued tsetse surveillance and agricultural intensification in the settled areas to minimize chances of conflicts in land-use.

13520. **Sciarretta, A., Girma, M., Tikubet, G., Belayehun, L., Ballo, S. & Baumgartner, J., 2005**. Development of an adaptive tsetse population management scheme for the Luke Community, Ethiopia. *Journal of Medical Entomology*, **42**(6): 1006-1019.

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Since 1996, tsetse (*Glossina* spp.) control operations, using odor-baited traps, have been carried out in the Luke area of Gurage zone, southwestern Ethiopia. *Glossina morsitans morsitans* Newstead was identified as the dominant species in the area, but the presence of *Glossina fuscipes* Newstead and *Glossina pallidipes* Austen also was recorded. Here, we refer to the combined number of these three species and report the work undertaken from October 2002 to October 2004 to render the control system more efficient by reducing the number of traps used and maintaining the previously reached levels of tsetse occurrence and trypanosomiasis prevalence. This was done by the design and implementation of an adaptive tsetse population management system. It consists first of an efficient community-participatory monitoring scheme that allowed us to reduce the number of traps used from 216 to 127 (107 monitoring traps and 20 control traps). Geostatistical methods, including kriging

and mapping, furthermore allowed identification and monitoring of the spatiotemporal dynamics of patches with increased fly densities, referred to as hot spots. To respond to hot spots, the Luke community was advised and assisted in control trap deployment. Adaptive management was shown to be more efficient than the previously used mass trapping system. In that context, trap numbers could be reduced substantially, at the same time maintaining previously achieved levels of tsetse occurrences and disease prevalence.

13521. **Torr, S.J., Hargrove, J.W. & Vale, G.A., 2005.** Towards a rational policy for dealing with tsetse. *Trends in Parasitology*, **21** (11): 537-541.

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The past 20 years have seen the development of bait technologies that enable livestock keepers to control tsetse flies and, hence, African trypanosomiasis. The techniques have, however, often been applied on too small a scale, without due regard to the realities of tsetse population dynamics. The consequent lack of progress has led to calls for a return to large-scale operations. Analysis of successful programmes to control or eliminate tsetse in southern Africa suggests that the combined use of recently improved bait methods and insecticide spraying will provide the building blocks for achieving the wider objective of the African Union, which is to create large tsetse-free zones.

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

[See also **29**: nos. 13470, 13474, 13475, 13491, 13493, 13494]

13522. **Abenga, J.N. & Lawal, I.A., 2005**. Implicating roles of animal reservoir hosts in the resurgence of Gambian trypanosomosis (Sleeping Sickness). *African Journal of Biotechnology,* **4**(2): 134-137.

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Gambian trypanosomiasis (Sleeping Sickness) is a complex and debilitating disease of man. For many years the disease has been ravaging in several parts of sub-Saharan Africa despite decades of therapeutic control. Although animal reservoir hosts are believed to be associated with the disease, not much evidence has been produced to prove the true existence of animal reservoir hosts for *Trypanosoma brucei gambiense* and the zoometric nature of Gambian Sleeping Sickness. This paper reviews recent evidences based on molecular and other biotechnologies leading to the identification of mammalian hosts as reservoirs of *T. b. gambiense* and the roles of such hosts in transmission and resurgence of sleeping sickness in sub-Saharan Africa.

13523. **Bossche, P., Kadoka, K., Kobe, C. & Marriott, T., 2006**. The transmissibility of *Trypanosoma congolense* seems to be associated with its level of resistance to isometamidium chloride. *Veterinary Parasitology*, **135** (3/4): 365-367.

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In large parts of Africa the control of livestock trypanosomiasis relies on the use of trypanocidal drugs. Resistance against the available compounds is developing rapidly in the trypanosome population. The effect of the development of drug resistance on the fitness of the trypanosome is not well known. To determine the effect of the development of resistance to isometamidium chloride on the trypanosome's transmissibility, transmission experiments were conducted. Use was made of three isogenic clones of *Trypanosoma congolense* with different susceptibility to the drug. The infection rate in *Glossina morsitans morsitans* differed significantly between clones and was significantly higher in tsetse flies infected with the *T. congolense* clone with the highest level of drug resistance.

13524. **Botto-Mahan, C., Cattan, P.E., Canals, M. & Acuna, M., 2005**. Seasonal variation in the home range and host availability of the blood-sucking insect *Mepraia spinolai* in wild environment. *Acta Tropica*, **95** (2): 160-163.

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In this study, we quantify the home range of *Mepraia spinolai*, a wild vector of *Trypanosoma cruzi*, and the abundance of wild mammals during summer and winter seasons in a protected area of north-central Chile. Results revealed significant differences between seasons for home range size and host availability. *M. spinolai* presented larger home range sizes, and mammal hosts were more abundant in summer, indicating that *T. cruzi* would have a higher probability of being transmitted during warmer months.

13525. **Bouyer, J., Cuisance, D., Messad, S. & Guerin, P.M., 2005**. Learning affects host preference in tsetse flies. *Revue d'Élévage et de Médecine Vétérinaire des Pays Tropicaux*, **58** (1/2): 27-29.

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Tsetse flies are very efficient cyclic vectors of African trypanosomosis. Since tsetse are generally infected by the first blood meal, as in the case of sleeping sickness for example, any propensity to feed on the same host a second time will improve transmission within this host species, whereas transmission between host species will decrease. To test this hypothesis we presented a monitor lizard and a cow in a stable to marked tsetse flies that had first fed on one of these two hosts. 80 percent of the teneral flies that fed did so on the cow when provided the choice. Among the flies having feeding experience, a disproportionately high number of flies that had fed on one host returned to this host for the second meal. We discuss the energetic advantages of such a learning behavior and its importance in sleeping sickness

epidemiology. The findings are of relevance to the role played by such learning behavior in disease transmission by other insect vectors of zoonoses.

13526. **Cherenet, T., Sani, R.A., Speybroeck, N., Panandam, J.M., Nadzr, S. & Van den Bossche, P., 2006.** A comparative longitudinal study of bovine trypanosomiasis in tsetse-free and tsetse-infested zones of the Amhara Region, northwest Ethiopia. *Veterinary Parasitology*, **In Press. Corrected Proof.**

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A study was conducted to determine the incidence of trypanosome infections in cattle in tsetse-free and tsetse-infested zones of the Amhara Region of northwest Ethiopia. A total of six sentinel herds were established and the cattle observed during a period of 8 consecutive months. The prevalence of seropositive cattle was high in both the tsetse-free and tsetse-infested zones. The average monthly incidence of trypanosome infection, determined using molecular diagnostic tools, was 20.9 percent and 25.7 percent in the tsetse-free and the tsetse-infested zones, respectively. In the tsetse-free, *Trypanosoma vivax* was responsible for 90.9 percent of the cattle trypanosome infections. In the tsetse-infested zone, *Trypanosoma congolense* and *T. vivax* contributed almost equally to the trypanosome infections in cattle. Trypanosome infection, regardless of species, resulted in anaemia as evidenced by a significant decrease in the packed cell volume of the infected animal. The outcome of this longitudinal study suggests that control of trypanosomiasis in the Amhara Region cannot be achieved by tsetse control alone. Supplemental measures to include drug therapy and biting fly control are discussed.

13527. **Courtin F., Jamonneau V., Oke E., Coulibaly B., Oswald Y., Dupont S., Cuny G., Doumenge J.P. & Solano P., (2005).** Towards understanding the presence/absence of Human African Trypanosomosis in a focus of Cote d'Ivoire: a spatial analysis of the pathogenic system. *International Journal of Health Geographics*, **4**: 27.

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This study aimed at identifying factors influencing the development of Human African Trypanosomosis (HAT, or sleeping sickness) in the focus of Bonon, located in the mesophile forest of Cote d'Ivoire. A previous study mapping the main daytime activity sites of 96 patients revealed an important disparity between the area south of the town- where all the patients lived- and the area north of the town, apparently free of disease. In order to explain this disparity, we carried out a spatial analysis of the key components of the pathogenic system, i.e. the human host, the tsetse vector and the trypanosomes in their environment using a geographic information system (GIS). This approach at the scale of a HAT focus enabled us to identify spatial patterns which linked to the transmission and the dissemination of this disease. The history of human settlement (with the rural northern area exploited much earlier than the southern one) appears to be a major factor which determines the land use pattern, which itself may account for differences found in vector densities (tsetse were found six

times more abundant in the southern rural area than in the northern). Vector density, according to the human and environmental context in which it is found (here an intense mobility between the town of Bonon and the rural areas), may explain the observed spatial differences in HAT prevalence. This work demonstrates the role of GIS analyses of key components of the pathogenic system in providing a better understanding of transmission and dissemination of HAT. Moreover, following the identification of the most active transmission areas, and of an area unfavourable to HAT transmission, this study more precisely delineates the boundaries of the Bonon focus. As a follow-up, targeted tsetse control activities starting north of Bonon (with few chances of reinvasion due to very low densities) going south, and additional medical surveys in the south will be proposed to the Ivoirian HAT control program to enhance the control of the disease in this focus. This work also shows the evolution of HAT regarding time and environment, and the methodology used may be able to predict possible sleeping sickness development/extinction in areas with similar history and space organization.

13528. **Cox, J.ST.H. & Vreysen M.J.B., 2005**. Use of geographical information systems and spatial analysis in area-wide integrated pest management programmes that integrate the sterile insect technique. In**:** *Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management.* Springer, the Netherlands, pp. 453-477.

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The advantages that geographic information systems (GIS) and associated technologies can offer, in terms of the design and implementation of area-wide programmes of insect and/or disease suppression, are becoming increasingly recognized, even if the realization of this potential has not been fully exploited and for some area-wide programmes adoption appears to be progressing slowly. This chapter provides a basic introduction to the science of GIS, Global Positioning System (GPS), and satellite remote sensing (RS), and reviews the principal ways in which these technologies can be used to assist various stages of development of the sterile insect technique (SIT) as part of area-wide integrated pest management (AW-IPM) programmes — from the selection of project sites, and feasibility assessments and planning of pre-intervention surveys, to the monitoring and analysis of insect suppression programmes, and the release of sterile insects. Potential barriers to the successful deployment of GIS tools are also discussed.

13529. **De Deken, R.S., Mpiana, S., Mansinsa, P., Wat'Senga, F., Lutumba, P., Boelaert, M. & Van den Bossche, P., 2005**. Trypanosomiasis in Kinshasa: distribution of the vector, *Glossina fuscipes quanzensis*, and risk of transmission in the peri-urban area. *Medical and Veterinary Entomology*, **19** (4): 353-359.

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Because human and animal cases of African trypanosomiasis have been reported in and around the city of Kinshasa for a long time, the likelihood of local transmission was

examined. A georeferenced image of the city was produced, based on a satellite image (SPOT 4). Urban, peri-urban and rural areas were delineated. All recent data on captures of *Glossina fuscipes quanzensis* Pires (Diptera: Glossinidae) between 1999 and 2004, as well as epidemiological data on a 1999 outbreak of human trypanosomiasis by *Trypanosoma brucei gambiense* in the Kisenso District, were entered in a geographical information system (GIS). Tsetse flies were mainly found along some of the major rivers in the rural and peri- urban area of Kinshasa. Unsupervised classification of the satellite image allowed identification of riverine habitats suitable for tsetse flies and indicated sites where further entomological surveys were needed. The study produced strong indications that local transmission of human trypanosomiasis had occurred in the recent past in the peri-urban zone of Kinshasa.

13530. **Delafosse, A., Thebaud, E., Desquesnes, M. & Michaux, Y., 2006**. Epidemiology of *Trypanosoma vivax* infection in cattle in the tsetse free area of Lake Chad. *Preventive Veterinary Medicine*, **In Press, Corrected Proof.**

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A study was conducted in Chad to estimate the prevalence and the incidence of *Trypanosoma vivax* infection in herds of cattle from the Lake Chad area. The risk factors associated with disease were also identified. A random sample of 933 cattle from 17 herds was initially selected (January 1999, cold dry season). Cattle were identified by ear-tags and sampled in the rainy season (July 1999) and the cold dry season (January 2000). Each animal sampled was treated with diminazene aceturate (3.5 mg/kg). Samples were examined for the presence of *T. vivax* using an antibody (indirect ELISA) and a parasite detection test (buffy-coat technique, BCT). Standardized questionnaires with information about the host and management practices were collected and evaluated for their association with seroprevalence (model 1) and parasitological prevalence (model 2) as indicator of host susceptibility to *T. vivax* infection. Risk factors were selected using two approaches: ordinary logistic regression (OLR) and generalized estimating equations (GEE) to account for within-herd correlation. The apparent prevalence was 1.6 percent using BCT and 42.3 percent with indirect ELISA. The true prevalence in the sample was estimated to (2.0 percent-8.0 percent) with two assumptions of BCT sensitivity. Overall, 58.8 percent (BCT) and 100.0 percent (ELISA) of the herds had a least one-positive animal. In January-July 1999, apparent monthly incidence was calculated at 0.24 percent in comparison with 0.76 percent for August 1999-January 2000. The true monthly incidence was estimated at 0.36 percent-1.43 percent for the first period and at 0.94 percent-3.78 percent for the second period. Risk factors associated with seroprevalence were age, race, a great number of small ruminants in the herd, and latitude and longitude of pasture area in the rainy season. Risk factors associated with BCT prevalence were duration of seasonal migration and longitude of pasture area in the rainy season.In conclusion, *T. vivax* is present and widely disseminated in the cattle herds of tse-tse free area of Lake Chad. Farm-level factors, particularly seasonal migration, should be considered as the main risk factors for infection and for host susceptibility to the parasite.

13531. **de la Rocque, S., Michel, J.F., Bouyer, J., De Wispelaere, G. & Cuisance, D., 2005**. Geographical Information Systems in parasitology: a review of potential applications using the example of animal trypanosomosis in West Africa. *Parassitologia,* 47 (1): 97-104.

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The epidemiology of vector-borne diseases is complex due to the variability in the ecology of the different actors involved, i.e. hosts, parasites and vectors. The transmission of African animal trypanosomosis in the West-African savannah region is an excellent example of this complexity: riverine tsetse flies have an heterogeneous distribution along the rivers, depending of suitable habitats, and transmit pathogenic trypanosomes where they use domestic animal as feeding hosts. Contrasting epidemiological situations may thus occur at the local scale, and a broad view of the overall environment is necessary to quantify the interfaces in time and space between hosts and vectors. Geographical Information Systems (GIS) can provide new insight into the study of such complex epidemiological processes. GIS is a powerful technology that has been used mainly in map-making, and an enormous amount of knowledge can be gained simply by geographical data projection. GIS also allows juxtaposition of different types of information, creation of new variables, testing of theories and correlation, and generating of predictive models. The purpose of the present paper is to exemplify the potential application of GIS using a recent study carried out on animal trypanosomosis in a cattle-raising area of Burkina Faso.

13532. **de la Rocque, S., Michel, J.F.; Bouyer, J.; De Wispelaere, G. & Cuisance, D., 2004**. GIS and animal trypanosomosis in West Africa. In: *Multidisciplinarity for Parasites, Vectors and Parasitic Diseases*. Medimond Publishing Co., Bologna, Italy, pp.273-278

CIRAD, EMVT, Montpellier, France.

Recent studies in an agro-pastoral area of Burkina Faso showed that riparian tsetse flies (*Glossina tachinoides* and *G. palpalis gambiensis*) were present along the main rivers, but depending on their location, were not infected by the same species of trypanosomoses. Different epidemiological situations may occur at the very local scale and transmission risk assessment requires a global approach involving environmental and human parameters of hosts and vectors contacts. Various types of information on entomology, parasitology, ecology, land occupation and animal production systems were collected and combined in a GIS. High resolution remote sensing data and innovative modelling methods were used to describe tsetse habitats, landscapes of the valley and cattle distribution. Finally, not more than 18 percent of the river network infected by tsetse flies was identified as transmission sites. Practical applications in term of vector and disease control are presented.

13533. **Desquesnes, M.D., ML; Bouyer, J. & Fatehi, M., 2004.** Mechanical transmission of *Trypanosoma vivax* and *Trypanosoma congolense* by common African tabanids *Atylotus agrestis* and *Atylotus fuscipes*. In: *Multidisciplinarity for Parasites, Vectors and Parasitic Diseases*. Medimond Publishing Co., Bologna, Italy, pp. 143-147.

CIRAD, Department EMVT, Montpellier, France.

To demonstrate mechanical transmission of African trypanosomes by tabanids, a series of 3 experiments was carried out in Lahirasso, Burkina Faso. Ten heifers free of trypanosome infection were kept together in a corral covered by a mosquito net. In the two first experiments, 2 heifers were experimentally infected with a local stock of *T. vivax*. Tabanids freshly-captured with 2 Nzi traps were released into the fly proof corral, during 20 days: on average 32 *Atylotus agrestis* / heifer / day in the first experiment, and 54 *Atylotus fuscipes* in the second one. Mechanical transmission of *T. vivax* was demonstrated in both cases with high incidence rates: respectively 63 percent and 75 percent. In a third experiment 2 heifers were experimentally infected with a local stock of *T. congolense*. On average 29 freshly-captured *Atylotus agrestis* per heifer / day were released in the same conditions. The incidence rate of *T congolense* infection was 25 percent. Impact of tabanids as mechanical vectors of trypanosomes should be re-considered in light of these results.

13534. **Fevre, E.M., Tilley, A., Picozzi, K., Fyfe, J., Anderson, I., Magona, J.W., Shaw, D.J., Eisler, M.C. & Welburn, S.C., 2006**. Central point sampling from cattle in livestock markets in areas of human sleeping sickness. *Acta Tropica*, **97** (2): 229-232.

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We present the results of a study to determine the value of central point sampling in cattle markets as a means of estimating the trypanosomiasis (*T. brucei s.l.*) prevalence in the surrounding landscape in Uganda. We find that in the epidemic area studied, central point sampling is a good predictor of prevalence in surrounding villages, but not in endemic areas. We also find that animals infected with trypanosomiasis are more likely to be brought for sale in livestock markets in endemic areas; we discuss these results in relation to the prevention of the spread of sleeping sickness.

13535. **Gouteux, J.P., 2005**. Risk evaluation in sleeping sickness: a mathematical contribution. *Parasite*, **12** (3): 259-264.

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The concept of "risk" is important in epidemiology but is often used in a confused way for sleeping sickness. Using a rigorous approach resulting from mathematical modelling, new virtual entomological risk indicators and parasitological transmission indexes derived from the basic reproduction rate are proposed and discussed.

13536. **Holmstad, P.R., Jensen, K.H. & Skorping, A., 2006**. Vector-borne parasites decrease host mobility: A field test of freeze or flee behaviour of willow ptarmigan. *International Journal for Parasitology*, **In Press, Uncorrected Proof**.

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Transmission mode has been suggested to be a strong predictor of virulence. According to theory, the transmission of vector-borne parasites should be less dependent on host mobility than directly transmitted parasites. This could select for increased exploitation of host resources in parasites transmitted by vectors, which may be manifested as higher virulence. Here, we test the prediction that there is an association between transmission mode and the effect on host mobility by comparing parasite infection levels and mobility in willow ptarmigan (*Lagopus lagopus* L.). We examined the endoparasite infracommunities of individual hosts to obtain annual, quantitative data on four vector-transmitted species (*Leucocytozoon lovati, Trypanosoma avium, Haemoproteus mansoni* and microfilaria), two directly transmitted species (*Trichostrongylus tenuis* and *Eimeria* sp.) and two species with indirect life cycles (*Hymenolepis microps* and *Parionella urogalli*). We then used observed variations in freeze-or-flee responses of individual willow ptarmigan to assess whether parasite intensities were related to scored freezing responses. From a field data set covering a period of 9 years from a single area, we found that stronger freezing responses were associated with higher intensities of vector-borne parasites, especially with higher intensities of the haemosporidian *L. lovati*. Freezing responses were not associated with parasites transmitted in other ways. Thus, high intensities of vector-borne parasites tended to reduce host movements, while parasites with other transmission modes did not.

13537. **Kaba, D., Dje, N.N., Courtin, F., Oke, E., Koffi, M., Garcia, A., Jamonneau, V. & Solano, P., 2006**. The impact of war on the evolution of sleeping sickness in west-central Cote d'Ivoire. *Tropical Medicine and International Health*, **11** (2): 136-143.

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To evaluate the situation of sleeping sickness in west-central Cote d'Ivoire from 2000 to 2003, in view of the war which broke out in September 2002, active surveys by medical teams and passive case detection were carried out. Between 2000 and 2003, 250 patients were diagnosed with sleeping sickness. At first it appeared that sleeping sickness prevalence had fallen since the beginning of political troubles. But this apparent drop was due to poor population coverage. Participation in medical surveys differed according to ethnic group, reflecting land use conflicts between ethnic communities. Such conflicts are common in this area, but have been exacerbated by the war. It was concluded that in war, assessing the importance of sleeping sickness by medical surveys only is very difficult. But detection of sleeping sickness cases by passive surveillance increased.

13538. **Magona, J.W., Walubengo, J., Odiit, M., Okedi, L.A., Abila, P., Katabazi, B.K., Gidudu, A.M. & Olaho-Mukani, W., 2005**. Implications of the re-invasion of southeast Uganda by *Glossina pallidipes* on the epidemiology of bovine trypanosomosis. *Veterinary Parasitology*, **128** (1-2): 1-9.

Livestock Health Research Institute, P.O. Box 96, Tororo, Uganda. [liridir@hotmail.com].

A study to assess the influence of re-invasion of *Glossina pallidipes* on the epidemiology of bovine trypanosomosis was conducted in southeast Uganda. A total of 1,992

cattle were screened in villages, with (949) and without *G. pallidipes* (1,043) for trypanosomosis using a combination of the BCT and HCT methods. The prevalence of trypanosomosis (15.5 percent), *Trypanosoma brucei* infection (1.4 percent), *T. congolense* infection (7.2 percent), *T. vivax* infection (5.3 percent) and mixed infection (1.6 percent) in cattle in villages with was significantly higher than in those without *G. pallidipes*: trypanosomosis (7.1 percent), *T. brucei* infection (0.6 percent), *T. congolense* infection (2.0 percent), *T. vivax* infection (3.3 percent) and mixed infection (1.2 percent). *Trypanosoma congolense* was predominant in cattle in villages with *G. pallidipes*, while *T. vivax* infections were predominant in cattle in villages without. In all villages, *T. brucei* infections were fewer than either *T. congolense* or *T. vivax* infections. The risk of transmission of *T. brucei, T. congolense* and *T. vivax* infections was 3, 2.7 and 1.6 times, respectively, higher in villages with *G. pallidipes* than in those without, despite the presence of *G. f. fuscipes* in either set of villages. This is a rare case of a re-invasion of a tsetse species whose disease transmission capability calls for refocusing of the traditional national tsetse and trypanosomosis control strategies to contain it.

13539. **Mahama C.I., D.M., Dia M.L., Losson B., De Deken R., Speybroeck N. & Geerts S., 2005.** A longitudinal epidemiological survey of bovine trypanosomosis and its vectors in the White Volta river basin of northern Ghana. *Veterinary Parasitology*, **128** (3-4): 201-208.

Tsetse and Trypanosomiasis Control Unit, Veterinary Services Department, P.O. Box 97, Pong-Tamale, Ghana.

A longitudinal epidemiological survey of bovine trypanosomosis and its vectors was carried out in the Volta river basin of Northern Ghana to determine the relationship between cattle management and the incidence of bovine trypanosomosis. Two groups of sentinel cattle under different systems of management, classified as "fully-sedentary" and "partially-sedentary" (depending on the type of management) were followed over a 1-year period starting from March 2003 onwards. Cattle were screened at intervals of 3 months using the buffy coat technique (BCT). Buffy coat specimen from animals that were positive for the BCT and those that were negative, but with a packed cell volume (PCV) of less than 21 percent were further tested using the polymerase chain reaction (PCR). Plasma from all animals was tested for antibody using the indirect antibody enzyme-linked immunosorbent assay (ELISA). Trypanosomosis challenge was determined in tandem with the epidemiological survey with watering sites of sentinel cattle being the foci of interest. The parasitological prevalence at the start of the survey was higher in the fully-sedentary group (9 percent) than in the partially-sedentary group (3 percent). In subsequent visits, however, the parasitological incidence was consistently higher in the partially-sedentary group than in the fully-sedentary group. The mean seroprevalence (ELISA) of both groups increased from 3 percent in March to 54 percent in December. Statistical analysis of the serological results using a random effect logistic regression, showed a significant difference in incidence of bovine trypanosomosis between the two groups. There was also a significant effect of time. The influence of cattle herding on host-vector-parasite interface and its consequence on the incidence of trypanosomosis are discussed.

13540. **Matete, G.O. & Kajejo, O.A., 2005**. Human African trypanosomiasis and human immunodeficiency virus co-infection in western Kenya. *East African Medical Journal*, **82** (1): 20-23.

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To determine possible interaction between *Trypanosoma brucei rhodesiense* infection and HIV/AIDS in Western Kenya, serum samples from 25 randomly selected African trypanosomiasis patients were tested for HIV infection using indirect, single phase, enzyme linked immunosorbent assay. 53 control patients were selected from a local sexually transmitted disease clinic. Patients were selected from the National Sleeping Sickness Referral Hospital-Alupe. In African trypanosomiasis patients, 4 serum samples (16 percent) were seropositive for HIV-1 and HIV-2, and another 4 (16 percent) were seropositive for HIV-2 alone. In control patients, 27 (51 percent) serum samples were seropositive for both HIV-1 and HIV-2, and none was seropositive for HIV-2 alone. A calculated Yates chi-square value of 17.31 indicated a significant association of *T. brucei rhodesiense* and HIV-2 infection. It is suggested that *T. brucei rhodesiense* infection suppresses the immune system predisposing patients to HIV-2 infection, although further investigations are needed to prove this.

13541. **Njiokou, F., Laveissiere, C., Simo, G., Nkinin, S., Grebaut, P., Cuny, G. & Herder, S., 2006**. Wild fauna as a probable animal reservoir for *Trypanosoma brucei gambiense* in Cameroon. *Infection, Genetics and Evolution*, **6** (2): 147-153.

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In order to study the existence of a wild animal reservoir for *Trypanosoma brucei gambiense* in south Cameroon, blood was collected from wild animals in three human African trypanosomiasis foci and from a nonendemic control area.The 1,142 wild animals sampled belonged to 36 different species pertaining to eight orders (407 primates, 347 artiodactyls, 265 rodents, 54 pangolins, 53 carnivores, 11 saurians and crocodilians, and five hyraxes). QBC(R) and KIVI tests detected trypanosomes on 1.7 percent (13/762) and 18.4 percent (43/234) of animals examined, respectively.Using specific primers, *T. brucei* non-*gambiense* group 1 DNA was detected on 56 animals (4.9 percent). This infection rate was 5.3 percent in the endemic zone and 3.8 percent in the control zone. Of the 832 animals of the endemic zone, PCR revealed *T. b. gambiense* group 1 DNA in 18 (2.2 percent). These hosts included two rodents, two artiodactyls, two carnivores and two primates. *T. b. gambiense* group 1 was absent from animals from the nonendemic zone. A decrease in the prevalence of *T. b. gambiense* group 1 was observed in wild animals from the Bipindi sleeping sickness focus after a medical survey and vector control in this area. The epidemiological implications of these findings remain to be determined with further investigations.

13542. **Odiit, M.B., Bessell, P.R., Fevre, E.M., Robinson, T., Kinoti, J., Coleman, P.G., Welburn, S.C., McDermott, J. & Woolhouse, M.E.J., 2006**. Using remote sensing and geographic information systems to identify villages at high risk for *rhodesiense* sleeping sickness in Uganda. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* **100** (4): 354-362.

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Geographic information systems (GIS) and remote sensing were used to identify villages at high risk for sleeping sickness, as defined by reported incidence. Landsat Enhanced Thematic Mapper (ETM) satellite data were classified to obtain a map of land cover, and the Normalised Difference Vegetation Index (NDVI) and Landsat band 5 were derived as unclassified measures of vegetation density and soil moisture, respectively. GIS functions were used to determine the areas of land cover types and mean NDVI and band 5 values within 1.5 km radii of 389 villages where sleeping sickness incidence had been estimated. Analysis using backward binary logistic regression found proximity to swamp land and low population density to be predictive of reported sleeping sickness presence, with distance to the steeping sickness hospital as an important confounding variable. These findings demonstrate the potential of remote sensing and GIS to characterize village-level risk of sleeping sickness in endemic regions.

13543. **Picozzi, K., Fevre, E.M., Odiit, M., Carrington, M., Eisler, M.C., Maudlin, I. & Welburn, S.C., 2005.** Sleeping sickness in Uganda: a thin line between two fatal diseases. *British Medical Journal (Clinical Research edition)*, **331** (7527): 1238-1241.

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A study was conducted to determine, through the use of molecular diagnostic tools, whether the two species of parasite that cause human African trypanosomiasis have become sympatric. It involved blood sampling of all available patients from sleeping sickness treatment centres diagnosed as having sleeping sickness between June 2001 and June 2005 in central Uganda and between July and September 2003 in northwest Uganda and analysis of subcounty sleeping sickness records in Uganda between 1985 and 2005. Parasites from patients from each disease focus were classified as either *Trypanosoma brucei rhodesiense* (acute form) or *T. b. gambiense* (chronic form). Blood from 231 patients with sleeping sickness in central Uganda and from 91 patients with sleeping sickness in northwest Uganda and south Sudan were screened for *T. b. rhodesiense* (detection of SRA gene) and *T. b. gambiense* (detection of TgsGP gene). All samples from central Uganda were classified as *T. b. rhodesiense*, and all samples from northwest Uganda and south Sudan were identified as *T. b. gambiense*. In conclusion, the two focuses of human African trypanosomiasis remain discrete, but the area of Uganda affected by the acute form of human sleeping sickness has increased 2.5-fold since 1985, spreading to three new districts within the past five years through movement of infected livestock. Without preventive action targeted at the livestock reservoir of this zoonotic disease, it is likely that the two disease focuses will converge. This will have a major impact on diagnosis and treatment of this neglected disease. Real time monitoring is recommended, using molecular diagnostic tools (at a regional surveillance centre, for example) targeted at both livestock and human patients.

13544. **Ravel, S.G., Grebaut, P., Mariani, C., Jamonneau, V., Cuisance, D. & Cuny, G., 2004**. Interests and limits of the polymerase chain reaction for monitoring the developmental status of trypanosomes in *Glossina* during experimental infections: A help for field studies. In: *Multidisciplinarity for Parasites, Vectors and Parasitic Diseases*. Medimond Publishing Co., Bologna, Italy, pp. 137-141.

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The developmental status of two *Trypanosoma* species in experimentally infected *Glossina* was monitored by checking the anal drop and saliva of individual flies for parasites, at different times post - infection, using PCR and microscopy. PCR was clearly more sensitive than microscopy in detecting trypanosomes in saliva and anal drop, and to reveal mature infections, while it was not more sensitive in detecting infections in midguts. On the contrary, PCR failed to amplify about 40 percent of the parasitologically positive midguts, which has important implications in the field. This monitoring allowed to determine the kinetics of establishment and maturation of the parasites in *Glossina* and permitted successful identification of the parasitic status of tsetse flies without dissection. This should enable to analyse interactions between different *Trypanosoma* species in a same *Glossina.*

13545. **Simo, G., Asonganyi, T., Nkinin, S.W., Njiokou, F. & Herder, S., 2006**. High prevalence of *Trypanosoma brucei gambiense* group 1 in pigs from the Fontem sleeping sickness focus in Cameroon. *Veterinary Parasitology*, **In Press, Corrected Proof.**

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To understand the importance of domestic pigs in the epidemiology of human trypanosomiasis, PCR was used to identify trypanosome populations in 133 pigs from the Fontem sleeping sickness focus of Cameroon. The results from this study show that 73.7 percent (98/133) of pigs from the Fontem area carry at least one trypanosome species. *Trypanosoma vivax, T. brucei s.l.* and *T. congolense* forest were found in 34.6 percent (46/133), 40.0 percent (53/133) and 46.0 percent (61/133) of the pigs respectively. *T. simiae* and *T. congolense* savannah were not identified in these animals. The use of repeated DNA sequences detected *T. b. gambiense* group 1 in 14.8 percent (15/101) of the pigs. Such pigs can be possible reservoir hosts for *T. b. gambiense* group 1 and contribute to the maintenance of the disease in the area. Mixed infections were revealed in 35.3 percent (47/133) of the pigs. Furthermore, we observed that under natural conditions, 52.4 percent (11/21) of the pigs from the Fontem focus carry mixed infections with *T. b. gambiense* group 1. No significant difference was observed between the percentage of *T. b. gambiense* group 1 single and mixed infections, and between the prevalence of this trypanosome in pigs from villages with and without sleeping sickness patients.

13546.**Vreysen, M.J.B., 2005**. Monitoring sterile and wild insects in area-wide integrated pest management programmes.In**:** *Sterile Insect Technique: Principles and*

Practice in Area-Wide Integrated Pest Management. Springer, the Netherlands, pp. 325-361.

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Insect pest control programmes, which integrate the release of sterile insects, can be efficient only if the released insects have an optimal biological quality. Frequent monitoring of the quality of reared insects after being released in the field is an important but often neglected component of area-wide integrated pest management (AW-IPM) programmes that integrate the sterile insect technique (SIT). Parameters of sterile insects, which should be monitored regularly, are sexual competitiveness of the released insects, and related components, e.g. survival, mobility, dispersal characteristics, and spatial occupation of the habitat. A well-balanced monitoring programme will, at any given time, provide essential feedback on the progress being made. This information is prerequisite to efficient implementation of the release and cost-efficient use of sterile insects. The type of monitoring to be done will be determined largely by the particular biology of the target insect species. The most important parameter in relation to the release of sterile insects is the rate of sterility induced in the wild insect pest population; it will provide the best evidence that any observed changes, e.g. in the density of the target insect, are caused by the release of sterile insects.

13547. **Zambia, P., Garcia, E.S. & Radcliff, N.A., 2005**. Gut micro biota and parasite transmission by insect vectors. *Trends in Parasitology*, **21** (12): 568-572.

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In the gut of some insect vectors, parasites ingested with the blood meal decrease in number before coming into contact with host tissues. Many factors could be responsible for this reduction in parasite number but the potentially important role of the large communities of naturally occurring micro-organisms that exist alongside the newly ingested parasites in the vector midgut has been largely overlooked. Some previous reports exist of the inhibition of parasite development by vector gut micro biota and of the killing of *Trypanosoma cruzi* and *Plasmodium* spp. by substances produced by bacteria. Based on this evidence, we believe that the micro biota present in the midgut of vector insects could have important roles as determinants of parasite survival and development in insect vector hosts and, therefore, contribute to the modulation of vector competence for many important diseases.

5. HUMAN TRYPANOSOMIASIS

(a) SURVEILLANCE

[See also **9**: 13470, 13474, 13475, 13491, 13493, 13494]

13548**. Bisoffi, Z., Beltrame, A., Monteiro, G., Arzese, A., Marocco, S., Rorato, G., Anselmi, M. & Viale, P., 2005.** African trypanosomiasis *gambiens*e, Italy. *Emerging Infectious Diseases,* **11** (11): 1745-1747.

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African trypanosomiasis caused by *Trypanosoma brucei gambiense* has not been reported in Italy. We report 2 cases diagnosed in the summer of 2004. Theses cases suggest an increased risk for expatriates working in trypanosomiasis-endemic countries. Travel medicine clinics should be increasingly aware of this potentially fatal disease.

13549. **Camara, M.K., Kaba, D., KagbaDouno, M., Sanon, J. R., Ouendeno, F. F. & Solano, P., 2005**. Human African trypanosomiasis in a mangrove zone in the Republic of Guinea: epidemiological and clinical characteristics in two adjacent outbreak areas. *Médecine Tropicale,* **65** (2): 155-161.

Programme National de Lutte contre la Trypanosomose Humaine Africaine, Conakry, Guinee.

A study was conducted during January-February 2002 in two adjacent areas in the coastal mangrove forest of Guinea to screen for information on human African trypanosomiasis (HAT) and compare the clinical and epidemiological features seen in these areas with those seen in the Ivory Coast. 91 of 9637 subjects examined were confirmed as having HAT by parasitological testing. Five cases were confirmed in patients in treatment centres. Of the first 57 cases of HAT admitted for treatment, 29 subjects responded to a clinical and epidemiological questionnaire and had a thorough clinical examination. Most patients were workers in farming, fishing or salt extraction. 98 percent of patients were from the native Soussou population. Study of clinical aspects showed a high prevalence (97 percent) of cervical adenopathy. 5 percent of patients had meningoencephalitis.

13550. **Courtin, F., Dupont, S., Zeze, D.G., Jamonneau, V., Sane, B., Coulibaly, B., Cuny, G. & Solano, P., 2005**. Human African trypanosomiasis: urban transmission in the focus of Bonon (Cote d'Ivoire). *Tropical Medicine and International Health,* **10** (4): 340-346.

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Human African trypanosomiasis (HAT) is a vector-borne parasitic disease which has often been considered a rural disease. Population increases in African countries have entailed the spread of urban centres, creating favourable conditions for the appearance of new epidemiological conditions. In Cote d'Ivoire, HAT transmission has been described in the surroundings of towns such as Daloa or Sinfra. In the focus of Bonon, located in central-western Cote d'Ivoire, a medical survey detected 96 patients. The sites visited by the patients every day were geo-referenced and the routes between them recorded. In parallel, an entomological survey of the patients' daily locations enabled the collection of data on the

vector. In Bonon, we observed urban cases and tsetse (*Glossina palpalis*) feeding on men. *Trypanosoma brucei gambiense* was identified in both man and vector; thus all conditions for possible intra-urban trypanosomosis transmission were met. The consequences of this are discussed regarding the problem of diffusion of the disease.

13551. **Courtioux, B., Bisser, S., M'Belesso, P., Ngoungou, E., Girard, M., Nangouma, A., Josenando, T., Jauberteau-Marchan, M.O. & Bouteille, B., 2005.** Dot enzyme-linked immunosorbent assay for more reliable staging of patients with human African trypanosomiasis. *Journal of Clinical Microbiology,* **43**(9):4789-95.

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Human African trypanosomiasis (HAT) or sleeping sickness is a disease characterized by a hemolymphatic stage 1 followed by a meningoencephalitic stage 2 which is fatal without specific treatment. Furthermore, due to the toxicity of drugs used to treat stage 2 (mainly melarsoprol) accurate staging is required. Current criteria employed during field surveys are not sensitive enough for precise staging. Anti-neurofilament (anti-NF) and antigalactocerebrosides (anti-GalC) antibodies have been identified in cerebrospinal fluid (CSF) as potential markers of central nervous system (CNS) involvement. We describe a dot enzyme-linked immunosorbent assay (dot-ELISA) to detect anti-GalC and anti-NF antibodies and its value in staging. NF- and GalC-dotted nitrocellulose strips were first developed in our laboratory. They were then evaluated in Angola and Central African Republic on 140 CSF samples. Compared to our staging criteria (i.e., CSF cell count >=20 cells/ micro l, CSF immunoglobulin M concentration >=100 mg/liter, and/or the presence of trypanosomes in the CSF), combined detection of both CSF anti-NF and CSF anti-GalC by dot-ELISA showed 83.2 percent sensitivity and 100.0 percent specificity. Dot-ELISA could be a useful test to diagnose CNS involvement in HAT in the less-equipped laboratories or in the field situation and to improve patient treatment.

13552. **Legros, F., Ancelle, T. & Anofel, 2006**. African human trypanosomiasis: inventory of imported cases observed in France, 1980-2004. *Bulletin Epidemiologique* **7**: 57-59.

Hebdomadaire Institut de Veille Sanitaire, Saint-Maurice, France.

Among 50 laboratories represented in the Anofel network in France, 46 responded to the inventory study and of these, 13 reported at least one case of imported African human trypanosomiasis. During 1980-2004, 26 cases were reported: 24 caused by *Trypanosoma gambiense* and 2 by *T. rhodesiense*. The incidence of the disease among travellers to Africa was estimated at 1.2 cases per million travellers. Among the 26 cases, 18 were male and 8 female; ages ranged from 4 to 62 years (mean age 34.2 years). 15 patients were of African origin and 11 were of European origin. More than half of the patients were infected in countries bordering the Gulf of Guinea. The two cases of *T. rhodesiense* were observed in subjects who were posted in Rwanda in 1993. The delay in diagnosis, known for 14 patients, ranged from 1 week to 1 year in patients of European origin and from 5 months to 7 years in patients of African origin. Among 23 cases that were clinically documented, 8 presented a

blood-lymphatic form and 15 presented with neurological form. 18 patients were cured; three patients had neurological sequelae and two patients died.

13553. **Lutumba, P., Robays, J., Miaka, C., Kande, V**. The efficiency of different detection strategies of human African trypanosomiasis by *T. b. gambiense*. *Tropical Medicine and International Health,* **10** (4): 347-356.

Programme National de Lutte contre la Trypanosomiase Humaine Africaine, Kinshasa, République Démocratique du Congo.[plutumba@itg.be].

Population screening for human African trypanosomiasis (HAT) is often based on a combination of two screening tests: lymph node palpation (LN) and card agglutination test for trypanosomiasis (CATT). This decision analysis compared the efficiency of three alternative detection strategies: screening by LN only, CATT only and their combination (LN and CATT). An HAT detection strategy was defined as the sequence of screening and confirmation. Efficacy was evaluated in terms of lives saved. The cost of screening and confirmation tests was estimated in USD. The different parameters in the decision tree were based on published literature and observations of the HAT control programme in the Democratic Republic of Congo. A sensitivity analysis was carried out on those parameters subject to uncertainty. The cost-effectiveness of a detection strategy based on CATT was USD 125 per life saved, compared with USD 517 for LN and USD 452 for the combined. Marginal cost to add LN to CATT only was between USD 1,225 and USD 5,000 per life saved. Sensitivity analysis shows that these results are robust to variation. The CATT strategy was the most efficient. None of the strategies was able to avoid more than 60 percent of HAT deaths. This moderate efficacy is due to the low sensitivity of the confirmatory (diagnostic) tests. Substantial efficiency gains can be obtained by adopting a CATT only strategy and resources can be better allocated to more sensitive confirmatory tests or to increasing the coverage of populations at risk.

(b) PATHOLOGY AND IMMUNOLOGY

[See also **29**: nos.13471, 13482, 13488, 13492]

13554. **Bisser, S., Ouwe-Missi-Oukem-Boyer, O.N., Toure, F.S., Taoufiq, Z., Bouteille, B., Buguet, A. & Mazier, D., 2006.** Harbouring in the brain: A focus on immune evasion mechanisms and their deleterious effects in malaria and human African trypanosomiasis. *International Journal for Parasitology,* **36***(5): 529-540.*

Centre International de Recherches Médicales de Franceville, Unité de parasitologie médicale, BP 769 Franceville, Gabon.

Malaria and human African trypanosomiasis represent the two major tropical vector-transmitted protozoan infections, displaying different prevalence and epidemiological patterns. Death occurs mainly due to neurological complications which are initiated at the blood-brain barrier level. Adapted host-immune responses present differences but also similarities in blood-brain barrier/parasite interactions for these diseases: these are the focus

of this review. We describe and compare parasite evasion mechanisms, the initiating mechanisms of central nervous system pathology and major clinical and neuropathological features. Finally, we highlight the common immune mediated mechanisms leading to brain involvement. In both diseases neurological damage is caused mainly by cytokines (interferon-gamma, tumour necrosis factor-alpha and IL-10), nitric oxide and endothelial cell apoptosis. Such a comparative analysis is expected to be useful in the comprehension of disease mechanisms, which may in turn have implications for treatment strategies.

13555. **Blum, J., Beck, B.R., Brun, R. & Hatz, C., 2005**. Clinical and serologic responses to human 'apathogenic' trypanosomes. *Transactions of the Royal Socity of Tropical Medicine and Hygiene,* **99** (10): 795-797.

Swiss Tropical Institute, Department of Medical and Diagnostic Services, Basel, Switzerland. [johannes.blum@unibas.ch].

We describe a female patient suffering from a benign self-healing febrile disease with strongly positive serology for *Trypanosoma brucei*. The patient showed a clinical picture with similarities to that of human African trypanosomiasis (HAT). HAT due to *T. b. gambiense* and *T. b. rhodesiense* were ruled out. We performed serologic tests because the patient was worried about HAT after receiving tsetse bites. The possibilities of an infection with human 'apathogenic' trypanosomes such as *T. b. brucei*, *T. congolense* or *T. vivax* are discussed.

13556. **Blum, J., Schmid, C. & Burri, C., 2006**. Clinical aspects of 2,541 patients with second stage human African trypanosomiasis. *Acta Tropica,* **97** (1): 55-64.

Swiss Tropical Institute, Medical and Diagnostic Services, Socinstrasse 57, 4002 Basel, Switzerland. [johannes.blum@unibas.ch].

The clinical symptoms and signs of patients with second stage HAT are described for a large cohort of patients treated in a prospective multicentre, multinational study. Special emphasis is given to the influence of disease stage (duration, number of WBC in CSF) and patient age to the clinical picture. Even though the frequencies of symptoms and signs are highly variable between centres, the clinical picture of the disease is similar for all countries. Headache (78.7 percent), sleeping disorder (74.4 percent) and lymphadenopathy (56.1 percent) are the most frequent symptoms and signs and they are similar for all stages of the disease. Lymphadenopathy tends to be highest in the advanced second stage (59.0 percent). The neurological and psychiatric symptoms increase significantly with the number of WBC in the CSF indicating the stage of progression of the disease. Pruritus is observed in all stages and increases with the number of WBC in CSF from 30 to 55 percent. In children younger than 7 years, lymphadenopathy is less frequently reported (11.8-37.3 percent) than in older children or adults (56.4-61.2 percent). Fever is most frequently reported in children between 2 and 14 years of age (26.1-28.7 percent) and malnutrition is significantly more frequently observed in children of all ages (43-56 percent) than in adults (23.5 percent).

13557. **Courtin, D., Argiro, L., Jamonneau, V., N'Dri, L., N'Guessan, P., Abel, L., Dessein, A., Cot, M., Laveissiere, C. & Garcia, A., 2006.** Interest of tumor

necrosis factor-alpha -308 G/A and interleukin-10 -592 C/A polymorphisms in human African trypanosomiasis. *Infection, Genetics and Evolution,* **6** (2): 123-129.

Institut de Recherche pour le Développement (IRD), Unité de recherche 010: Santé de la mère et de l'enfant en milieu tropical, BP 1386, CP 18524 Dakar, Sénégal.

This study aimed to determine whether single nucleotide polymorphisms (SNPs) within tumour necrosis factor-alpha (TNF) and interleukin-10 (IL10) promoters and genes are associated with human African trypanosomiasis (HAT). The polymorphisms used in the analysis were TNF-308 G/A, TNF-238 G/A, TNF-1031 T/C, TNF+488 G/A, IL10-1082 G/A and IL10-592 C/A. A familial case-control sample of 277 individuals (102 cases and 175 parents) and a matched case-control group of 225 subjects (88 cases and 137 unrelated controls) were gathered together in this study. A conditional logistic regression was used to test for association. We carried out this analysis in the overall population and after stratification by time of exposure, age and ethnic group. Our results show that in the overall population, and after stratification by time of exposure, the IL10-592 A allele is associated with a lower risk of disease, suggesting the possibility of a protective effect. After stratification by time of exposure, individuals homozygous for the SNP located in the TNF-308 promoter were shown to present a higher risk of developing the disease early after exposure. Our study shows that TNF-308 G/A and IL10-592 C/A SNPs are polymorphisms of interest in the investigation of the genetic susceptibility to human African trypanosomiasis. Larger studies are currently underway to confirm these results.

13558. **Ehrhardt, S., Lippert, U., Burchard, G.D. & Sudeck, H., 2006**. Orchitis as an unusual manifestation of human African trypanosomiasis. *Journal of Infection,* **52**(1):e31-e33..

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African trypanosomiasis is a re-emerging disease. We report the case of an African patient whose predominant symptom was infertility due to a granulomatous orchitis. The patient was afebrile and had not been in Africa for years. Lymphadenopathy and splenomegaly led us eventually to the diagnosis of sleeping sickness. After treatment with suramin his spermiogram returned to normal. Sleeping sickness evolves through clinically different stages and leads to death if left untreated. The disease may, however, present a clinically extremely variable picture and may thus be difficult to diagnose.

13559. **Kennedy, P.G., 2006**. Human African trypanosomiasis-neurological aspects. *Journal of Neurology*, **253**(4): 411-416.

Department of Neurology Division of Clinical Neurosciences, University of Glasgow Southern General Hospital Institute of Neurological Sciences, Glasgow G51 4TF, Scotland, UK. [P.G.Kennedy@clinmed.gla.ac.uk.].

Human African Trypanosomiasis (HAT), which is also known as sleeping sickness, is a major cause of death and disability in 36 countries in sub-Saharan Africa. The disease is caused by the protozoan parasite of the *Trypanosoma* genus which is transmitted by the bite of the tsetse fly. The two types of HAT, the East African form due to *Trypanosoma b.rhodesiense* (*T. b. rhodesiense*) and the West African form due to *T. b. gambiense*, differ in their tempo of infection but in both cases the disease is always fatal if untreated. As well as multiple systemic features seen in the early (haemolymphatic) stage of disease, the late (encephalitic stage) stage, is associated with a wide range of neurological features including neuropsychiatric, motor and sensory abnormalities. Accurate staging of the disease is absolutely essential because of the potentially fatal complications of melarsoprol treatment of late-stage disease, the most important of which is a severe post-treatment reactive encephalopathy (PTRE) the pathogenesis of which is not fully understood. However, there is not a universal consensus as to how late stage disease should be diagnosed using CSF criteria, and this has been very problematic in HAT. A more recent alternative drug for late stage gambiense disease is eflornithine (DFMO). There is a pressing need for a non-toxic oral drug for both early and late stage disease that would obviate many of the problems of staging, and various possible strategies to achieve this goal are currently underway. However, control of the disease will also require more effective measures of reducing man/fly contact and also the allocation of much greater financial and infrastructural resources than are currently available in Africa.

13560. **Kennedy, P.G.E., 2006**. Diagnostic and neuropathogenesis issues in human African trypanosomiasis. *International Journal for Parasitology,* **36**(5):505-512.

Division of Clinical Neurosciences, Department of Neurology, Institute of Neurological Sciences, Southern General Hospital, University of Glasgow, Glasgow G51 4TF, Scotland, UK.

Human African trypanosomiasis, also known as sleeping sickness, is caused by protozoan parasites of the genus *Trypanosoma*, and is a major cause of human mortality and morbidity. The East African and West African variants, caused by *Trypanosma brucei rhodesiense* and *Trypanosoma brucei gambiense*, respectively, differ in their presentation but the disease is fatal if untreated. Accurate staging of the disease into the early haemolymphatic stage and the late encephalitic stage is critical as the treatment for the two stages is different. The only effective drug for late stage disease, melarsoprol, which crosses the blood-brain barrier, is followed by a severe post-treatment reactive encephalopathy in 10 percent of cases of which half die. There is no current consensus on the diagnostic criteria for CNS involvement and the specific indications for melarsoprol therapy also differ. There is a pressing need for a quick, simple, cheap and reliable diagnostic test to diagnose Human African trypanosomiasis in the field and also to determine CNS invasion. Cerebrospinal fluid and plasma analyses in patients with Human African trypanosomiasis have indicated a role for both pro-inflammatory and counter-inflammatory cytokines in determining the severity of the meningoencephalitis of late stage disease, and, at least in *T. b. rhodesiense* infection, the balance of these opposing cytokines may be critical. Rodent models of Human African trypanosomiasis have proved very useful in modelling the post-treatment reactive encephalopathy of humans and have demonstrated the central role of astrocyte activation and cytokine balances in determining CNS disease. Such animal models have also allowed a

greater understanding of the more direct mechanisms of trypanosome infection on CNS function including the disruption of circadian rhythms, as well as the immunological determinants of passage of trypanosomes across the blood-brain barrier.

13561. **Lejon, V. & Buscher, P., 2005**. Review Article: cerebrospinal fluid in human African trypanosomiasis: a key to diagnosis, therapeutic decision and post-treatment follow-up. *Tropical Medicine and International Health,* **10** (5): 395-403.

Department of Parasitology, Institute of Tropical Medicine, Antwerpen, Belgium. [vlejon@itg.be].

Human African trypanosomiasis is a lethal parasitic infection with neurological involvement. Examination of the cerebrospinal fluid (CSF) plays an essential role in diagnosis, selection of treatment and post-treatment follow-up. This paper reviews clinical presentation, diagnosis and treatment of the disease, with emphasis on CSF characteristics and interpretation of the CSF results for therapeutic decision and post-treatment follow-up.

13562. **MacLean, L., Odiit, M. & Sternberg, J.M., 2006**. Intrathecal cytokine responses in *Trypanosoma brucei rhodesiense* sleeping sickness patients. *Transactions of the Royal Society of tropical Medicine and Hygiene,* **100** (3): 270-275.

Department of Zoology, School of Biological Sciences, University of Aberdeen, Aberdeen AB24 2TZ, UK.

Intrathecal cytokine levels and blood-cerebrospinal fluid (CSF) barrier function were studied in 91 *Trypanosoma brucei rhodesiense*-infected patients. The CSF concentration of the cellular immune activation marker neopterin and the cytokines IL-6 and IL-10 were increased over control and post-treatment levels in all patients, with maximal levels observed in late-stage (meningoencephalitic) individuals. Analysis of CSF/serum concentration quotients indicated that IL-10 and neopterin were derived from central nervous system synthesis in at least 25 percent of the patients. Blood-CSF barrier dysfunction occurred in 64 percent of late-stage patients but not in early-stage patients. While the high level of neopterin observed in the late-stage patient CSF is indicative of widespread cellular activation, the increased levels of IL-6 and IL-10 suggest that counter-inflammatory cellular responses may be important in the regulation of neuropathogenesis in late-stage human African trypanosomiasis.

13563. **Power, C. & Johnson, R.T., 2005**. Emerging neurological infections. In: *Neurological Disease and Therapy.* Taylor and Francis, Boca Raton, USA, xxi + 505 pp.

In this book, the basis for emergence or resurgence of neurological infections is emphasized together with recognition of the disease and its pathogenesis. The book contains chapters from authors selected for their internationally recognized expertise in areas relating to emerging diseases and specific neurological infections. The spectrum of topics covered ranges from determinants of emerging infections to new pathogens, new locations and disease manifestations of infectious neurological disease, drug resistance and potential

interventions. Part I discusses the origins of and environmental factors associated with emergence of new infections. Part II examines new human pathogens, concentrating on Nipah virus, prion diseases and neurotropic viruses causing haemorrhagic fevers. Part III discusses the spread of pathogens into new geographic domains and includes chapters dealing with cerebral malaria, rabies, neurocysticercosis, borrelial infections, flaviviruses including West Nile and Japanese encephalitis viruses and African trypanosomiasis. Part IV focuses on new human diseases caused by previously recognized pathogens (including enterovirus 71 encephalitis, campylobacteriosis, Guillain-Barre syndrome, human herpes virus 6 infection and retroviral infections). Part V reviews the clinical aspects and mechanisms of drug resistance of herpes simplex virus, human immunodeficiency virus type 1 and nosocomial infections. Part VI addresses potential interventions including vaccine development and priority strategies.

13564. **Walker, M., Kublin, J.G. & Zunt, J.R., 2006**. Parasitic central nervous system infections in immunocompromised hosts: malaria, microsporidiosis, leishmaniasis, and African trypanosomiasis. *Clinical Infectious Diseases,* **42**(1): 115-125.

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Immunosuppression associated with HIV infection or following transplantation increases susceptibility to central nervous system (CNS) infections. Because of increasing international travel, parasites that were previously limited to tropical regions pose an increasing infectious threat to populations at risk for acquiring opportunistic infection, especially people with HIV infection or individuals who have received a solid organ or bone marrow transplant. Although long-term immunosuppression caused by medications such as prednisone likely also increases the risk for acquiring infection and for developing CNS manifestations, little published information is available to support this hypothesis. In an earlier article published in *Clinical Infectious Diseases*, we described the neurologic manifestations of some of the more common parasitic CNS infections. This review will discuss the presentation, diagnosis, and treatment of the following additional parasitic CNS infections: malaria, microsporidiosis, leishmaniasis, and African trypanosomiasis.

13565. **Walker, M.D. & Zunt, J.R., 2005.** Neuroparasitic infections: cestodes, trematodes, and protozoans. *Seminars in Neurology*, **25** (3): 262-277.

Department of Neurology, University of Washington School of Medicine, Seattle, Washington 98104, USA.

Parasitic infection of the nervous system can produce a variety of symptoms and signs. Because symptoms of infection are often mild or nonspecific, diagnosis can be difficult. Familiarity with basic epidemiological characteristics and distinguishing radiographic findings can increase the likelihood of detection and proper treatment of parasitic infection of the nervous system. This article discusses the clinical presentation, diagnosis, and treatment for some of the more common infections of the nervous system caused by cestodes, trematodes and protozoans: *Echinococcus* spp., *Spirometra* spp. (sparganosis), *Paragonimus*

spp., *Schistosoma* spp., *Trypanosoma* spp., *Naegleria fowlerii*, *Acanthamoeba histolytica*, and *Balamuthia mandrillaris*.

(c) TREATMENT

[See also **29**: nos. 13469, 13484, 13485]

13566. **Balasegaram, M.D., Dejene, S., Tinnemann, P., Perkins, S. & Davidson, R., 2006**. Examples of tropical disease control in the humanitarian medical programmes of MSF and Merlin. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **100** (4): 327-334.

Médecine Sans Frontières UK, 67-74 Saffron Hill, London EC1N 8QX, England.

Humanitarian medical programmes in the tropics have the opportunity to provide beacons of good practice. The use of modern drugs and diagnostics, a lack of bureaucracy, adequate budgets, motivated staff and well-functioning supply lines all contribute to the success of this approach. At a joint meeting of the Royal Society of Tropical Medicine, the London School of Hygiene and Tropical Medicine, Medecins Sans Frontieres and Merlin, new data were presented on the outcomes of recent humanitarian programmes to control malaria (Ethiopia), human African trypanosomiasis (south Sudan), Lassa fever (Sierra Leone) and tuberculosis (Tomsk, former USSR)

13567. **Buguet, A., Bisser, S., Josenando, T., Chapotot, F. & Cespuglio, R., 2005**. Sleep structure: a new diagnostic tool for stage determination in sleeping sickness. *Acta Tropica* **93**(1): 107-117.

EA 3734 Neurobiologie des états de Vigilance, and IFR-19, Université Claude-Bernard-Lyon 1, 8 Avenue Rockefeller, 69373 Lyon Cedex 08, France. [a.buguet@free.fr].

Human African trypanosomiasis (HAT), due to the transmission of *Trypanosoma brucei*, (*T. b.*), *T.b. gambiense* and *T. b. rhodesiense* by tsetse flies, is re-emerging in inter-tropical Africa. It evolves from the hemolymphatic Stage I to the meningo-encephalitic Stage II. The latter is generally treated with melarsoprol, an arseniate provoking often a deadly encephalopathy. A precise determination of the HAT evolution stage is therefore crucial. Stage II patients show: (i) a deregulation of the 24-h distribution of the sleep-wake alternation; (ii) an alteration of the sleep structure, with frequent sleep onset rapid eye movement (REM) periods (SOREMPs). Gambian HAT was diagnosed in eight patients (four, Stage II; three, Stage I; one, "intermediate" case) at the trypanosomiasis clinic at Viana (Angola). Continuous 48-h polysomnography was recorded on Oxford Medilog 9000-II portable systems before and after treatment with melarsoprol (Stage II) or pentamidine (Stage I and "intermediate" stage). Sleep traces were visually analyzed in 20-s epochs using the PRANA software. Stage II patients showed the complete sleep-wake syndrome, partly reversed by melarsoprol 1 month later. Two Stage I patients did not experience any of these alterations. However, the "intermediate" and one Stage I patient exhibited sleep disruptions

and/or SOREMPs, persistent after pentamidine treatment. Polysomnography may represent a diagnostic tool to distinguish the two stages of HAT. Especially, SOREMPs appear shortly after the central nervous system invasion by trypanosomes. The reversibility of the sleep-wake cycle and sleep structure alterations after appropriate treatment constitutes the basis of an evaluation of the healing process.

13568**. Buckner, F.S., Eastman, R.T., Yokoyama, K., Gelb, M.H. & Van Voorhis, W.C., 2005**. Protein farnesyl transferase inhibitors for the treatment of malaria and African trypanosomiasis. *Current Opinion in Investigational Drugs,* **6** (8): 791-797.

Department of Medicine, University of Washington, Seattle, WA 98125-7185, USA.

Protein farnesyl transferase inhibitors (PFTIs) have been developed as oncology therapeutics but recent studies have supported the use of PFTIs for the treatment of eukaryotic pathogens. Data supporting PFTIs for the treatment of African sleeping sickness caused by *Trypanosoma brucei* spp. and for the therapy of malaria caused by *Plasmodium* spp is reviewed. Protein prenylation in *T. brucei* and *P. falciparum* has been studied using a variety of techniques, including recombinant and native enzyme assays. Studies have demonstrated farnesylation and geranylgeranylation in these parasites. A variety of PFTIs have shown growth inhibition activity and killing of *T. brucei* and *P. falciparum*, yet not all mammalian PFTIs are active on parasitic PFTs. Protein farnesyl transferase as well as protein geranylgeranyl transferase type II enzymatic activities have been demonstrated in *T brucei* and *P. falciparum*, but protein geranylgeranyl transferase type I activity may be lacking from these parasites, perhaps explaining the extreme sensitivity of these organisms to PFTIs compared with mammalian cells. Given that PFTIs are relatively non-toxic in short-term administration to humans, PFTIs specific to parasites are not required for therapy. Thus, the challenge in PFTI drug development is not to identify selective antiparasite compounds, but to identify compounds with sufficient potency and pharmacokinetic properties to produce satisfactory drugs for malaria and African sleeping sickness.

13569. **Croft, S.L., Barrett, M.P. & Urbina, J.A., 2005**. Chemotherapy of trypanosomiases and leishmaniasis. *Trends in Parasitology*, **21** (11): 508-512.

Drugs for Neglected Diseases Initiative, 1 Place Saint-Gervais, CH-1201 Geneva, Switzerland. [scroft@dndi.org].

New formulations, therapeutic switching of the established drugs amphotericin B and paromomycin, and the serendipitous discovery of miltefosine have markedly improved leishmaniasis chemotherapy in the past 21 years. The situation for the two trypanosomiases has been less encouraging. Apart from the introduction of eflornithine for the treatment of late-stage human African trypanosomiasis, with its serious limitations in terms of cost and difficulty of administration, no new drugs have been incorporated into the chemotherapeutic arsenal in the past 25 years, despite important advances in knowledge of the biology of the etiological agents and the pathophysiology of these diseases. In the case of Chagas' disease, several classes of compound that target the validated biochemical pathways of the parasite

(e.g. inhibitors of sterol biosynthesis and cysteine proteases) are in the pipeline. With the availability of complete genome sequences for all three pathogens, and methods for rapid validation of targets, it is hoped that much-needed amelioration will occur soon. Financial constraints continue to represent a major hurdle to drug development. However, the appearance of not-for-profit product-development partnerships offers a new paradigm for bringing new drugs to patients.

13570. **Bukachi, S.A., Nyamwaro, S.O., Matete, G.O. & Karuga, J.W., 2005**. Capacity of community-based organisations to disseminate sleeping sickness information. *East African Medical Journal*, **82** (8): 409-413.

Epidemiology Division, Kenya Trypanosomiasis Research Institute, P.O. Box 399 Busia, Kenya.

To assess the capacity of established community based organisations (CBOs) to disseminate information on sleeping sickness control, a participatory interview process was administered to randomly selected CBOs in the tsetse and trypanosomosis endemic area of Busia district, Western Kenya. The results indicated that community based organisations especially women groups and farmer field schools that are internally initiated have the potential to contribute greatly to sustainable sleeping sickness dissemination strategies. The study indicated a mean reach of between 400-600 persons per day, but with a range of up to 1,000 persons per day. In conclusion, internally initiated women groups may be the best options for targeting health education programmes with the aim of ensuring sustained community participation.

13571. **Joshi, P.P., Chaudhari, A., Shegokar, V.R., Powar, R.M., Dani, V.S., Somalwar, A.M., Jannin, J. & Truc, P., 2006**. Treatment and follow-up of the first case of human trypanosomiasis caused by *Trypanosoma evansi* in India. *Transactions of the Royal Socity of Tropical Medicine and Hygiene,* **In Press, Corrected Proof**.

Department of Medicine, Government Medical College, Nagpur, India.

The first reported human case of trypanosomiasis caused by *Trypanosoma evansi* was treated using suramin. Patient follow-up indicates that the drug and specific regimen used were well tolerated. Clinical, serological and parasitological investigations at 6 months indicate complete cure of the patient. Suramin should be considered in the treatment of other cases of human *T. evansi* infection, if they occur.

13572. **Kibona, S.N., Matemba, L., Kaboya, J.S. & Lubega, G.W., 2006**. Drug-resistance of *Trypanosoma b. rhodesiense* isolates from Tanzania. *Tropical Medicine and International Health*, **11** (2): 144-155.

National Institute for Medical Research, Tabora, Tanzania.

To determine the drug resistance of *Trypanosoma brucei rhodesiense* strains isolated from sleeping sickness patients in Tanzania, 35 *T. b. rhodesiense* strains were screened in the mouse model for sensitivity to melarsoprol (1.8, 3.6 and 7.2 mg/kg), diminazene aceturate

(3.5, 7 and 14 mg/kg), suramin (5, 10 and 20 mg/kg) and isometamidium (0.1, 1.0 and 2 mg/kg). Thirteen isolates suspected to be resistant were selected for further testing *in vitro* and *in vivo*. From the *in vitro* testing, IC50 values were determined by short-term viability assay, and MIC values were calculated by long-term viability assay. For *in vivo* testing, doses higher than those in the initial screening test were used. The results showed that two *T. b. rhodesiense* stocks expressed resistance *in vivo* to melarsoprol at 5 mg/kg and at 10 mg/kg. These strains had high IC50 and MIC values consistent with those of the melarsoprol-resistant reference strain. Another isolate relapsed after treatment with 5 mg/kg of melarsoprol although it did not appear resistant *in vitro*. One isolate was resistant to diminazene at 14 mg/kg and another was resistant at both 14 and 28 mg/kg of diminazene. These two isolates had high IC50 values consistent with the diminazene-resistant reference strain. Two isolates relapsed at a dose of 5 mg/kg of suramin, although no isolate appeared resistant in the *in vitro* tests. Two isolates were resistant to isometamidium at 1.0 mg/kg and had higher IC50 values. Two isolates were cross-resistant to melarsoprol and diminazene and one isolate was cross-resistant to suramin and isometamidium. The reduced susceptibility of *T. b. rhodesiense* isolates to these drugs strongly indicates that drug resistance may be emerging in north-western Tanzania.

13573. **Louis, F.J. & Simarro, P.P., 2005**. Rough start for the fight against sleeping sickness in French equatorial Africa. *Médecine Tropicale* **65**(3): 251-257.

Travail de l'Organisation mondiale de la santé, CDS/CDE/ZFK, Yaoundé, Cameroun.

This article describes the initiation of strategies for the treatment and prevention of sleeping sickness (trypanosomiasis) in man in equatorial Africa, following the colonization of this region by the French. Sleeping sickness in the pre-colonial era is described, as well as the epidemiology of trypanosomiasis, and the establishment of colonial programs to study the disease. The prophylaxis of trypanosomiasis is also discussed.

13574. **Pepin, J. & Mpia, B., 2005**. Trypanosomiasis relapse after melarsoprol therapy, Democratic Republic of Congo, 1982-2001. *Emerging Infectious Diseases,* **11** (6): 921-927.

Centre for International Health and Department of Microbiology and Infectious Diseases, University of Sherbrooke, Sherbrooke, Quebec, Canada.

Recently, a high proportion of patients with late-stage *Trypanosoma brucei gambiense* trypanosomiasis, who had been treated with melarsoprol in some disease-endemic areas, subsequently relapsed. To determine whether the frequency of postmelarsoprol relapses increased over time, we reviewed data from 2,221 trypanosomiasis patients treated with melarsoprol during this period in Nioki, Democratic Republic of Congo, from 1982 to 2001. The frequency of relapses was 5.6 percent(31/553), 6.8 percent(35/512), 4.5 percent(18/398), 11.4 percent(34/299), and 5.0 percent(17/343) for those treated from 1982 to 1985, 1986 to 1989, 1990 to 1993, 1994 to 1997, and 1998 to 2001, respectively. The higher frequency of relapses in 1994 to 1997 was associated with an incremental dosage regimen of melarsoprol. In multivariate analysis, after adjustment for treatment regimen, sex, residence, and

trypanosomes in cerebrospinal fluid, postmelarsoprol relapses did not increase in Nioki, perhaps because 1) little drug pressure exists; 2) subtherapeutic doses have rarely been administered; 3) little potential exists for the preferential transmission of melarsoprol-resistant strains.

13575. **Pepin, J. & Mpia, B., 2006**. Randomized controlled trial of three regimens of melarsoprol in the treatment of *Trypanosoma brucei gambiense* trypanosomiasis. *Transactions of the Royal Socity of Tropical Medicine and Hygiene,* **100** (5): 437-441.

Department of Microbiology and Infectious Diseases and Centre for International Health, University of Sherbrooke, 3001, 12eme Avenue Nord, Sherbrooke, Quebec J1H 5N4, Canada. [jacques.pepin@usherbrooke.ca].

A total of 389 patients with late-stage *Trypanosoma brucei gambiense* trypanosomiasis were enrolled in a randomized controlled trial comparing the efficacy and toxicity of three regimens of melarsoprol: regimen A, 3.6 mg/kg (max. 180 mg) for all i.v. injections, given as three series of three injections separated by 1-week intervals; regimen B, 10 consecutive daily i.v. injections of 2.16 mg/kg; or regimen C, three series of three i.v. injections separated by 1-week intervals, but with graded dosing (1.8, 2.16, 2.52, 2.52, 2.88, 3.24, then 3.6 mg/kg for the last three injections). After treatment, patients were followed with half-yearly lumbar punctures for 2 years. During treatment, convulsions were significantly more common in patients allocated to the graded dosing regimen (7/70 [10.0 percent] vs. 11/319 [3.4 percent], P = 0.03). The 2-year probability of relapse was 5.4 percent, 7.4 percent and 25.0 percent for regimens A, B and C respectively (P < 0.001). The new regimen of 10 daily injections of melarsoprol was as effective and had the same toxicity as the traditional regimen of three series of three injections at the full dose. Graded dosing, which was associated with a much lower efficacy and more frequent convulsions, should be abandoned.

13576. **Schliebs, W., 2006**. Sleeping sickness: PEX and drugs. *Biochimica Biophysica Acta,* **1763** (1): 4-5.

Institute fur Physiologische Chemie, Abt. Systembiochemie, Ruhr-Universitat Bochum, D-44780, Germany. [wolfgang.schliebs@rub.de].

Finding new ways in the treatment of fatal parasitic diseases like the human sleeping sickness is a major challenge of biomedical research. The growing body of knowledge about the biogenesis of the glycosome, a peroxisome-related organelle of trypanosomes, might allow defining novel targets for drug development.

13577. **te Pas, M.F., Claes, F. & Buscher, P., 2005**. Fast, simple, and low-cost test for drug-resistant pathogens. *Lancet,* **366** (9484): 437-438.

Wageningen University and Research Centre, Animal Sciences Group, ID-Lelystad, Division of Animal Resource Development, Animal Genomics Group, 8200 AB Lelystad, Netherlands. [epas@wur.nl].

13578. **Welburn, S.C., Coleman, P.G., Maudlin, I., Fevre, E.M., Odiit, M. & Eisler, M.C., 2006**. Crisis, what crisis? Control of Rhodesian sleeping sickness. *Trends in Parasitology,* **22** (3): 123-128.

Centre for Infectious Diseases, College of Medicine and Veterinary Medicine, University of Edinburgh, Roslin, Midlothian, EH25 9RG, UK.

There is an urgent need for cost-effective strategies for the sustainable control of *Trypanosoma brucei rhodesiense* (Rhodesian) sleeping sickness, which is a fatal zoonotic disease that has caused devastating epidemics during the past century. Sleeping sickness continues to be controlled by crisis management, using active case detection, treatment and vector control - activities that occur only during major epidemics; during the intervening periods, farmers and communities must fend for themselves. There are several methods for assessing the burden of this disease and there is a series of farmer-led methodologies that can be applied to reduce the burden of human and animal trypanosomiases.

6. ANIMAL TRYPANOSOMIASIS

(a) SURVEY AND DISTRIBUTION

[See also **29**: nos. 13468, 13478, 13504, 13512, 13526, 13528, 13530, 13531, 13532, 13533, 13538, 13539, 13541, 13545]

13579. **Abdalla, M.A.S., Siham, E. S. & Amel, O. B., 2005.** *Trypanosoma vivax* infection in Sudanese cattle in Central Sudan. *Journal of Animal and Veterinary Advances*, **4** (11): 945-948.

Department of Clinical Studies, College of Veterinary Medicine and Animal Production, Sudan University of Science and Technology, P.O. Box 204 Khartoum North, Sudan.

Investigations were conducted during the early dry season in an area about 50 km south of Singa, the capital town of Sennar State, Central Sudan. Reports were received of excessive mortality and abortion affecting dairy cattle at the Sudanese Arab Kenaf Company, situated near Abu Naama village about 50 km south of Singa and 415 km south of Khartoum. The area of the project is 1,000 hectare, where 750 hectares are irrigated. The majority of cattle were of Kenana breed, but a few were crosses of Butana × Kenana and Kenana × Friesian breeds. The cattle were sampled and their blood investigated using parasitological diagnostic methods. A total of 177 cattle were sampled, out of which 89 animals were found to be infected with trypanosomes. The average parasitological prevalence was 50.3 percent. All infected animals were infected with *T. vivax*. The average haematocrit (PCV) of the animals infected with trypanosomes was 20.89±6.39 percent, which was significantly different ($P<0.001$) than the average PCV of the animals that were parasitological negative (27.17±7.5 percent).

13580. **Dede, P.M., Halid, I., Omoogun, G.A., Uzoigwe, N.R., Njoku, C.I., Daniel, A.D. & Dadah, A.J., 2005.** Current tsetse and trypanosomosis situation on Jos Plateau,

Nigeria: Epizootiological factors that may enhance disease transmission and spread. *Revue d' Élevage et de Médecine Vétérinaire des Pays Tropicaux,* **58**(1) 31-55.

CIRAD-EMVT (Departement d'Élevage et de Médecine Vétérinaire du CIRAD), Cachan Cedex, France.

Tsetse and trypanosomosis surveys were carried out in Jos-East, Riyom, Bassa and Bokkos local government areas (LGAs) of Jos Plateau, Nigeria. They followed reports of cases of trypanosomosis that led to the death of several livestock animals in the areas. Biconical and Nitse traps were pitched in suspected tsetse habitats. Also, cattle and sheep from selected native and Fulani herds within the areas surveyed were screened. Altogether 240 tsetse flies were caught, comprising 114 *Glossina tachinoides* and 126 *G. palpalis* palpalis, and revealing an overall apparent density of 4.63 flies /trap /day. Fly dissection showed an overall infection rate of 1.67 percent due to *Trypanosoma brucei* and *T. vivax*. Also, 87 *G. tachinoides* pupae were collected from Bassa and Jos-East LGAs. Other biting flies totaling 1536 were caught (*Stomoxys*, *Tabanus* and *Haematopota*). A total of 1,053 cattle and 65 sheep were screened for trypanosome infection. The hematocrit centrifugation, animal inoculation, and morphological differential techniques were used to determine trypanosome species and prevalence rates. Results revealed a 7.79 percent prevalence rate in cattle due to *T. brucei*, *T. congolense*, *T. vivax,* and *T. theileri*, and a 3.08 percent prevalence rate in sheep due to *T. vivax.* The main factors that may predispose Jos Plateau to tsetse presence and trypanosomosis infection include dry and rainy seasons' cattle migrations across the plateau to and from tsetse infested areas, abundance of other biting flies, changes in climatic conditions and increased human activities. These findings have debunked the protracted notion upholding Jos Plateau to be tsetse and trypanosomosis free; hence the safety of resident and migrant livestock, which unfortunately have increased in recent times, may no longer be guaranteed because of the trypanosomosis risk.

13581. **Dinka, H. & Abebe, G., 2005**. Small ruminants trypanosomosis in the southwest of Ethiopia. *Small Ruminant Research,* **57** (2-3): 239-243.

Alage Agriculture Technical College, Alage, Ethiopia.

A study was conducted in two valleys of the southwest Ethiopia (Didessa and Ghibe valleys) from November 2002 to April 2003 to collect baseline data on the prevalence of trypanosomosis in local breeds of sheep and goats. Blood samples from 533 randomly selected small ruminants of different species, sex and age groups were collected and examined with conventional haematological and parasitological techniques. Among the small ruminants examined during the study period 27 animals (5.1 percent) were infected with trypanosomes. Most of the infections were due to *Trypanosoma congolense* (46.7 percent, 33.3 percent) followed by *T. vivax* (26.7 percent, 25.0 percent) and the rest were due to *T. brucei* (6.7 percent, 8.3 percent) and mixed infections of *T. congolense* and *T. vivax* (13.3 percent, 25.0 percent), *T. brucei* and *T. vivax* (6.7 percent, 8.3 percent) in sheep and goats, respectively. There was no statistically significant difference ($P > 0.05$) in infection between male and female, among age groups in sheep and goats as well as valleys. Infection between sheep and goats showed significant difference between the *morsitans* group (*Glossina*

pallidipes and *G. morsitans submorsitans*) and the p*alpalis* group (*G. fuscipes fuscipes*) and mechanical vectors of trypanosomosis that belong to the *Tabanidae* family were captured in the lowlands of Didessa (1,400-1,780 m above sea level) and Ghibe (1,250-1,700 m above sea level) valleys. The study revealed that trypanosomosis in sheep and goats is an important disease and small ruminants serve as a potential reservoir of infection for other animals.

13582**. Enwezor, F.N.C.S. & Sackey, A. K. B., 2005**. Camel trypanosomosis - a review. *Veterinarski Arhiv*, **75** (5): 439-452.

Camel trypanosomosis (surra), caused by *Trypanosoma evansi*, is the most important single cause of morbidity and mortality in camels. The disease, transmitted non-cyclically by other haematophagus flies is endemic in Africa, Asia and South America, and in addition to camels other species of domesticated livestock are affected. Because of the wide geographic range of surra, its control has attracted international attention, with a focus on formulating and implementing effective strategies aimed at increasing productivity and achieving a decrease in mortality and morbidity. In this review, the clinico-pathological effects of surra are presented, as their understanding may help in the design of effective control. Anaemia appears to be a major component of the pathology of surra. Its development and persistence in the course of the disease induce anoxic conditions which manifest signs of dysfunction in various organs as a result of a fall in tissue pH and vascular damage. This is followed by the release of large quantities of cytoplasmic and mitochondrial enzymes, especially aspartate alanine transferase (AST) and alanine transferase (ALT), among others, into serum, causing further cellular and tissue damage. The net effect associated with the above changes is immunosuppression which later develops and predisposes the animals to other infections and death if untreated. Therefore, emphasis is placed on accurate diagnosis of surra, treatment with effective trypanocidal drugs such as trypan and the use of vector control methods in the control and management of this disease.

13583. **Goossens, B., Mbwambo, H., Msangi, A., Geysen, D. & Vreysen, M., 2006**. Trypanosomosis prevalence in cattle on Mafia Island (Tanzania). *Veterinary Parasitology,* **In Press, Corrected Proof**.

European Food Safety Authority, BSE Unit, Largo N. Palli 5/A, I-43100 Parma, Italy.

During two consecutive surveys (February and August/Sept 2002), a total of 970 cattle from the cattle population of Mafia Island (United Republic of Tanzania) were blood-sampled. All blood samples were microscopically screened for the presence of trypanosomes and a portion of these were checked for antibodies with an Ab-ELISA and for the presence of trypanosomal DNA with PCR. Microscopic evidence of trypanosomes of the *congolense* group (sub-genus *Nannomonas*) was found in 0.8 percent of the animals (8/970) and in two cases the species identified was confirmed by PCR as *Trypanosoma congolense* savannah type. Non-pathogenic *Trypanosoma theileri* were detected in 3.2 percent (31/970) of the samples using the Dark Ground-Buffy Coat (DG-BC) technique. For survey 1 (S1), detection of antibodies (Ab-ELISA) against pathogenic trypanosomes indicated a seroprevalence of 14.2 percent (68/480). Of the samples, either DG positive or with a PCV lower then 25, examined by PCR, a total of 8.4 percent (5/59) (selected from 970 samples), were found

positive for *T. congolense*. The low prevalence of pathogenic trypanosomes on Mafia Island is intriguing, especially in view of the omnipresence of the tsetse fly *Glossina brevipalpis*. Although the presence of detected trypanosomal antibodies does not necessarily indicate a current infection, the combination of serological/parasitological examinations and the results of the PCR do support this low prevalence of trypanosomosis in cattle. Despite the low prevalence, pathogenic trypanosomes are present on Mafia Island and possible reasons for this low infection rate, taking account of the relation between *Glossina* species present, transmission risk and trypanosomes found in cattle, are discussed also in view of a future appropriate intervention strategy.

13584. **Jindal, N.G., Batra, M. & Singh, R, 2005**. A note on prevalence of surra in bovines in Haryana. *Indian Veterinary Journal*, **82**: 1114-1115.

Department of Veterinary Epidemiology and Preventive Medicine, College of Veterinary Sciences, CCS Haryana Agricultural University, Hisar - 125 004, India.

The status of surra (trypanosomiasis) in buffaloes and cattle from Haryana was recorded from January 2001 to December 2003. The seasonal pattern of the disease was also studied. 480 outbreaks of surra were recorded based on clinical symptoms. The morbidity and cumulative mortality were 0.074 and 0.009 percent, respectively. The case fatality rate due to the disease was 11.78 percent. The outbreaks and case fatality rates were greater in the eastern zone throughout the study period compared to the western zone. The number of outbreaks was greater in the winter season, followed by the rainy and summer seasons. The environmental conditions in these months were conducive for multiplication of the vector, leading to more outbreaks of the disease.

13585. **Mottelib, A.A.H., H. I., Mourad, I., El-Sherif, A. M. & Abo-Zeid, A. S. I., 2005.** Comparative evaluation of various diagnostic techniques for *Trypanosoma evansi* in naturally infected camels. In: *Proceedings of the XIIth ISAH Congress on Animal Hygiene*, Warsaw, Poland, pp.505-507.

Department of Infectious Disease, Faculty of Veterinary. Medicine, Cairo University, Beni-Suef, Egypt.

13586. **Mugunieri, G.L. & Matete, G.O., 2005**. Association of trypanosomosis risk with dairy cattle production in western Kenya. *Onderstepoort Journal of Veterinary Research* **72**(4): 279-284.

Onderstepoort Veterinary Institute, Onderstepoort, South Africa.

Dairy cattle reared in western Kenya are exposed to medium to high levels of trypanosomosis risk. The social background, farm characteristics and dairy cattle productivity of 90 and 30 randomly selected farmers from medium- and high-risk trypanosomosis areas, respectively, were compared. All the 120 farmers were visited between July and August 2002. Data analysis was performed using descriptive statistics and analysis of variance. The results showed that increased trypanosomosis risk represented by an increase in disease

prevalence in cattle of 1 percent to 20 percent decreased the density of dairy cattle by 53 percent and increased the calving interval from 14 to 25 months. The increased risk was also associated with a significant increase in cattle mortalities and in a lactation period of 257 to 300 days. It was concluded that removal of the trypanosomosis constraint on dairy production would lead to expansion of dairying since the domestic demand for dairy products is expected to increase.

13587. **Van Den Bossche P., Esterhuizen J., Nkuna R., Matjila T., Penzhorn B., Geerts S. & Marcotty, T., 2006**. An update of the bovine trypanosomosis situation at the edge of Hluhiuwe-Imfolozi Park, Kwazulu-Natal Province, South Africa. *Onderstepoort Journal of Veterinary Research*, **73**(1):77-9.

Institute of Tropical Medicine, Animal Health Department, Nationalestraat 155, B-2000 Antwerp, Belgium [pvdbossche@itg.be].

To obtain updated data on and assess the contribution of trypanosomosis to the disease burden of cattle kept at the edge of the Hluhluwe-Mfolozi Park, a survey was conducted at Mvutshini Dip. Use was made of a purposeful sampling strategy by restricting sampling to animals that the livestock owner considered to be in poor condition. Of a total of 76 blood samples collected, 26 were parasitologically positive and 46 were positive on PCR/RFLP. Almost all infections were due to *Trypanosoma congolense* savannah subgroup. A total of 63 animals had an average PCV of 24 percent and were considered to be anaemic. Results from the survey show that trypanosome infections contribute significantly to the overall burden of disease in the area. Further research is required to develop appropriate control methods.

(b) PATHOLOGY AND IMMUNOLOGY

[See also **29**: 13492]

13588. **Gutierrez, C., Corbera, J.A., Juste, M.C., Doreste, F. & Morales, I., 2005**. An outbreak of abortions and high neonatal mortality associated with *Trypanosoma evansi* infection in dromedary camels in the Canary Islands. *Veterinary Parasitology,* **130** (1-2): 163-168.

Department of Animal Medicine and Surgery, Veterinary Faculty, University of Las Palmas, 3416, Arucas, Las Palmas, Canary Islands, Spain. [cgutierrez@dpat.ulpgc.es].

Trypanosoma evansi was diagnosed for the first time in the Canary Islands (Spain) in 1998 in a dromedary camel. Seroprevalences of 4.8 percent up to 9 percent have been observed using different diagnostic methods. Affected animals have been treated but the dissemination of the disease is unknown. This article presents an outbreak of abortions and high neonatal mortality attributable to *T. evansi* infection in camels as well as the clinical assessment of the affected animals. The patients were diagnosed by routine checking (three pregnant animals), after abortion (five dams), or after delivered premature or weak calves

(eight dams). At clinical examination, 2 out of 16 affected animals showed moderate signs of chronic form, particularly hyporexia and intolerance to exercise. The aborted fetuses were aged 6-8 months of gestation, approximately. The main laboratorial findings were regenerative anemia (haemolytic anemia), lymphocytic and monocytic leukocytosis, hyperproteinemia, hyperglobulinemia, hypoglycaemia, serum urea increased and serum iron decreased. Treatment using trypanocidal drug (Cymelarsan(R)) resulted highly effective. Massive treatment would be recommended in the entire camel population in the Canary Islands (less than 2000 animals), as therapeutic or preventive measure, in order to control and to achieve an eventual eradication of the disease.

13589**. Muraguri, G.R., McLeod, A., McDermott, J.J. & Taylor, N., 2005**. The incidence of calf morbidity and mortality due to vector-borne infections in smallholder dairy farms in Kwale District, Kenya. *Veterinary Parasitology*, **130** (3-4): 305-315.

4339 Mantua Way, Raleigh, NC 27604, USA.

An observational longitudinal study was carried out on 92 randomly selected smallholder farms in two coastal lowland zones of Kwale District in Kenya between December 1997 and November 1999. The objective was to estimate the incidence of the main vector-transmitted diseases in pre-weaned calves. From an initial 41 pure or cross-bred *Bos taurus* calves which were less than 2 months and whose birth and disease histories were known, study calves were recruited progressively and monitored until they were weaned at around 146 days. Overall, 130 calves in 67 farms were monitored and these contributed a total risk period of 30,062 days.Disease parameters were analysed and compared as true annual and age-specific incidence rates. The incidences of East Coast fever (ECF) (23.1 percent) and trypanosomosis (29.1 percent) were the highest among the vector-borne diseases. The corresponding mortality incidence rates of ECF and trypanosomosis were 10.9 and 3.6 percent, respectively. The annual incidence rates of anaplasmosis and babesiosis were 10.9 and 1.2 percent, respectively. There was no mortality arising specifically from anaplasmosis or babesiosis. Analysis of survival times to natural infection indicated that the field challenge resulting in cases of trypanosomosis was much higher compared to the risk of either ECF or anaplasmosis. It was concluded that these vector-borne diseases constrain production of replacement stock in this coastal lowlands region of Kenya.

13590. **Rodrigues, A., Fighera, R.A., Souza, T.M., Schild, A.L., Soares, M.P., Milano, J. & Barros, C.S.L., 2005**. Outbreaks of trypanosomiasis in horses by *Trypanosoma evansi* in the state of Rio Grande do Sul, Brazil: epidemiological, clinical, hematological, and pathological aspects. *Pesquisa Veterinaria Brasileira,* **25(**24): 239-249.

Colegio Brasileiro de Patologia Animal, Rio de Janeiro, Brazil.

Cases of trypanosomiasis by *Trypanosoma evansi* were diagnosed in horses in the state of Rio Grande do Sul, Brazil, between 2003 and 2004. In one stud farm (Farm A) with 125 horses, 52 died. Additionally, around 80 mares were sent to Farm A to be bred. Of those, 66 became ill and 56 died after being returned to their farms of origin. Twenty-one horses clinically affected by the disease were observed. Clinical signs included loss of weight

(despite voracious appetite), lethargy, incoordination and instability of hindlimbs, atrophy of the large muscles of the hindlimbs, muscle weakness and paleness of mucosae. Specimens of *T. evansi* were detected in the blood drawn from four affected horses. Normocytic normochromic anemia with PCVs ranging from 15 to 31 percent, leucocytosis due to lymphocytosis associated to large atypical lymphocytes was observed in several affected horses. High levels of antibodies against *T. evansi* were detected in the serum of six horses from Farm A. Eight horses presented encephalic neurological signs such as circling, ataxia, blindness, excitation, falls, listlessness, proprioception deficits and head tilt. One horse assumed a "dog-seating position". Necropsy findings included muscle atrophy, enlargement and lymphoid hyperplasia of the spleen and lymph nodes, oedema and softening of the white and grey matter of the brain. Histologically, an overwhelming necrotizing panencephalitis was observed in the seven horses with encephalic signs. This panencephalitis was characterized by marked oedema, demyelination and necrosis and perivascular infiltrates of 6-10 layers of lymphocytes and plasma cells affecting both the white and gray matter. Several plasm cells in the inflammatory infiltrate contained numerous eosinophilic globules in their cytoplasm (Mott cells). Similar histological lesions were observed in the spinal cord of the horse with the "dog-seating position". The brains of five horses with the encephalic signs were submitted to immunohistochemistry stain by the streptavidin-biotin technique. In all of those five brains moderate to abundant specimens of *T. evansi* in the perivascular spaces and neuropile were marked by the specific antibody. Epidemiological, clinical, hematological, and pathological aspects of equine trypanosomiasis caused by *T. evansi* are discussed.

13591. **Wymann, M.N., Bonfoh, B., Schelling, E., Bengaly, S., Tembely, S., Tanner, M. & Zinsstag, J., 2006**. Calf mortality rate and causes of death under different herd management systems in peri-urban Bamako, Mali. *Livestock Science,* **100** (2-3): 169-178.

Swiss Tropical Institute, Public Health and Epidemiology, Socinstrasse 57, P.O. Box CH-4002 Basel, Switzerland.

Calf mortality rate and causes of death were studied in peri-urban livestock production systems in Bamako, Mali, for calves born and dying from November 2002 to March 2004. Causes of death for 93 deceased calves were diagnosed from clinical autopsies, reported history of death and parasitic information. Calves originated from traditional, modernized and station management systems. Overall mortality rate was 17 percent during the first year of life (N = 756 live-births). Mortality rate was significantly lower for traditionally (10 percent) compared to modernised (19 percent) or to station managed calves (25 percent). Total perinatal loss (abortions + stillbirths + perinatal mortality) was 5 percent (N = 784 gestations). The most important death categories were digestive tract disorders (28 percent), perinatal mortality (16 percent) and accidents (14 percent). Vector-borne and infectious diseases were of low importance. Digestive tract disorders and perinatal mortality were the most important categories of death in modernized management while accidents and starvation were the most important causes of death in traditional management. Digestive tract disorders were more common in modernized than in traditional management ($p = 0.02$), revealing a serious problem with hygiene in stationary enclosures. With better calf management in regard to hygiene, surveillance and control of milk off-take, overall calf survival may be increased and peri-urban livestock production made more profitable.

(c) TRYPANOTOLERANCE

13592. **Agyemang, K., 2005**. Trypanotolerant livestock in the context of trypanosomiasis intervention strategies. *PAAT Technical and Scientific Series*. Food and Agriculture Organization of the United Nations (FAO) Rome, Italy: 2005. viii + 66pp.

International Trypanotolerance Centre, Banjul, Gambia.

An overview of the tsetse and trypanosomiasis problem and the various options for its control is provided. The information gathered is synthesized to provide a guiding principle that will facilitate the definition of the role of trypanotolerant livestock in an integrated approach to fighting tsetse-trypanosomiasis. A framework is provided that can contribute to determining where and under what circumstances trypanotolerant livestock might be used economically and sustainably to fight the tsetse-trypanosomiasis problem.

13593 **Alexandre, G. & Mandonnet, N., 2005**. Goat meat production in harsh environments. *Small Ruminant Research,* **60** (1/2): 53-66.

Unité de Recherches Zootechniques, Centre de Recherches Agronomiques des Antilles et de la Guyane, INRA Antilles-Guyane, Domaine Duclos 97170 Petit-Bourg, Guadeloupe.

This paper provides some insight into special attributes of the goat as an efficient producer of meat under harsh environments. The overview is not intended to be exhaustive; it gives the readers a comprehensive synthesis on the subject allowing them to consult the list of references. Moreover, it would not be possible to classify the most limiting factor among the numerous and diverse constraints that negatively affect goat production: high ambient temperatures and/or humidity, and erratic and/or low rainfall that have concomitant effects on quality and quantity of feeds, a wide variety of diseases and low levels of animal husbandry. The paper highlights some particular conditions illustrated by data coming from different parts of the world, which can be classified as having harsh environments. Finally, the objectives of this work are not to propose ready-made solutions, but to recommend a holistic approach to the problems and their analyses allude to opportunities for improvement in the future.

13594. **Bosso, N.A., 2006**. Genetic improvement of livestock in tsetse infested areas in West Africa. In: *Genetic improvement of livestock in tsetse infested areas in West Africa.* Wageningen University, Wageningen, the Netherlands, 147pp.

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Genetic improvement of indigenous breeds can make a significant contribution to the conservation and utilization of local genetic resources. At present, there is insufficient documentation on phenotypic and genetic performance for important production and reproduction traits under low input production circumstances for indigenous populations.

This limited knowledge is putting local animal genetic resources at risk. This thesis has focused on ways to better utilize local animal genetic resources by developing strategies for the implementation of improvement programmes for trypanotolerant breeds in The Gambia and in West Africa in general. The project was built on the analysis of ongoing selection programmes coordinated by the International Trypanotolerance Centre (ITC) in The Gambia. The analysis of this selection programme indicated that genetic improvement programmes in the context of sustainability within the low input production system were feasible and could serve as a model for effective breeding schemes in low and medium input livestock production systems in the West African region. Genetic progress was achieved and effectively transmitted to farmers through the involvement of farmers and their communities in the improvement programmes. Genetic progress was realized and the estimated genetic parameters obtained could be used for further improvement of cattle and small ruminant selection strategies. It was recommended to intensify training and capacity building activities for both implementation and further development of the programme. In addition, financial security is important for the long-term sustainability of the programme. For a practical breeding scheme (low input system) for the N'Dama cattle, a young sire scheme was suggested. Model calculations showed that this scheme leads to the best improvements in the overall breeding goal and consolidates efficient dissemination of the genetic improvement to the whole farming population. The project has demonstrated that development of strategies for the implementation of improvement programmes in West African countries is feasible and that they contribute to a better utilization of trypanotolerant breeds.

13595. **Chiejina, S.N., Musongong, G.A., Fakae, B.B., Behnke, J.M., Ngongeh, L.A. & Wakelin, D., 2005**. The modulatory influence of *Trypanosoma brucei* on challenge infection with *Haemonchus contortus* in Nigerian West African Dwarf goats segregated into weak and strong responders to the nematode. *Veterinary Parasitology,* **128** (1/2): 29-40.

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Although Nigerian West African Dwarf (WAD) goats are relatively resistant to infection with *Haemonchus contortus* and are also trypanotolerant, natural outbreaks of both infections are known to occur. Despite their relative resistance to *H. contortus,* WAD goats nevertheless show variability in response phenotype and it was of interest to examine the effect of this variability on the outcome of concurrent trypanosome infection. *Trypanosoma brucei* infections were established in goats that were initially classified as good or poor responders to *H. contortus*. Thirty-nine goats were exposed to an escalating infection with *H. contortus*, and on the basis of their mean faecal egg counts (FEC) were allocated to high FEC (poor responders, 18 goats with the highest FEC) or low FEC (good responders, 18 goats with the lowest FEC) classes. Nine uninfected naive control goats were included to provide reference baseline values. Retrospective analysis of parasitological and pathological parameters after allocation into high/low FEC classes showed that FECs differed significantly, in both classes packed cell volume (PCV) values fell relative to naive controls, neither class lost weight and both generated marked IgG responses. All goats received anthelmintic on day 61, half of each group was infected with 50 million trypanosomes and on day 67, except the controls, all goats were challenged with 3,000 L3 of *H. contortus*.

Trypanosome parasitaemia was generally low, and marginally, but not significantly, higher in the low compared with high FEC class, peaking 12-16 days after exposure in both groups and then falling to below microscopically detectable levels (although still detectable by sub-inoculation into mice) by week 3. At autopsy (days 109/110), worm burdens were significantly higher in the trypanosome-infected goats from the high FEC class, relative to all other groups. Trypanosome infected goats showed a tendency (although not significant) towards higher FEC and, irrespective of their FEC class, had lower PCV values although body weight did not vary significantly. All goats challenged with *H. contortus* had higher antibody levels than naive controls, but neither trypanosome infection nor FEC class affected the magnitude of responses. These results confirm that WAD goats comprise a range of response phenotypes to initial *H. contortus* infection and that trypanotolerance is a key trait of this breed. Although immunity to nematode infection develops even in poor responders, these animals harbour higher nematode burdens during concurrent infection with *T. brucei*.

13596. **Hill, E.W., O'Gorman, G.M., Agaba, M., Gibson, J.P., Hanotte, O., Kemp, S.J., Naessens, J., Coussens, P.M. & MacHugh, D.E., 2005**. Understanding bovine trypanosomiasis and trypanotolerance: the promise of functional genomics. *Veterinary Immunology and Immunopathology,* **105** (3/4): 247-258.

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African bovine trypanosomiasis, caused by the protozoan parasite *Trypanosoma congolense,* is endemic throughout sub-Saharan Africa and is a major constraint on livestock production. A promising approach to disease control is to understand and exploit naturally evolved trypanotolerance. We describe the first attempt to investigate the transcriptional response of susceptible Boran (*Bos indicus*) cattle to trypanosome infection via a functional genomics approach using a bovine total leukocyte (BOTL) cDNA microarray platform. Four male Boran cattle were experimentally infected with *T. congolense* and peripheral blood mononuclear cells (PBMC) were collected before infection and 13, 17, 23 and 30 days postinfection (dpi). A reference experimental design was employed using a universal bovine reference RNA pool. Data were normalized to the median of a set of invariant genes (GAPDH) and BRB-Array tools was used to search for statistically significant differentially expressed genes between each time-point. Using a set of 20 microarray hybridizations, we have made a significant contribution to understand the temporal transcriptional response of bovine PBMC *in vivo* to a controlled trypanosome infection. The greatest changes were evident 13 dpi after parasites were first detected in the blood. Significant differences were observed in clusters of protein kinase C subunits and MHC class I/II related molecules.

13597. **Maichomo, M.W., Ndung'u, J.M., Ngare, P.M. & Ole-Mapenay, I.M., 2005**. The performance of Orma Boran and Maasai Zebu crossbreeds in a trypanosomosis endemic area of Nguruman, south western Kenya. *Onderstepoort Journal of Veterinary Research,* **72** (1): 87-93.

Kenya Trypanosomiasis Research Institute, P.O. Box 362, Kikuyu, Kenya.

Studies on the trypanotolerance of Orma Boran x Maasai Zebu (Orma Zebu) crossbred cattle (F1 progeny) and purebred Maasai Zebu contemporaries were carried out in Nguruman, south western Kenya. The two groups were monitored from birth for a period of 2 years. The incidence of trypanosomosis, parasitaemia, packed cell volume (PCV), body mass and average daily mass gain were monitored. During the study period, overall trypanosomosis incidence was low (3 percent). The crossbred cattle had a higher incidence of infection (61 vs. 39 percent). The mean PCV and mean mass gain for the crossbred cattle was higher than that of the Maasai Zebu. The mean calf body mass at weaning (8 months) for the Orma Zebu and Maasai Zebu was 72 and 64 kg, respectively, while at 18 months of age their mean body mass was 164 and 123 kg, respectively. During the rainy season, significant differences in average daily mass gains were noted ($P<0.05$). The superior mass gain of the Orma Zebu observed during the rainy season, despite higher infection rates, indicate an enhanced trypanotolerance. Moreover, the better performance of the Orma Zebu is an attribute that could be exploited in the adoption of the trypanotolerance genotype, as a sustainable trypanosomosis control strategy.

13598. **Naessens, J., 2006**. Bovine trypanotolerance: A natural ability to prevent severe anaemia and haemophagocytic syndrome? *International Journal for Parasitology,* **36**(5): 521-528.

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Trypanotolerance is the capacity of certain West-African, taurine breeds of cattle to remain productive and gain weight after trypanosome infection. Laboratory studies, comparing *Trypanosoma congolense* infections in trypanotolerant N'Dama cattle (*Bos taurus*) and in more susceptible Boran cattle (*Bos indicus*), confirmed the field observations. Experiments using haemopoietic chimeric twins, composed of a tolerant and a susceptible co-twin, and T cell depletion studies suggested that trypanotolerance is composed of two independent traits. The first is a better capacity to control parasitaemia and is not mediated by haemopoietic cells, T lymphocytes or antibodies. The second is a better capacity to limit anaemia development and is mediated by haemopoietic cells, but not by T lymphocytes or antibodies. Weight gain was linked to the latter mechanism, implying that anaemia control is more important for survival and productivity than parasite control. Anemia is a marker for a more complex pathology which resembles human haemophagocytic syndrome: hepatosplenomegaly, pancytopenia and a large number of hyperactivated phagocytosing macrophages in bone marrow, liver and other tissues. Thus, mortality and morbidity in trypanosome-infected cattle are primarily due to self-inflicted damage by disproportionate immune and/or innate responses. These features of bovine trypanotolerance differ greatly from those in murine models. In mice, resistance is a matter of trypanosome control dependent on acquired immunity. However, a model of anaemia development can be established using C57BL/6J mice. As in cattle, the induction of anaemia was independent of T cells but its development differed with different trypanosome strains. Identification of the molecular pathways that lead to anaemia and haemophagocytosis should allow us to design new strategies to control disease.

(d) TREATMENT

[See also **29**: nos. 13530]

13599. **Bharkad, G.P., Bhikane, A.U., Raote, Y.V., Markandeya, N.M. & Khan, M.A., 2005**. Surra in a Kathiawari mare: a case report. *Intas Polivet,* **6**(2): 205-206.

A seven-year-old Kathiawari mare was presented to the polyclinic of the Veterinary College in Udgir, India, with a history of progressive loss of body weight, anorexia, dullness, weakness and restlessness of 10-day duration. Clinical examination revealed profuse sweating, rapid and deep abdominal respiration, tachycardia, fever, pale conjunctiva and oedema of limbs. Haematological examination revealed very low haemoglobin and haematocrit values. Peripheral blood smear examination revealed heavy *Trypanosoma evansi* infection. The animal was treated with a single dose of diminazene intramuscularly. Supportive treatment included 5 percent dextrose, multivitamin, vitamin B-complex injection and chlorpheniramine maleate. Although the animal showed some clinical improvement on the second day, the severity of anasarca was rapidly increasing and the animal died on the third day of treatment. Post-mortem examination showed enlargement of the spleen and liver with petechial haemorrhages on the serous surfaces of the liver and kidneys.

13600. **Knoppe, T.N., Bauer, B., McDermott, J.J., Peregrine, A.S., Mehlitz, D. & Clausen, P.-H., 2006.** Isometamidium sensitivity of *Trypanosoma congolense* stocks from cattle in West Africa tested in mice and the drug incubation infectivity test. *Acta Tropica,* **97** (1): 108-116.

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Four *Trypanosoma congolense* reference clones with known isometamidium sensitivity and 16 T. congolense stocks from cattle in Kenedougou in south-western Burkina Faso, an area with known history of drug resistance, were characterised with the standard mouse test (SMT) and the drug incubation infectivity test (DIIT). All field stocks from Kenedougou were resistant to 1.0 mg/kg body weight isometamidium in the SMT. Fourteen stocks (87.5 percent) also proved to be refractory to 10 mg/kg bw. Testing with the DIIT confirmed the results of the SMT. By comparison to reference clones, all the Kenedougou populations expressed high levels of resistance to isometamidium.

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