vol. 29 / 2 2006

year 2006

volume 29

part 2

PAAT

Programme Against African Trypanosomiasis

ISSN 1812-2442

TSETSE AND TRYPANOSOMIASIS INFORMATION

FAO

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, 00153 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
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

Page

SECTION A – NEWS

From the Editor 123
Report of the 10th Meeting of the PAAT Programme Committee 123
Report of the 31st ISCTRC Executive Committee Meeting 140
Book Publications 142
Data Resources for Tsetse Researchers 146
Recent Research & Guidelines Developed by ILRI and Partners 146

SECTION B – ABSTRACTS

1. General (including land use) 149
2. Tsetse Biology
   - (a) Rearing of tsetse flies 160
   - (b) Taxonomy, anatomy, physiology, biochemistry 160
   - (c) Distribution, ecology, behaviour, population studies 165
3. Tsetse Control (including environmental side effects) 172
4. Epidemiology: vector-host and vector-parasite interactions 174
5. Human Trypanosomiasis
   - (a) Surveillance 177
   - (b) Pathology and immunology 182
   - (c) Treatment 186
6. Animal Trypanosomiasis
   - (a) Survey and distribution 186
   - (b) Pathology and immunology 187
   - (c) Trypanotolerance 191
   - (d) Treatment 193
7. Experimental Trypanosomiasis
   - (a) Diagnostics 195
   - (b) Pathology and immunology 198
   - (c) Chemotherapeutics 216
8. Trypanosome Research
   - (a) Cultivation of trypanosomes 236
   - (b) Taxonomy, characterisation of isolates 236
   - (c) Life cycle, morphology, biochemical and molecular studies 249

SECTION A – NEWS

FROM THE EDITOR

Dear Reader,
As mentioned in the introduction to the previous edition of TTI, it was not possible to include in Volume 29 (1) the abstract of any paper dealing with either Experimental Trypanosomiasis or Trypanosome Research. This volume now addresses this "shortfall" in that it includes both abstracts of peer reviewed papers published over the past 12 months falling within the scope of these two categories, and abstracts of papers published over the past 6 months under the headings of "General" and "Tsetse Biology, Tsetse Control, Human and Animal Trypanosomiasis". The result is a volume which is substantially longer than normal despite a shorter News Section than has often been the case before. This, in turn, has prompted further thought about how to keep costs within budget (recall that each volume has to be prepared and printed in English and French) while both maintaining the focus of TTI and meeting the needs of the vast majority of its readers.

During the process of conducting the literature searches for both this and the previous volume of TTI, it has become very clear that papers covering the subjects of "*T. cruzi"*, "Chemotherapy" and "Molecular Methods" dominated. However, in an effort to keep the focus of TTI on tsetse flies and the trypanosomiases in Africa while at the same time covering preferentially abstracts dealing with more applied or "downstream" type of field and research developments, the number of abstracts covering the American trypanosomes were drastically reduced, while many of those dealing with chemotherapy and applications of molecular techniques were increasingly dealt with by omitting abstracts and publishing only titles and authors' names and addresses. Since all of these steps will have be more strictly adhered to in future volumes of TTI, any reader wishing the abstract of a paper referred to in this or future volumes of TTI by title can receive this simply by making a request to me by e-mail.

With best wishes,

James Dargie

PROGRAMME AGAINST AFRICAN TRYPANOSOMIASIS: 10TH MEETING OF THE PROGRAMME COMMITTEE

Foreword

This meeting was convened at the Istituto Agronomico per l'Oltremare (IAO, Overseas Agronomic Institute), Florence, Italy, 26-27 April 2006. The meeting focused on (i) achievements of PAAT mandated organizations (i.e. FAO, IAEA, WHO, AU-IBAR) and AU-PATTEC, (ii) implementation of AfDB-PATTEC supported T&T intervention in six sub-Saharan countries (Burkina Faso, Ghana, Mali in West Africa and Ethiopia, Kenya, Uganda in East Africa), (iii) activities in Tsetse and Trypanosomiasis (T&T) Research and Development by PAAT research partners (CIRAD, ICIPE, ILRI, ITM), and (iv) new and potential PAAT partnerships (IFAH, UNIDO, World Bank, FAO/IGAD-LPI)

The meeting was officially opened by Dr A. Perlini, IAO Director General, who on behalf of IAO warmly welcomed the participants to Florence to work on the problems posed by T&T which affect both human and livestock health and sustainable agricultural development in a substantial portion of Africa. Mr A. Scappini, Livestock Officer, presented an overview of IAO activities focusing on livestock agriculture projects.

An introduction to PAAT and the objectives of the meeting were presented in the opening address of the PAAT chairman, Prof. A. Ilemobade. He reminded participants that in 2006 PAAT celebrates the 10th anniversary of its founding when the idea of a global, international alliance aiming at clarifying the problem of tsetse and trypanosomiasis was mooted at a conference in Brussels, Belgium. The progress made by PAAT in ten years was impressive and internationally acknowledged. Also, the support that PAAT continuously provides to the African countries affected by the T&T problem and to the PATTEC initiative was recalled.

Mr R. Mattioli welcomed the group on behalf of the FAO/PAAT Secretariat and thanked the Italian Government and the IAO for hosting the meeting. He also welcomed the renewed interest in PAAT shown by other FAO initiatives/projects such as the Inter-Governmental Authority on Development-Livestock Policy Initiative (IGAD-LPI) and the Pro-Poor Livestock Policy Initiative (PPLPI), and more generally by the United Nations system, with UNIDO and IFAD participating in the meeting and actively supporting PAAT actions. The contribution and participation of the private sector through the International Federation for Animal Health (IFAH), to PAAT events and activities and the financial assistance of the Japanese Government to the joint Ethiopian Government/IAEA/FAO project on T&T intervention in the Southern Rift Valley of Ethiopia were further recognition of the work of PAAT. The advanced PAAT-PATTEC harmonisation and the fact that T&T intervention is now placed in the broader context of SARD were considered instrumental in creating a positive, collaborative and attractive environment for donors and other potential stakeholders.

The meeting was chaired by Prof. A.A. Ilemobade and FAO provided secretarial assistance.

Minutes of the Previous Meeting

The report and recommendations of the 9th PAAT-PC meeting were revised and adopted.

Reports from UN and Regional Organizations and Institutions

***FAO/PAAT - R.C. Mattioli*:** Activities and progress on the implementation of recommendations since the 9th PAAT-PC meeting were presented.

The recommendation to apply the PAAT-PATTEC criteria in the selection of intervention areas was re-emphasised at the PAAT Advisory Group Coordinators meeting held in Addis Ababa in September 2005, and at a workshop on "Improving decision support for T&T intervention in Uganda". 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 initiatives.

The problem of human resources development was duly addressed by PAAT mandated organizations. WHO organized an international course on African Trypanosomiasis

in Tunisia (10-28 October 2005) and trained staff from Ministries of Health and Veterinary Services Departments on HAT control methods. IAEA convened an FAO/IAEA regional training course on "Standardized Baseline Data Collection for Area-wide Tsetse and Trypanosomiasis Management" in Nairobi from 13 March–7 April 2006. In the period between the 9th and the 10th meetings of the PAAT-PC, i.e. May 2005–April 2006, IAEA funded 54 person-month fellowships for collaborators from seven T&T affected countries. Within the project "Strengthening the PAAT-Information System (IS)" funded by IFAD, FAO/PAAT assessed the training needs and requirements of national technical staff and the development of human resources with respect to Information System management and GIS. In this regard, missions were undertaken in Burkina Faso, Ghana, Mali, Ethiopia, Kenya and Uganda.

In relation to the recommendation to establish standardized guidelines and procedures for field and laboratory operations, the importance of available manuals and technical papers was stressed. Also, work is in progress to produce guidelines for declaring areas free of tsetse flies and transmitted trypanosomiasis, and to develop a new tool for guiding the economic decision making process for field T&T interventions ("Mapping the Benefits"). 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 "FAO/IAEA Guidelines for Conducting Baseline Tsetse Surveys for Area-wide Integrated Pest Management Programmes".

Regarding the recommendation concerning the involvement of other stakeholders in the management of other diseases and constraints to SARD, the most interesting partnerships concern IFAH, UNIDO and the World Bank (the last, under the umbrella of the African Livestock (ALIVE) initiative. Within FAO, the new collaboration between PAAT and the Inter-Governmental Authority on Development-Livestock Policy Initiative (IGAD-LPI) project was mentioned.

An economic analysis of tsetse suppression techniques, including SAT, was performed and modelled in a paper dealing with the costs of alternative tsetse control approaches in Uganda. The paper was authored by A. Shaw for the FAO/PPLPI project with the assistance of FAO/PAAT. The option to use SAT has also been considered in the joint Ethiopian Government-FAO/IAEA project for T&T intervention and related SARD approved by the Government of Japan and in the FAO/PAAT and FAO/IGAD-LPI project proposal submitted for funding to the Wellcome Trust 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".

IAEA – U. Feldmann: Regarding the recommendation to establish standardized guidelines and procedures for field and laboratory operations, progress was reported on the production of "Guidelines for Declaring Areas Free of Tsetse and Tsetse Transmitted Trypanosomiasis". Further guidelines to member countries for identifying the optimal location of mass-rearing units were produced along with a spreadsheet that assists in defining the room size and associated budget. An international conference on "Area-wide Control of Insect Pests" was held in May 2005 in Vienna. The conference was attended by more than 400 participants. In October 2005, a representative of the Joint FAO/IAEA Division attended the PATTEC regional meeting (Nairobi, Kenya).

An outline was given of the meaning of the "phased approach" to area-wide tsetse control and the need was emphasised for both commitment and a national policy/strategy for T&T intervention in member countries. The need for baseline data was also stressed for deciding on the best approach to deal with tsetse flies, human and animal trypanosomiasis, as was the importance of linking agricultural development to the removal of T&T, capacity building and international assistance. Although SIT remains a major tool for tsetse elimination, it may not be needed in all scenarios. With regard to the production of tsetse sterile males, substantial action and planning are needed to overcome the shortage of sterile flies.

At the meeting for national coordinators in Vienna in December 2005, a questionnaire was used to assess the status and progress of national efforts against the tsetse and trypanosomiasis problem in PATTEC "phase-1" Member States. It was obvious that, along the phased and conditional planning and implementation approach, several aspects/issues remain to be addressed by Member States in the different phases i.e. (i) policy and strategy establishment, (ii) feasibility assessment, (iii) capacity building and pre-operational activities, and (iv) operational intervention. Representatives of the national PATTEC projects were also asked to identify topics on which the three mandated UN agencies (FAO, IAEA and WHO) may provide assistance. The discussions at the meeting revealed that besides the new "FAO/IAEA Guidelines for Standardized Entomological Baseline Data Collection" there are other technical fields where similar manuals and guidelines are needed. A joint effort by the PAAT community and other partners will be needed to develop these manuals and guidelines. In this process the information already available in the existing FAO tsetse control manuals will be instrumental for generating the required updated manuals and guidelines.

***WHO – P. Simarro*:** The support provided to countries involved in the AfDB funded PATTEC initiative, including training activities, was described. Participants were also informed about the contribution of WHO to recent PAAT publications and on the latest update on HAT epidemiology.

WHO is working on better integrating HAT as a component of the AfDB-PATTEC initiative in national projects (e.g. by producing of a plan of action for Ministry of Health (MoH) participation in the AfDB-PATTEC project in Ghana). Screening activities for HAT detection were carried out in several affected areas and capacity building was addressed through service and formal training. In this regard, one of the most important initiatives was the "IV International Course on African Trypanosomoses", held from 10–28 October 2005 in Tunisia and attended by 16 participants from HAT endemic countries. WHO contributed to the upcoming documents on "Mapping the Benefits of Tsetse & Trypanosomiasis Intervention" and to "Linking Sustainable Human and Animal African Trypanosomiasis Control with Rural Development Strategies".

The epidemiology of HAT was outlined with respect to the degree of surveillance at national level and to the average number of cases for the period 1990-2004. Countries have been grouped into five classes according to the number of cases per year: 1 - reporting no cases (no surveillance activities implemented), 2 - reporting no cases (surveillance activities implemented), 3 - reporting less than 50 cases, 4 - reporting between 50 and 1 500 cases, and 5 – reporting more than 1 500 cases. Cases and countries have also been classified on the basis of the pathogenic agent (*Trypanosoma brucei gambiense* or r*hodesiense*). Each class requires a different intervention strategy. The three countries reporting more than 1 500 cases per year (Angola, RDC and Sudan) account for approximately 85 percent of the total number

of registered cases. At continental level, a constant decline in the number of cases has been observed during the last years. This positive trend has been associated with increased disease surveillance and control performed by WHO.

WHO pointed out that both the 11th Meeting of the PAAT Advisory Group Coordinators (PAG) (21-22 September 2005, Addis Ababa, Ethiopia) and the 28th ISCTRC Conference (26–30 September, 2005, Addis Ababa) encouraged WHO to consider HAT as a disease candidate for elimination.

In future, WHO's work will further concentrate on: (i) increasing the awareness among decision makers with a view to removing sleeping sickness from its neglected list, (ii) advocating and developing people's participation programmes (PPP) in order to raise the needed funds, (iii) encouraging and coordinating research for new diagnostic and treatment tools, (iv) providing access to diagnosis and treatment to affected populations, and (v) increasing control activities. Finally, WHO expressed the view that better coordination between AAT - HAT components within national PATTEC initiatives is needed.

***AU/IBAR – S. Haile-Mariam*:** The AU/IBAR representative presented the apologies of the IBAR Director, Mr Modibo Traoré, for not being able to attend. He then summarized the recommendations of the 28th ISCTRC Conference held from 25 - 30 September 2005, in Addis Ababa, Ethiopia.

In the official declaration, the ISCTRC Conference called upon the 37 AU Member States affected by T&T to implement the PATTEC Project by 2015 side by side with the Global Programme for HIV/AIDS and Malaria.

Concerning recommendations, the most relevant were:

- Strengthening the ISCTRC Secretariat through the appointment of a full time secretary, provision of adequate resources and training;
- For national PATTEC projects, each participating country should make feasibility studies, address the problem of capacity building and put in place an efficient management structure before embarking on any field operation;
- With respect to HAT, WHO is encouraged to launch a programme to eliminate sleeping sickness, to introduce control strategies and to support countries in their efforts to update their epidemiological status. R&D groups are urged to look into new diagnostic tools and drugs;
- Further development of standard manuals and field guides (for example on area wide suppression) are needed. Standardized procedure for entomological and veterinary monitoring and subsequent analysis should be formulated and applied at the field level;
- PATTEC should urgently coordinate the assessment of training needs for mid-level and senior staff. PATTEC should also assist the preparation of national and regional action plans for T&T;
- WHO/TDR is encouraged to mobilize resources to address the potential problem of the merger of *T. b. gambiense* and *T. b. rhodesiense* foci in Uganda;
- As regards vector control, gaps should be filled in data collection; the application of integrated technologies needs be pursued. The possible contribution of community participation should be further investigated;

- Environmental issues in T&T interventions should be properly addressed in order to ensure sustainable agriculture and rural development. Standardized methodologies for environmental monitoring and impact assessment should be developed and made available to all countries.

***AU-PATTEC – J. Kabayo*:** The representative of the PATTEC Coordination Office reported on plans and progress in implementing the PATTEC initiative. A brief reminder was given regarding the main features of the PATTEC initiative (decision of the African Heads of State, principles of the "Plan of Action", activities of the "PATTEC Coordination Office", nature of PATTEC projects).

The current status and the roadmap for the activities of the PATTEC initiative were presented. With the support of the AfDB, the first phase of multi-national tsetse eradication projects has already been initiated involving Burkina Faso, Ghana and Mali in West Africa and in Ethiopia, Kenya and Uganda in East Africa. In the tsetse belt of Angola, Botswana, Namibia and Zambia, project implementation is due to start in May 2006. In June 2007 five more multi-national projects should commence (they should tackle transboundary areas in Rwanda and Tanzania, in Benin, Togo, Niger and Nigeria, in Chad, Central African Republic, Cameroon and Nigeria, in Sudan and Ethiopia and in Senegal, Mali and Guinea).

PATTEC indicated that the expected support and assistance to its actions should come from PAAT members and partners. WHO is requested to continue providing surveys, diagnosis and treatment of sleeping sickness in PATTEC project areas; technical support in tsetse mass-rearing, sterilisation and release is expected from the Joint FAO/IAEA Division, while FAO should assure technical support in project development, land cover monitoring and land use planning. Donors are required to provide financial contributions while regional and international research institutions are requested to support operational research, capacity building, project development and evaluation.

AfDB-supported T&T Intervention: Country Reports

Reports on countries benefiting from AfDB support for T&T intervention were presented by representatives of Burkina Faso, Ethiopia, Kenya, Mali and Uganda (representative from Ghana absent with apologies).

Ethiopia – T. Alemu

The Southern Tsetse Eradication Project (STEP) covers an area of around 25 000 km^2 in the Southern Rift Valley in Ethiopia. The project started in 1997 and its impact on livestock, as perceived by the beneficiaries, includes reduced mortality and abortion, improved livestock body condition and increased animal production. The total cost of STEP was estimated to be US$ 43.8 million, but the resources available initially were sufficient for the first phase only (about US$ 8.9 million). Additional funding was provided by the AfDB as part of the regional PATTEC initiative, with the launching workshop scheduled for 16-17 May 2006 in Awassa. Major components of the AfDB project are tsetse suppression and elimination, capacity building, sustainable land management, and project coordination and management.

For the application of the SIT component of STEP, fly mass-rearing and irradiation facilities were established. The fly population of the insectary recently faced problems of

unknown origin, but since January 2006 the colony size has been increasing. Additional funds for STEP are expected from the Japanese Government through the United Nations Trust Fund for Human Security for a total budget of US$ 1.76 million.

Major challenges for the future are: improvement of the tsetse mass production, sterile male release, availability of a skilled expert team to monitor and guide the application of area-wide insect pest management (AW-IPM), including SAT, manpower development, and increased efficiency with respect to the management and use of structure more focused to an operational SIT-based AW programme. An issue for discussion is the presence of inaccessible field sites (approximately 20 percent of project area), in which SAT may be used. Issues also to be addressed by STEP to properly operate are: the establishment of an appropriate data management and information system for prompt day-to-day decision making, and the identification of partner institutions that can provide assistance in land use management and address environmental issues.

In future, STEP will continue tsetse suppression in agreement with the area-wide concept, expand the tsetse colony, extend baseline data collection to the whole project area and establish a structured monitoring system. The project will also strengthen human resource capacity in the fields of GIS, project management and insectary management.

Burkina Faso – I. Sidibe

The AfDB and the Government of Burkina Faso are finalizing the administrative procedures for the initiation of the AfDB supported project in the country and a request for the first disbursement has been submitted. The ongoing activities related to T&T are supported by the country itself.

Four main components are embodied in the AfDB funded project. The "suppression and eradication" component includes community involvement, baseline data collection and processing, tsetse mass-rearing and serial release of sterile males. The "capacity building" component will focus on the creation of an integrated data information system, the rehabilitation of sub-regional training facilities and the reinforcement of national and regional capacities. The "sustainable land management" component concerns land use planning and institutional strengthening, aimed to guide the agricultural intensification and expansion. Last, the "project coordination and management" component will establish a system for information exchange and coordination between the national Project Coordination and Management Units (PCMU), PATTEC "Focal Points" in each country and the AU/PATTEC Office in Addis Ababa, Ethiopia.

Mali – E. Coulibaly

The tsetse infested area in Mali covers 240 000 km^2 (out of a total country area of 1 241 000 km^2). Since 2001, Mali and Burkina Faso have collaborated in joint T&T intervention activities, with financial and technical assistance provided by IAEA. In Mali, the objective of the project is the elimination of tsetse from an area of 40 000 km^2 around Bamako in the northern Niger River basin; the project foresees the use of SIT. Significant success has been achieved in tsetse suppression using the community based approach.

In February 2005, the loan agreement with the AfDB was signed. Within the AfDB project, elimination of flies over an initial project area of 8 000 km^2 will be attempted

through the release of sterile males. After tsetse surveys, suppression will also be expanded on an area of approximately 32 000 km^2.

Kenya – P. Olet

In Kenya there is a close association between the presence of tsetse and high levels of poverty. Eight tsetse species are present in 92 000 km^2. They are spread across three belts: Lake Victoria Basin, Lake Bogoria Basin and Meru-Mwea. Lake Victoria basin is within the first zone that will be targeted; all five districts in this region were also included in the FITCA (Farming in Tsetse Controlled Areas) project, which ended in 2004. Since there is evidence that flies are recovering in the areas previously targeted by FITCA, the new AfDB funded project will take up control activities over those areas in order to guarantee continuity of intervention.

The first disbursement from AfDB was in April 2006. A Project Coordination and Management Unit (PCMU) and members of the National Steering Committee have been identified. Procurement of equipment (e.g. targets, trypanocides, pesticides, GPS receivers and microscopes) has been approved.

For the full implementation of the AfDB funded project, Kenya has requested assistance from PAAT mandated organisations and stakeholders for a range of programme activities: procurement of GIS software and hardware, creation of a centralized database, training on data processing and analysis (GPS/GIS/remote sensing), identification of priority areas of intervention, formulation of a national strategy for T&T intervention. Assistance is also needed in the fields of fly production and release, and for collection of baseline data in the Lambwe Valley.

Uganda – L. Semakula

In February 2006, the AfDB and the Ugandan Government officially launched the project in South East Uganda. The request for an initial advance of the grant was approved in April 2006, while the loan disbursement had to be revised according to specific categories (the request was officially re-submitted in April 2006). A Contracts Committee to undertake procurement of goods and services has been established and is due to start its work in May 2006. In March 2006, the National PATTEC Coordinator participated in a planning workshop in Kigali, Rwanda, to finalize a regional project proposal on eradication of T&T in the Kagera region of Rwanda and Tanzania.

With respect to capacity building, Ugandan staff participated in a course on baseline data collection organized by IAEA in Nairobi in March 2006; further training activities (i.e. GIS) have also been planned for 2006.

Reports from International Centres and Organizations

Activities of the International Livestock Research Institute (ILRI) under PATTEC Initiative - J. Maitima: Possible contributions of the Institute to the implementation of the PATTEC initiative were presented. ILRI developed significant experience in environmental and socio-economic impact assessments of T&T control strategies, sustainable land management and capacity building, in particular in the fields of RS and GIS. ILRI also

offered its support to national institutes and the PATTEC Office for the development of research activities.

With respect to the environmental and socio-economic impacts assessment, it is important to evaluate pressures on the agroecological systems, their status and response. Cause-effect relationships must be established and appropriate indicators identified with a view to scaling the results obtained up and out. Further information on the development of this work is given later.

In the field of Sustainable Land Management (SLM) a proposal to develop an integrated framework for SLM in PATTEC tsetse freed areas is under discussion with UNEP/GEF (Global Environment Facility). Another proposal investigating the ecological and environmental implications of land use/land cover changes in PATTEC tsetse freed areas is under development for submission to NASA.

SLM should build on approaches similar to those used in some already completed projects like LUCID (Land Use Change Impacts and Dynamics) and TOC (Trajectories of Change). Other approaches could include the survey-based expert opinion and indigenous knowledge system analysis, the spatially based land use/land cover modelling and scenario analysis, the identification and scaling out of best land use, land management practices and the policy analysis.

In the field of training, ILRI plans to hold a GIS training course from 8-26 May 2006.

International Centre of Insect Physiology and Ecology (ICIPE) - R. Saini: An overview was provided on the way in which ICIPE operates and on its potential contribution to the PATTEC initiative.

ICIPE works on four major programme areas: human, animal, plant and environmental health. The core activities of the animal health area aim at increasing livestock productivity by effectively managing tsetse flies and ticks. Ongoing projects are:

- Enhancing the diffusion of new tsetse control technologies for improved livestock health and productivity in smallholder indigenous communities in sub-Saharan Africa (Donor: IFAD; Collaborators: KARI-TRC and ILRI);
- Community based tsetse control in the Mwea National Reserve (Donor: Biovision, Switzerland; Collaborators: Kenya Wild Life Services);
- Tsetse control through adaptive management in Ethiopia (Donor: SDC, Biovision & Helvetas; Collaborators: Regional and National Governments).

As regards potential contributions to PATTEC, ICIPE could provide assistance for ecological studies (dispersal/distribution of vectors), vector suppression, barrier development using baits and repellents (push-pull approach), tsetse mass-rearing, backstopping on R&D activities, socioeconomic studies and capacity building.

The capacity building and institutional development programme of the institute was presented, implemented through the "African Regional Postgraduate Programme in Insect Science" (ARPPIS). Within the ARPPIS programme ICIPE trained over 170 PhD students, over 100 MSc students, 600 veterinary services extension staff and IPM specialists and over 14 000 farmers.

***International Federation for Animal Health (IFAH) – F. van Gool*:** IFAH is an international federation representing manufacturers of veterinary drugs, vaccines and other

animal health products in both developed and developing countries across five continents. The representative of IFAH introduced the mission, priorities and members of the federation.

IFAH corporate members' role in T&T interventions is to guarantee the supply of quality drugs to combat tsetse flies and trypanosomiasis in the most efficient and safest way. IFAH is also committed to providing services such as training of veterinarians, technicians and farmers on diseases, diagnosis, food hygiene and good veterinary practice.

An FAO-IFAH cooperation is currently dealing with the problem of quality control of trypanocidal drugs. A considerable amount of dubious quality and fake trypanocidal and other veterinary drugs are found on the African markets. These compounds are characterised by reduced or lack of efficacy, by toxicity and by unknown/unwanted residues in the food chain and by resistance in pathogens. The FAO-IFAH collaboration also foresees the transfer of generated technology to two analytical laboratories (one in West Africa and one in East Africa) for quality control of veterinary drugs available in Africa. The laboratories will use standardised protocols, methodologies and equipment and will provide continuous training to African technicians. Comparative results between original and non-original drugs were presented.

The IFAH representative concluded his presentation by stressing the urgent need for the African veterinarians and farmers to know exactly the quality of veterinary drugs on the local market. The FAO-IFAH cooperation provides a means to assist African partners in controlling the quality of veterinary drugs locally available and in disseminating the results to all involved stakeholder (regulatory authorities, veterinary services, veterinarians, farmers). This effort should support the African market to provide effective and safe drugs, which in turn will enable livestock owners and marketers to significantly increase animal production and contribute to both food safety and food security.

Reports from National Institutes

T&T Research, Development and Training at CIRAD - S. de la Rocque: An overview was presented of CIRAD (French Agricultural Research Centre for International Development), its activities, human resources and ongoing research programmes, with special emphasis on activities related to the T&T problem.

CIRAD-EMVT has a long experience in T&T research activities. Since 2000, EMTV has joined IRD (Research Institute for Development) to establish a unit working on T&T. The main fields of activity concern vectors and pathogens (population genetics; taxonomy; vector competence; drug resistance), interactions between tsetse/trypanosome/host (epidemiology; trypanotolerance; host specificity; competition; symbionts), risk assessment (diagnosis; risk factors and indicators; prevention; aid for decision making), prevention and control (friendly environmental techniques; trapping protocols; vaccine development).

EMTV is currently involved in a project funded by the Wellcome Trust aiming at understanding the impact of habitat fragmentation on tsetse population dynamics. The project uses environmental and remotely sensed datasets to quantify and qualify the fragmentation of riparian and savannah woodland vegetation. The results are expected to contribute to the development of more effective T&T intervention strategies.

CIRAD-EMVT is also deeply involved in training activities, the most important being the "Certificat d'Études Appliquées Vétérinaires", the DESS in Animal Production in Tropical Countries, the International Training Course in Entomology (Pasteur Institute of Paris), Master of Tropical Diseases (Valencia, Spain), Master of Parasitology (University of

Montpellier II), and the "Master International d'Entomologie médicale et vétérinaire" (Cotonou, Benin).

Animal Trypanosomiasis Research at the Institute of Tropical Medicine - S. Geerts: The T&T research objectives for 2006-2007 of the ITM, which is celebrating its 100th anniversary in 2006, were presented.

Focus is on three main subjects: development and validation of molecular techniques for the detection of drug-resistant trypanosomes, study of the animal reservoir of *T. b. gambiense* and molecular epidemiology and control of trypanosomiasis.

Considering that present tests have a numbers of drawbacks, namely cost and labour intensity, the improvement of drug resistance diagnosis is necessary. The novel technology developed foresees that samples are taken on a filter paper and sent by snail mail to a laboratory; results could be obtained within 2 days. Molecular tools for the detection of drug-resistant trypanosomes are expected to be validated by 2007 and then the technology will be transferred to the affected countries.

A brief overview was also provided on distance learning opportunities at the Universities of Pretoria and Utrecht, in collaboration with ITM. Currently available modules target tropical medicine and animal health.

The difficult financial situation of ITC (International Trypanotolerance Centre, The Gambia), a partner centre of ITM was mentioned. Actions taken to improve the situation included reductions in numbers of staff, animals and field stations. The ITC Council has proposed to merge CIRDES and ITC with a view to creating a stronger livestock research centre in West Africa.

Updates on Specific PAAT Activities

The FAO/PAAT Information System - G.Cecchi: Activities carried out within the framework of the IFAD-funded project "Strengthening the Information System of the Programme Against African Trypanosomiasis (PAAT)" were presented.
The on-line accessibility to PAAT information has been increased. The layout of available tsetse distribution maps has been improved and additional maps have been created and made available, GIS datasets and relevant standard metadata have been published on the PAAT web-site and uploaded in the FAO Geospatial portal (GeoNetwork). The PAAT web site has been fully revised and new pages concerning the disease, vectors, parasite, hosts, remote sensing, land use, environment and donors have been created and incorporated into the web site.

Coordination missions have been made to PAAT Secretariat partners (WHO, IAEA, AU-IBAR), PAAT scientific partners (CIRAD, France; CIRDES, Burkina Faso; ICIPE and ILRI, Kenya; ITM, Belgium) and to the six countries (Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Uganda) implementing Phase 1 of the AfDB-PATTEC initiative. The visits contributed to accelerating the process of harmonization of the respective web-sites and Information Systems and the collection of further GIS datasets. In particular, the visits to the T&T affected countries enabled better assessment of the strengths and weaknesses in national GIS and Information Systems capacities, the main constraint presently being the management of entomological data.

With respect to the collection of baseline datasets for planning and implementing T&T control activities, PAAT-IS proposed the adoption of the FAO/UNEP Land Cover

Classification System (LCCS) as a tool to standardise land cover mapping exercises carried out in the context of the alleviation of the African trypanosomiasis problem. These datasets are essential for planning and monitoring T&T interventions but maps available at national level are not necessarily conceived for the needs of the T&T problem and are often produced using heterogeneous classification systems.

To demonstrate the potential of LCCS, present and future land cover maps compliant with LCCS were illustrated. In particular, one initial attempt to customize the Africover map of Uganda was presented. It is believed that the use of LCCS can foster regional coordination and increase the possibility of using standard land cover products within T&T intervention projects.

Future activities within the IFAD-supported project will include additional coordination visits to PAAT scientific partners (CTVM, Edinburgh University and Glasgow University, UK), the production of a CD-ROM with the updated PAAT web-site and GIS resources and the provision of a tool kit (on-line and on CD-ROM) for training of e-conference moderators.

Issues to be tackled through possible future activities were identified as:

- updating predictive maps of tsetse absence/presence and abundance (e.g. by using entomological datasets collected in a consistent manner by countries benefiting from AfDB financial support);
- producing standard land cover maps for T&T (either through adaptation of existing standard multipurpose datasets or producing new ones);
- supporting human resource development through training on GIS, Remote Sensing and DBMS (Data Base Management Systems);
- backstopping efforts at national level to develop environmental monitoring procedures (land use change, biodiversity, etc.), and guidelines for land use planning and natural resources management (at both national or local levels).

FAO/Pro-Poor Livestock Policy Initiative - T. Robinson: The IGAD (Inter-Governmental Authority on Development) Livestock Policy Initiative (LPI) project and its contribution to the planning of trypanosomiasis interventions in the Horn of Africa were presented. This project aims at strengthening capacity in Member States (Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, Uganda), regional organizations and other stakeholders to formulate and implement livestock sector and related policies that sustainably reduce food insecurity and poverty.

In the context of trypanosomiasis control, the two important policy issues are where to control and how to control. Activities were presented of a project on the "Spatial Targeting of Trypanosomiasis Control", carried out in Uganda in collaboration with COCTU (Coordinating Office for the Control of Trypanosomiasis in Uganda) and ILRI (jointly funded by the Pro-Poor Livestock Policy Initiative [PPLPI] and IFAD). The methodology selected is based on multi-criteria evaluation and it is aimed at generating priority maps for the control of animal trypanosomiasis in the context of poverty alleviation. In a GIS environment, several layers are combined and factors are weighted to identify priority areas for intervention. The input layers used are livestock density, human population density, crop cover, length of vegetation growing period, density of poor livestock keepers and trypanosomiasis risk index. In the future, more layers could be added to the analysis: sleeping sickness data, modelled poverty data, land cover maps, market accessibility and livestock

production systems. Weights are assigned to indexes through pairwise comparisons. In the workshops held in Uganda, the trypanosomiasis risk index, as compared with other indexes, was identified as the single most important criterion for identifying priority areas for intervention, followed by the index of density of poor livestock keepers.

Future steps will concern the development of a multi-objective approach and include a whole set of other determinants, i.e. district-level importance of trypanosomiasis, sleeping sickness risk, willingness to pay (potential benefits), terrain, livestock-wild host ratios, tsetse species associations, degree of isolation of tsetse populations, re-invasion risk, land planning and environmental issues.

***FAO/IGAD LPI - A. Shaw*:** Results were presented of the work carried out under the PPLPI: "Comparable Costing for Alternative Tsetse Control Options: Examples from Uganda".

The core of the presentation concerned the costing of different vector control strategies for Uganda. Of the many possible approaches to dealing with the vector the following were considered: bait technology with insecticide (in this case with traps), bait technology using insecticide-treated cattle (ITC), aerial spraying using fixed wing aircraft and the sequential aerosol technique (SAT) (5 cycles spraying), the use of the sterile insect technique (SIT) after suppression of the fly population by one of the above means. Due to the uncertainties related to the isolation of tsetse populations in Uganda, like in many other countries, both scenarios, i.e. isolated and non-isolated populations, were studied.

In the case of isolated population, the least expensive option to achieve eradication was estimated to be the ITC technique, with an average US$ 250 per km^2 of tsetse infestation; very close values, around US$ 550 per km^2, were estimated for traps and SAT. If SIT is used, either alone or following suppression with others techniques, costs rise up to an average of US$ 1 100/ km^2.

In the case of non-isolated populations, two options for dealing with reinvasion pressure were evaluated:

- intensification of control measures used for clearing tsetse;
- barriers, based on the less expensive technologies (traps in savannah fly areas, alternatively ITC).

In the first scenario, using ITC and traps, the cost per km^2 increases by 11 percent, with the use of SAT it increases by nearly 40 percent, while for SIT the cost grows dramatically and it can be in the magnitude of 500 percent (more than US$ 5 000/ km^2).

In the second and more realistic scenario, barriers can be used to halt reinvasion. In the study presented, barriers are assumed to be kept in place for 3 years and they contribute between 15 percent and 30 percent to the programme cost. In this scenario, the cost of dealing with non-isolated population seems lower. It should be mentioned that the estimated costs consider:

- barriers to be kept in place for 3 years only;
- barriers assumed to be successful;
- re-invasion pressure hypothesized to be exerted only from one side of the area.

The study provides technical options for the elimination of the T&T at various costs and takes also into account sensitivity analysis for contingencies, logistic and field operations.

Further analysis is needed to refine some prices and adjust operational costs (e.g. costs of the use of aircraft, to which SAT and SIT can be very sensitive) and for sensitivity analysis. In addition, it should be considered that the efficacy of tsetse intervention techniques is affected by habitats, fly species and scale of intervention, which in turn impacts the overall cost.

Linking Sustainable Human and Animal African Trypanosomiasis Control with Rural Development Strategies - P. Cattand: The draft document of this PAAT position paper dealing with a logical framework for integrating AAT and HAT in the global effort as delineated in the Millennium Development Goals (MDG) was presented. The paper also integrates T&T in the general context of improved human health, better livelihoods, reduced poverty and increased food security.

Food security in Africa has substantially worsened since 1970. The proportion of malnourished individuals in sub-Saharan Africa has remained in the range of 33–35 percent, but the absolute number of malnourished people has increased substantially with population growth, from 88 million to over 200 million in 2001. UN MDGs stipulate that development should focus on eight points, each goal to be achieved by 2015. T&T control will contribute to many of these goals, among which are:

- to eradicate extreme poverty and hunger;
- to combat HIV/AIDS, malaria and other diseases;
- to develop global partnership for development (e.g. in cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries).

With the support of the International Monetary Fund and the World Bank, T&T affected countries produced national Poverty Reduction Strategy Papers (PRSP). With the exception of a few countries, the T&T problem is not included in these documents; hence it is essential to continue to inform national governments on the impact of T&T on the rural development of sub-Saharan Africa and insert actions against trypanosomiasis as a component of the national strategies for poverty reduction.

Guidelines for Declaring Areas Free of Tsetse Flies and Tsetse-transmitted Trypanosomiasis – a new proposed PAAT Technical and Scientific Series Paper – U. Feldmann: No internationally accepted guidelines exist regarding a sequence of agreed veterinary and entomological screening criteria that need to be met for declaring an area free of tsetse flies and trypanosomiasis.

A draft of a paper which aims at setting such guidelines and criteria was introduced. The approach consists of a series of parasitological, serological and entomological screening activities used in a phased process (*ante*, *intra* and *post* completion of integrated area-wide intervention measures) to assess the absence of flies and parasites and thus declare the area free. The methodology used follows the general principles developed by OIE for declaring an area free of rinderpest.

T&T intervention can be discontinued when the criteria established for declaring the area "provisional T&T free" are met. This is followed by two post-intervention phases of monitoring of different intensity. If during these two post-intervention phases evidence is obtained on the existence of cyclical trypanosome transmission, or if any adult fly of the target population is trapped, a re-initiation of intervention activities will result. If the veterinary and entomological monitoring activities during both post-intervention phases are conducted properly, and result in no evidence for trypanosome transmission and evidence of tsetse absence, a "declaration of freedom from tsetse flies and the trypanosomosis problem" can be made. The paper provides full details on the techniques and probability models to be used in the different phases of the monitoring and surveillance activities.

A spreadsheet was also presented which guides determining how many traps or how many trapping days are needed to reach a given level of confidence in declaring the area free of tsetse.

General discussion

During the round-table discussion, attention concentrated initially on the comparative costs of tsetse control options. The analysis presented is based on a model, which assumes that all control options compared will eventually result in the complete removal of the target tsetse species. The model aims at illustrating how tsetse elimination can be achieved using various techniques implying variations of costs, with SIT as the most expensive one. Both the necessity of the SIT in all circumstances for tsetse elimination, as well as the applicability of such a model for the complex decision making on practical tsetse control options were questioned.

Kenya was congratulated for taking into consideration the previous FITCA experience in the implementation of the new AfDB project. This approach of learning from past experience was recommended to other countries. A matter of concern was the little attention devoted to biotechnology applied to T&T, tsetse biology, diagnosis and environmental issues. It was recommended to include these activities in the AfDB funded projects.

Another neglected aspect was the development of rural communities and with this, the final objective of assisting rural populations through education and development activities.

Concerning HAT, the participants were reminded that control activities are ongoing in some endemic countries (e.g. Guinea and Côte d'Ivoire) and the important progress made since 1999 in developing control programmes was emphasised.

The meeting expressed its concern on epidemiological changes linked to anthropogenic activities in some areas. In the case of the reintroduction of white rhinoceroses into Matusodona Game Reserve in Zimbabwe, all these animals died of trypanosomiasis due to loss of resistance caused by being bred in captivity without contact with tsetse flies. Another example reported was the cotton belt in West Africa where heavy use of insecticides has had the effect in reducing tsetse populations. The use of insecticides is now being discouraged, due to environmental pollution and the introduction of new varieties of cotton more resistant to disease. This may result in an upsurge of tsetse fly populations.

Discussion on Training Needs of Affected Countries

Participants agreed to evaluate the real impact of training: in this respect, feedback on the recently held training courses should be provided by national PATTEC Coordinators.

Participants were reminded that the United States Department of Agriculture (USDA) is willing to provide 6-months training to young field officers on the principles of tsetse mass rearing.

Training in community participation should also be provided to rural communities to stimulate their active participation in field T&T activities.

Additional training should address:

- GIS technology on three different levels:
  - field level, to collect geo-referenced information and insert it into a database;
  - project office level, to summarise data and produce reports
  - higher level, to design databases and complex data analysis.
- data management (processing and analysis);
- planning of T&T intervention;
- technology transfer and introduction and adoption of new improved technology;
- sustainable capacity building/human resources development.

Recommendations

The following recommendations were formulated.

1. On training and human resource development:

- to develop training modules at various levels for personnel and communities involved in T&T field intervention activities.

Action: PATTEC.

- to improve networking and coordination of training activities among the AfDB beneficiary countries.

Action: PATTEC, beneficiary countries, PAAT, research institutes.

2. On the PAAT Information System:

- to continue and further expand the PAAT-IS resources.

Action: PAAT.

3. On investments to model tsetse populations:

- to enhance GIS applications to facilitate planning, decision making and progress assessment.

Action: Donors, PATTEC, beneficiary countries, PAAT, research institutes.

4. Prior planning of interventions:

While acknowledging the existence of baseline datasets in AfDB benefiting countries and the availability of guidelines and strategies for designing T&T field intervention programmes,

prior to the planning and implementation of standardised baseline data collection the following steps are essential:

- a thorough screening of existing information;
- the efficient use of existing guidelines and strategies for designing T&T field intervention programmes in the AfDB beneficiary countries;
- the transfer to digital format of datasets which are still in paper format

Action: PATTEC, beneficiary countries, assisted by PAAT.

5. On overcoming certain weakness in communication flow:

- all partners make an effort to ensure efficient exchange of information amongst one another, making optimal use of existing dissemination pathways, in particular the PAAT-IS.

Action: all PAAT partners and stakeholders, PATTEC.

6. As follow up to its support for the IGAD Livestock Policy Initiative project:

- to include policy issues related to trypanosomiasis control in the Greater Horn of Africa within the IGAD-LPI project activities.

Action: IGAD-LPI.

7. On HAT Control Activities:

As follow up to the 11th Meeting of the Panel Advisory Group Coordinators of PAAT, held in Addis Ababa, 21-22 September 2005 which encouraged WHO to strengthen control activities to consider HAT as a disease candidate to be eliminated, it is essential:

- to ensure the involvement of MoH in PATTEC project elaboration in order to guarantee that HAT control is included in PATTEC operations.

Action: National coordinators of AfDB beneficiary countries.

8. With reference to the recommendation of the 28th ISCTRC conference in Addis Ababa (September 2005):

- All partners and stakeholders of the ISCTRC should provide feedback to the ISCTRC Secretariat on the progress of the implementation of the 28th ISCTRC recommendation as soon as possible.

Action: beneficiary countries, PAAT, PATTEC, FAO, IAEA, WHO, research institutes.

9. Acknowledging the progress made in producing guidelines in the form of position papers:

- to disseminate to an appropriate audience and thus provide feedback to the two draft PAAT position papers ("Linking Sustainable Human and Animal African Trypanosomiasis Control with Rural Development Strategies", "Guidelines for

Declaring Areas Free of Tsetse Flies and Tsetse-transmitted Trypanosomiasis") and to the PPLPI working paper "Comparable Costings of Alternatives for Dealing with Tsetse: Estimates for Uganda".

- in the case of the paper dealing with declaring areas free of T&T, to complement it with a simple guide for field implementation.

Action: beneficiary countries, PAAT, IAEA.

10. With respect to research activities:

- to adapt the programmes of research institutes to service the requirements of the AfDB beneficiary countries.

Action: CIRAD, ICIPE, ILRI, ITM.

11. Recognizing the importance of applied field research in T&T and related subjects:

- to take advantage of AfDB funded projects to identify and carry out demand driven research.

Action: donors, research institutes, beneficiary countries, PAAT, PATTEC.

12. Acknowledging the support of IFAD and UNIDO to PAAT:

- to further strengthen the inter-Agency (PAAT mandated organisations / IFAD /UNIDO) collaboration;
- to advance implementation of the cooperation with IFAH on quality control/quality assurance of trypanocides and other veterinary drugs;
- to extend partnership with the private sector in the field of both human and animal trypanosomiasis.

Action: PAAT, IFAD, UNIDO, IFAH.

Closing

Ms Alice Perlini, DG of IAO, thanked all participants for attending the meeting. She expressed IAO interest in being informed about the follow-up from the PAAT PC meeting, considering the common goal of alleviating poverty, improving socio-economic conditions in the developing world through technical and scientific collaboration. She declared the meeting closed.

The next PAAT-PC meeting will be held at the WHO Headquarters in Geneva in April or May 2007.

31ST ISCTRC EXECUTIVE COMMITTEE MEETING, ADDIS ABABA, 25-26 SEPTEMBER, 2006

Report and Recommendations

1. On Strengthening the ISCTRC:

The Committee noted with appreciation the good work done by the consultants who were tasked by the AU/IBAR to review the ISCTRC and to recommend actions needed to strengthen it. The Committee noted that the report presented by the consultants contained information necessary for revitalising and reshaping the ISCTRC to respond to the demands of the present and of the future. The Committee adopted the report and recommends to the AU:

- To consolidate this achievement through the initiation of a 3-year Action Plan aimed at strengthening the ISCTRC using the Report as a guide;
- To engage major stakeholders both within and without the African Union in the implementation of the 3-year Action Plan.

2. On the Organization of the 29th ISCTRC Conference:

The Committee noted with appreciation the progress made by the National Organising Committee of Angola for the organization of the 29th ISCTRC conference. The Committee however noted that concerns raised by some observers on issues such as communication, costs of accommodation and problems related to obtaining an Angolan visa needed to be taken seriously. The Committee recommends to the AU and to the NOC:

- To jointly identify the major problems likely to hamper the organization of the conference in Angola and to address them as soon as possible;
- The Committee endorsed the dates chosen for the meeting by the NOC: i.e. 17-21 September 2006.

3. On Capacity Building:

The Committee noted with appreciation the increasing commitment and input being made by the WHO/TDR and WHO/NTD to capacity building for greater efficiency in the control of HAT and recommends:

- That WHO sustains the support given to the capacity building initiatives;
- That countries and international organisations:
    - harmonize all T&T capacity building activities;
    - take stock of available expertise within the region that can contribute to this initiative and this information needs to be availed to those in need; and
    - source funding for these activities.

4. On ISCTRC Proceedings:

The Committee noted with appreciation the timely publication of the proceedings of the 28th ISCTRC conference. It however noted that their production and distribution still pose difficulties. The Committee recommends to the AU:

- To consider increasing circulation of proceedings of the ISCTRC meetings in the form of electronic copies;
- To create a website for the ISCTRC to enable easy access to publications and other information emanating from the Secretariat;

- To form a scientific committee that would restructure the conference and offer advice to potential presenters so as to make the conferences more productive. It was proposed that a committee comprising Dr Grace Murilla, Dr Solomon Haile-Mariam, Dr Modibo Troaré, Mr Francis Oloo, Dr Saini Rajinder and Prof. Josenando should be assigned this responsibility.

On PATTEC:

The Committee noted with appreciation the significant progress made by PATTEC in the last year regarding resource mobilisation, awareness creation and greater participation. The Committee, however, noted with concern that expertise needed to carryout efficient field operations was inadequate. The Committee recommends to PATTEC:

- To carry out training needs assessments for participating countries;
- Initiate actions to address manpower deficiencies in participating countries.

On Private Sector Participation:

The Committee noted the increasing demand for tsetse control/eradication in Africa and realised with concern the budgetary constraints faced by most governments to directly support these operations through state budgets. The Committee recommends to member countries:

- To create an enabling environment that would encourage private sector participation in tsetse and trypanosomiasis control to complement Government effort.
- To put mechanisms in place to monitor and regulate the activities of the private sector to ensure sustainability.
- To take measures to ensure effectiveness, ownership and sustainability of T&T control/eradication.

BOOK PUBLICATIONS

Disease Control Priorities in Developing Countries, 2nd Edition

Editors: Jamison, D.T., Bremen, J.G., Measham, A.R., Alleyne. G., Claeson, M., Evans, D.B., Jha, P., Mills, A. & Musgrove, P., 2006. The International Bank for Reconstruction and Development, The World Bank and Oxford University Press. ISBN: 10 0-8213-0821361791; eISBN: 0-8213-6180-5.

Six hundred public health and policy experts from more than 100 countries contributed to the data sources and methodologies and identified challenges and priorities, resulting in an integrated, comprehensive reference volume of 1450 pages on the state of health in developing countries. Based on careful analysis of health systems and the costs of the burden of disease, the 73 chapters of *DCP2* highlight achievable priorities; measure progress toward providing efficient, equitable care; promote cost-effective interventions to targeted populations; and encourage integrated efforts to optimize health.

The first part of the book provides a summary of cross-cutting themes and includes such topics as: priorities for global research and development of interventions, science and technology for disease control, product development priorities, cost-effectiveness of interventions, and lessons from experience in improving the health of populations. In its subsequent chapters, the book deals in detail with subjects like fiscal policies and financing health systems in the 21st century, ethical issues, cost-effectiveness analysis for priority setting etc., and then moves on to the issue of selecting interventions covering in some detail the principal diseases affecting humans in developing countries ranging from cancer, diabetes and mental health through to malaria, leprosy and vaccine preventable diseases.

Of particular interest to readers of TTI is chapter 23 written by Cattand *et al.,* dealing with Tropical Diseases Lacking Adequate Control Measures: Dengue, Leishmaniasis and African Trypanosomiasis (see Abstract 13605 of this issue).

The book then goes on to deal with risk factors such as water and sanitation, alcohol, tobacco addiction and smoking, and finally over the course of some 20 chapters deals with the need/requirements for strengthening health systems.

In the Editor's view, while there is relatively little direct coverage given to tsetse and trypanosomiasis, this book (cost $125 but available at a discount of 75 percent to most African countries) is a "must read" for anyone involved in the subject at policy, institutional or science and technology levels and whether they be interested in the medical or animal health dimensions of the problem since it contains such a wealth of information and knowledge on so many aspects of disease control in developing countries.

Global Burden of Disease and Risk Factors

Editors: Jamison, D.T., Bremen, J.G., Measham, A.R., Alleyne. G., Claeson, M., Evans, D.B., Jha, P., Mills, A. & Musgrove, P., 2006.. The International Bank for Reconstruction and Development, The World Bank and Oxford University Press. ISBN: 0-8213-6262-3.

This book (6 chapters and 552 pages; price $65) emerges from two separate, but intersecting, strands of work that began in the late 1980s, when the World Bank initiated a review of priorities for the control of specific diseases. The review generated findings about the comparative cost-effectiveness of interventions for most diseases important in developing countries. The purpose of the cost-effectiveness analysis (CEA) was to inform decision making within the health sectors of highly resource-constrained countries. This process resulted in the publication of the first edition of *Disease Control Priorities in Developing Countries (DCP1).*

Also important for informing policy is a consistent, quantitative assessment of the relative magnitudes of diseases, injuries, and their risk factors. *DCP1* included an initial assessment of health status for low- and middle-income countries as measured by deaths from specific causes; importantly, the numbers of cause-specific deaths for each age-sex group were constrained by the total number of deaths as estimated by demographers. This consistency constraint led to downward revision of the estimates of deaths from many diseases. These two strands of work-CEA and burden of disease-were further developed during preparation of the *World Development Report 1993: Investing in Health*. This report drew on both the CEA work in DCP1 and on a growing academic literature on CEA. In addition, the World Bank invested in generating improved estimates of deaths and the disease burden by age, cause, and region for 1990. Over the past six years, the World Health

Organization has undertaken a new assessment of the global burden of disease for 2000-2. The World Health Organization has also invested in improving the conceptual, methodological, and empirical basis of burden of disease assessments and the assessment of the disease and injury burden from major risk factors.

During 1999-2004, the authors of this volume and many collaborators from around the world worked intensively to assemble an updated, comprehensive assessment of the global burden of disease and its causes. The *Global Burden of Disease and Risk Factors* is the definitive, scientific account of these efforts and of the health conditions of the world's population at the beginning of the 21st century. This book includes a full account of methods, the complete results of recent work, and an assessment of trends for total mortality and for major causes of death among children under five. In addition, two chapters cover sensitivity and uncertainty analyses in relation to a broad range of potentially important parameters.

Priorities in Health

Editors: Jamison, D.T., Bremen, J.G., Measham, A.R., Alleyne. G., Claeson, M., Evans, D.B., Jha, P., Mills, A. & Musgrove, P., 2006. The International Bank for Reconstruction and Development, The World Bank and Oxford University Press. ISBN: 0-8213-6260-7.

This 212–page book (the third in the DCP Series and costing $10) begins by dealing with accomplishments, challenges and priorities and then through a series of three chapters deals with cost-effective analysis and strategies for reducing disease burdens. Following chapters on providing interventions and pillars of health systems, it then provides a blueprint for action.

The book as a whole demonstrates that delivering efficacious and inexpensive health interventions leads to dramatic reductions in mortality and disability at modest cost. Globalization has been diffusing the knowledge about what these interventions are and how to deliver them. The pace of this diffusion into a country–more than its level of income–determines the tempo of health improvement in that country.

Also, two overarching themes emerge from the extensive research and analyses: (a) current resources can yield substantial health gains if knowledge of cost-effective interventions were applied more fully; and (b) additional resources are needed in low-income countries to minimize the glaring inequities in health care. Such resources would provide highly-effective interventions, expand research, and extend basic health coverage to more people.

Proceedings of an International Conference on Livestock Agriculture in West and Central Africa

The Proceedings of this 4-day Conference which was held in November 2004 in Banjul; The Gambia, were recently published in electronic (pdf) format. The Conference was jointly organized by the two sub-regional livestock research Centres, the International Trypanotolerance Centre (ITC) in The Gambia and the Centre International de Recherche-Développement sur l'Elevage en zone Subhumide (CIRDES) in Burkina Faso, in partnership with the Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands, and with support from the European Union. It was attended by over 110 participants from 13 West and Central African countries (Benin, Burkina Faso, Cameroon,

Chad, Gambia, Ghana, Guinea, Guinea Bissau, Mali, Niger, Senegal, Sierra Leone, Togo), four European countries (Belgium, France, Germany, UK), from regional and international institutions (CIRDES, CTA, IFPRI, ILRI, ITC) and organisations (CORAF/WECARD, ECOWAS, EU, FAO, FARA, IDRC, UEMOA, UNDP).

The programme was structured in a way that combined the broader past, present and future issues of livestock agriculture with the specific research and development aspects and lessons learnt from the EU-funded regional '*Programme Concerté de Recherche-Développement sur l'Elevage en Afrique de l'Ouest*' (PROCORDEL), as a possible model for future livestock-based R&D for the region.

The main objective was to bring a re-focus to Livestock Agriculture in Sub-Saharan Africa with emphasis on West and Central Africa (WCA) in the context of overall developments in the region. Its specific objectives and intended outputs included:

- Sharing experiences, knowledge and information accrued from various external donor-supported projects and national government efforts in the past 25 years;
- Review and assess the achievements of the latest EU-funded regional Project PROCORDEL executed in 13 countries in West Africa, as a model for future livestock-based R&D for the region;
- Identify new, and strengthen existing communication links among the donor community, other stakeholders and producers, processors and marketers in the region as a means of improving policy dialogue, planning and resource mobilization;
- Identify communication and information tools and resources that will ensure sustainability in dialogue among various actors / stakeholders involved in the development of livestock-based agriculture;
- Concrete policy and biological research and development guidelines as a basis for articulating long term R&D strategies that address the priority needs of stakeholders of the region.

The Conference also provided an overview on the background and achievements of PROCORDEL in the sub-region, with the possible avenues for out and up scaling the results of the regional project, namely on:

(a) Development of the dairy sector; (b) zoonoses, food safety and public health aspects of livestock production; (c) advances in diagnostics and epidemiological studies; (d) livestock breeds, breeding practices and producer preferences - including the important place of trypanotolerant ruminant livestock; (e) effects of policy reforms and performances of livestock; (f) natural resources management and intensification of agriculture; and (g) communication, training and regional dialogue.

The 150-page document can be accessed and downloaded from the websites of CIRDES, CTA and ITC (e.g.: www.itc.gm/Downloads/BanjulIntConfLivestockWCA.pdf).

DATA RESOURCES FOR TSETSE RESEARCHERS

Considerable raw data are freely available to researchers interested in the performance of fabrics and traps for tsetse and biting flies at http://www.nzitrap.com. Through the link "Resources for Researchers" on the home page, public access has been provided to several major data sets in Excel and/or ACCESS. Although there is a minimum of annotation, several guides to the raw information are provided in WORD documents, e.g. a guide to suitable fabrics with relevant comparisons, a quality assurance guide to standard phthalogen blue fabrics, and a guide to the data collected to date in standardized trials of Nzi traps. A bibliography of over 4 000 references has also been provided in both ENDNOTE and text formats. Of particular interest is the large database of raw reflectance and transmission spectra for fabrics, netting and other materials in EXCEL. Steve Mihok, 388 Church Street, Russell, Ontario, Canada K4R 1A8, smihok@rogers.com .

RECENT RESEARCH AND GUIDELINES DEVELOPED BY ILRI AND PARTNERS

Irungu, P. *, Bett, B., Mbogoh, S.G., Nyamwaro, S.O. and Randolph, T.F. (2006). Utilizing conjoint analysis to evaluate farmers' preference for tsetse repellent attributes in Kenya: An ordered probit application. Published in Proceedings of the 10th KARI Biennial Conference held at the KARI Headquarters, 13-17th November 2006.

Ninety-four pastoral cattle keepers were interviewed in Kajiado and Narok Districts of Kenya between December 2005 and February 2006. The objective of the interview was to evaluate the cattle keepers' preference for the attributes of a new tsetse fly repellent that is in its final stages of development at the International Centre for Insect Physiology and Ecology (ICIPE). This study used the conjoint analysis technique to elicit farmer preferences. An ordered probit model was applied to the data to estimate the choice probabilities. Results indicate that farmers preferred long-acting repellent collars and were willing to pay more relative to improved ease of use. Farmer preferences for repellent attributes were influenced by education level, age and wealth status of the household heads and the District in which they were located. Implications of the results for commercial developers seeking to mass-produce and disseminate the new repellent technology are discussed.

Irungu P.*, Bett, B., Mbogoh, S.G., Nyamwaro, S.O., Murilla, G.A. and Randolph, T.F. (2006). Evidence of extra-label usage of veterinary drugs in cattle in Maasailand, Kenya. Published in Proceedings of the 5th Faculty of Veterinary Medicine Biennial Conference held at the College of Agriculture and Veterinary Sciences, University of Nairobi, 6-8th September 2006.

The extent of farm-level extra-label drug use in Kenya is not well documented in spite of its important implications for food safety, human health and international trade. One hundred thirteen farmers in Kajiado and Narok Districts were interviewed between October 2005 and February 2006 using a pre-tested questionnaire. The aim was to gather information on farmer veterinary drug use practices at the farm level. Descriptive and regression analyses were performed. There was a high level of extra-label usage of veterinary drugs in cattle in the two study areas. Specifically, farmers used the wrong drugs to treat some cattle diseases. They

also used lower than recommended doses of all available trypanocides in all classes of cattle except in adult bulls, which they overdosed with Veriben®, Novidium® and Tryzan®. Adamycin®, the most commonly used antibiotic in the two study sites, was under dosed at all concentrations in all classes of cattle. Except for Novidium® which farmers dissolved correctly, farmers in both study sites used less than the recommended volume of water to prepare trypanocides. Farmers also used less than the recommended strength of acaricides for tick control, except for Dominex®. They also sprayed more cattle at each acaricide strength than the number recommended by the manufacturers. The propensity to use veterinary drugs correctly was positively correlated to farmer's age and District of origin ($p<0.1$), but negatively associated with years of formal education of the household head ($p<0.05$). Policy suggestions are made based on the results.

*Corresponding author Email: p.irungu@cgiar.org.

Bett B. *, Irungu P., Nyamwaro S., Murilla G., Olet P., Kitala P., Gathuma J., Randolph T.F., & McDermott, J. 2006. Evaluating the effectiveness of a synthetic tsetse repellent technology developed for tsetse and trypanosomosis control in Kenya. Published in Proceedings of the 5th Faculty of Veterinary Medicine Biennial Conference held at the College of Agriculture and Veterinary Sciences, University of Nairobi, 6-8th September 2006. [Paper to be published in Bulletin of Animal Health and Production in Africa].

A field trial was carried out in purposefully selected pastoral areas in Narok and Kajiado districts, Kenya to evaluate the effectiveness of a synthetic tsetse-repellent technology developed for tsetse and trypanosomosis control. The technology is made up of a repellent (guiaicol + carbon) emitted from dispensers attached to a collar worn around the necks of cattle. The technology is applied to all animals in a herd to ensure protection, possibly in conjunction with traps/targets in a strategy referred to as "push-pull" tactic.

The trial used a total of 24 randomly selected pastoral cattle herds. The sample size was estimated assuming an error of 5 percent and intra-herd correlation coefficient of 0.07 and that the repellent technology, if effective, would reduce the incidence of trypanosomosis in treated herds by at least 50 percent. The study was conducted over a period of 12 months preceded by a baseline period of 4 months. All the animals in the recruited herds were screened for trypanosomosis on a monthly basis using the buffy coat technique. Tsetse challenge (measured at the village-level), grazing patterns, status of the repellent dispenser and the amount of trypanocides used per herd by the stock owners were monitored as well. Trypanosomosis incidence was the main outcome indicator of effectiveness.

*Corresponding author Email: b.bett@cgiar.org

Environment and Socio-economic Impacts Assessment of T&T Interventions

Environmental and socio-economic impact assessment on T&T interventions has in the past been conducted on a project by project basis in many countries without a general framework and methodological guidelines for doing so. The methods used to assess have therefore varied both in approaches and methods such that there are inconsistencies in the content of assessment reports. Such results are not comparable between project areas and countries even though the issues being assessed are the same. The PATTEC project being continental wide and applying area-wide approaches across national boundaries, tsetse belts and ecological

zones and being funded centrally will more than before require standardized approaches and methodologies.

The existence of a general framework and a methodological guide would not only standardize the approaches and methods but also inform both the decision makers and project implementers on areas and issues to consider in targeting assessments of the benefits achieved through the expected T&T interventions.

The need to have such a framework and guidelines was made clear in a needs assessment workshop held in ILRI in February 2005 and attended by AU-PATTEC Coordinator, AU-IBAR, United States State Department, Coordinators of country PATTEC projects in Burkina Faso, Ethiopia, Ghana, Kenya, Uganda and Mali as well as the stakeholders involved with research on trypanosomosis control. It was considered necessary to identify these needs from the project practitioners themselves so that the framework and guidelines developed can be articulate and practical. Following this meeting, the following needs were identified:

- A standard methodological guide for environmental and socio-economic impacts assessments that is applicable in the varied ecological and social backgrounds;
- Tools to analyze and demonstrate socio-economic impacts and outcomes of tsetse control interventions that will produce results acceptable to all T&T stakeholders;
- A framework for identifying the environmental and socio-economic changes to serve as an early warning system for short term and long term impacts.

Key observations made by stakeholders in this consultative meeting included:

- That the problems reported by different countries are general enough to be replicated.
- That the indicators (both social and environmental) should look at the tradeoffs in welfare, natural resources, socioeconomics, and livelihoods.

Decisions made at the meeting:

- To synthesize methodologies used in the assessment of environmental and social impacts of tsetse control.
- In consultation with subject specialists develop indicators of environmental, social and economic changes in tsetse eradication areas.

Following this consultative meeting and receipt of financial support from the United States State Department, ILRI completed the development of the framework and the methodological guide for T&T interventions. Initially the guidelines were targeted for the first phase of PATTEC project countries which include: Burkina Faso, Ethiopia, Ghana, Kenya, Uganda, and Mali. However, they can be used in any other tsetse control/ eradication area in sub Saharan Africa.

Drafts of these two documents were discussed at a stakeholders meeting held in ILRI in November 2006. The purpose of the meeting was to share the drafts with the stakeholders to make sure that the contents met their expectations and will be useful to them. The meeting made some very useful suggestions that will make the documents more applicable in impact assessments.

It is anticipated that the final framework and the guidelines will be ready for use by countries by February 2007.

SECTION B – ABSTRACTS

1. GENERAL (INCLUDING LAND USE)

13601. **Bernardi, M., Gommes, R. & Grieser, J., 2006.** Downscaling climate information for local disease mapping. *Parassitologia*, **48** (1-2): 69-72.

Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00153, Rome, Italy. [michele.bernardi@fao.org]

The study of the impacts of climate on human health requires the interdisciplinary efforts of health professionals, climatologists, biologists, and social scientists to analyze the relationships among physical, biological, ecological, and social systems. As the disease dynamics respond to variations in regional and local climate, climate variability affects every region of the world and the diseases are not necessarily limited to specific regions, so that vectors may become endemic in other regions. Climate data at local level are thus essential to evaluate the dynamics of vector-borne disease through health-climate models and most of the times the climatological databases are not adequate. Climate data at high spatial resolution can be derived by statistical downscaling using historical observations but the method is limited by the availability of historical data at local level. Since the 1990s, the statistical interpolation of climate data has been an important priority of the Agrometeorology Group of the Food and Agriculture Organization of the United Nations (FAO), as they are required for agricultural planning and operational activities at the local level. Since 1995, date of the first FAO spatial interpolation software for climate data, more advanced applications have been developed such as SEDI (Satellite Enhanced Data Interpolation) for the downscaling of climate data, LOCCLIM (Local Climate Estimator) and the NEW_LOCCLIM in collaboration with the Deutscher Wetterdienst (German Weather Service) to estimate climatic conditions at locations for which no observations are available. In parallel, an important effort has been made to improve the FAO climate database including at present more than 30,000 stations worldwide and expanding the database from developing countries coverage to global coverage.

13602. **Bowman, D.D., 2006**. Successful and currently ongoing parasite eradication programmes. *Veterinary Parasitology*, **139** (4): 293-307.

Department of Microbiology and Immunology, College of Veterinary Medicine, Cornell University, Ithaca, NY 14850, USA. [ddb3@cornell.edu]

The eradication of parasitic diseases is not a new concept. The most successful programmes of parasite eradication have occurred with species of veterinary importance. The first such program, the eradication of Texas Cattle Fever from the United States, is one of the

great success stories of disease eradication. The American screwworm eradication programme is ongoing and is serving as a guiding impetus for many of the ongoing or proposed vector eradication schemes around the world. The success of these programmes prompted similar successful operations in human health. Although they once led the way, veterinary parasitologists have taken second place in eradication planning. The only three parasitic diseases of veterinary importance that have been targets of recent eradication programs are Hypoderma species in Great Britain and Europe, *Cochliomyia hominivorax* after its introduction into Libya from the Americas, and *Echinococcus granulosus* in Tasmania, Australia. There is also work on the eradication of the tick, Amblyomma variegatum, from the Caribbean Islands. Some animal diseases are targeted under the auspices of the human eradication programs, most notably the eradication of the tsetse fly from parts or all of Africa. This paper reviews some of the past or ongoing successful eradication programs and presents a brief summary of the history of the programmes, the methods used or planned, and potential controversies surrounding their success and implementation.

13603. **Brun, R. & Balmer, O., 2006.** New developments in human African trypanosomiasis. *Current Opinion in Infectious Diseases*, **19** (5): 415-420.

Swiss Tropical Institute, Parasite Chemotherapy, Basel, Switzerland. [reto.brun@unibas.ch]

This paper reviews recent literature on human African trypanosomiasis, focussing on genome sequencing, diagnosis and drug discovery, and typing of trypanosomes. The most important recent development has been the completion of the *Trypanosoma brucei* genome which will greatly facilitate the discovery of new drug targets and genetic markers. Correct staging of the disease is of key importance for treatment. The analysis of sleep patterns is a promising new method to this end and has advanced enough to begin thorough clinical trials. In terms of novel drug candidates, dicationic molecules show the most promise with one oral diamidine in phase 3 clinical trials. New targets and classes of molecules which show *in vitro* trypanocidal activity are also described. Two new methods - MGE-PCR and microsatellites - allow analyses without parasite cultivation, eliminating a major impediment to efficient sampling for population studies. The finding that several wild animal species harbour *T. b. gambiense*, and that parasite transmission is efficient even from very low parasitaemias, sheds a new light on the importance of animal reservoirs. The use of *T. brucei* as a model system for molecular and cell biology is regularly producing new technologies exploitable for diagnosis and new drugs. Drug discovery and development have experienced a revival through new public-private partnerships and initiatives. The challenge remains to translate this progress into improvements for affected people in disease endemic areas.

13604. **Brunet, B., La Ruche, G. & Gastellu-Etchegorry, M., 2006.** Evaluation of the pertinence of international courses on human African trypanosomiasis. *SantéPublique*, **18** (2): 323-332.

Ministère de la Santé, Direction départementale des affaires sanitaires et sociales du Val-d'Oise 2, avenue de la Palette, 95011 Cergy-Pontoise, France. [benebrunet@hotmail.com]

The goal of this study was to evaluate the adequacy and relevance of a training course on Human African Trypanosomiasis, targeted to reach support and coordination staff in charge of activities being carried out in related prevention and control programmes. A questionnaire was e-mailed to the four course organizers and the 65 participants. The response rate among the participants was 41 percent. The training needs expressed covered issues such as treatment, diagnostic and epidemiological techniques, improved knowledge of the disease, and control planning. The lectures given were adapted for participants' professional activities. At the time of the evaluation (one to three years after the course) 67 percent of the participants had begun implementing the knowledge they had acquired and applying it to their practice, particularly in the area of programme planning. The analysis of the questionnaire's results pointed to the sections of the course that would benefit from modifications, such as the need for the development of lessons and modules in the areas of patient management and planning for future training sessions.

13605. **Cattand, P., Desjeux, P., Guzmán, M.G.,Jannin, J., Kroeger, A., Medici, A., Musgrove, P., Nathan, M.B., Shaw, A. & Schofield C.J., 2006.** Tropical diseases lacking adequate control measures: dengue, leishmaniasis, and African trypanosomiasis. In: Jamison, D.T., Bremen, J.G., Measham, A.R., Alleyne. G., Claeson, M., Evans, D.B., Jha, P., Mills, A. & Musgrove, P., (eds.,), *Disease Control Priorities in Developing Countries, 2nd Edition*. International Bank for Reconstruction and Development, The World Bank and Oxford University Press. pp.451-466.

For dengue, leishmaniasis, and African trypanosomiasis, the longstanding problem is the lack of adequate specific treatment. For dengue, no specific treatment is available. For the leishmaniases and African trypanosomiases, specific treatment has long depended on antiquated drugs that would be considered far too toxic for introduction under modern registration systems. Even though progress is being made, especially in relation to the development of new oral drugs for leishmaniasis, in purely pragmatic terms what is currently available will probably represent almost the entire therapeutic arsenal for the coming decades. Even without toxicological problems, the development and registration of a new candidate drug will, given current requirements, take at least a decade. Although basic research will continue, the current challenge is to make better use of what is already available. Dengue can be prevented with available vector control tools and strategies designed to reduce the risk of transmission. This method requires a sustainable surveillance system capable of providing early warning and predictions based on experience of factors predisposing to new epidemic outbreaks. To a large extent, it becomes a management exercise that accepts that some dengue transmission will occur but aims at pre-empting epidemic outbreaks rather than instigating emergency measures after an outbreak is in full crudescence. Moreover, because pre-emptive measures and emergency responses are competing strategies, analyses of their relative cost-effectiveness would be appropriate. Case finding and treatment for the leishmaniases and African trypanosomiases depend on the effectiveness of the diagnostic and treatment packages. Such packages are available, and research is required into the most cost-effective means for large-scale implementation. Again, the management exercise is to accept that some transmission will occur but to be aware that cases can be found and treated with minimal losses to healthy life. As with dengue, predictive surveillance will help focus attention on those areas where outbreaks seem most likely, and

rapid, accurate diagnostics are crucial both to avoid the waste and danger of mistreatment and to minimize delays in administering the specific treatment required. But should such approaches rely on health centres, on mobile teams, or on some combination of the two? To what degree can the specialist diagnosis and treatment teams be integrated into more general approaches to health care? And, most crucially, how is the epidemiological surveillance to be organized: disease and vector notification, geographic information system mapping, analysis, and prediction? For the leishmaniases, vector control seems unlikely to become a major component of disease control except where sandfly distribution overlaps with that of other vectors or where use of personal protection measures can be more widely encouraged. For dengue, vector control is a major component, but unless *Aedes* eradication appears again on the agenda, predicting the levels of control required in specific situations will require much greater understanding of transmission dynamics. Significant resources have been wasted on emergency dengue vector control, which has subsequently been seen to have had little more than a palliative effect, whereas sustained suppression of vector populations may require changes in urban water management and in human behaviour that exceed the usual remit of health specialists. For African trypanosomiasis, however, the prospects for sustainable vector control are more promising. The vector's low reproductive rate, combined with its extreme sensitivity to ultra-low doses of biodegradable insecticides, put tsetse flies among the most promising candidates for large-scale elimination. Campaigns against tsetse flies during the past century were invariably successful until they were discontinued and the controlled areas became reinvaded. Thus, the operational issue is to design large-scale international programs that can successively eliminate tsetse populations and prevent reinvasion of controlled areas, as contemplated by the African Union's Pan African initiative. In essence, all three diseases face parallel needs involving some marginal improvements to existing control techniques, but, most important, they require a management exercise that acknowledges the long-term need for surveillance, adequate reporting, case finding, and treatment. The primary challenges seem to reside less in the domain of new tools and more in the deployment of what is already available.

13606. **Coleman, M., Sharp, B., Seocharan, I. & Hemingway, J., 2006.** Developing an evidence-based decision support system for rational insecticide choice in the control of African malaria vectors. *Journal of Medical Entomology*, **43** (4): 663-668.

Liverpool School of Tropical Medicine, Pembroke Place, Liverpool, L3 5QA, UK.

The emergence of *Anopheles* species resistant to insecticides widely used in vector control have the potential to impact directly on the control of malaria. This may have a particularly dramatic effect in Africa, where pyrethroids impregnated onto bed-nets are the dominant insecticides used for vector control. Because the same insecticides are used for crop pests, the extensive use and misuse of insecticides for agriculture has contributed to the resistance problem in some vectors. The potential for resistance to develop in African vectors has been apparent since the 1950s, but the scale of the problem has been poorly documented. A geographical information system-based decision support system for malaria control has recently been established in Africa and used operationally in Mozambique. The system incorporates climate data and disease transmission rates, but to date it has not incorporated

spatial or temporal data on vector abundance or insecticide resistance. As a first step in incorporating this information, available published data on insecticide resistance in Africa has now been collated and incorporated into this decision support system. Data also are incorporated onto the openly available Mapping Malaria Risk in Africa (MARA) Web site (http://www.mara.org.za). New data, from a range of vector population-monitoring initiatives, can now be incorporated into this open access database to allow a spatial understanding of resistance distribution and its potential impact on disease transmission to benefit vector control programs.

13607. **Dafa'alla, T.H., Condon, G.C., Condon, K.C., Phillips, C.E., Morrison, N.I., Jin, L., Epton, M.J., Fu, G. & Alphey, L., 2006.** Transposon-free insertions for insect genetic engineering. *Nature Biotechnology*, **24** (7): 820-821.

Oxitec Limited, 71 Milton Park, Oxford OX14 4RX, UK.

Methods involving the release of transgenic insects in the field hold great promise for controlling vector-borne diseases and agricultural pests. Insect transformation depends on nonautonomous transposable elements as gene vectors. The resulting insertions are stable in the absence of suitable transposase, however, such absence cannot always be guaranteed. We describe a method for post-integration elimination of all transposon sequences in the pest insect Medfly, *Ceratitis capitata.* The resulting insertions lack transposon sequences and are therefore impervious to transposase activity.

13608. **Faulde, M., 2006**. Emergence of vector-borne diseases during war and conflict. *Deutsche Gesellschaft fur allgemeine und angewandte Entomologie,* **15**: 327-335.

Laborgruppe Medizinische Zoologie des Zentralen Institutes des Sanitätsdienstes der Bundeswehr, Postfach 7340, D-56065 Koblenz, Germany [MichaelFaulde@bundeswehr.org].

Throughout history, the deadly comrades of war and disease have accounted for a major proportion of human suffering and death. During conflict, human populations are often suddenly displaced, associated with crude mortality rates over 60 times higher than baseline rates. Risk factors like mass population movements, overcrowding, no access to clean water, poor sanitation, lack of shelter, and poor nutritional status directly result in the rapid increase of infectious diseases, especially measles, respiratory tract infections, diarrhoea and vector-borne diseases. In 26 out of 52 retrospectively analysed wars from 480 B.C. to 2002 A.D., vector-borne diseases like plague, louse-borne typhus, malaria, yellow fever, relapsing fever, scrub typhus and visceral leishmaniasis prevailed, or essentially contributed to, overall mortality. During the last decades, devastating war-related outbreaks of malaria, louse-borne typhus, trench fever, African sleeping sickness, visceral and cutaneous leishmaniasis, and dengue fever have been reported. According to the humanitarian imperative to protect or re-establish the health of the affected population, essential medical entomological expertise has been involved increasingly in complex emergencies in order to analyse the transmission modes and epidemiological impact. Adequate countermeasures, such as personal protection against arthropod vectors and vector control efforts, have to be initiated and implemented subsequently, aiming at rapid and efficient interruption of transmission cycles. Recent

experiences made during emergency situations reveal that more medical entomological expertise and involvement is necessary worldwide to successfully react to future disease threats.

13609. **Fevre, E.M., Picozzi, K., Jannin, J., Welburn, S.C. & Maudlin, I., 2006.** Human African trypanosomiasis: epidemiology and control. *Advances in Parasitology*, **61**: 167-221.

Centre for Infectious Diseases, Royal (Dick) School of Veterinary Studies, University of Edinburgh, Easter Bush, Roslin, Midlothian, EH25 9RG, UK.

Human African trypanosomiasis (HAT), or sleeping sickness, describes not one but two discrete diseases: that caused by *Trypanosoma brucei rhodesiense* and that caused by *T. b. gambiense*. The Gambian form is currently a major public health problem over vast areas of central and western Africa, while the zoonotic, Rhodesian form continues to present a serious health risk in eastern and southern Africa. The two parasites cause distinct clinical manifestations, and there are significant differences in the epidemiology of the diseases caused. We discuss the differences between the diseases caused by the two parasites, with an emphasis on disease burden, reservoir hosts, transmission, diagnosis, treatment and control. We analyse how these differences impacted on historical disease control trends and how they can inform contemporary treatment and control options. We consider the optimal ways in which to devise HAT control policies in light of the differing biology and epidemiology of the parasites, and emphasise, in particular, the wider aspects of control policy, outlining the responsibilities of individuals, governments and international organisations in control programmes.

13610. **Hemingway, J., Beaty, B.J., Rowland, M., Scott, T.W. & Sharp, B.L., 2006**. The Innovative Vector Control Consortium: improved control of mosquito-borne diseases. *Trends in Parasitology,* **22** (7): 308-312.

Liverpool School of Tropical Medicine, Pembroke Place, Liverpool, UK, L3 5QA. [hemingway@liv.ac.uk]

Few new insecticides have been produced for control of disease vectors for public health in developing countries over the past three decades, owing to market constraints, and the available insecticides are often poorly deployed. The Innovative Vector Control Consortium will address these market failures by developing a portfolio of chemical and technological tools that will be directly and immediately accessible to populations in the developing world. The Bill and Melinda Gates Foundation has supported this new initiative to enable industry and academia to change the vector control paradigm for malaria and dengue and to ensure that vector control, alongside drugs, case management and vaccines, can be better used to reduce disease.

13611. **Kissinger, J.C., 2006**. A tale of three genomes: the kinetoplastids have arrived. *Trends in Parasitology,* **22** (6): 240-243.

Department of Genetics and Center for Tropical and Emerging Global Diseases, University of Georgia, Athens, GA 30606, USA. [jkissing@uga.edu]

July 2005 marked a milestone in kinetoplastid biology research. A tour de force effort led by the Tri-Trypanosomatidae "Tritryp" genome consortium yielded the publication of three prominent kinetoplastid parasite genome sequences: *Trypanosoma brucei, Trypanosoma cruzi* and *Leishmania major*. The individual and combined comparative analyses of these three genome sequences, combined with proteomic analyses, have yielded insights into topics ranging from genome evolution and horizontal gene transfer to potential new therapeutic and vaccine targets.

13612. **Malone, J.B., Nieto, P. & Tadesse, A., 2006.** Biology-based mapping of vector-borne parasites by geographic information systems and remote sensing. *Parassitologia*, **48** (1-2): 77-79.

Pathobiological Sciences, School of Veterinary Medicine, Louisiana State University, Baton Rouge, Louisiana, USA.

Application of growing degree day-water budget analysis and satellite climatology to vector-borne parasites is reviewed to demonstrate the value of using the unique thermal-hydrological preferences and limits of tolerance of individual parasite-vector systems to define the environmental niche of disease agents in the landscape by modern geospatial analysis methods. Applications of geospatial modelling are illustrated by examples on fascioliasis, malaria, leprosy and leishmaniasis.

13613. **Mejia, J.S., Bishop, J.V. & Titus, R.G., 2006**. Is it possible to develop pan-arthropod vaccines? *Trends in Parasitology*, **22** (8): 367-370.

Department of Microbiology, Immunology and Pathology, Colorado State University, 1619 Campus Delivery, Fort Collins, CO 80523, USA. [jsmejia@colostate.edu]

Hematophagous arthropods that transmit the etiological agents of arthropod-borne diseases have become the focus of anti-vector vaccines, targeted mainly at components of their saliva and midgut. These efforts have been directed mostly towards developing species-specific vaccines. An alternative is to target cross-reactive epitopes that have been preserved during evolution of the arthropods. The N- and O-linked glycans that are attached to arthropod glycoproteins are one of the potential targets of this pan-arthropod vaccine approach. Here, we discuss how genetically modified *Drosophila melanogaster* cells can be used to synthesize and to deliver these arthropod glycans to vertebrate hosts.

13614. **Mihok, S., Carlson, D.A., Krafsur, E.S. & Foil, L.D., 2006**. Performance of the Nzi and other traps for biting flies in North America. *Bulletin of Entomological Research*, **96** (4): 387-397.

388 Church Street, Russell, Ontario, Canada, K4R 1A8. [smihok@rogers.com]

The performance of Nzi traps for tabanids (*Tabanus similis* Macquart, *T. quinquevittatus* Wiedemann, *Chrysops aberrans* Philip, *C. univittatus* Macquart, *C. cincticornis* Walker, *Hybomitra lasiophthalma* (Macquart)), stable flies (*Stomoxys calcitrans* Linnaeus) (Diptera: *Muscidae*) and mosquitoes (*Aedes)* (Diptera: *Culicidae*) was investigated at various sites in Canada (Ontario, Alberta) and USA (Iowa, Florida, Louisiana). Traps made from selected fabrics, insect nettings and hand-dyed blue cotton were compared to the African design to provide practical recommendations for temperate environments. Comparisons of substituted materials showed that trap performance was optimal only when traps were made from appropriate fabrics in the colours produced by either copper phthalocyanine (phthalogen blue), or its sulphonated forms (turquoise). Fabrics dyed with other blue chromophores were not as effective (anthraquinone, disazo, formazan, indanthrone, triphenodioxazine). An appropriate texture as well as an appropriate colour was critical for optimal performance. Smooth, shiny synthetic fabrics (polyester, nylon) and polyester blends reduced catches. Low catches occurred even for mildly phthalogen blue, but slightly-shiny, polyester fabrics in widespread use for tsetse. The most suitable retail fabric in place of phthalogen blue cotton was Sunbrella Pacific Blue acrylic awning/marine fabric. It was both attractive and durable, and had a matching almost black colour.. Nzi traps caught grossly similar numbers of biting flies as canopy, Vavoua, and Alsynite cylinder traps, but with differences in relative performance among species or locations.

13615. **Nwaka, S. & Hudson, A., 2006**. Innovative lead discovery strategies for tropical diseases. *Nature Reviews Drug Discovery*, **5** (11): 941-955.

Special Programme for Research and Training in Tropical Diseases (TDR), World Health Organization, Geneva, Switzerland.

Lead discovery is currently a key bottleneck in the pipeline for much-needed novel drugs for tropical diseases such as malaria, tuberculosis, African sleeping sickness, leishmaniasis and Chagas disease. Here, we discuss the different approaches to lead discovery for tropical diseases and emphasize a coordination strategy that involves highly integrated partnerships and networks between scientists in academic institutions and industry in both wealthy industrialized countries and disease-endemic countries. This strategy offers the promise of reducing the inherently high attrition rate of the early stages of discovery research, thereby increasing the chances of success and enhancing cost-effectiveness.

13616. **Ohta, N., 2006.** Endemic tropical diseases: comtemporary health problem due to abandoned diseases in the developing world. *Kansenshogaku Zasshi*, **80** (5): 469-474.

Section of Environmental Parasitology, Tokyo Medical and Dental University.

There are two kinds of infectious diseases in the world: diseases being paid attention and neglected diseases. The former diseases include HIV/AIDS, tuberculosis and malaria, the latter group include many parasitic, fungal, bacterial and some viral infections. "Neglected Infectious Diseases", which have been renamed as Endemic Tropical Diseases by WHO, are endemic in the developing world and are not new, having affecting humans for decades. In fact, DALYs for several diseases in this category are huge- more than 300 million for soil-

transmitted helminthiasis, 5 million for lymphatic filariasis, 4-5 million for schistosomiasis and so forth. However, those diseases were not recognized as serious health problems because of socio-economical and/or scientific reasons. Furthermore, these diseases are not fatal in the acute phases and are therefore not given appropriate attention by policy makers in the world. From the view point of basic medical sciences, however, there is no reason to neglect those diseases since no improved diagnostics and therapeutics have been developed in spite of the urgent necessities in endemic areas. Considering this situation, WHO has started to take action for solving these problems and many developed countries are recognizing the imbalanced input of human and financial resources only for 3 major infectious diseases, HIV/AIDS, tuberculosis and malaria. There are now various international schemes for supporting research on Neglected diseases. DNDi, Drugs for Neglected Diseases initiative, is one example and it's scope is only on drug development for Neglected diseases. African trypanosomiasis is one of Neglected diseases, causing serious health problem both for humans and domestic animals in Africa. No safe and effective medicine has been available but a drug with serious side effects is only the drug of choice even nowadays. Under the grant support from DNDi, a Japanese group is developing a new drug, ascofuranone, for African trypanosomiasis without any detectable side effects. Developing new prophylactic drugs for schistosomiasis and new diagnostic tools for lymphatic filariasis are underway under the support of grant for Neglected or Re-emerging infectious diseases in Japan. Considering that issues of "Neglected Infectious Diseases" are in urgent need of solution and also are challenging for modern medicine and medical sciences, researchers in the developed countries including Japan should make efforts to promote more active research in this field.

13617. **Riehle, M.A. & Jacobs-Lorena, M., 2005.** Using bacteria to express and display anti-parasite molecules in mosquitoes: current and future strategies. *Insect Biochemistry and Molecular Biology*, **35** (7): 699-707.

Department of Molecular Microbiology & Immunology, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD 21205, USA.

Vector-borne diseases impose enormous health and economical burdens throughout the world. Unfortunately, as insecticide and drug resistance spread, these burdens will increase unless new control measures are developed. Genetically modifying vectors to be incapable of transmitting parasites is one possible control strategy and much progress has been made towards this goal. Numerous effector molecules have been identified that interfere with parasite development in its insect vectors, and techniques for transforming the vectors with genes encoding these molecules have been established. While the ability to generate refractory vectors is close at hand, a mechanism for replacing a wild vector population with a refractory one remains elusive. This review examines the feasibility of using bacteria to deliver the anti-parasitic effector molecules to wild vector populations. The first half briefly examines paratransgenic approaches currently being tested in both the triatomine bug and tsetse fly. The second half explores the possibility of using midgut bacteria to control malaria transmission by *Anopheles* mosquitoes.

13618. **Smith, A., Telfer, S., Burthe, S., Bennett, M. & Begon, M., 2006**. A role for vector-independent transmission in rodent trypanosome infection? *International Journal of Parasitology*, **36** (13): 1359-1366.

Population Biology Research Group, School of Biological Sciences, Bioscience Building, University of Liverpool, Merseyside L69 7ZB, UK. [andy23x@gmail.com]

Within host-pathogen systems where vector-borne transmission is the primary route of infection, little or no attention has been paid to the relative importance of secondary or alternative routes of transmission. Here, by contrast, we report the results from a controlled longitudinal field-scale experiment in which the prevalence of fleas (Siphonaptera) was manipulated and the occurrence and distribution of a flea-borne protozoan (*Trypanosoma* (Herpetosoma) *microti*) in a natural field vole (*Microtus agrestis*) population was monitored over a 2-year period. A non-systemic insecticide was applied to individual voles within two treatment grids and the prevalences of fleas and of *T. microti* were monitored on these and on two control grids. Blood samples were taken from all voles and PCR-based methods used to determine infection status. Insecticidal treatment was highly effective at reducing overall flea prevalence and recaptured animals (treated ca. 4 weeks previously) were very rarely infested (ca. 3 percent, compared with 50-70+ percent normally). On the other hand, the probability of trypanosome infection was reduced in treated animals on experimental grids to only around one-third of that normally observed. This suggests that direct, as opposed to flea-borne, transmission may not only occur, it may also be of epidemiological importance. The possibility that the importance of such transmission routes may have been underestimated in 'vector-borne' infections more generally is discussed.

13619. **Steverding, D., 2006.** A new initiative for the development of new diagnostic tests for human African trypanosomiasis. *Kinetoplastid Biology and Disease*, **5**: 1.

Biomedical Research Centre, School of Medicine, Health Policy and Practice, University of East Anglia, Norwich NR4 7TJ, UK. [dsteverding@hotmail.com]

Human African trypanosomiasis is a threat to millions of people living in sub-Saharan countries and is fatal unless treated. At present, the serological and parasitological tests used in the field for diagnosis of sleeping sickness have low specificity and sensitivity. There is clearly an urgent need for accurate tools for both diagnosis and staging of the disease. The Foundation for Innovative New Diagnostics and the World Health Organization has announced that they will collaborate to develop and evaluate new diagnostic tests for human African trypanosomiasis.

13620. **Tatem, A.J., Hay, S.I. & Rogers, D.J., 2006.** Global traffic and disease vector dispersal. *Proceedings of the National Academy of Sciences USA*, **103** (16): 6242-6247.

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

The expansion of global air travel and seaborne trade overcomes geographic barriers to insect disease vectors, enabling them to move great distances in short periods of time. Here we apply a coupled human-environment framework to describe the historical spread of *Aedes albopictus*, a competent mosquito vector of 22 arboviruses in the laboratory. We contrast this

dispersal with the relatively unchanged distribution of *Anopheles gambiae* and examine possible future movements of this malaria vector. We use a comprehensive database of international ship and aircraft traffic movements, combined with climatic information, to remap the global transportation network in terms of disease vector suitability and accessibility. The expansion of the range of *Ae. albopictus* proved to be surprisingly predictable using this combination of climate and traffic data. Traffic volumes were more than twice as high on shipping routes running from the historical distribution of *Ae. albopictus* to ports where it has established in comparison with routes to climatically similar ports where it has yet to invade. In contrast, *An. gambiae* has rarely spread from Africa, which we suggest is partly due to the low volume of sea traffic from the continent and, until very recently, a European destination for most flights.

13621. **Taylor, J.E. & Rudenko, G., 2006**. Switching trypanosome coats: what's in the wardrobe? *Trends in Genetics*, **22** (11): 614-620.

Peter Medawar Building for Pathogen Research, University of Oxford, South Parks Road, Oxford OX1 3SY, UK; Department of Statistics, University of Oxford, 1 South Parks Road, Oxford OX1 3TG, UK.

The African trypanosome *Trypanosoma brucei* is best known for its extraordinarily sophisticated antigenic variation of a protective variant surface glycoprotein (VSG) coat. *T. brucei* has >1000 VSG genes and pseudogenes, of which one is transcribed at a time from one of multiple telomeric VSG expression sites. Switching the active VSG gene can involve DNA rearrangements replacing the old VSG with a new one, or alternatively transcriptional control. The astonishing revelation from the *T. brucei* genome sequence is that <7 percent of the sequenced VSGs seem to have fully functional coding regions. This preponderance of pseudogenes in the VSG gene repertoire will necessitate a rethink of how antigenic variation in African trypanosomes operates.

13622. **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, UK. [sue.welburn@ed.ac.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.

13623. **Willadsen, P., 2006.** Tick control: thoughts on a research agenda. *Veterinary Parasitology*, **138** (1-2): 161-168.

CSIRO Livestock Industries, Queensland Bioscience Precinct, 306 Carmody Road, St. Lucia, Qld 4067, Australia. [Peter.Willadsen@csiro.au]

Tick control is critical to the control of tick borne disease, while the direct impact of ticks on livestock productivity is also well known. For livestock, tick control today rests overwhelmingly on the twin approaches of genetics and chemical acaricides, although the disadvantages and limitations of both are recognized. The achievement of the full potential of vaccination, the application of biocontrol agents and the coordinated management of the existing technologies all pose challenging research problems. Progress in many areas has been steady over the last decade, while the acquisition of molecular information has now reached a revolutionary stage. This is likely to have immediate impact on the identification of potential antigens for improved vaccines and novel targets for acaricide action. In many circumstances, the rate limiting step in making scientific progress will remain unchanged, namely the resource constraint on evaluating these appropriately in large animals. For other approaches, such as the use of biocontrol agents, the limitation is likely to be less in the identification of suitable agents than in their delivery in an efficient and cost effective way. Our scientific understanding of the molecular basis for the tick vector-tick borne disease interaction is in its infancy but the area is both challenging and, in the long term, likely to be of great practical importance. What is arguably the most difficult problem of all remains: the translation of laboratory research into the extremely diverse parasite control requirements of farming systems in a way that is practically useful.

2. TSETSE BIOLOGY

(a) REARING OF TSETSE FLIES

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

13624. **Abubakar, L.U., Bulimo, W.D., Mulaa, F.J. & Osir, E.O., 2006.** Molecular characterization of a tsetse fly midgut proteolytic lectin that mediates differentiation of African trypanosomes. *Insect Biochemistry and Molecular Biology*, **36** (4): 344-352.

International Centre of Insect Physiology and Ecology (ICIPE), P.O. Box 30772, Nairobi, Kenya.

Differentiation of bloodstream-form trypanosomes into procyclic (midgut) forms is an important first step in the establishment of an infection within the tsetse fly. This complex process is mediated by a wide variety of factors, including those associated with the vector itself, the trypanosomes and the bloodmeal. As part of an on-going project in our laboratory, we recently isolated and characterized a bloodmeal-induced molecule with both lectin and trypsin activities from midguts of the tsetse fly, *Glossina longipennis*. and purified and characterized a midgut lectin-trypsin complex from the tsetse fly, *Glossina longipennis*. The protein (lectin-trypsin complex) was found to be capable of stimulating differentiation of bloodstream trypanosomes *in vitro*. Using polyclonal antibodies to the complex, we screened

a *G. fuscipes fuscipes* cDNA midgut expression library and identified a putative proteolytic lectin gene. The cDNA encodes a putative mature polypeptide with 274 amino acids (designated *Glossina* proteolytic lectin, Gpl). The deduced amino acid sequence includes a hydrophobic signal peptide and a highly conserved N-terminal sequence motif. The typical features of serine protease trypsin family of proteins found in the sequence include the His/Asp/Ser active site triad with the conserved residues surrounding it, three pairs of cysteine residues for disulfide bridges and an aspartate residue at the specificity pocket. Expression of the gene in a bacterial expression system yielded a protein (MWt approximately 32,500). The recombinant protein (Gpl) bound d(+) glucosamine and agglutinated bloodstream-form trypanosomes and rabbit red blood cells. In addition, the protein was found to be capable of inducing transformation of bloodstream-form trypanosomes into procyclic forms *in vitro*. Antibodies raised against the recombinant protein showed cross-reactivity with the alpha subunit of the lectin-trypsin complex. These results support our earlier hypothesis that this molecule is involved in the establishment of trypanosome infections in tsetse flies.

13625. **Amin, D.N., Kamita, S.G., Muluvi, G.M., Machuka, J., Hammock, B.D. & Osir, E.O., 2006.** *Glossina* proteolytic lectin does not require a carbohydrate moiety for enzymatic or trypanosome-transforming activities. *Journal of Medical Entomology*, **43** (2): 301-308.

International Center of Insect Physiology and Ecology, P.O. Box 30772, Nairobi, Kenya.

The developmental cycle of the cyclically transmitted African trypanosome involves an obligatory passage through the tsetse fly, *Glossina* spp. This intricate relationship requires the presence of molecules within the insect vector, including a midgut lectin, that interact with the trypanosome. Recently, a gene encoding for a proteolytic lectin, with trypanosome-transforming activity, was isolated from a midgut cDNA library of *Glossina fuscipes fuscipes* Austen in our laboratory. Using the same approach, we have identified a similar gene from a midgut cDNA library of *Glossina austeni* (Newstead). The protein encoded by this gene was expressed in bacteria and a baculovirus-based expression system. The baculovirus-expressed lectin was found in the medium of baculovirus-infected Sf-21 cell cultures, indicating that the tsetse fly-derived signal peptide was recognized and cleaved by the Sf-21 cells. The baculovirus-expressed protein also was glycosylated despite the absence of classical O-linked and N-linked sugar attachment motifs. Both the baculovirus- and bacterium-expressed lectin proteins were shown to agglutinate trypanosomes and rabbit red blood cells *in vitro*. This agglutination was strongly inhibited by D-glucosamine. D-glucosamine also inhibited the action of the authentic and recombinant lectins upon the chromogenic substrate Chromozym TRY. Interestingly, both baculovirus- and bacterium-expressed lectins showed no significant differences in terms of these activities, indicating that a sugar moiety is not essential for biological activity. Our results provide an important molecular tool for further characterization of *Glossina* proteolytic lectin.

13626. **Attardo, G.M., Guz, N., Strickler-Dinglasan, P. & Aksoy, S., 2006.** Molecular aspects of viviparous reproductive biology of the tsetse fly (*Glossina morsitans*

morsitans): Regulation of yolk and milk gland protein synthesis. *Journal of Insect Physiology,* **52:** 1128-1136.

Department of Epidemiology and Public Health, Yale University School of Medicine, 60 College Street, 606 LEPH New Haven, CT 06510, USA.

Tsetse fly (Diptera: Glossinidae) viviparous reproductive physiology remains to be explored at the molecular level. Adult females carry their young *in utero* for the duration of embryonic and larval development, all the while supplying their offspring with nutrients in the form of a "milk" substance secreted from a modified accessory gland. Flies give birth to fully developed third instar larvae that pupariate shortly after birth. Here, we describe the spatial and temporal expression dynamics of two reproduction-associated genes and their products synthesized during the first and second gonotrophic cycles. The proteins studied include a putative yolk protein, *Glossina morsitans morsitans* yolk protein 1 (GmmYP1) and the major protein found in tsetse "milk" secretions (*Glossina morsitans morsitans* milk gland protein, GmmMGP). Developmental stage and tissue-specific expression of GmmYP1 show its presence exclusively in the reproductive tract of the fly during oogenesis, suggesting that GmmYP1 acts as a vitellogenic protein. Transcripts for GmmMGP are present only in the milk gland tissue and increase in coordination with the process of larvigenesis. Similarly, GmmMGP can be detected at the onset of larvigenesis in the milk gland, and is present during the full duration of pregnancy. Expression of GmmMGP is restricted to the adult stage and is not detected in the immature developmental stages. These phenomena indicate that the protein is transferred from mother to larvae as nourishment during its development. These results demonstrate that both GmmYP1 and GmmMGP are involved in tsetse reproductive biology, the former associated with the process of oogenesis and the latter with larvigenesis.

13627. **Attardo, G.M., Strickler-Dinglasan, P., Perkin, S.A., Caler, E., Bonaldo, M.F., Soares, M.B., El-Sayeed, N. & Aksoy, S., 2006.** Analysis of fat body transcriptome from the adult tsetse fly, *Glossina morsitans morsitans*. *Insect Molecular Biology*, 15 (4): 411-424.

Department of Epidemiology and Public Health, Section of Vector Biology, Yale University School of Medicine, New Haven, CT 06510, USA.

Tsetse flies (Diptera: Glossinidae*)* are vectors of pathogenic African trypanosomes. To develop a foundation for tsetse physiology, a normalized expressed sequence tag (EST) library was constructed from fat body tissue of immune-stimulated *Glossina morsitans morsitans*. Analysis of 20,257 high-quality ESTs yielded 6,372 unique genes comprised of 3,059 tentative consensus (TC) sequences and 3,313 singletons (available at http://aksoylab.yale.edu). We analysed the putative fat body transcriptome based on homology to other gene products with known functions available in the public domain. In particular, we describe the immune-related products, reproductive function related yolk proteins and milk-gland protein, iron metabolism regulating ferritins and transferrin, and tsetse's major energy source proline biosynthesis. Expression analysis of the three yolk proteins indicates that all are detected in females, while only the yolk protein with similarity to lipases, is expressed in males. Milk gland protein, apparently important for larval nutrition, however, is primarily synthesized by accessory milk gland tissue.

13628. **Darby, A.C., Lagnel, J., Matthew, C.Z., Bourtzis, K., Maudlin, I. & Welburn, S.C., 2005.** Extrachromosomal DNA of the symbiont *Sodalis glossinidius*. *Journal of Bacteriology*, **187** (14): 5003-5007.

Centre of Infectious Diseases, College of Medicine and Veterinary Medicine, University of Edinburgh, UK. [alistair.darby@ed.ac.uk]

The extrachromosomal DNA of *Sodalis glossinidius* from two tsetse fly species was sequenced and contained four circular elements: three plasmids, pSG1 (82 kb), pSG2 (27 kb), and pSG4 (11 kb), and a bacteriophage-like pSG3 (19 kb) element. The information suggests *S. glossinidius* is evolving towards an obligate association with tsetse flies.

13629. **Gariou-Papalexiou, A., Yannopoulos, G., Robinson, A.S. & Zacharopoulou, A., 2006.** Polytene chromosome maps in four species of tsetse flies *Glossina austeni, G. pallidipes, G. morsitans morsitans* and *G. m. submorsitans* (Diptera: Glossinidae): a comparative analysis. *Genetica.* **In press; corrected proof.**

Department of Biology, University of Patras, Patras, Greece, [zacharop@upatras.gr].

Photographic polytene chromosome maps from pupal trichogen cells of four tsetse species, *Glossina austeni, G. pallidipes, G. morsitans morsitans* and *G. m. submorsitans* were constructed and compared. The homology of chromosomal elements between the species was achieved by comparing banding patterns. The telomeric and subtelomeric chromosome regions were found to be identical in all species. The pericentromeric regions were found to be similar in the X chromosome and the left arm of L1 chromosome (L1L) but different in L2 chromosome and the right arm of L1 chromosome (L1R). The L2 chromosome differs by a pericentric inversion that is fixed in the three species, *G. pallidipes, G. morsitans morsitans* and *G. m. submorsitans*. Moreover, the two *morsitans* subspecies appeared to be homosequential and differ only by two paracentric inversions on XL and L2L arm. Although a degree of similarity was observed across the homologous chromosomes in the four species, the relative position of specific chromosome regions was different due to chromosome inversions established during their phylogeny. However, there are regions that show no apparent homology between the species, an observation that may be attributed to the considerable intra-chromosomal rearrangements that have occurred following the species divergence. The results of this comparative analysis support the current phylogenetic relationships of the genus *Glossina*.

13630. **Hu, C. & Aksoy, S., 2006.** Innate immune responses regulate trypanosome parasite infection of the tsetse fly *Glossina morsitans morsitans*. *Molecular Microbiology*, **60** (5): 1194-1204.

Department of Epidemiology and Public Health, Yale University School of Medicine, 60 College St., 606 LEPH, New Haven, CT 06510, USA.

Tsetse flies transmit the protozoan parasite African trypanosomes, the agents of human sleeping sickness in sub-Saharan Africa. Parasite transmission in the insect is restricted by a natural resistance phenomenon (refractoriness). Understanding the mechanism of parasite resistance is important as strengthening fly's response(s) via transgenic approaches can prevent parasite transmission and lead to the development of novel vector control strategies. Here, we investigated the role of one of the two major pathways regulating innate immunity in invertebrates, the immunodeficiency (Imd) pathway, for *Glossina morsitans morsitans*'s natural defence against *Trypanosoma brucei* spp. infections. We determined the molecular structure of the Imd pathway transcriptional activator Relish (GmmRel), which shows high amino acid identity and structural similarity to its *Drosophila* homologue. Through a double-stranded RNA-based interference approach, we showed that the pathogen-induced expression profile of the antimicrobial peptides (AMPs) attacin and cecropin is under the regulation of GmmRel. Unexpectedly, the AMP diptericin appears to be constitutively expressed in tsetse independent of the presence of the Rel factor. Through GmmRel knock-down, we could successfully block the induction of attacin and cecropin expression in the immune responsive tissues, fat body and proventriculus (cardia), following microbial challenge. The midgut and salivary gland trypanosome infection prevalence, as well as the intensity of midgut parasite infections were found to be significantly higher in flies when attacin and relish expression were knocked down. Our results provide the first direct evidence for the involvement of antimicrobial peptides in trypanosome transmission in tsetse.

13631. **Krafsur, E.S. & Endsley, M.A., 2006.** Shared microsatellite loci in *Glossina morsitans sensu lato* (Diptera: *Glossinidae*). *Journal of Medical Entomology,* **43** (3): 640-642.

Department of Entomology, Iowa State University, Ames, Iowa 50011-3222, USA.

Estimation of allelic frequencies at three microsatellite loci among 20 populations of *Glossina morsitans morsitans* Westwood, *Glossina morsitans submorsitans* Newstead, and *Glossina morsitans centralis* Machado indicated only two of 99 alleles were shared between three subspecies and 18 between any two subspecies; 81 alleles were unshared. The conserved flanking regions of each locus were completely shared. Genetic differentiation among subspecies, based on allele size, was RST = 0.87, close to the theoretic maximum value. All evidence suggests longstanding and complete reproductive isolation in nature among the sibling species. They should be elevated to specific rank.

13632. **Rio, R.V., Wu, Y.N., Filardo, G. & Aksoy, S., 2006.** Dynamics of multiple symbiont density regulation during host development: tsetse fly and its microbial flora. *Proceedings in Biological Science*, **273** (1588): 805-814.

Department of Epidemiology and Public Health, Yale University School of Medicine, 606 LEPH, New Haven CT 06510, USA.

Symbiotic associations often enhance hosts' physiological capabilities, allowing them to expand into restricted terrains, thus leading to biological diversification. Stable maintenance of partners is essential for the overall biological system to succeed. The

viviparous tsetse fly (Diptera: Glossinidae) offers an exceptional system to examine factors that influence the maintenance of multiple symbiotic organisms within a single eukaryotic host. This insect harbours three different symbionts representing diverse associations, coevolutionary histories and transmission modes. The enterics, obligate mutualist *Wigglesworthia* and beneficial *Sodalis*, are maternally transmitted to the intrauterine larvae, while parasitic *Wolbachia* infects the developing oocyte. In this study, the population dynamics of these three symbionts were examined through host development and during potentially disruptive events, including host immune challenge, the presence of third parties (such as African trypanosomes) and environmental perturbations (such as fluctuating humidity levels). While mutualistic partners exhibited well-regulated density profiles over different host developmental stages, parasitic *Wolbachia* infections varied in individual hosts. Host immune status and the presence of trypanosome infections did not impact the steady-state density levels observed for mutualistic microbes in either sex, while these factors resulted in an increase in *Wolbachia* density in males. Interestingly, perturbation of the maternal environment resulted in the deposition of progeny harbouring greater overall symbiont loads. The regulation of symbiont density, arising from coadaptive processes, may be an important mechanism driving inter-specific relations to ensure their competitive survival and to promote specialization of beneficial associations.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **29**: 13601, 13612, 13620, 14004]

13633. **Abd-Alla, A., Bossin, H., Cousserans, F., Parker, A., Bergoin, M. & Robinson, A., 2006.** Development of a non-destructive PCR method for detection of the salivary gland hypertrophy virus (SGHV) in tsetse flies. *Journal of Virological Methods.* **In press; corrected proof**.

Entomology Unit, FAO/IAEA Agriculture and Biotechnology Laboratory, A-2444 Seibersdorf, Austria; Department of Pests and Plant Protection, National Research Centre, Dokki, Giza, Egypt.

A PCR based diagnostic method to detect salivary gland hypertrophy virus (SGHV) in tsetse flies is described. Two sets of primers GpSGHV1F/GpSGHV1R and GpSGHV2F/GpSGHV2R were selected from a virus-specific sequence. Both primer sets can detect specifically the virus in individual tsetse flies by generating an amplicon of 401bp. Attempts were made to develop a simple and reliable non-destructive virus detection method in live flies. PCR reactions were performed on either crude or purified tsetse DNA from saliva and legs. While saliva can be an indicator for the presence of the virus in flies, the method is laborious. Crude extract from an excised middle leg resulted in a positive PCR reaction equivalent to crude extract from whole fly. However, sensitivity could be significantly increased when purified DNA was used as the template. In conclusion, PCR using a purified DNA template from a single tsetse leg represents an efficient, non-destructive method for virus diagnosis in live tsetse flies.

13634. **Artzrouni, M. & Gouteux, J.P., 2006**. A parity-structured matrix model for tsetse populations. *Mathematical Biosciences*, **204** (2): 215-31.

Department of Mathematics, University of Pau, 64000 Pau, France.

A matrix model is used to describe the dynamics of a population of female tsetse flies structured by parity (i.e., by the number of larvae laid). For typical parameter values, the intrinsic growth rate of the population is zero when the adult daily survival rate is 0.970, corresponding to an adult life expectancy of 1/0.030=33.3 days. This value is plausible and consistent with results found earlier by others. The intrinsic growth rate is insensitive to the variance of the interlarval period. Temperature being a function of the time of the year, a known relationship between temperature and mean pupal and interlarval times was used to produce a time-varying version of the model which was fitted to temperature and (estimated) population data. With well-chosen parameter values, the modelled population replicated at least roughly the population data. This illustrates dynamically the abiotic effect of temperature on population growth. Given that tsetse flies are the vectors of trypanosomiasis ("sleeping sickness") the model provides a framework within which future transmission models can be developed in order to study the impact of altered temperatures on the spread of this deadly disease.

13635. **Camara, M., Caro-Riano, H., Ravel, S., Dujardin, J.P., Hervouet, J.P., De Meeus, T., Kagbadouno, M.S., Bouyer, J. & Solano, P., 2006.** Genetic and morphometric evidence for population isolation of *Glossina palpalis gambiensis* (Diptera: *Glossinidae*) on the Loos islands, Guinee. *Journal of Medical Entomology*, **43** (5): 853-860.

PNLTHA Conakry, BP 851 Guinee.

Allele frequencies at four microsatellite loci, and morphometric features based on 11 wing landmarks, were compared among three populations of *Glossina palpalis gambiensis* (Diptera: Glossinidae) in Guinea. One population originated from the Loos islands separated from the capital Conakry by 5 km of sea, and the two others originated from the continental mangrove area close to Dubreka, these two groups being separated by approximately 30 km. Microsatellites and wing geometry data both converged to the idea of a separation of the Loos island population from those of the mangrove area. Although occasional contacts cannot be excluded, our results support the hypothesis of the Loos population of tsetse flies being a completely isolated population. This situation will favour a sequenced intervention against human African trypanosomosis and the possibility of an elimination of tsetse from this island.

13636. **Dujardin, J.P., Beard, C.B. & Ryckman, R., 2006.** The relevance of wing geometry in entomological surveillance of *Triatominae*, vectors of Chagas disease. *Infection Genetics and Evolution.* **In press, corrected proof**.

UMR IRD-CNRS 2724, Agropolis, 911, BP 64501, 34394 Montpellier, France; Division of Vector-borne Infectious Diseases, U.S. Centers for Disease Control and Prevention, Fort Collins, CO 80526, USA.

An important epidemiological challenge in controlling the Triatominae (Hemiptera: Reduviidae), vectors of Chagas disease, is identifying the origin of insects re-infesting treated areas, especially when reinfestation occurs during the first 1 or 2 years following insecticide application and in the absence of insecticide resistance. When using strict insect characteristics, the standard approach is to compare reinfesting specimens with those collected prior to treatment. Because of the long generation time of Triatominae, the experimental intent is to reject the hypothesis of a previous population, the one prior to insecticide application, to be the parental population of the reinfesting population. Biometric techniques are based on the hypothesis of more similarity between offspring and parents, and have been tested in the field. Reinfesting specimens are very few when discovered, which might cause sampling problems. The present study used museum material to test the performance of modern morphometrics to assess the origin of a single individual. A configuration of 13 landmarks was used to assign a single wing to its known parental line or relatives. For the 313 wings tested, correct attribution to the parental line was four times higher than expected at random. Moreover, most of the apparently wrong assignments were not random, but driven by lower levels of kinship. These results suggest that the geometry of the wing contains helpful information to identify the possible source of reinfesting specimens.

13637. **Geiger, A., Cuny, G. & Frutos, R., 2005.** Two tsetse fly species, *Glossina palpalis gambiensis* and *Glossina morsitans morsitans*, carry genetically distinct populations of the secondary symbiont *Sodalis glossinidius*. *Applied Environmental Microbiology*, **71** (12): 8941-8943.

UMR 17, IRD-CIRAD, CIRAD TA 207/G, Campus International de Baillarguet, 34398 Montpellier Cedex 5, France. [Anne.Geiger@mpl.ird.fr]

Genetic diversity among *Sodalis glossinidius* populations was investigated using amplified fragment length polymorphism markers. Strains collected from *Glossina palpalis gambiensis* and *Glossina morsitans morsitans* flies group into separate clusters, being differentially structured. This differential structuring may reflect different host-related selection pressures and may be related to the different vector competences of *Glossina* spp.

13638. **Geiger, A., Ravel, S., Mateille, T., Janelle, J., Patrel, D., Cuny, G. & Frutos, R., 2006.** Vector competence of *Glossina palpalis gambiensis* for *Trypanosoma brucei* s.l. and genetic diversity of the symbiont *Sodalis glossinidius*. *Molecular Biology and Evolution.* **In press; corrected proof.**

UMR 17, IRD-CIRAD, CIRAD TA 207 / G, Campus International de Baillarguet, 34398 Montpellier, Cedex 5, France.

Tsetse flies transmit African trypanosomes, responsible for sleeping sickness in humans and Nagana in animals. This disease affects many people with considerable impact on public health and economy in sub-Saharan Africa, while trypanosomes resistance to drugs is rising. The symbiont *Sodalis glossinidius* is considered to play a role in the ability of the fly to acquire trypanosomes. Different species of *Glossina* were shown to harbour genetically

distinct populations of *S. glossinidius*. We therefore investigated whether vector competence for a given trypanosome species could be linked to the presence of specific genotypes of *S. glossinidius*. *Glossina palpalis gambiensis* individuals were fed on blood infected either with *Trypanosoma brucei gambiense* or *Trypanosoma brucei brucei*. The genetic diversity of *S. glossinidius* strains isolated from infected and non-infected dissected flies was investigated using AFLP markers. Correspondence between occurrence of these markers and parasite establishment was analysed using multivariate analysis. *S. glossinidius* strains isolated from *T. brucei gambiense*-infected flies clustered differently than that isolated from *T. brucei brucei*-infected individuals. The ability of *T. brucei gambiense* and *T. brucei brucei* to establish in *G. palpalis gambiensis* insect midgut is statistically linked to the presence of specific genotypes of *S. glossinidius*. This could explain variations in *Glossina* vector competence in the wild. Then, assessment of the prevalence of specific *S. glossinidius* genotypes could lead to novel risk-management strategies.

13639. **Kubi, C., Van Den Abeele, J., de Deken, R., Marcotty, T., Dorny, P. & Van Den Bossche, P., 2006.** ffect of starvation on the susceptibility of teneral and non-teneral tsetse flies to trypanosome infection. *Medical and Veterinary Entomology,* **206** (4) 388-392.

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

Transmission of vector-borne diseases depends largely on the ability of the insect vector to become infected with the parasite. In tsetse flies, newly emerged or teneral flies are considered the most likely to develop a mature, infective trypanosome infection. This was confirmed during experimental infections where laboratory-reared *Glossina morsitans morsitans* Westwood (Diptera: Glossinidae) were infected with *Trypanosoma congolense* or *T. brucei brucei*. The ability of mature adult tsetse flies to become infected with trypanosomes was significantly lower than that of newly emerged flies for both parasites. However, the nutritional status of the tsetse at the time of the infective bloodmeal affected its ability to acquire either a *T. congolense* or *T. b. brucei* infection. Indeed, an extreme period of starvation (3–4 days for teneral flies, 7 days for adult flies) lowers the developmental barrier for a trypanosome infection, especially at the midgut level of the tsetse fly. Adult *G. m. morsitans* became at least as susceptible as newly emerged flies to infection with *T. congolense*. Moreover, the susceptibility of adult flies, starved for 7 days, to an infection with *T. b. brucei* was also significantly increased, but only at the level of maturation of an established midgut infection to a salivary gland infection. The outcome of these experimental infections clearly suggests that, under natural conditions, nutritional stress in adult tsetse flies could contribute substantially to the epidemiology of tsetse-transmitted trypanosomiasis.

13640. **Marquez, J.G., Malele, II, Ouma, J.O. & Krafsur, E.S., 2006.** *Glossina swynnertoni* (Diptera: Glossinidae): effective population size and breeding structure estimated by mitochondrial diversity. *Bulletin of Entomological Research*, **96** (4): 353-360.

Department of Entomology, Iowa State University, Ames, Iowa 50011, USA.

Nucleotide diversity was examined at mitochondrial COI and r16S2 loci in eight *Glossina swynnertoni* Austen collections from northern Tanzania and from a culture maintained by the International Atomic Energy Agency. Eighteen composite haplotypes were observed among 149 flies, two of which were common to all samples and 10 were private. Mean haplotype diversity was 0.59 and nucleotide diversity was 0.0013. There were excess singular haplotypes and mutation-drift disequilibrium suggesting that populations had experienced an earlier bottleneck and subsequent expansion. Factorial correspondence analysis showed that haplotype frequencies varied much more temporally (G ST=0.18) than spatially (G ST=0.04). The estimate of effective population size N in Tarangire was a harmonic mean of approximately 50 reproductive flies, averaged over approximately 47 generations. The mean rate of gene flow was estimated to be approximately 5+/-1 reproducing females per generation but inflated because of mutation-drift disequilibrium arising from likely earlier bottlenecks.

13641. **Ouma, J.O., Marquez, J.G. & Krafsur, E.S., 2006**. Patterns of genetic diversity and differentiation in the tsetse fly *Glossina morsitans morsitans* Westwood populations in East and southern Africa. *Genetica.* **In press; corrected proof**.

Department of Entomology, Iowa State University, Ames, Iowa, 50011-3222, USA, [ekrafsur@iastate.edu].

Genetic diversity and differentiation within and among nine *G. morsitans morsitans* populations from East and southern Africa were assessed by examining variation at seven microsatellite loci and a mitochondrial locus, cytochrome oxidase (COI). Mean COI diversity within populations was 0.63 +/- 0.33 and 0.81 taken over all populations. Diversities averaged over microsatellite loci were high (mean number of alleles/locus >/=7.4; mean H (E) >/= 65 percent) in all populations. Diversities averaged across populations were greater in East Africa (mean number of alleles = 22 +/- 2.6; mean h (e) = 0.773 +/- 0.033) than in southern Africa (mean number of alleles = 18.7 +/- 4.0; mean h (e) = 0.713 +/- 0.072). Differentiation among all populations was highly significant (R (ST) = 0.25, F (ST) = 0.132). Nei's G (ij) statistics were 0.09 and 0.19 within regions for microsatellites and mitochondria, respectively; between regions, G (ij) was 0.14 for microsatellites and 0.23 for mitochondria. G (ST) among populations was 0.23 for microsatellite loci and 0.40 for mitochondria. The F, G and R statistics indicate highly restricted gene flow among *G. m. morsitans* populations separated over geographic scales of 12-917 km.

13642. **Ravel, S., de Meeus, T., Dujardin, J.P., Zeze, D.G., Gooding, R.H., Dusfour, I., Sane, B., Cuny, G. & Solano, P., 2006.** The tsetse fly *Glossina palpalis palpalis* is composed of several genetically differentiated small populations in the sleeping sickness focus of Bonon, Côte d'Ivoire. *Infection Genetics and Evolution.* **In press; corrected proof**.

IRD UR 177, Laboratoire de Recherche et de Coordination sur les Trypanosomoses IRD/CIRAD, Campus de Baillarguet, 34398 Montpellier Cedex 5, France.

Glossina palpalis is the main vector of human African trypanosomosis (HAT, or sleeping sickness) that dramatically affects human health in sub-Saharan Africa. Because of the implications of genetic structuring of vector populations for the design and efficacy of control campaigns, *G. palpalis palpalis* in the most active focus of sleeping sickness in Côte d'Ivoire was studied to determine whether this taxon is genetically structured. High and statistically significant levels of within population heterozygote deficiencies were found at each of the five microsatellite loci in two temporally separated samples. Neither null alleles, short allele dominance nor trap locations could fully explain these deviations from random mating, but a clustering within each of the two samples into different genetic sub-populations (Wahlund effect) was strongly suggested. These different genetic groups, which could display differences in infection rates and trypanosome identity, were composed of small numbers of individuals that were captured together, leading to the observed Wahlund effect. Implications of this population structure on tsetse control are discussed.

13643. **Terblanche, J.S. & Chown, S.L., 2006**. The relative contributions of developmental plasticity and adult acclimation to physiological variation in the tsetse fly, *Glossina pallidipes* (Diptera: Glossinidae). *Journal of Experimental Biology*, **209** (6): 1064-1073.

Spatial, Physiological and Conservation Ecology Group, Department of Botany and Zoology, University of Stellenbosch, Private Bag X1, Matieland, 7602, Stellenbosch, South Africa. [jst@sun.ac.za]

Recent reviews of the adaptive hypotheses for animal responses to acclimation have highlighted the importance of distinguishing between developmental and adult (non-developmental) phenotypic plasticity. There has been little work, however, on separating the effects of developmental plasticity from adult acclimation on physiological traits. Therefore, we investigated the relative contributions of these two distinct forms of plasticity to the environmental physiology of adult tsetse flies by exposing developing pupae or adult flies to different temperatures and comparing their responses. We also exposed flies to different temperatures during development and re-exposed them as adults to the same temperatures, to investigate possible cumulative effects. Critical thermal maxima were relatively inflexible in response to acclimation temperatures (21, 25, 29^0 C) with plasticity type accounting for the majority of the variation (49-67 percent, nested ANOVA). By contrast, acclimation had a larger effect on critical thermal minima with treatment temperature accounting for most of the variance (84-92 percent). Surprisingly little of the variance in desiccation rate could be explained by plasticity type (30-47 percent). The only significant effect of acclimation temperature on standard (resting) metabolic rate of adult flies was at 21^0 C, resulting in treatment temperature, rather than plasticity type, accounting for the majority of the variance (30-76 percent). This study demonstrates that the stage at which acclimation takes place has significant, though often different, effects on several adult physiological traits in *G. pallidipes*, and therefore that it is not only important to consider the form of plasticity but also the direction of the response and its significance from a life-history perspective.

13644. **Terblanche, J.S., Klok, C.J., Krafsur, E.S. & Chown, S.L., 2006**. Phenotypic plasticity and geographic variation in thermal tolerance and water loss of the tsetse

Glossina pallidipes (Diptera: Glossinidae): implications for distribution modelling. *American Journal of Tropical Medicine and Hygiene*, **74** (5): 786-794.

Centre for Invasion Biology, Department of Botany and Zoology, Stellenbosch University, Stellenbosch, South Africa. [jst@sun.ac.za]

Using the tsetse, *Glossina pallidipes*, we show that physiologic plasticity (resulting from temperature acclimation) accounts for among-population variation in thermal tolerance and water loss rates. Critical thermal minimum (CT (min)) was highly variable among populations, seasons, and acclimation treatments, and the full range of variation was 9.3^0 C (maximum value = 3.1 x minimum). Water loss rate showed similar variation (max = 3.7 x min). In contrast, critical thermal maxima (CT (max)) varied least among populations, seasons, and acclimation treatments, and the full range of variation was only approximately 1^0 C. Most of the variation among the four field populations could be accounted for by phenotypic plasticity, which in the case of CT (min), develops within 5 days of temperature exposure and is lost rapidly on return to the original conditions. Limited variation in CT (max) supports bioclimatic models that suggest tsetse are likely to show range contraction with warming from climate change.

13645. **Weiss, B.L., Mouchotte, R., Rio, R.V., Wu, Y.N., Wu, Z., Heddi, A. & Aksoy, S., 2006.** Interspecific transfer of bacterial endosymbionts between tsetse fly species: infection establishment and effect on host fitness. *Applied Environmental Microbiology*, **72** (11): 7013-7021.

Department of Epidemiology and Public Health, Yale University School of Medicine, LEPH 606, 60 College Street, New Haven, CT 06510, USA. [Serap.Aksoy@yale.edu].

Tsetse flies (*Glossina* spp.) can harbour up to three distinct species of endosymbiotic bacteria that exhibit unique modes of transmission and evolutionary histories with their host. Two mutualist enterics, *Wigglesworthia* and *Sodalis*, are transmitted maternally to tsetse flies' intrauterine larvae. The third symbiont, from the genus *Wolbachia*, parasitizes developing oocytes. In this study, we determined that *Sodalis* isolates from several tsetse fly species are virtually identical based on a phylogenetic analysis of their ftsZ gene sequences. Furthermore, restriction fragment-length polymorphism analysis revealed little variation in the genomes of *Sodalis* isolates from tsetse fly species within different subgenera (*Glossina fuscipes fuscipes* and *Glossina morsitans morsitans*). We also examined the impact on host fitness of transinfecting *G. fuscipes fuscipes* and *G. morsitans morsitans* flies with reciprocal *Sodalis* strains. Tsetse flies cleared of their native *Sodalis* symbionts were successfully repopulated with the *Sodalis* species isolated from a different tsetse fly species. These transinfected flies effectively transmitted the novel symbionts to their offspring and experienced no detrimental fitness effects compared to their wild-type counterparts, as measured by longevity and fecundity. Quantitative PCR analysis revealed that transinfected flies maintained their *Sodalis* populations at densities comparable to those in flies harbouring native symbionts. Our ability to transinfect tsetse flies is indicative of *Sodalis*' recent evolutionary history with its tsetse fly host and demonstrates that this procedure may be used as a means of streamlining future paratransgenesis experiments.

3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE EFFECTS)

[See also **29**: 13606, 13607, 13614, 13623, 13651]

13646. **Esterhuizen, J., Kappmeier Green, K., Nevill, E.M. & Van Den Bossche, P., 2006**. Selective use of odour-baited, insecticide-treated targets to control tsetse flies G*lossina austeni* and *G. brevipalpis* in South Africa. *Veterinary Entomology.* **In press; corrected proof.**

Onderstepoort Veterinary Institute, Postbag X05, Onderstepoort, Pretoria 0110, South Africa. [helsgate@iafrica.com]

The effectiveness of odour-baited targets treated with 0.8 percent deltamethrin in controlling *Glossina austeni* Newstead and *G. brevipalpis* Newstead (Diptera: Glossinidae) was evaluated in Zululand, South Africa. Targets were initially deployed in the three habitat types (grassland, woodland and forest) of two adjacent areas at a density of four targets per km^2. One area functioned as the treatment block (ca. 35 km^2) and included the focus of the target deployment, and the second area functioned as a barrier block (ca. 40 km^2) against tsetse fly re-invasion from the untreated area to the south. After 8 months, targets were removed from open grassland in both areas and target density in wooded habitats and sand forest was increased to eight per km^2. Twelve months later, all targets were removed from the barrier block and used to increase target density in the wooded and sand forest habitats of the treatment block to 12 per km^2. This target density was maintained for 14 months. In the treatment area, a 99 percent reduction in *G. austeni* females occurred after 13 months at a target density of eight per km^2 in wooded habitat; this was maintained for 22 months. Reduction in *G. brevipalpis* was less marked. The relatively poor reduction in *G. brevipalpis* is attributed to the high mobility of this species and its distribution throughout less wooded and more open habitats.

13647. **Kgori, P.M., Modo, S. & Torr, S.J., 2006.** The use of aerial spraying to eliminate tsetse from the Okavango Delta of Botswana. *Acta Tropica*, **99** (2-3): 184-199.

Tsetse Control Division, Maun, Botswana.

In Botswana, 16,000 km^2 of the Okavango Delta were aerial sprayed five times with deltamethrin, applied at 0.26-0.3g/ha, to control *Glossina morsitans centralis* Machado (Diptera: Glossinidae) over a period of approximately 8 weeks. The northern half of the Delta (7,180 km^2) was sprayed in June-September 2001 and the southern half (8,720 km^2)) in May-August 2002. A barrier (mean width approximately 10 km) of 12,000 deltamethrin-treated targets was deployed at the interface of these two blocks to prevent tsetse from invading from the southern to the northern block. Prior to spraying, the mean catches of tsetse from man fly-rounds were 44.6 flies/day in the northern block and 101 in the southern. Between September 2002 and November 2005, surveys (approximately 820 daily fly-rounds and approximately 2050 trap-days) in the northern and southern blocks failed to detect tsetse. Simulations of tsetse populations suggest that while spraying operations can reduce tsetse populations to

levels that are difficult to detect by standard survey techniques, such populations will recover to densities >100 tsetse/km^2 after 1000 days, at which density there is a very high probability (>0.999) that the survey methods will catch at least one fly. Since none was caught, it is argued that tsetse have been eliminated from the Delta. The particular success of this operation in comparison to the 18 aerial spraying operations conducted in the Delta prior to 2001 is attributed to the application of an adequate dose of insecticide, the use of a GPS-based navigation system to ensure even application of insecticide, and the large size and spatial arrangement of the spray blocks coupled with the use of a barrier of targets which prevented tsetse from re-invading the northern sprayed block before the southern one was treated.

13648. **Mamoudou, A., Zoli, A., Mbahin, N., Tanenbe, C., Bourdanne, Clausen, P.H., Marcotty, T., Van Den Bossche, P. & Geerts, S., 2006**. Prevalence and incidence of bovine trypanosomosis on the Adamaoua plateau in Cameroon 10 years after the tsetse eradication campaign. *Veterinary Parasitology*, **142** (1-2): 16-22.

Université de Dschang, Faculté d'Agronomie et des Sciences Agricoles BP 96, Dschang, Cameroun; Freie Universitat Berlin, Institute for Parasitology and Tropical Veterinary Medicine, Konigsweg 67, D-14163 Berlin, Germany.

Between March 2004 and February 2005, the monthly incidence of trypanosome infections was measured in cattle from nine sentinel herds in the Adamaoua province of Cameroon. Three herds of 20 cattle each were kept on the plateau which has been cleared from tsetse flies about 10 years ago, three other herds were grazing in the tsetse infested valley whereas the last three were herded in the buffer zone. The cross-sectional study showed that the initial trypanosomosis prevalence was 1.8, 5.2 and 2.0 percent on the plateau, in the buffer zone and the valley, respectively. During the longitudinal study, the trypanosomosis incidence was high in the valley (3.7-20 percent) and the buffer zone (1.8-13.4 percent), whereas it was significantly lower (0-2.1 percent) on the plateau. Tsetse flies, mainly *Glossina morsitans submorsitans* and a few *G. tachinoides*, were caught in the valley and the buffer
zone, but none on the plateau. The data indicate a low trypanosomosis risk on the plateau. Further entomological studies, however, are required to clarify the origin of the trypanosome infections on the plateau.

13649. **Symeonakis, E., Robinson, T. & Drake, N., 2006**. GIS and multiple-criteria evaluation for the optimisation of tsetse fly eradication programmes. *Environmental Monitoring and Assessment.* **In press; corrected proof.**

CSIRO Mathematical and Information Sciences, Private Bag 5, Wembley 6913, Western Australia, Australia. [elias.symeonakis@csiro.au].

Tsetse flies are the vectors of trypanosomes, the causal agent of trypanosomiasis, a widespread disease of livestock and people in Africa. Control of tsetse may open vast areas of land to livestock-keeping, with the associated benefits of developing mixed crop-livestock production systems. However, as well as possible positive impacts there are also risks: bush clearing would accelerate and cattle numbers would rise, leading to a reduction of vegetation

cover, and an increase in runoff and erosion; there may also be increased pressure on conserved areas and reductions in biodiversity. The objective of this study is to show how remotely sensed and other environmental data can be combined in a decision support system to help inform tsetse control programmes in a manner that could be used to limit possible detrimental effects of tsetse control. For Zambia, a methodology is developed that combines a tree-based decision-support approach with the use of Multiple-Criteria Evaluation (MCE), within a Geographical Information System (GIS), in order to target areas for tsetse control. The results show clear differentiation of priority areas under a series of hypothetical scenarios, and some areas (e.g. northwest of Petauke in the Eastern Province of Zambia) are consistently flagged as high priority for control. It is also demonstrated that priority areas do not comprise isolated tsetse populations, meaning that disease control using an integrated approach is likely to be more economically viable than local eradication.

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

[See also **29**: 13603, 13618, 13701, 13758, 13836, 13971]

13650. **Caljon, G., Van Den Abbeele, J., Sternberg, J.M., Coosemans, M., De Baetselier, P. & Magez, S. 2006.** Tsetse fly saliva biases the immune response to Th2 and induces anti-vector antibodies that are a useful tool for exposure assessment. *International Journal for Parasitology,* **36** *(9), 1025-1035.*

Unit of Cellular and Molecular Immunology, Flanders Interuniversity Institute for Biotechnology, Vrije Universiteit Brussel, Pleinlaan 2, B-1050 Brussels, Belgium; Unit of Entomology, Prins Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium; School of Biological Sciences, Zoology Building, University of Aberdeen, Aberdeen AB24 2TZ, Scotland, UK.

Tsetse flies (*Glossina* sp.) are blood-feeding dipteran insects that transmit African trypanosomes, parasites that are responsible for human sleeping sickness and veterinary infections. Increasing attention is being paid to the effects of tsetse fly saliva deposited at the feeding site, which enables the blood-feeding process and putatively promotes parasite transmission. Here we demonstrate that saliva induces strong humoral responses against the major 43–45 kDa protein fraction (tsetse salivary gland proteins 1 and 2 – Tsal1 and Tsal2) in mice and humans and suppresses murine T and B cell responses to heterologous antigen. The saliva-induced immune response is associated with a Th2-biased cytokine profile and the production of mainly IgG1 and IgE antibody isotypes. Functionally, the antibodies raised in mice exposed to tsetse fly bites or induced after experimental saliva immunisation do not affect the fly's blood-feeding efficiency nor its survival. We propose that anti-saliva as well as anti-Tsal1/2 antibody responses can be used in epidemiological studies as a tool to analyze human exposure to tsetse flies.

13651**. Grace, D., 2005.** Epidemiology and control of cattle trypanosomosis in villages under risk of trypanocide resistance in West Africa. *Thesis, Freie Universitat Berlin.*195 pp.

Institut für Parasitologie und Tropenveterinärmedizin, Königsweg 67, 14163 Berlin, Germany.

African Animal Trypanosomiasis (AAT) is the most serious cattle disease in sub-Saharan Africa. It is managed through vector control, keeping trypanotolerant cattle, but most importantly, by the use of trypanocidal drugs. Resistance to trypanocidal drugs is emerging and threaten the livelihoods of pastoralists and agropastoralists in sub-Saharan Africa who depend on cattle for traction, manure, milk, meat, savings, insurance, status and cultural obligations. A study was carried out in the cotton zone of west Africa (south west Burkina Faso, south Mali and north east Guinea) to: firstly, characterise trypanosomiasis control and epidemiology in villages with presence or risk of drug resistance; secondly develop, test, and evaluate best-bet strategies for the control of trypanosomiasis in the presence/risk of drug resistance; thirdly, model the dynamics of trypanocide resistance. To understand the situation, Knowledge, Attitude and Practice questionnaires were administered to all cattle-keepers in 65 villages, an Agricultural Knowledge and Information Study on trypanosomiasis management was carried out in eight villages, Participatory Rural Appraisals held in seven villages and 73 animal health service providers interviewed. Entomological studies were carried out in 54 villages, 16,935 cattle were examined parasitologically for trypanosomes, 834 blood samples were checked for haemoparasites and 1,463 coprological samples examined. Three strategies were evaluated for trypanosomiasis management: participatory vector control in eight villages, keeping trypanotolerant cattle in 65 villages and rational drug use (RDU); the latter by informing farmers in 46 villages, establishing/evaluating primary health services in 18 villages and training service providers who covered 235 villages. A dynamic mathematical model was developed to elucidate development and reversal of trypanocide resistance. We found AAT was the most important cattle disease in the area and was managed at community level. Animal health services were dysfunctional, with a large informal sector and low quality in the formal sector. Policy deficits and incoherence impede the management of AAT: most actors were unaware of trypanocide resistance. Modelling suggested resistance is inevitable given agricultural intensification, will worsen without intervention, but can be reversed by vector control. All strategies were effective at managing trypanosomiasis, but rational drug use had the highest benefit-cost ratio. Vector control delivered most benefits, but because of high transaction costs requires continued support. Vector control, funded as a public good, is recommended for the containment of resistance, and RDU for its prevention. Trypanotolerant cattle-keeping is less attractive to farmers but should be retained as a fall-back option. Integrated approaches to AAT management combined with initiatives to promote evidence-based policy are likely to prove the best bet for trypanosomiasis management under risk of resistance in the cotton zone of West Africa.

13652. **Steuber, S., 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.

Federal Office of Consumer Protection and Food Safety, Diedersdorfer Weg 1, 12277 Berlin, Germany. [stephan.steuber@bvl.bund.de]

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.

13653. **Van Den Bossche, P., Akoda, K., Djagmah, B., Marcotty, T., De Deken, R., Kubi, C., Parker, A. & Van Den Abbeele, J., 2006.** Effect of isometamidium chloride treatment on susceptibility of tsetse flies (Diptera: Glossinidae) to trypanosome infections. *Journal of Medical Entomology,* **43** (3): 564-567.

Department of Animal Health, Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium.

Experiments were conducted to determine the effect of a single isometamidium chloride treatment of teneral tsetse flies, *Glossina morsitans morsitans* Westwood (Diptera: Glossinidae), on the subsequent susceptibility to an infection with *Trypanosoma congolense* or *Trypanosoma brucei brucei*. Flies were offered a first bloodmeal on sterile gamma-irradiated defibrinated bovine blood that contained either 10 or 100 µg of isometamidium chloride/ml. Treated flies were subsequently infected with *T. congolense* IL 1180 or *T. b. brucei* AnTAR1 on day 3, 5, 10, or 20 post-treatment. To determine the effect of a single treatment with isometamidium chloride at 10 µg/ml on the fly's susceptibility to infection with isometamidium chloride-resistant trypanosome strains, treated flies were infected with one of two resistant isogenic *T. congolense* IL 1180 strains 3 d after the first feed. Results showed that a single isometamidium chloride treatment at 10 µg/ml blood sufficed to reduce significantly the fly's subsequent susceptibility to infection. Only 6.8 percent of the flies that were treated with isometamidium chloride developed a mature infection with *T. congolense* in the mouthparts compared with 34.3 percent of the control group. None of the flies that were administered isometamidium chloride and subsequently infected on day 3 or 6 with *T. b. brucei* developed a metacyclic infection in the salivary glands compared with 22.7 percent of the control flies. Likewise for the resistant *T. congolense* strains, a single treatment with isometamidium chloride significantly reduced the subsequent susceptibility to infection (6.5 and 33.5 percent of flies with metacyclic infections for treated and untreated flies, respectively). In practice and with respect to the release of sterile male flies to eradicate an

isolated tsetse fly population, our results show that administering isometamidium chloride during the first bloodmeal (and before release) would significantly reduce the ability of these released males to transmit trypanosomes.

13654. **Waiswa, C., Picozzi, K., Katunguka-Rwakishaya, E., Olaho-Mukani, W., Musoke, R.A. & Welburn, S.C., 2006.** *Glossina fuscipes fuscipes* in the trypanosomiasis endemic areas of south eastern Uganda: apparent density, trypanosome infection rates and host feeding preferences. *Acta Tropica*, **99** (1): 23-29.

Makerere University, Faculty of Veterinary Medicine, P.O. Box 7062, Kampala, Uganda. [cwaiswa@vetmed.mak.ac.ug]

A study was undertaken in three districts in south eastern Uganda endemic for human and animal trypanosomiasis, to investigate the status of the vector tsetse fly population. Apparent density (AD) of tsetse was between 2 and 21 flies/trap/day across the three districts, with *Glossina fuscipes fuscipes* identified as the predominant species. Trypanosomes were observed in *G. f. fuscipes* with an infection rate, as determined by microscopy, of 1.55 percent across the three studied areas. However, trypanosome infections were only identified in female flies giving an infection rate of 2.39 percent for the female tsetse when this sex was considered in isolation; no male flies were found to be infected. Bloodmeal analysis highlighted 3 principal vertebrate hosts, namely cattle, pigs and monitor lizards (*Varanus niloticus*). The implication of this, in relation to the cycle of transmission for human infective trypanosomes between domestic animals and man, is discussed.

5. HUMAN TRYPANOSOMIASIS

(a) SURVEILLANCE

[See also **29**: 13603, 13605, 13609, 13619, 13622, 13688]

13655. **Berrang-Ford, L., Berke, O., Abdelrahman, L., Waltner-Toews, D. & McDermott, J., 2006.** Spatial analysis of sleeping sickness, southeastern Uganda, 1970-2003. *Emerging Infectious Diseases*, **12** (5): 813-820.

Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada. [berrang1@uoguelph.ca]

Sleeping sickness re-emerged in south eastern Uganda in the 1970s and remains a public health problem. It has continued to spread north into new districts, and gaps remain in the understanding of the causes of its spread and distribution. We report the distribution and magnitude of sleeping sickness in south eastern Uganda from 1970 to 2003. Data were collected from records of the Ugandan Ministry of Health, individual sleeping sickness treatment centres, and interviews with public health officials. Data were used to develop incidence maps over time, conduct space-time cluster detection analyses, and develop a velocity vector map to visualize spread of sleeping sickness over time in south eastern

Uganda. Results show rapid propagation of sleeping sickness from its epicentre in southern Iganga District and its spread north into new districts and foci.

13656 **Deborggraeve, S., Claes, F., Laurent, T., Mertens, P., Leclipteux, T., Dujardin, J.C., Herdewijn, P. & Buscher, P., 2006.** Molecular dipstick test for diagnosis of sleeping sickness. *Journal of Clinical Microbiology*, **44** (8): 2884-2889.

Department of Parasitology, Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerpen, Belgium. [sdeborggraeve@itg.be]

Human African trypanosomiasis (HAT) or sleeping sickness is a neglected disease that affects poor rural populations across sub-Saharan Africa. Confirmation of diagnosis is based on detection of parasites in either blood or lymph by microscopy. Here we present the development and the first-phase evaluation of a simple and rapid test (HAT-PCR-OC [human African trypanosomiasis-PCR-oligochromatography]) for detection of amplified *Trypanosoma brucei* DNA. PCR products are visualized on a dipstick through hybridization with a gold-conjugated probe (oligochromatography). Visualization is straightforward and takes only 5 min. Controls both for the PCR and for DNA migration are incorporated into the assay. The lower detection limit of the test is 5 fg of pure *T. brucei* DNA. One parasite in 180 µl of blood is still detectable. Sensitivity and specificity for *T. brucei* were calculated at 100 percent when tested on blood samples from 26 confirmed sleeping sickness patients, 18 negative controls (non endemic region), and 50 negative control blood samples from an endemic region. HAT-PCR-OC is a promising new tool for diagnosis of sleeping sickness in laboratory settings, and the diagnostic format described here may have wider application for other infectious diseases.

13657. **Inojosa, W.O., Augusto, I., Bisoffi, Z., Josenado, T., Abel, P.M., Stich, A. & Whitty, C.J., 2006.** Diagnosing human African trypanosomiasis in Angola using a card agglutination test: observational study of active and passive case finding strategies. *British Medical Journal*, **332** (7556): 1479.

CUAMM-Angola and Angotrip Project, Caritas, Luanda, Angola. [inojosawalter@hotmail.com]

A study was made within a control programme in the Negage focus, northern Angola, during a period of civil war to assess the operational feasibility of detecting human African trypanosomiasis by active and passive case-finding using the card agglutination test with serial dilution of serum to guide treatment. It involved 359 patients presenting themselves to health centres with symptoms (passive case finding) and 14,446 people actively screened in villages. Whole blood and serological tests were performed at different dilutions using the card agglutination test, and detection of parasites was by microscopy. Active case finding identified 251 people with a positive card agglutination test result, 10 of whom had confirmed parasites. In those presenting for investigation 34 of 51 with a positive card agglutination test result at the dilution of 1:8 or more used to guide treatment had parasites in blood, lymph node fluid, or cerebrospinal fluid, compared with 10 of 76 in those detected by active case finding: positive predictive values of 67 percent for passive case detection and 13 percent for active case detection. Only at a cut-off dilution more than 1:32 was the positive

predictive value in active case detection reasonable (46 percent) and at this dilution 40 percent of microscopically proved cases were missed. The results suggest that the card agglutination test is useful for initial screening in active detection of cases with human African trypanosomiasis but, given the toxicity of the drugs, serology using the card agglutination test should be not used alone to guide treatment after active case finding. A second confirmatory test is needed.

13658. **Kinde-Gazard, D., Alyko-Chaffa, E., Atchade, P. & Massougbodji, A., 2006**. The re-emergence of the human African trypanosomiasis in Kerou, Benin. *Bulletin de la Société de pathologie exotique*, **99** (3): 191-193.

Faculté des sciences de la santé, 03 BP 1428, Cotonou, Bénin. [kindegazard@yahoo.fr]

Located in the northern part of Bénin, the district of Kerou is an historical HAT focus of the 1960s formerly called the "Atacora focus". This survey was conducted in 2001 to determine the prevalence of HAT in Kerou. The methodology consisted of a cross-sectional survey based on random sampling with two levels of stratification. 3367 persons were included (i=5 percent). After screening based on the CATT test using whole blood, the examination of trypanosomes was performed with QBC on the subjects that had persistent antibodies above a serum dilution of 1/4, followed by lumbar puncture. For the 3,367 surveyed subjects, the CATT seroprevalence was 4.2 percent and it was 2.4 percent using serum diluted at 1/8. The detection of trypanosomes with QBC was positive in 48 patients and the prevalence was 1.4 percent. The community survey conducted among 106 positive persons with CATT test serum at 1/4 dilution revealed that 71 (67 percent) persons never left the area since their birth. HAT was actually emerging in Atacora district in the north of Bénin, especially in Kerou.

13659. **Koffi, M., Solano, P., Denizot, M.., Courtin, D., Garcia A., Lejon, V., Büscher, P., Cuny, G., & Jamonneau, V. 2006.** Aparasitemic serological suspects in *Trypanosoma brucei gambiense* human African trypanosomiasis: A potential human reservoir of parasites? *Acta Tropica*, **98** (2): 183-188.

Institut de Recherche Pour le Développement, Unité de Recherche 177, Programme Santé Animale, TA 207/G, Campus International de Baillarguet, 34398 Montpellier Cedex 5, France.

The serological and parasitological tests used for *Trypanosoma brucei gambiense* human African trypanosomiasis (HAT) diagnosis have low specificity and sensitivity, respectively, and in the field, control programme teams are faced with subjects with positive serology but negative parasitology who remain untreated. The aim of this work was to explore, using PCR tool, the significance of these aparasitaemic serological suspects. Since discordant PCR results have been observed earlier with different extraction methods, two DNA extraction methods were compared (the Chelex 100® resin and the DNeasy® Tissue kit). The study was conducted on 604 blood samples: 574 from parasitologically confirmed patients, aparasitaemic serological suspects and endemic controls collected in Côte d'Ivoire and 30 from healthy volunteers collected in France. No significant differences were observed

between the PCR results obtained with the two extraction methods. Concerning PCR, problems of reproducibility and discordances with both serological and parasitological test results were observed, mainly for the aparasitaemic serological suspects. In addition to previous results that pointed to the existence of non-virulent or non-pathogenic trypanosome strains and of individual susceptibility leading to long term seropositivity without detectable parasitaemia but positive PCR, the results of this study support the notion of a long lasting human reservoir that may contribute to the maintenance or periodic resurgences of HAT in endemic foci.

13660. **Lejon, V., Jamonneau, V., Solano, P., Atchade, P., Mumba, D., Nkoy, N., Bebronne, N., Kibonja, T., Balharbi, F., Wierckx, A., Boelaert, M. & Buscher, P., 2006.** Detection of trypanosome-specific antibodies in saliva, towards non-invasive serological diagnosis of sleeping sickness. *Tropical Medicine and International Health*, **11** (5): 620-627.

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

The detection of trypanosome-specific antibodies in saliva is technically feasible, and, if clinically validated, could become an attractive option for non-invasive diagnosis of sleeping sickness. We wanted to optimize the test format of an enzyme-linked immunosorbent assay (ELISA)-based antibody detection system. Different ELISA formats for antibody detection in serum and saliva were developed and standardized. Saliva and serum samples were collected from 78 patients and 128 endemic controls, and sensitivity and specificity of saliva ELISAs, serum ELISAs and the card agglutination test for trypanosomiasis (CATT), were evaluated. All ELISA formats showed sensitivity and specificity above 90 percent. Saliva ELISAs showed a similar test performance as serum ELISAs and the CATT on whole blood or serum. This study confirmed the potential of trypanosome-specific antibody detection in saliva.

13661. **Lutumba, P., Robays, J., Miaka, C., Kande, V., Mumba, D., Buscher, P., Dujardin, B. & Boelaert, M., 2006.** Validity, cost and feasibility of the mAECT and CTC confirmation tests after diagnosis of African sleeping sickness. *Tropical Medicine and International Health*, **11** (4): 470-478.

Programme National de Lutte contre la Trypanosomiase Humaine Africaine, Kinshasa, République Democratique du Congo.

A study was conducted to evaluate the validity, cost and feasibility of two parasitological tests for the confirmation of Human African Trypanosomiasis (HAT): the mini Anion-exchange Centrifugation Technique (mAECT) and Capillary Tube Centrifugation (CTC). During a sleeping sickness screening campaign in 2004, we screened 6,502 people in Kwamouth, DRC. Those with a positive result in the Card Agglutination Test for trypanosomiasis (CATT) had a gland puncture, fresh blood examination, stained thick blood film, mAECT, CTC and CATT titration. Sensitivity and specificity of the confirmation tests were calculated using the combination of all parasitological tests as a reference standard. Each method was costed and its feasibility was assessed with structured interviews of the

technicians. Sensitivity of classical parasitological methods was 44.8 percent (36.8-53.0), of CTC 56.5 percent (48.3-64.5) and of mAECT 75.3 percent (95 percent CI: 67.7-81.9). Cost per test was 2.82 Euro for mAECT and 0.76 Euro for CTC. Time per test was 29.78 min for mAECT and 18.25 min for CTC. These two tests were judged feasible in field conditions. It was concluded that CTC and mAECT used alone or in combination would bring a considerable improvement to HAT active case finding when used as confirmation tests in CATT-whole blood-positive persons. They proved feasible in operational conditions if a 220 V power supply can be guaranteed. As mAECT is more sensitive but also considerably more expensive, efficiency as well as feasibility considerations will have to guide the choice of the best algorithm.

13662. **Magai, T., Kaare, Picozzi, K., Mlengeya, T., Fèvre, E.M., Mellau, L.S., Mtambo, M.M., Cleaveland, S. & Welburn, S.C., 2006.** Sleeping sickness: a re-emerging disease in the Serengeti? *Travel Medicine and Infectious Disease***, In press; corrected proof.**

Centre for Tropical Medicine, University of Edinburgh, Easter Bush, Roslin, Scotland, EH25 9RG, UK.

Sleeping sickness is a re-emerging disease in the Serengeti ecosystem affecting both local people and tourists. Here we report the results of a survey to assess the prevalence of trypanosomiasis in both domestic and wild animals from this area. Five hundred and eighteen cattle samples were collected from 12 villages that bordered the Serengeti National Park and 220 samples from 15 different wild animal species were collected from within the park. PCR analysis, directed against the human serum resistance associated gene SRA, identified human infective *Trypanosoma brucei rhodesiense* parasites in both cattle and warthogs.

13663. **Simarro, P. P.; Franco, J. R.; Ndongo, P.; Nguema, E.; Louis, F. & Jannin, J., 2006.** The elimination of *Trypanosoma brucei gambiense* sleeping sickness in the focus of Luba, Bioko Island, Equatorial Guinea. *Tropical Medicine and International Health.* **11** (5); 636-646.

Sleeping Sickness Control Centre, Bata, Equatorial Guinea. [simarrop@who.int]

After the resurgence of sleeping sickness in Luba, Equatorial Guinea, a major campaign to control the disease was established in 1985. The campaign comprised no vector control, but intensive active and passive surveillance using serology for screening, and treatment of all parasitological and suspected serological cases. Total prevalence was used to classify villages as endemic, at risk, anecdotal and non-endemic which also allowed defining the geographic extent of the focus. Active case-finding was implemented from 1985 to 2004. The frequency of surveys was based on parasitological prevalence: twice a year during intensified control, once a year during ordinary control and once every 2 years during the control consolidation phase, when the parasitological prevalence in the whole focus fell to 0.1 percent. From 1985 to 1999, the indirect immunofluorescent antibody test (IFAT) was used as an initial screening tool, followed by parasitological confirmation of IFAT positive cases, and the Card Agglutination Trypanosomiasis Test (CATT) if necessary. In 2000, the IFAT

was replaced by the CATT. Serum-positive individuals without parasitological confirmation were subsequently tested on serial dilution. All cases underwent lumbar puncture to determine the stage of the disease. First-stage cases were treated with pentamidine and second-stage cases with melarsoprol. A few relapses and very advanced cases were treated with eflornithine. The last sleeping sickness case was identified and treated in 1995.

(b) PATHOLOGY AND IMMUNOLOGY

[See also **29**: 13621, 13714, 13715, 13719, 13722, 13723, 13727, 13871, 13873, 13878, 13881, 13984, 13987, 13906, 13923, 13943, 13944, 13970, 13977, 13978, 13999]

13664. **Braakman, H.M., van de Molengraft, F.J., Hubert, W.W. & Boerman, D.H., 2006.** Lethal African trypanosomiasis in a traveller: MRI and neuropathology. *Neurology*, **66** (7): 1094-1096.

Department of Neurology, Rijnstate Hospital, Arnhem, The Netherlands. [HBraakman@alysis.nl]

The authors report a case of human African trypanosomiasis with CNS involvement caused by *Trypanosoma brucei rhodesiense* in a 52-year-old woman, which relapsed after melarsoprol treatment. After a second regimen, she developed a severe toxic polyneuropathy, progressing to coma and eventually death. MRI revealed rapidly progressive multiple white matter lesions as well as damage of the central gray matter and cortex. The autopsy results confirmed the diagnosis of human African trypanosomiasis.

13665. **Calderoni, D.R., Andrade Tdos, S. & Grotto, H.Z., 2006**. Haptoglobin phenotype appears to affect the pathogenesis of American trypanosomiasis. *Annals of Tropical Medicine and Parasitology*, **100** (3): 213-221.

Department of Clinical Pathology, Faculty of Medical Sciences, State University of Campinas-UNICAMP, CP 6111, CEP 13083-970, Campinas, Sao Paulo, Brazil.

In Latin America, 16-18 million people are thought to be infected with *Trypanosoma cruzi*, the parasite that causes American trypanosomiasis. The pathophysiology of this disease, particularly that of its chronic phase, has yet to be fully elucidated. The major function of haptoglobin, an acute-phase plasma protein found in three different phenotypes (Hp1-1, Hp2-1 and Hp2-2), is to bind to free haemoglobin and so prevent the accumulation of reactive hydroxyl radicals and renal damage. The haptoglobin phenotype present can influence the severity and progression of many diseases, including infectious ones. The aim of the present study was to see if any haptoglobin phenotype could be associated with any of the various clinical forms of American trypanosomiasis, and so explore the possibility that haptoglobin and iron metabolism have a role in the pathophysiology of this disease. The Brazilian subjects investigated were either suffering from the "indeterminate" (N=16), chronic cardiac (N=34), chronic digestive (N=13) or chronic "combined" (i.e. cardiac plus digestive; N=29) forms of the disease or were apparently healthy blood donors from the same

region as the patients (N=197). Haptoglobin phenotypes were determined by polyacrylamide-gel electrophoresis. Among the iron-related parameters investigated in the patients, only total iron-binding capacity and the serum concentration of haptoglobin differed significantly with haptoglobin phenotype. Compared with its frequency in the healthy controls, the Hp2-2 phenotype was much more frequent in the patients with any form of American trypanosomiasis, in the patients with the indeterminate form of the disease, and in the patients with the chronic combined form (p <or=0.0001 for each). It therefore appears that, in terms of the pathogenesis in those exposed to *T. cruzi*, possession of the 2-2 phenotype of haptoglobin may be detrimental.

13666. **Courtin, D., Jamonneau, V., Mathieu, J.F., Koffi, M., Milet, J., Yeminanga, C.S., Kumeso, V.K., Cuny, G., Bilengue, C.M. & Garcia, A., 2006.** Comparison of cytokine plasma levels in human African trypanosomiasis. *Tropical Medicine and International Health,* **11** (5): 647-653.

Institut de Recherche pour le Développement, Santé de la mère et de l'enfant en milieu tropical, Paris, France.

Immunological studies suggest that human African trypanosomiasis (HAT) is associated with inflammatory responses. A better understanding of the complex cytokine interactions regulating HAT infections is essential to elucidate the mechanisms of generalized immunosuppression. We determined levels of interleukin (IL)-2, IL-4, IL-6, IL-10, tumour necrosis factor (TNF)-alpha and interferon (IFN)-gamma protein levels in plasma samples from three groups of individuals from the Democratic Republic of Congo: (i) HAT cases; (ii) seropositive individuals for whom parasite detection was negative and (ii) controls. Plasma levels of six cytokines were significantly higher in HAT cases than in both controls (P<0.003) and seropositive individuals (P<0.016). IL-2 and IL-10 concentrations were significantly lower (P<0.02) in the seropositive group than in the control one. It was concluded that HAT leads to the development of strong cytokine responses, indicating the potential involvement of IL-2 and IL-10 in the phenomenon of seropositivity without parasitological confirmation. This strongly suggests the involvement of immunity in this particular aspect of HAT epidemiology.

13667. **Courtin, D., Milet, J., Jamonneau, V., Yeminanga, C.S., Kumeso, V.K., Bilengue, C.M., Betard, C. & Garcia, A., 2006.** Association between human African trypanosomiasis and the IL6 gene in a Congolese population. *Infection Genetics and Evolution.* **In press; corrected proof.**

Institut de Recherche pour le Développement (IRD), Unité de recherche 010: Santé de la mère et de l'enfant en milieu tropical, Faculté de pharmacie, 4 Avenue de l'observatoire, 75270 Paris, France.

Despite the importance of behavioural and environmental risk factors, there are arguments consistent with the existence of a genetic susceptibility to human African trypanosomiasis (HAT). A candidate gene association study was conducted in the Democratic Republic of Congo using a family-based sample which included a total of 353 subjects (86 trios; one case and parents (n=258) and 23 families with more than one case and parents

(n=95)). Polymorphisms located on the IL1alpha, IL4, IL6, IL8, IL10, TNFalpha and IFNgamma genes were genotyped after re-sequencing of the genes for extensive SNP search. The T allele of the IL6 (4339) SNP was significantly associated with a decreased risk of developing the disease (p=0.0006) and a suggestive association was observed for the IL1alpha (5417 T) SNP and an increased risk of developing the disease. These results suggest that genetic variability of the IL6 and to a lesser extent the IL1alpha gene are involved in the development of HAT. For the TNFalpha and IL10 gene polymorphisms, association results obtained here were different from those we observed in another population living under different epidemiologic conditions. This underlines the complexity of the interactions existing between host genetic polymorphisms, parasite diversity and behavioural and environmental risk factors in HAT.

13668. **Courtioux, B., Boda, C., Vatunga, G., Pervieux, L., Josenando, T., M'Eyi, P.M., Bouteille, B., Jauberteau-Marchan, M.O. & Bisser, S., 2006.** A link between chemokine levels and disease severity in human African trypanosomiasis. *International Journal of Parasitology*, **36** (9): 1057-1065.

Équipe Accueil 3174 Neuroparasitologie et Neuroépidémiologie Tropicale, Institut d'Épidémiologie Neurologique et de Neurologie Tropicale, Faculté de Médecine, 2 Rue du Dr Raymond Marcland, 87025 Limoges Cedex, France. [bertrand.courtioux@unilim.fr]

Trypanosoma brucei gambiense infection is an important public health challenge in sub-Saharan Africa. This parasitic disease is difficult to diagnose due to insidious clinical signs and transient parasitaemias. The clinical course is marked by two stages of increasing disease severity. An early systemic parasitic invasion is followed by the development of a progressive meningo-encephalitis. During this latter stage, a broad spectrum of neurological signs appears, which finally lead to a demyelinating and fatal stage if untreated. Treatment is toxic and difficult to administer when the CNS is invaded. Therefore, accurate diagnostic methods for stage determination are needed. The classically used criteria are not sufficiently specific and mechanisms of parasite invasion through the blood-brain barrier remain poorly understood. As cytokines/chemokines are involved in the early recruitment of leukocytes into the CNS, this study has focused on their potential value to define the onset of CNS involvement. Levels of monocyte chemoattractant protein-1/CCL-2, macrophage inflammatory protein-1alpha/CCL-3, IL-8/CXCL-8, regulated upon activation T cell expressed and secreted (RANTES)/CCL-5 and IL-1beta were measured in paired sera, and in CSF from 57 patients and four controls. Patients were classified into three groups (stage 1, intermediate and stage 2) according to current field criteria for stage determination (CSF cell count, presence of trypanosomes in CSF and neurological signs). In sera, cytokine/chemokine levels were poorly related to disease stage. Only CXCL-8 was higher in stage 1 patients when compared with stage 2 and CCL-5 was higher in controls when compared with patients. In contrast, in CSF the expression of the selected cytokines, except CCL-5, was associated with the presence of neurological signs, demonstrating their diagnostic value. We observed a relationship between the presence of trypanosomes or trypanosome-related compounds in CSF and levels of IL-1beta, CXCL-8, CCL-2 and CCL-3. These cytokines and chemokines may be triggered by the parasite and hence are potential markers of CNS invasion.

13669. **Cross, P., Doua, F. & Jaffar, S., 2006**. The risk factors for relapse among patients with African trypanosomiasis in Daloa, Cote d'Ivoire. *Tropical Doctor*, **36** (2): 90-93.

Department of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London WC1E 7HT, UK.

We describe rates of follow-up and the risk factors for relapse in a cohort of adult patients treated for *Trypanosoma brucei gambiense* African trypanosomiasis. 812 patients were discharged from hospital between 6 January 1983 and 16 January 1992. The numbers who did not attend a scheduled follow-up appointment at 6, 12, 18 and 24 months were 383 (47 percent), 467 (58 percent), 536 (66 percent) and 533 (66 percent), respectively. Thirty-two patients relapsed over the 2 years follow-up: 24 (75 percent) before the 12-month follow-up appointment. The presence of antibody to trypanosomes in the cerebrospinal fluid (CSF) at discharge from hospital was associated significantly with the risk of relapse at any time. When the analysis was restricted to a follow-up of 1 year, a protein level in the CSF above the median and the presence of antibody in the CSF (both at discharge) were associated in univariate analysis with relapse. A high number of patients were lost to follow-up, which may have resulted in bias. From the data available, the majority of the relapses were recorded within 12 months and the presence of antibody in the CSF at hospital discharge was identified as an independent predictor of future relapse at any time.

13670. **Kibiki, G.S. & Murphy, D.K., 2006.** Transverse myelitis due to trypanosomiasis in a middle aged Tanzanian man. *Journal of Neurology, Neurosurgery and Psychiatry*, **77** (5): 684-685.

Department of Internal Medicine, Kilimanjaro Christian Medical Centre, Tumaini University, Moshi, Tanzania.

We report the case of a middle aged Tanzanian man who developed a spinal cord syndrome over 6 weeks, along with a mild encephalopathy. Investigations ruled out the usual major causes of such a syndrome in our setting in northern Tanzania. Examination of his cerebrospinal fluid revealed trypanosomes, and he made a slow but dramatic improvement after a full course of suramine and melarsoprol. We postulate that he had a transverse myelitis due to African trypanosomiasis, a rare and barely recognised cause.

13671. **Kumar, N., Orenstein, R., Uslan, D.Z., Berbari, E.F., Klein, C.J. & Windebank, A.J., 2006.** Melarsoprol-associated multifocal inflammatory CNS illness in African trypanosomiasis. *Neurology*, **66** (7): 1120-1121.

Division of Infectious Diseases, Department of Neurology, Mayo Clinic, Rochester, MN 55905, USA. [kumar.neeraj@mayo.edu]

Abstract not available.

(c) TREATMENT

[See also **29**: 13615, 13617, 13736, 13737, 13744, 13748, 13769, 13770, 13776, 13828, 13865, 13875, 13880, 13959, 13973, 14008]

13672. **Garcia, A., Courtin, D., Solano, P., Koffi, M. & Jamonneau, V., 2006.** Human African trypanosomiasis: connecting parasite and host genetics. *Trends in Parasitology*, **22** (9): 405-409.

Institut de Recherche pour le Développement, Unité de Recherche 010, Faculté de Pharmacie, 4 Avenue de l'Observatoire, 75270 Paris, France. [andre.garcia@ird.fr]

In West and Central Africa, the protozoan parasite *Trypanosoma brucei (T. b.) gambiense* causes a chronic form of Human African trypanosomiasis (HAT) that might last several years, whereas *T. b. rhodesiense* refers to an acute form in East Africa that lasts weeks to months. Without treatment, both forms can cause death. Diagnosis relies on detecting parasites in blood, lymph or cerebrospinal fluid. HAT was no longer considered a public health problem in the 1960s, but it returned to alarming levels in the 1990s. After intensifying case detection and treatment, WHO recently declared the situation is under control. However, research based on host and trypanosome interactions should be encouraged to help develop innovative tools for HAT diagnosis and treatment to prevent re-emergence.

6. ANIMAL TRYPANOSOMIASIS

(a) SURVEY AND DISTRIBUTION

[See also **29**: 13648, 13689, 13690, 13691, 13692, 13693]

13673. **Bouyer, J., Guerrini, L., Desquesnes, M., de la Rocque, S. & Cuisance, D., 2006.** Mapping African animal trypanosomosis risk from the sky. *Veterinary Research*, **37** (5): 633-645.

Centre de coopération internationale en recherche agronomique pour le développement, Département Élevage et Médecine vétérinaire, Montpellier, France. [boyer@cirad.fr]

In Burkina Faso, African Animal Trypanosomosis (AAT) is still a major hindrance to cattle breeding, especially in the Mouhoun river basin, which was identified as a priority area for tsetse control. The attempt of the present work was to assess the abundance of tsetse flies and AAT risk using remote sensing coupled to field environmental data, along a Mouhoun river section of 234 km long, harbouring an open riverine forest where *G. tachinoides* Westwood is the predominant tsetse species. The water course was classified into three epidemiological landscapes, corresponding to a "disturbed", "natural" and finally "border" vegetation formation at the interface of the two formers. Using the mean number of infected flies by trap and by day as a risk indicator, the border landscape was found to be 5.4 (1.3-12.0) and 15.8 (4.7-41.6) times more risky than the natural and disturbed ones respectively.