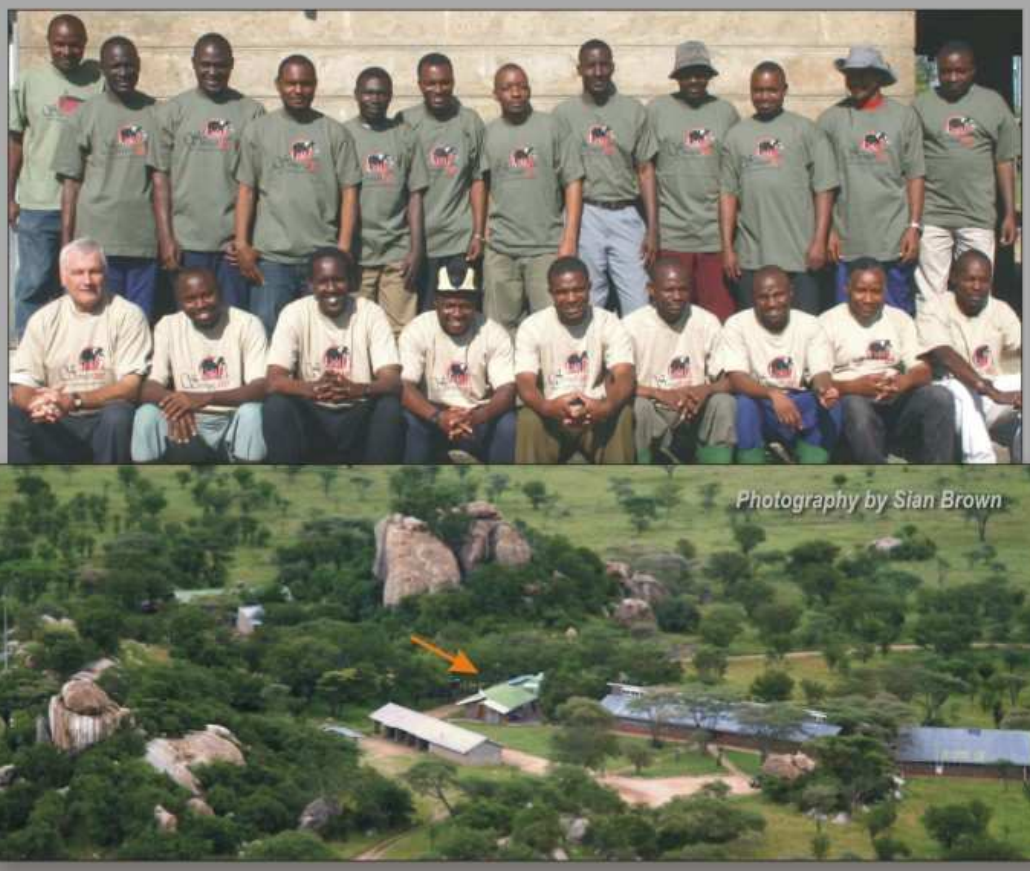
TAWIRI - Messerli Foundation

Wildlife Veterinary Programme

ANNUAL REPORT 2007

By Drs. Richard Hoare & Robert Fyumagwa



Project staff and final year veterinary students from Sokoine University of Agriculture, attending 2007 annual wildlife veterinary field practical based at the Herta Messerli Laboratory, SWRC, Serengeti National Park.

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Abbreviations

AfESG	African Elephant Specialist Group (part of IUCN)
CDV	Canine Distemper Virus
CVL	Central Veterinary Laboratory (part of MLD, formerly ADRI)
FZS	Frankfurt Zoological Society (international conservation NGO)
GPS	Global Positioning System (for radio-collars)
GR	Game Reserve (administered by WD)
HEC	Human-elephant conflict
HWC	Human-wildlife conflict
IUCN	The World Conservation Union (formerly International Union for Conservation of Nature)
MNRT	Ministry of Natural Resources and Tourism
NCA	Ngorongoro Consevation Area
NCAA	Ngorongoro Consevation Area Authority
NP	National Park (administered by TANAPA)
OIE	Office Internationale des Epizooties (UN agency monitoring animal diseases worldwide)
PAC	Problem Animal Control
PCR	Polymerase Chain Reaction (method to isolate genetic material e.g. from a pathogen)
RVF	Rift Valley Fever
SUA	Sokoine University of Agriculture, Morogoro Tanzania
SWRC	Serengeti Wildlife Research Centre, (TAWIRI) – home base of this programme
TANAPA	Tanzania National Parks (responsible only for NPs, not other wildlife areas)
TAWIRI	Tanzania Wildlife Research Institute
TNRF	Tanzania Natural Resources Forum
TRAFFIC	Trade Records Analysis for Fauna and Flora in Commerce (monitoring illegal wildlife trade)
VHF	Very High Frequency (for radio-collars)
VIC	Veterinary Investigation Centre, (MLD – zonal laboratories)
WCS	Wildlife Conservation Society (international conservation NGO)
WD	Wildlife Division, (MNRT, responsible for Game Reserves)
WDA	Wildlife Disease Association
WWF	World Wide Fund for Nature (international conservation NGO)

PREFACE

The Tanzania Wildlife Research Institute (TAWIRI) was established by Parliamentary Act No. 4 of 1980. The main functions include, among others, conducting and supervising wildlife research in Tanzania and using this knowledge to advise the government and management authorities on how best to sustainably conserve wildlife. In providing such advice, sound scientific data is required as generated from diverse research and monitoring work carried out by the Institute and other research institutions / scientists. The TAWIRI Wildlife Veterinary Programme, which is one of several similar programmes in the Institute, is designed to fill the need for sound scientific information in all veterinary-related aspects of Tanzania's wildlife management.

The veterinary programme fits into the organisational structure of TAWIRI under the Directorate of Research Development and Co-ordination. In this regard the TAWIRI veterinarians are responsible for all immobilizations of wildlife handled for research purposes. Other responsibilities include disease surveillance in wildlife through long and short-term research investigations as well as assisting with the monitoring of certain nationally important wildlife diseases on behalf of the Government of Tanzania. A wildlife sample tissue and serum bank is maintained in the Herta Messerli Veterinary Laboratory at the Serengeti Wildlife Research Centre in the Serengeti. This collection provides a unique reference for laboratory analyses of wildlife health and is therefore of national importance. It is being increasingly used as laboratory tests become more sophisticated.

The Messerli Foundation of Zurich, Switzerland has kindly provided full funding for this veterinary programme since its inception in 1992 and in recent years has supported a significant upgrade of the facilities in Serengeti. We in TAWIRI are very grateful to the Messerli Foundation for this long-standing support and we look forward to continued collaboration and increased support in this and other research areas.

Dr Simon A.R. Mduma

Acting Director-General

Tanzania Wildlife Research Institute

Date: 22nd May 2008

EXECUTIVE SUMMARY

The work of the wildlife veterinary programme primarily involves doing applied research to assist natural resource conservation efforts in Tanzania. The programme is involved in a very wide range of activities but the broad focus is on the wildlife-human interface, specifically issues where (i) threats to wildlife and natural resources are posed by human activity, or (ii) where humans are impacted by wildlife. The programme (a) conducts some research sub-projects on its own, (b) some with other researchers and (c) does others at the request of and in partnership with the conservation authorities. These categories are, however, closely linked and often overlap.

Most activities in the veterinary programme make use of a valuable expanding archive collection of specially prepared and preserved wildlife blood and tissue samples that have built up over ten years, and represent the heart of our operation. More samples continue to enter this sample bank than leave it for analysis (1979 entered vs 850 removed in 2007), but this is in part due to expanding field activity and the retention of duplicates from each case. Whilst collaborative projects with others have been the major use of the sample archive, smaller internal sub-projects using batches of samples were undertaken, for example Brucellosis was further investigated in wildlife and the role of wildlife in Rift Valley Fever is being checked – in response to an outbreak in East African livestock in 2006/7. Our back-up facility for long-term cold storage of valuable archive biological samples in Switzerland that was commissioned in 2006, received its first large batch of valuable duplicate carnivore samples in 2007. This is a first step in reducing the vulnerability of the entire sample archive being in one place in our laboratory at Serengeti.

Longer-term research sub-projects originally initiated from within the programme made steady progress in 2007. Robert Fyumagwa's long-term research on tick-borne diseases entered an important phase of writing up exciting new results from the NCA for publication. The year 2007 was the second of a longer-term plan to focus investigative effort on pathogens of economic importance – i.e. those transmissible between livestock and wildlife and vice-versa, and on some 'zoonoses' – pathogens transmissible from animals to humans. In this regard we consolidated our first batch of outputs in the form of scientific papers in leading international journals. The list of what was achieved is an impressive show of collaborative effort between ourselves as the collectors and processors of strategic samples, and leaders in different fields of microbiology or disease research, whose laboratories provided analytical services on those samples. We produced collaborative research papers with some of the best known international specialists on the following subjects:

- Ecology of tick-borne disease in wildlife (South African Journal of Wildlife Research)
- Micro-parasites isolated from ticks
- Trypanosomiasis - in equids on which very little was previously known (Veterinary Parasitology)
- Rabies - contributing data to collaborators in an important study of its epidemiology in wild carnivores. (Journal of Applied Ecology)
- Viruses present in wild equids (zebra) (The Journal of Veterinary Medical Science)
- Genital infection with *Treponema* in baboons (journal choice not finalized)

In another long-term initiative, Richard Hoare continued to provide guidance to people and projects in the conservation community in Tanzania that are concerned with the mitigation of human-wildlife conflict. The focus involved using data from recent field studies of direct human-elephant conflict in six different sites in Tanzania to guide new and innovative management proposals for 'problem' elephants. The objective is that Tanzania with its huge wildlife resources, becomes one of the focus countries for testing national HWC management models that can be copied elsewhere in Africa.

The veterinary programme is mandated to carry out animal handling work for wildlife researchers and the wildlife management authorities in Tanzania. In 2007 our immobilization work was slightly less than previous years, with some 65 animals from 11 wild mammal species being immobilized for diverse reasons: disease surveillance, radio-collar deployment, removal of wire snares or student training. But we are particularly specialized in capture of large and dangerous species – for example elephant and lion that made up much of our capture work during the year.

In addition to scientific publications we try to publicise our work and disseminate our results in simpler and more focussed, practical ways. Advisory 'services' both for conservation authorities and for individuals continued in 2007. A training programme similar to that in previous years was followed with the field practical for veterinary students at Sokoine University being the main event. Lectures were given to wildlife students from Mweka and Pasiansi colleges and various groups of foreign visitors to SWRC. We contributed three illustrated presentations at two international meetings (The Wildlife Disease Association and the 6th TAWIRI Conference) and produced or contributed to four substantial documents on human-wildlife conflict that are available free via the internet. A programme of presenting the relevance of wildlife research projects to tour guides and tour drivers was started. Because we have the capacity to do computer-aided graphic design and colour printing, we are able to supply much visual material in digital or hard copy form (CDs, visual 'Powerpoint' presentations) and the like to other projects.

The Herta Messerli Veterinary Laboratory has to be totally self-sufficient in water and electric power, provided respectively from rainwater collection and solar sources. In 2007 we undertook the first phase of a major upgrade of solar power facilities, so that freezer units safely storing the majority of the sample bank can continue to run efficiently in the months when solar radiation is reduced.

In 2007 TAWIRI appointed substantive directors to each of its four wildlife research centres in the country. It was a source of great pride that the person selected for this post at SWRC is Dr Robert Fyumagwa, who has worked in the veterinary programme since 2000. We are particularly happy that he has not moved far away and will continue some involvement in certain activities within the programme.

The wildlife veterinary programme in marked its 15th year of operation in Tanzania in 2007. It was set up in 1991 by Mrs Herta Messerli, President of the Messerli Foundation, in the early days of the work of the foundation, and remains one of the bigger projects in the portfolio that the foundation supports worldwide (in Europe, Asia and Africa see Messerli Stiftung : www.messerlifoundation.org). The veterinary programme is an extremely specialized and unique project that goes from strength to strength due to the benefits of consistent financial support, widening collaboration with other experts, and high quality outputs. These all contribute to a vital ingredient in any successful conservation effort**:** long-term continuity. For the initial vision and continued support over such a long period, both Mrs Messerli and the board are sincerely and gratefully acknowledged.

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TAWIRI - Messerli Foundation
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Dr Richard Hoare, programme manager(2nd from left) meeting Messerli Foundation board members L to R Prof. Hans Lutz, Dr Peter Humbel, Dr Heinz Schweizer, Mrs Herta Messerli, Dr Alfred Hartmann, at the Zooh! Restaurant in Zurich, Switzerland.

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Dr Robert Fyumagwa

Dr. Robert Fyumagwa who has worked in the Veterinary Programme since 2000, was promoted to Director of the Serengeti Wildlife Research Centre.
His quiet dedication and professional expertise in the veterinary programme will be sorely missed.

1 INTRODUCTION: history of the programme and its rationale

Wildlife populations are increasingly subjected to the negative impact of growing human populations with the result that the continued existence of many species is dependent on populations within protected areas. Thus the long-term preservation of many wildlife species will increasingly depend on efficacious management of protected areas, and to achieve this, a sound understanding of ecological factors that influence wildlife populations is required.

Pathogens are an important ecological factor in natural populations and ecosystems. Despite this, current knowledge of the ecological role of pathogens is rudimentary, and evolutionary associations between pathogens and their wildlife hosts are poorly understood (Munson & Karesh 2002). Thus the presence of a pathogen within a wildlife host often leads to concern among wildlife managers about increased levels of mortality. As a result pathogens may be viewed as detrimental, and thus measures to control pathogens may be practiced.

Due to the current lack of knowledge about the ecological role of pathogens in ecosystems, insufficient data is often available to managers to permit a scientific assessment as to whether or not pathogens require management action. This is an important issue because control measures themselves may lead to unforeseen and detrimental effects on wildlife populations and human communities when they are implemented in a vacuum of knowledge. To assist effective management of wildlife populations, continuously updated knowledge is required about pathogens and their role in ecosystems. In recognition of this need, the Messerli Foundation in collaboration with TAWIRI aims to increase the wildlife veterinary capacity in Tanzania and to promote the acquisition of relevant veterinary knowledge necessary for effective wildlife and natural resource management. Therefore one of the key roles of the programme is to be able to react to field situations requiring its specialist knowledge and equipment and to evaluate such situations scientifically. Both basic and applied veterinary-related research are thus pursued.

In practical terms the above objectives involve assisting managers of protected areas with issues such as unexplained increases in mortality in wildlife populations, potential zoonoses involving wildlife, possible spill-over of diseases between wildlife and domestic stock and the removal of wire snares set by illegal game-meat hunters.

Support for veterinary science at TAWIRI began in 1992 with the refurbishment of the veterinary facilities at the Serengeti Wildlife Research Centre (SWRC). From its inception until 1996 Dr Melody Roelke-Parker was project leader, Dr Harald Wiik was in charge from 1998-2003 and during this period was joined by Dr Robert Fyumagwa, and in 2004 Dr Richard Hoare became programme manager. The programme currently employs two veterinarians, a laboratory technician and two field staff based at the laboratory facility in Seronera.

An extensive upgrade of facilities at the Herta Messerli Laboratory in 2004 created greater self-sufficiency in both the supply of water (collected from roofs and stored in tanks) and electric power (supplied by solar panels and stored in batteries). However, veterinary investigations in this remote location will always be limited by the relatively low capacity of these two commodities and other constraints in expertise, equipment, storage space and safe disposal of biological waste. Thus much collaboration with other research institutions is essential.

Over 15 years of the programme, opportunistic and systematic sampling of many live and dead animals has produced a national ‘bank’ of many wildlife samples. This is now a very valuable resource, particularly given the improvement in laboratory diagnostic techniques worldwide, and the great value of archive wildlife samples in retrospective disease investigations. Recently efforts have been directed towards utilizing the sample bank more extensively, both by conducting more tests on archive samples *in situ* and sending more stored samples away for specialist investigation, using local Tanzanian resources and facilities where possible. All specialist investigations are written up for publication in scientific literature.

What has become clear over the life of the veterinary programme is that in order to follow up effectively on disease investigations 'opportunistic' sampling from wildlife (waiting for reports of suspicious cases) is seldom adequate to answer the relevant questions scientifically, and so 'systematic' sampling (designing a study) is usually a necessity. In practical terms this involves strategic veterinary sampling in the field, followed by specialist processing and proper storage of samples that are mainly destined for other laboratories for analysis. Most samples are stored in liquid preservative solutions or at low temperature – freezers or liquid nitrogen. A new field of sample processing, however, was fully established in 2006: a facility to prepare histological sections for the investigation of microscopic pathology. Specialist equipment provided by a collaborative donor was adapted to the SWRC circumstances and now uses simple, non-automated preparation techniques for histological tissue sections.

The Messerli Foundation places particular importance on education, training and the dissemination of scientific information within Tanzania. The core element of education and training is an annual practical course in wildlife veterinary practice for final year veterinary students from Sokoine University of Agriculture. In addition presentations are frequently given to other interest groups that include students, government officials, societies and researchers.

A new focus and work-plan for the programme was agreed between the relevant parties in 2006 with a time scale of three to five years and so the goal of the wildlife veterinary programme has been stated as:
"To support wildlife conservation in Tanzania through a structured programme of research and veterinary assistance to stakeholders in the wildlife sector, concentrating on investigating and diminishing the threats to wildlife and natural resources posed by human activity".

The work-plan encompasses nine categories of activity in 'sub-projects', and all monthly and annual progress reports including this one, are structured along the lines of those categories:

1. Research projects within the programme
2. Diagnostics and use of the national wildlife sample bank
3. Sub-projects for government agencies
4. Sub-projects in collaboration with other researchers
5. Animal handling
6. Advisory services
7. Training activities
8. Reporting, publication and publicity
9. Programme administration

Under this workplan, the focus of disease research that the programme concentrates (in 1-4 above) are those conditions which are associated with both livestock and wildlife and / or in addition are zoonoses (Bigalke 1994, Grootenhuis 2000; Munson & Karesh 2002; Kock 2005). Most are thus economically important in Tanzania. In practice sub-projects may overlap the above categories to some extent.

Categories 5-8 (above) are diverse in nature and can involve any work with a veterinary component on any species or indeed contributing to a wider scientific or management issue in the wildlife sector in Tanzania.

The programme is steadily expanding and with a commitment to long-term funding, its potential continues to be very promising. The style of this annual report is deliberately 'semi-scientific' so as to appeal to a wide audience. Readers requiring more technical detail and scientific data should refer to literature cited or contact the veterinarians working in the programme (p.50).

2 RESEARCH PROJECTS WITHIN THE PROGRAMME 2006

2.1 Focus of wildlife disease research

In the broad taxonomic categories of wildlife disease hosts, carnivore disease is being investigated largely by another TAWIRI-approved research project and surveillance for disease conditions in primates is likewise often handled by specialist primate researchers in small study sites. However, it is still the responsibility of veterinarians from TAWIRI, TANAPA or NCAA to investigate disease outbreaks. This programme has previously researched some of the potential pathogens of another category - wild equids (zebras, see section 5).

In 2006 the veterinary programme refocused its efforts on investigating wildlife disease and aimed them at surveillance and research on important microbial pathogens that can affect both domestic livestock and wildlife. The justifications are that these conditions are economically important to the livestock industry, potentially important to wildlife conservation and several are in addition zoonoses. It was decided to concentrate efforts on herbivores, especially wild host species in the bovid and suid groups – for example buffalo (*Syncerus caffer*) and warthog (*Potomachoeros africanus*). The relevant background picture of the conditions being investigated is more easily understood if tabulated (Table 1). Some of the programme's research activites in regard to these conditions involve simply the collection of sufficient numbers of samples to be examined meaningfully and thus are explained under Section 3 (Diagnostics and Use of the Sample Bank).

Table 1 Infectious disease conditions targeted by the wildlife veterinary programme

INFECTIOUS CONDITION	**CAUSATIVE AGENT** (Transmission)	**ECONOMIC IMPORTANCE TO LIVESTOCK**	**BUFFALO HOST STATUS**	**POSSIBLE WILDLIFE MORTALITY**	**ZOONOSIS**
Tick-borne haemo-parasites	**Protozoa spp.** (Ticks)	High	Endemic	Low	No
Trypanosomiasis	**Protozoan** (Tsetse Fly)	High	Multiplier?	None	One spp.
Foot and Mouth Disease	**Virus** (Contagious)	High	Maintenance	Negligible	No
Tuberculosis	**Bacterium** (Contagious)	High	Multiplier? Epidemic	Moderate	Yes
Anthrax	**Bacterium** (Environmental)	Moderate	Multiplier? Epidemic	Variable	Yes
Brucellosis	**Bacterium** (Contagious)	Moderate	Multiplier? Epidemic	Low	Yes
Rinderpest	**Virus** (Contagious)	Very High	Multiplier Epidemic	High	No
INFECTIOUS CONDITION	**CAUSATIVE AGENT (Transmission)**	**ECONOMIC IMPORTANCE TO LIVESTOCK**	**WARTHOG HOST STATUS**	**POSSIBLE WILDLIFE MORTALITY**	**ZOONOSIS**
African Swine Fever	**Virus** (Contagious)	High	Maintenance	Negligible	No
Trypanosomiasis	**Protozoan** (Tsetse Fly)	High	Multiplier?	None	One spp.

2.2 Research into tick ecology and tick-borne haemo-parasites in Ngorongoro

Background

Robert Fyumagwa has been conducting research into the ecology of ticks, their mammalian hosts and ticks as disease vectors in the NCA since 2001, initially with a field component (2001 - 2004) and then a laboratory component at the University of Zurich (2005 - 2006). The work was initiated following past sporadic outbreaks of disease and mortality in different wildlife species, in which tick-borne haemo-parasites (Penzhorn 2004) were directly incriminated (Fyumagwa *et al* 2004; Nijhof *et al* 2003) or strongly suspected (Trollope *et al* 2002). The original catalyst for this study – the well-described deaths of black rhinoceros (*Diceros bicornis*) in Ngorongoro crater in 2001 – had revealed previously unknown *Babesia* and *Theileria* pathogens (Nijhof *et al* 2003). The long-term co-existence of wildlife, livestock and people in the NCA, an area of great biological diversity that is in need of a great deal of research input (Estes *et al* 2006), makes this a particularly good and important study site.

Molecular isolation techniques (PCR) were performed for 10 micro-organisms, of which six were positive. Isolates from ticks include the known genera of tick-borne pathogens viz: *Anaplasma*, *Theileria* and *Babesia*, but the important finding here is the species of these micro-organisms, both because many are unknown and because taxonomy is very difficult and periodically changes.

Ticks collected from lions have yielded particularly interesting results as two species of *haemoplasma* (haemotropic Mycoplasma) have been isolated, one as yet uncultured and therefore not fully classified. One *haemoplasma* organism is a known pathogen of domestic cats, causing haemolytic anaemia. These findings are important because long-term lion researchers maintain that there is evidence for poor performance of the lion population in Ngorongoro crater being due to disease (Kissui & Packer 2004). But because of co-infection with several tick-borne pathogens and possible simultaneous exposure to Canine Distemper virus, there has been disagreement about the actual cause of three separate episodes of lion mortality in the past (in 1959, 1994, and 2001) and thus no resulting conclusion in print.

Now at least a start has been made towards separating the existing potential pathogens of wild felines and herbivores in this area. In practical terms, our experience with tick-borne disease can be put to use to promote better understanding of the wildlife-livestock disease interface.

Activity in 2007

To do justice to six years of previous research effort three publications were planned and implemented. One scientific publication on the ecology of ticks as disease vectors in Ngorongoro crater was completed and published in the South African Journal of Wildlife Research (see section 9, Fyumagwa *et al* 2007). Much time was spent by Robert Fyumagwa on preparation of two further manuscripts on the isolation of various haemo-parasites for submission to journals specializing in veterinary parasitology (see section 9). Due to some problems with data and therefore finishing these manuscripts, he will return briefly to the laboratory in Zurich during 2008 to complete the work.

2.3 Human-elephant conflict (HEC) study and management 2007

Background

The study and management of human-wildlife conflict is a field in which Richard Hoare has a special interest and a lot of experience (Hoare 1999; Dublin & Hoare 2004). He started a national initiative on investigating this topic in Tanzania and this has been included into the activities of the veterinary programme since 2004. A standardized system developed for evaluating and managing human-elephant conflict (HEC) in African situations (Hoare 2001) has been introduced and used in several sites in the country (Malima *et al* 2005).. Field researchers have collected data in six separate sites adjoining protected areas (Tarangire NP, Mikumi NP, Selous GR, Ruaha NP, Kilimanjaro-Arusha NPs and Serengeti NP)

Collecting hard data on incidents of elephant damage is the first step in addressing the problem - you cannot mitigate against any problem wildlife species unless you have consistent and reliable information on the distribution, frequency and severity of the damage it causes. However, whilst these comparable essential data have, or are being collected from different sites in the country, the real focus of mitigation of HEC work nationally is now to use these data beyond the site level, since it is impossible for site-level officials and managers to find solutions to enormously complex land use questions which lie at the heart of the problem (Newmark 1996; Hoare & du Toit 1999). One of the main constituents of this new approach is a package of measures to show how crop farmers can defend their fields against elephants with very low technology and therefore low cost techniques and equipment using capsicum (chilli) as a repellent (www.elephantpepper.org).

At a national scale the objective in Tanzania is to make it a 'focus country' for the development of a HEC mitigation model which works at all administrative levels, and in 2006 Richard Hoare wrote a report with recommendations proposing how to do this, which was posted on the IUCN AfESG website in 2007. (http://www.iucn.org/themes/ssc/sgs/afesg/hec/pdfs/heccstzvertint.pdf - see section 9.3). This initiative has the highest level support in the MNRT (AfESG 2004), which allows elephants to be the high-profile species catalyzing a radical, new and innovative approach to include the management of a range of other wildlife pest species.

Activity in 2007

Policy and governance issues

The five main recommendations of the above report were to (i) create a national 'HWC co-ordinator' post (ii) revise Tanzania's national elephant management plan (iii) lobby and inform the government to develop an up to date national PAC policy within the new Wildlife Conservation Act.(iv) find ways to inform the wildlife sector and the wider interested public about the mandate and activities of TRAFFIC and (v) select four wildlife managers from Tanzania to attend a training course in community-based wildlife conflict management.

WCS raised funds to implement the first two of these recommendations. However, revision of the national elephant management plan (possibly by a team of local and foreign consultants) was put on hold during 2007 due to a difficult political climate in the main wildlife authority dealing with problem animals, the WD. But the active civil society organisation TNRF got to work on the hosting and management of a new post of 'national human-wildlife conflict co-ordinator' and several Tanzanian candidates were approached and interviewed during the year. After a promising one decided he could not leave his government post, an alternative was employed to start in early 2008.

Training
Four Tanzanians, an employee each from HEC projects in Selous, Ruaha, Kilimanjaro and Western Serengeti conflict zones attended a specially designed HEC mitigation training course in Zambia which was designed by an organisation called Elephant Pepper Development Trust (EPDT, www.elephantpepper.org) and is endorsed by the IUCN AfESG. The training manuals were reviewed finally by Richard Hoare in 2007 and released for use (see section 8.3, Parker *et al*) as part of the IUCN-EPDT initiative in both anglophone ad francophone African countries (AfESG 2004).

Field work in conflict zones
In the HEC conflict zones themselves Selous, Mikumi and Tarangire did not have much activity beside some on-going mitigation measures in the first site. But a sensitization exercise was mounted and a comprehensive incident reporting system was started in study area of the Kilimanjaro Elephant Research and Conservation Project (west Kilimanjaro, Longido GCA and Loliondo GCA) for which 16 field enumerators were trained in a series of workshops.

In western Serengeti the third consecutive year of data on recorded HEC incidents was completed and summarized at the end of the 2007 crop season. HEC mitigation work started in earnest. After giving feedback from the data collection phase of the project and showing each village the extent of its local problem, several pilot villages were selected to demonstrate the low technology elephant damage mitigation measures of the IUCN – EPDT, now being employed by subsistence farmers in many African countries (www.elephantpepper.org).

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2.3 Human Elephant Conflict (HEC) & Management 2007

Low-cost, low-tech defences against crop-raiding elephants based on chilli as a repellant.

Top right: Making chilli dung bricks to burn.

Bottom: Chilli soaked oil on simple string fences around crop fields

3 DIAGNOSTICS AND USE OF THE NATIONAL WILDLIFE SAMPLE BANK

Background

A central aspect of disease research, both within the programme itself and involving collaboration with others, is the use of the national wildlife sample bank maintained at the Herta Messerli Laboratory in Serengeti. In fact most research involves the sample bank, so it is central to the programme's activities. As an archive potentially able to provide valuable material for future enquiry, the sample bank is of great importance to the country, for a number of reasons. The material has been collected using considerable resources in terms of money, time, equipment and effort. Samples are collected systematically through our own research programme (section 2), but opportunistic samples are added when handling animals for other research projects (section 5, 6) or when carcasses are found. Sample records are computerized into files separated by year and species. This greatly facilitates retrieving sample records belonging to the different wildlife species and reduces the time required to copy them for separate enquiry.

As laboratory tests become more sophisticated with time, the inherent value of the continuously growing sample collection is constantly increasing. This raises the question of vulnerability as the collection has traditionally been maintained all in one location at SWRC. In 2006 the Messerli Foundaton purchased a freezer suitable for long-term storage of biological material (-80 degrees) and located it at the Vetsuisse Faculty of the University of Zurich, Switzerland. We have started to use this as a back-up storage facility for our most valuable samples.

Disease investigations in wildlife are not at all easy. A typical scenario is that (i) because of rapid scavenging and putrefaction of carcasses in the field, initially there may be very little evidence of a problem and little fresh material useful to investigative laboratory work (ii) it takes a long time to build up a meaningful number of sampled cases to answer a question about the prevalence of any disease condition, and (iii) a number of specialist investigations are often required, many of which can only be done outside the country after a cumbersome process to obtain the respective export and import permits. Although some diagnostic work can be done in Tanzania, due to the sophisticated nature of many investigative procedures there is still a need to regularly export them to foreign laboratories.

General activity in 2007

A large batch of carnivore samples was sent to Zurich, for both safekeeping and for future research supervised by Prof. Hans Lutz.

Hair sampling was started for all cases and an initial 37 samples were released for nutrient tracking. (to Netherlands)

We sorted out samples stored in liquid nitrogen for many years and decided what to remove and use to follow the 3 -5 year work-plan which prioritizes investigation of economically important pathogens. The first batch removed were for a collaborator to screen for Tuberculosis.

One of our collaborators introduced to us a new method of extracting hormones, and provided the reagents to do this for his project in our laboratory. This involves processing faeces from animals, mainly to measure levels of reproductive and stress hormones. It is therefore non-invasive to the animal and the chemical extraction procedure is quite simple. In addition no special preservative is required for transporting the dry sample tubes.

We were approached about the possibility of collaborating with a UK based researcher on supplying wildlife samples to screen for a cattle disease, which we have not previously considered as it has no known wildlife involvement. It is a type of pneumonia called Contagious Bovine Pleuro-Pneumonia (CBPP) and it would be good to show again that few diseases of domestic cattle can actually trace their source exclusively to a wildlife reservoir.

We compiled a sample export protocol – a list of all the steps in the procedure - for the complicated process of obtaining permits for export of biological samples.

Table 2 Cases entered into sample bank in 2007

CASES ENTERED INTO SAMPLE BANK, 2007			
HERBIVORE		**CARNIVORE**	
Topi	**21**	**Lion**	**18**
Zebra	**19**	**Wild Dog**	**14**
Warthog	**18**	**Bat-eared Fox**	**8**
Grant's Gazelle	**9**	**Spotted Hyena**	**5**
Elephant	**6**	**Jackal**	**3**
Hartebeest	**5**	**Cheetah**	**2**
Thomson's Gazelle	**4**	**Wild Cat**	**1**
Buffalo	**4**	**Mongoose**	**1**
Impala	**3**	**Honey Badger**	**1**
Wildebeest	**3**		
Black Rhino	**2**		
Baboon	**2**		
Giraffe	**1**		
Hare	**1**		
CASES	**98**		**53**
TOTAL CASES	**151**		
TOTAL SAMPLES	**1979**		
Mean samples per case	**13**		

Table 3 Details of wildlife sample releases from the veterinary laboratory in 2007

SAMPLE RELEASES FROM THE LABORATORY, 2007					
TEST / REASON	**No. SPECIES**	**No. SAMPLES**	**SENT TO**	**POSITIVES**	**SEE REF.**
RVF	**13**	**241**	**Tanzania**		
Genetics	**7**	**162**	**Tanzania**		
Storage	**5**	**114**	**Switzerland**		
TB	**17**	**90**	**Tanzania**		
Tryps	**21**	**83**	**UK**	**Yes**	
Anthrax	**3**	**78**	**USA**	**Yes**	
Nutrients	**16**	**37**	**Netherlands**		
Toxins	**1**	**28**	**Tanzania**	**Yes**	
Rabies	**6**	**17**	**USA**	**Yes**	
TOTAL		**850**			

3.1 Trypanosomiasis ("sleeping sickness")

Background
Typanosomes are protozoal blood parasites transmitted by an arthropod vector, tsetse flies (*Glossina* spp.). Wildlife maintenance hosts are asymptomatic but livestock, horses and humans are susceptible to trypanosome-associated diseases, although different species and strains of the parasite afflict the different non-wildlife hosts. Trypanosomosis is an economically important disease of livestock in Africa and including several parts of Tanzania. Our collaborator at the University of Edinburgh, UK is able to use sensitive molecular testing methods (PCR) for the detection of genetic material of trypanosomes so determine the species of the parasite, in particular distinguishing those causing animal and human 'sleeping sickness'.

Activity in 2007
Our collaborator supplied FTA cards and we continued to routinely sample all wildlife cases with this very convenient medium of blood sample preservation. A large number (118) FTA blood cards were released for export in order to perform screening using PCR in the UK.

A tourist who briefly visited Serengeti National Park died of acute trypanosomiasis according to medical reports. This person was diagnosed in Dar es Salaam but moved to Nairobi, Kenya for treatment. The victim's travel itinerary to areas harbouring tsetse fly did not initially appear to be compatible with the likely incubation period of the disease and Robert Fyumagwa did a follow up investigation.

Our main achievement in trypanosomiasis in 2007 was acceptance of our research publication by a respected scientific journal based in the UK (Veterinary Parasitology - see section 9.1).

3.2 Tuberculosis

Background
TB is a chronic bacterial disease of mammals that can be a serious problem if it becomes established in wildlife populations, due to the impossibility of eradicating the infection in free-ranging animals. Strangely its prevalence appears very low in the Serengeti ecosystem to date, despite a high potential source of infection existing at the livestock-wildlife interface. Past surveillance, however, has not been systematic or sustained. TB in carnivores might suggest an infection route via their prey, as is the case in the Kruger National Park, South Africa (www.widlifetb.com). The importance of this pathogen is to investigate any epidemiological aspect of its behaviour which might give us early warning of an increase in prevalence. Systematic study is therefore

Activity in 2007
Tissue samples from old cases (1998-2000) were removed from long term storage in Liquid Nitrogen and freezers and taken by a research collaborator for TB screening to a laboratory at SUA – 90 samples were selected comprising 53 cases from 17 species. Specialist TB diagnosis is done by a series of bacterial cultures on media and is thus very slow. The selection, carriage and supervision of these samples was done by a collaborative researcher.

A honey badger that had been behaving strangely around a tourist camp was examined post-mortem and was suspicious for TB. Stains that are specific for TB bacteria were negative so samples from this case were sent for culture in the above batch

3.3 Foot and Mouth Disease

Background
In contrast to Europe where the fear of FMD is widespread because of intensive livestock production systems, in many parts of Africa this is an acute but non-fatal condition that erupts sporadically and disappears again without severe long-term damage to extensive livestock systems. Buffalo are the most important wild maintenance hosts for the viral strains called SAT1, 2, and 3.. Many different strains of the highly infective virus exist, but their exact distribution and epidemiology is not well understood. In Tanzanian cattle only strains A, O, and SAT1 have been isolated. As such, the important aspect of monitoring this pathogen is the viral typing of strains circulating in East Africa (Thomson *et al* 2003). Opportunistic sampling may suffice for this at present.

Activity in 2007
Very little activity as we were waiting for the new protocol for FMD sampling from vets in Kenya. We need to accumulate a few more samples before a batch is sent for analysis.

3.4 Anthrax

Background
The anthrax bacterium (*Bacillus anthracis*) is one of the oldest pathogens known to mankind. Although infective to livestock and potentially a fatal zoonosis, actual infectivity for humans is quite low. Anthrax occurs sporadically in a number of species, particularly herbivores, where acute deaths can occur. In 2004 there were almost synchronous outbreaks involving wildlife in several African countries but no association between the widely separated sites could be explained. Like many diseases seen in wildlife, anthrax is characterised by periodic cycles of both spatial and temporal intensity, so constant vigilance will help detect it.

Activity in 2007
We continued working with our collaborators in carnivore research by providing serum samples: from herbivore species for Anthrax antibody testing. Results from the first batch of 193 herbivore sera (from buffalo, wildebeest and zebra) were obtained after testing in USA. A second batch of 47 zebra samples were sent to even out the numbers of cases between the three species. There were a significant number of positive cases in buffalo and wildebeest; but zebra were all negative.

3.5 Brucellosis

Background
Brucellosis or 'contagious abortion' is a bacterial infection with a worldwide distribution that causes reproductive problems in ruminants. In many countries government-sponsored programmes exist to control or eradicate the disease, as it is both an economic problem for the livestock industry and a zoonosis. In southern Africa, brucellosis is regarded as being self-sustaining in wildlife but the actual level of risk to livestock remains unknown (Godfroid 2002). It is currently not known what levels of infection exist in wild ruminants in Tanzania and whether brucellosis has any impact on wildlife populations.

In 2004 we had tested 369 sera from 13 wildlife species for exposure to *Brucella* (using the Rose Bengal and competitive ELISA tests) (Hoare & Fyumagwa 2004), and found a prevalence rate of 17% - 22% in two species, wildebeest and buffalo respectively.

In 2005 we took the investigation a step further. The highly synchronous annual calving of Serengeti wildebeest (*Connochaetes taurinus*) on short grass plains provides an opportunity to collect fresh samples of placenta and foetal membranes - tissues from which isolation of the bacterium can be attempted. Unfortunately the poor rains in 2004/2005 meant that most wildebeest calved in woodland areas with poorer visibility, so only

eight samples were collected. These were sent to SUA for bacterial culture. A further benefit is the same samples can be used to try to isolate another pathogen of importance to livestock, namely Malignant Catarrhal Fever (MCF) virus, which afflicts cattle in Maasai pastoral areas.

Activity in 2007
We submitted our positive serum cases from 2004 and the above foetal membrane samples to specialist laboratories at SUA for attempts to isolate the *Brucella* organsm via bacterial culture. All cases were negative. As a more sensitive test, molecular analysis is now planned for the buffy coats from these sero-positive cases.

3.6 African Swine Fever

Warthogs are the asymptomatic maintenance host for African Swine Fever (ASF) virus, an unusual pathogen that is transmitted by a species of argasid (soft) tick. ASF is a severe, acute disease of domestic pigs with very high mortality rates and so it is economically important in Tanzania and other parts of East Africa.

Activity in 2007
Another batch of 18 warthogs were sampled. Six of these were immobilized by us in Serengeti National Park (see section 6) and 12 were captured physically by a team operating in the adjacent Grumeti Game Reserve doing sampling for trypanosomes (see section 3.1). Samples from more than 30 warthogs have now been preserved. This is enough to send to a laboratory (in South Africa or Kenya) for screening for African Swine Fever. We have just been approached by one in Kenya and in 2008 will make arrangements to transfer them there for screening.

3.7 Rabies

Background
Rabies is a severe viral disease that potentially kills any mammal and is a dangerous zoonosis. Rabies is intensively studied world-wide and there is a separate research project studying rabies epidemiology in carnivores and instituting control measures amongst domestic animals in parts of Tanzania adjacent to the Serengeti ecosystem. Our involvement is not in systematic research on rabies, but rather as one of several veterinary service providers keeping a keen lookout for occurrence of the disease which typically shows periodic cycles of intensity.

Activity in 2007
We continued to collect and preserve the relevant tissues from carnivores during routine sample collection activity. Periodically our carnivore research collaborators take batches of these for rabies screening. We had input into a meeting on rabies control policy (section 7).

3.8 Rift Valley Fever

Rift Valley Fever (RVF) is a mosquito-borne virus disease of livestock that can also affect humans, sometimes fatally. It is typically seen in extremely wet years and an outbreak was experienced across East Africa in early 2007 after exceptionally heavy rainfall. Human fatalities were almost exclusively amongst pastoralists who closely handled or ate infected livestock. The consumption of beef and mutton in Tanzanian towns fell drastically as a result of publicity surrounding the outbreak, and so edible chicken was in great demand. To date there is no known significant wildlife involvement in RVF epidemiology, but in Kenya in 2007 a number of wild species that were tested showed antibody levels, and thus exposure to the virus.

Activity in 2007

In order to check the situation in Tanzania we selected over 240 archive samples from herbivore species, for RVF serological testing. Laboratories in Kenya were first approached, then the VIC in Mwanza. Both institutions however said that they had insufficient reagents to use on wildlife species. Robert Fyumagwa approached the Central Veterinary Laboratory (CVL) in Dar es Salaam who agreed to collaborate and co-operate on probable publication of results.

3.9 Processing samples for histopathology

The processing of these samples (largely manual, not automated as in a city laboratory) is a valuable addition to the capability of our laboratory, since tissues in solutions of formalin do slowly deteriorate, but can be preserved indefinitely once mounted in wax blocks. These wax-embedded tissues or their cut and stained sections can now easily be sent for microscopic investigation by specialist pathologists, while duplicates can remain safely in our sample archive. In cases where an urgent diagnosis is required, a tissue section can now be ready for specialist examination within 48 hours – a remarkable capability in such a remote location as ours.

Activity in 2007

All tissue samples preserved in formalin (some for up to for 10 years) were listed separately and a number from potentially interesting cases were selected for wax embedding. Some test samples were done when a visiting expert pathologist trained our laboratory technician in the final process of producing fully stained and mounted microscopic tissue slides. Since the electric generator has been installed in 2007 the process of wax embedding can be done more routinely, because the equipment involved uses a lot of power.

4 SUB-PROJECTS FOR GOVERNMENT AGENCIES

There were no requests from the conservation or veterinary authorities to sample animals for Avian Influenza or Rinderpest, and we were not consulted about developments in the Epidemiology Surveillance Network. We were however requested to react to a few cases of sudden or unusual wildlife mortality and the following were investigated by field visits and laboratory investigations.

4.1 Wild dogs: mortality episode and possible translocation

Sudden mortality occurred in a pack of wild dogs (*Lycaon pictus*) in the northern part of Loliondo GCA. This pack had been fairly habituated to tourist vehicles for a number of years and fees were being paid by nearby tourist operators to the village authorities to view these rare animals. Twenty five dogs were found dead in three or four closely situated locations within a period of about a week. Thirteen further individuals in this large pack survived. A local political storm erupted because it was very widely believed that the dead animals had been deliberately killed by someone using bait in the form of an animal carcass laced with poison.

Fourteen wild dog carcasses were examined and sampled in total, 11 in the field and three at our laboratory. Samples of tissue from six cases were rushed to Dar es Salaam where the Government Chief Chemist Laboratory was asked to test them for the presence of the most likely compounds usually involved in deliberate poisoning of wild carnivores – insecticides used to control ticks, mites and other external parasites of livestock. Compounds of the organophosphate group (which are used to dip cattle against tick infestation) were detected from wild dog tissue samples (liver, kidney and spleen). Significantly however, neither the exact chemical nor its concentration in the tissues was given.

During the aftermath reports then followed in the popular press giving opinions about the poisoning incident. These were depressingly informative about the prejudices, misinformation and ignorance that exist about wild animals in society at large. One article claimed it is well known that wild dogs are not scavengers and so they would never feed on bait. Therefore, the author reasoned, the culprit had to be someone who closely understood the habits of this species, and the strong inference was that the suspect must be a wildlife researcher. Even an amateur naturalist knows that almost any carnivore will scavenge, if such a feeding opportunity presents itself. Meanwhile a sample of the supposed poison had been given to the person in charge of the TAWIRI wild dog research project and the wildlife authorities, various conservation NGOs and villagers were all involved in wide-ranging discussions about investigating the criminal act of deliberately killing an endangered species. The case therefore became highly political.

The mortality investigation them took an unexpected turn with the results from an overseas laboratory that examined some of the same tissue samples taken from our laboratory. They claimed to have found evidence of Canine Distemper Virus (CDV) in the dead animals. CDV is known to be prevalent in the area but published literature on the virus being a mortality agent in wild dogs is equivocal – sometimes it is fatal but there is evidence that the species can also withstand infection (Van de Bildt *et al* 2002). So at this stage it must be investigated whether one agent alone or both in some combination, are responsible. In 2008 therefore, the laboratory investigation will be intensified with duplicate and more quantitative testing to examine and interpret what possible respective roles the poison and the virus may have played. TAWIRI management are adamant that a very thorough investigation must be done this time, in order to avoid the speculation and damaging controversy that surrounded wild dog mortality in the Serengeti ecosystem in the past.

Both veterinarians attended meetings on a new and large collaborative effort (co-ordinated by FZS) to monitor, and possibly later relocate, 'problem' wild dog packs from pastoralist areas outside Serengeti National Park (but within the Serengeti ecosystem) into the national park itself. A veterinarian from another Serengeti research project (Carnivore Disease) managed to immobilize and radio-collar one animal in each of three different packs of wild dogs in Loliondo GCA where these animals are in conflict with pastoral people – preying heavily on domestic livestock in places. This is the first step**;** the next one is to build holding facilities for capture and release. It is emphasised that of an estimated 150 or so animals in this wild dog population's range, less than a quarter of the packs are considered a problem to pastoral peoples' livestock.

4.2 Wildebeest sporadic deaths in Serengeti National Park

At the time of the annual migration reaching Seronera in mid-May 2007, sporadic deaths of a total of 40-50 wildebeest were noticed. Anthrax was initially suspected but rapid tests eliminated that cause. Unfortunately all other samples did not reveal anything with the local diagnostic capacity available. However, samples were stored in case of a more intense future investigation.

4.3 Buffalo mortality in Ngorongoro crater

Buffalo deaths were reported from Ngorongoro crater but very few fresh carcasses were found. No cause was diagnosed from the two cases sampled and the deaths subsided.

4.4 Flamingos dying in Lake Natron

Reports of severe mortality in lesser flamingos reached TAWIRI who asked us to investigate, and Robert Fyumagwa made a field visit to the Lake Natron area. The severity of the die-off was greatly exaggerated, apparently by reports extrapolating mortality levels from the number of carcasses visible around the lakeshore. A significant factor was thought to be the prevailing very slow rate of carcass decomposition in the extremely arid and caustic environment of a soda lake, creating an effect whereby 'normal' mortality probably appears much higher than it actually is. So in 2007 we were confident that the mortality problems of some previous years (see section 9.4.3) did not occur in flamingos.

4.5 Carnivore deaths with nervous symptoms - Serengeti

A cheetah in the Ndutu area of NCA was observed displaying seizures and non-specific nervous symptoms like circling and ataxia. Two carnivore researchers observed it continuously for 72 hours and even protecting it with their vehicles from attack by hyenas at night. Eventually when symptoms were terminal we euthanazed the animal and conducted a very thorough post-mortem at our laboratory. As it was emaciated this condition must have been of some duration. Samples were sent to a specialist laboratory in the USA where a viral encephalitis was diagnosed by histopathology. Various causative agents have so far been eliminated by immuno-histo-chemistry and serology**:** Rabies, CDV, West Nile Virus and RVF. The investigators are continuing to test sequentially for a variety of viral agents.

A lioness was also observed in Serengeti displaying peculiar nervous symptoms. Fortunately it was a radio-collared lioness from the Serengeti lion project, so could be relocated daily and observed closely for long periods. Towards the end of a two week period it was circling and apparently blind, plus it had become very emaciated. Similarly it was euthanazed and a very thorough post-mortem was also carried out. Laboratory tests will attempt to see if a similar condition exists to that in the cheetah.

4.6 Livestock and wildlife deaths from volcano ash, Ngorongoro

Background

The only active volcano in the Tanzanian section of Africa's Great Rift Valley is a mountain called Ol Doinyo Lengai, situated near the NCA (there are some active volcanoes in Uganda). After several years of relative inactivity it started to erupt again regularly in 2007. The ash that settles in the surrounding Maasai pastoralist area is thought to be toxic to grazing livestock and some species of wildlife. This volcano is unique in that the larva emitted consists a "hybrid magma formed by the assimilation of natrocarbonatite" (www.mtsu.edu/fbelton) which is grey in colour and cooler than the glowing red larva from most other volcanoes.

Activity in 2007

An investigation by Robert Fyumagwa and the NCA veterinary department visited affected areas and interviewed resident pastoralists. Among domestic stock cattle were apparently worst affected with claims of up to 1500 deaths and survivors suffering loss of hair, suggesting that the ash may be irritating or corrosive. Sheep, goats and donkeys were far less affected. There were also reports of resident wildlife from the following species suspected of being killed by the toxic ash**:** bushbuck, reedbuck, waterbuck, buffalo, duiker, bush pig, hyena, and various types of birds. Sampling opportunities were very limited but the Department of Chemistry of the University of Dar es Salaam has analysed elements and compounds present in organs of one (unidentified) wildlife carcass and interpretation is pending.

4.7 Rhino reintroduction

Background

In June 2007 Grumeti Reserves Ltd purchased a pair of the East African sub-species of Black Rhino (*Diceros bicornis michaeli*) from a zoo in the UK, and brought them to Tanzania by air. They are captive-bred but had wild-born parents. Rhino, being a critically endangered species are the property of the state in Tanzania (and most countries), but individual land holders are able to obtain permission to hold and protect them. In fact Grumeti Reserves / Grumeti Fund is a concession holder of two areas of state-owned land (Grumeti and Ikorongo Game Researves, adjoining Serengeti National Park) so they are merely facilitating the species reintroduction in partnership with government conservation agencies (WD and TANAPA).

Activity in 2007

We were most concerned about the vulnerability of these animals to pathogens, particularly trypanosomes that have affected other very susceptible species like the domestic horses at Grumeti (section 3.1 and 8.1). Accordingly we consulted a number of experts and drew up a protocol for trying to implement what is termed 'trickle exposure' to these blood parasites. This involves intense and diverse measures to locally control both tsetse flies and the trypanosome infection, but gradually reducing these over time to hopefully produce a slowly rising immunity in the rhino. As part of the monitoring of these animals we took reference blood samples on two occasions in 2007 – on arrival and again after three months in their holding facility (boma). It is still too early to judge the success of these measures, but if they prove to be effective, this could have very positive implications for other captive rhinos that apparently are available for similar re-introduction from zoos in Europe. We also darted an elephant that had refused to leave the electric-fenced rhino enclosure, and Grumeti Fund moved it outside while in an immobilized state, using heavy mechanical equipment.

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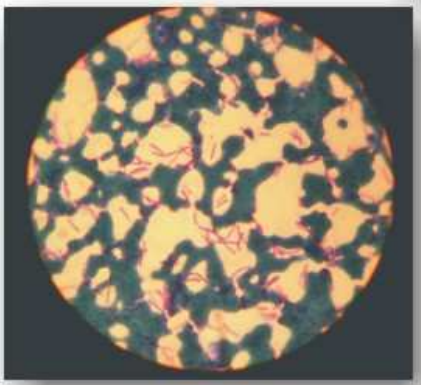
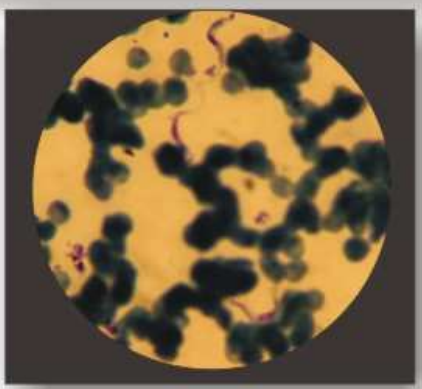
4 SUB-PROJECTS FOR GOVERNMENT AGENCIES

4.4 Flamingos

View of Lake Natron, main breeding ground of lesser flamingo in East Africa





3 Diagnostics and use of the wildlife sample bank

3.4 Anthrax **3.1 Trypanosomiasis**

Microscopic view of anthrax bacterium (left)and trypanasomes (right)
(Pink / purple organisms visible between dark areas of blood cells)

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4.5 Carnivore deaths with nervous symptoms - Serengeti

Sick cheetah (above left) & lion(below left) cases that were thoroughly examined at post mortem, and extensive samples taken.
Roadkill animals of various species are a source of opportunistic samples (below right) e.g. bat eared foxes.

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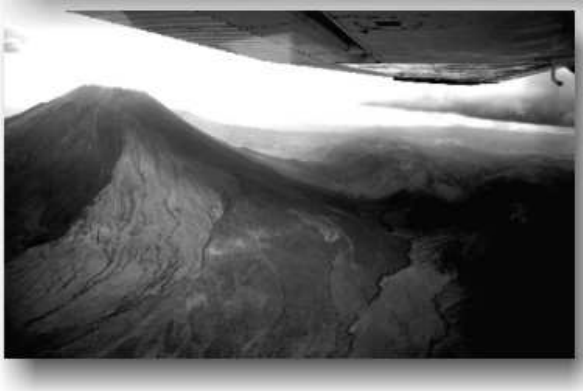

4.6 Livestock & wildlife deaths from volcano ash from Oldonyo Lengai, Ngorongoro

Eruption of the Volcano Oldonyo Lengai in the Ngorongoro Conservation Area causes toxic ash to fall and disperse over a large area, contaminating local grazing for livestock and some wildlife species. Air borne ash can also cause respiratory problems.

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4.7 Rhino reintroduction

Pair of zoo-bred black rhinos being offloaded from their transport aircraft and handled in "boma" At Grumeti Resreves Ltd.

5 SUB-PROJECTS IN COLLABORATION WITH OTHER RESEARCHERS

Trypanosome research (see section 3.1 and 9.1)
We have collaborated since 2006 with a project investigating trypanosomiasis in the Serengeti ecosystem. In every case of animal sampling (dead or live) a sample for trypanosomes was taken on a special testing medium (FTA card) for analysis in the UK. By the end of 2007 our collaborator reported that 11 wildlife species tested positive out of 24 and that the species of parasite causing the human form of 'sleeping sickness' was found in three wild host species

Baboon disease research
This research is fully described in many previous reports and has been an intermittent activity of this programme in northern Tanzania since 2001 (Hoare & Fyumagwa 2006)**.** In 2007 a PhD student based in Germany took over routine fieldwork on the most affected baboon population in Lake Manyara National Park. We had discussions with him about the start of his research project. As he is a veterinarian he did his own immobilizations of baboons (>60 in 2007), from which we will get a set of duplicate samples. We spent a lot of time communicating with our laboratory-based collaborator in the USA, refining the manuscript of the scientific publication on this topic (see section 9.2).

Anthrax research (see section 3.4)
We started collaborating on anthrax in 2006 with carnivore researchers who obtained access to a new laboratory test for antibodies. We have provided several hundred sera from three common herbivores prey species – buffalo, wildebeest and zebra while they provided corresponding anthrax exposure data in predators. Test results (antibody titres) were obtained from USA and preliminary data analysis began with the intention of a collaborative publication.

Research on viruses in wild equids (zebra)

The veterinary programme was involved in research on viruses in zebra from 1998 – 2006. Initially exposure to various equid viruses was published (Borchers *et al* 2005). In 2006 one of these (Equine Herpes Virus 9) was actually isolated (via PCR) and in 2007 a second publication was prepared and submitted to a scientific journal by our laboratory collaborator in Germany (see section 9.2).

Demographic data on zebra that we had collected in 2004-5 were given to a PhD student who is studying migratory herbivores in the Serengeti ecosystem. He has digitally entered these data and summarized them.

6 ANIMAL HANDLING

Background

Handling of wild animals is a very specialist field and restraint techniques, most commonly using chemical means (drugs) or occasionally augmented by physical means, are continually undergoing improvement. In terms of TAWIRI regulations for approved research projects in Tanzania, the wildlife veterinary programme is tasked with carrying out all animal handling related to research (TAWIRI Research Guidelines 2002). Through its international contacts the veterinary programme strives to keep abreast of and implement all improvements in wild animal handling techniques (Kreeger *et al* 2002). All animals immobilized for handling are sampled (e.g. blood, saliva, external parasites, hair) and these are added to the sample bank archive (section 3).

Activity in 2007

Table 4 Animals chemically immobilized in 2007

IMMOBILIZATIONS in 2007		
Spp.	**No.**	**Purpose**
Lion	**18**	Radio-collars, Disease sampling
Zebra	**18**	Snare removal, Radio-collars
Elephant	**6**	Radio-collars, Snare removal
Warthog	**6**	Disease sampling
Buffalo	**5**	Sampling, Student training
Wildebeest	**2**	Training
Baboon	**2**	Training
Giraffe	**1**	Snare removal
Impala	**1**	Training
Hyena	**1**	Snare removal
Cheetah	**1**	Euthanazia and sampling
TOTAL	**65**	

Lion

Lions were immobilized in Serengeti National Park (15), and Tarangire National Park (1) and Selous Game Reserve (2) for deployment or removal of radio-collars. There was a big problem locating lions for removal of GPS collars fitted in 2006, due to failure of the VHF (ground tracking) component.

Zebra

Ten of the eighteen zebra immobilized were for a researcher studying migratory herbivores in the Serengeti ecosystem (section 5). His GPS radio-collars are working better than those on some other species. These collars store location data and download them when in range of a mobile phone network.

Elephant

A five day field operation was undertaken to remove GPS (satellite) radio-collars that were deployed on elephants in West Kilimanjaro in 2005. These collars had produced extremely good data and reached the end of their two-year lives. Due to equipment failure (the VHF component that allows ground tracking) and the absence of a helicopter for the veterinary team, the operation was unsuccessful. A very serious situation then resulted whereby more than 20 elephants in northern Tanzania faced the prospect of not having their expired radio-collars removed. This is ethically unacceptable and represents a huge financial loss for the research project as the collars can be refurbished for future use, at much less than the original purchase cost.

Richard Hoare then wrote an emergency proposal and approached commercial helicopter operators in Kenya about quotations for the work. The researcher Mr Alfred Kikoti and his academic supervisor Prof. Curtice Griffin, used the same proposal to approach donors in the USA to fund these commercial helicopter costs. When it was obvious that the amount required (around USD 35 000 for two work sessions in 2008) would not be raised before the first radio-collar batteries expired, Richard Hoare arranged meetings to re-engage with Grumeti Fund to discuss the only option remaining – for them to donate their helicopter time again at a similarly favourable rate agreed when the collars were deployed. The helicopter used by Grumeti Fund is fully sponsored by an American businessman and conservationist, Mr Paul Tudor-Jones and much of its flying time is allocated to important conservation work in several African counties: South Africa, Mozambique, Zambia, Zimbabwe and Tanzania. It therefore has a very busy schedule and work in Tanzania has to be carefully planned well in advance. Grumeti Fund agreed to the proposal for flying in early 2008.

Three additional elephants were immobilized in Mr Kikoti's research project, for fitting new collars in Loliondo GCA, near Serengeti National Park. In this area, however, it was possible to do the job from a vehicle.

Warthog
With our collaborative researcher (trypanosomes- section 3.1) we immobilized and sampled six more animals in Serengeti National Park. The researcher also obtained samples from another 12 individuals in the adjoining Grumeti Game Reserve via a physical capture technique, with the assistance of Grumeti Fund. These samples, added to those obtained in 2006, has achieved a suitable number of cases for disease investigation (ASF – section 3.5).

Snare removal
Eight animals from four species were immobilized for snare removal (zebra, hyena, giraffe and elephant). One snared lion was seen but was not able to be approached due to difficult terrain.

Dart gun
We purchased another dart gun (Pneudart), so that each veterinarian can be equipped in the field with one of each type – a gas powered one for small, delicate or thin-skinned species, and a powder charge type for bigger species and less precise darting situations like snare removal. The advantage of the powder charge type is that the distance to the animal does not have to be so precisely measured.

Radio-collar problems
During immobilization work it became evident that considerable problems were experienced by new projects using radio-collars on wild animals. These began to fit a pattern, with those that were not a result of poor study design being mostly technical difficulties that could largely be traced back to the different manufacturers of the equipment. Accordingly the veterinarians compiled a presentation on this subject that was delivered at the end of year TAWIRI conference (section 9.4)

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6. ANIMAL HANDLING

The veterinary programme specializes in the safe and humane handling of dangerous species like elephant and lion.

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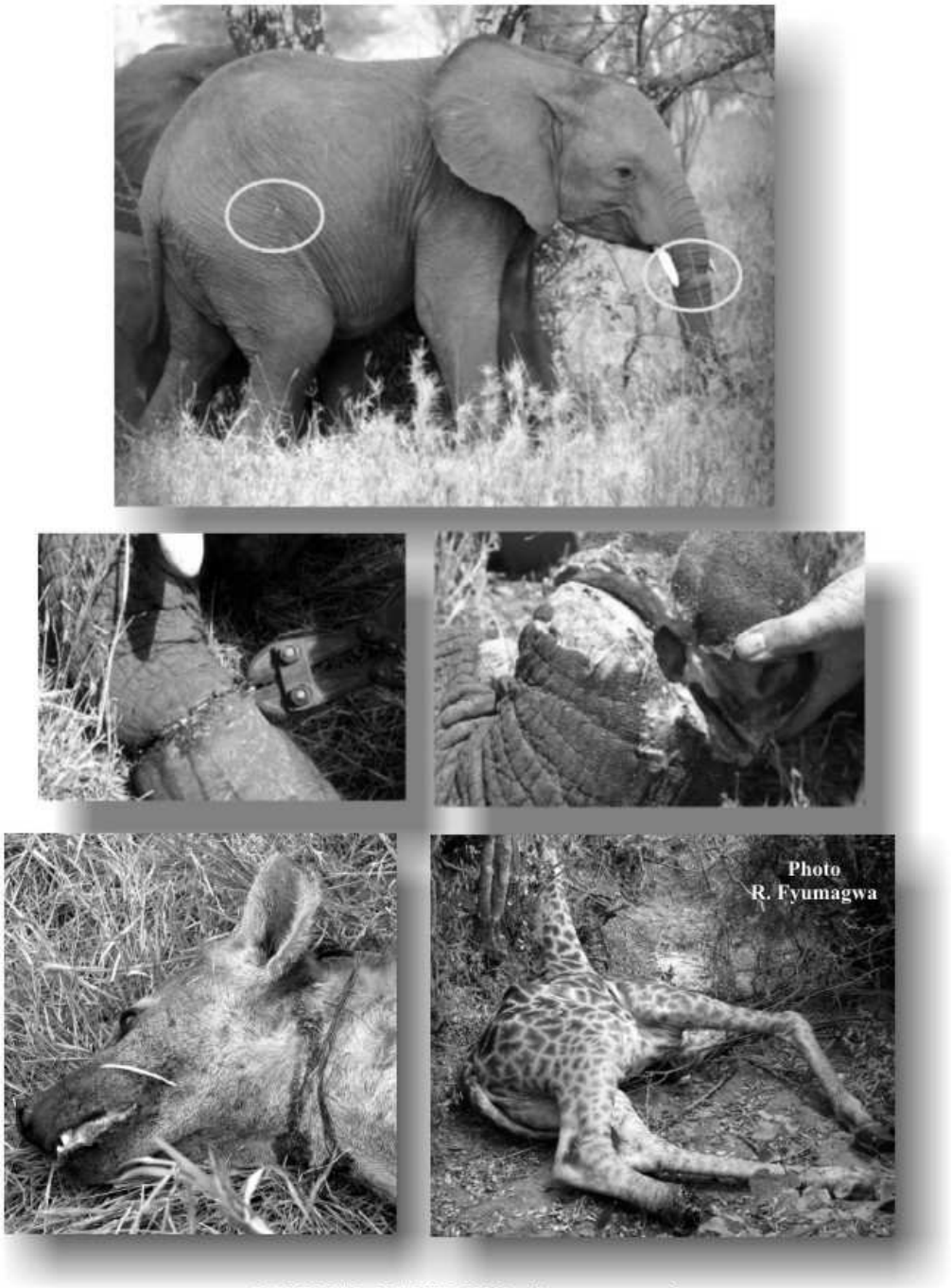

6 ANIMAL HANDLING - Snare removal

Above: Young elephant darted for removal of wire snare on trunk.
Below left: Neck snare on a hyena, before removal.
Below right: Giraffe died after it's foot, partially severed by a snare, completely broke off.

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6. ANIMAL HANDLING - Snare removal

Severe neck snare wounds in zebra. Photograph below taken at instant of impact by immobilizing dart. With the wire removed and the animal treated on the spot, there is a very good chance of recovery. In severe cases of snaring, a captive facility would be beneficial in ensuring full recovery. Individual cases could then also be monitored post treatment, and before release.

7 ADVISORY SERVICES

Robert Fyumagwa attended a meeting called by the government to discuss the serious situation with rabies in the country. It would appear that thanks to work by various wildlife researchers, government has realised that they have to rethink their decision of some years back, of not funding public rabies control campaigns. At this meeting the first steps were taken by the government to get back into rabies control on a national basis.

A veterinarian about to set up a wildlife veterinary laboratory in Zambia contacted us for advice. We related a number of our experiences about running our laboratory building in Serengeti, and made several suggestions about the facilities required in remote areas that are without external supplies of water and power.

We continue to advise PhD students and other conservation personnel as requested on subjects within our areas of specialization. In 2007 at least six such students sought advice.

8 TRAINING AND EDUCATIONAL ACTIVITIES

8.1 SUA course

The annual field practical course for final year veterinary students from Sokoine University hosted the largest class of students ever – a total of 32, split into two groups. It was again very successful and much appreciated by the SUA authorities who formally thanked us. As usual the students were given a few introductory lectures and several practical demonstrations before participating in the immobilization of six species of wild animals in the field. The logistics of accommodating and feeding so many extra people in SWRC were admirably handled by the workers union (RAAWU) members. A sample of written comment's from this years students:

"It was more than a tour and this field practical has added a big component in my career course"
"You have motivated me in wildlife conservation; I will keep it up"
"Excellent training and accommodation; the Serengeti is very beautiful, please maintain it"
"Field practicals have never been this eventful"
"Thanks for excellent training facilities as well as nice T-shirts".

8.2 Staff training

Robert Fyumagwa attended two short courses during the year:
(i) A 10 day course in animal biotechnology techniques held at Sokoine University of Agriculture, Morogoro, and sponsored by the UN.
(ii) A short sponsored practical course on primate necropsy (specifically on chimpanzees) This was held at Gombe National Park in western Tanzania where there is a project monitoring the health of primates, mainly chimpanzees and baboons.

8.3 MWEKA student sponsorship

A very motivated TAWIRI employee, Mr Elias Kalumbwa, appealed to us for sponsorship to attend the basic (Certiificate) course at the College of African Wildlife Management (CAWM), Mweka. We informed other researchers and organisations about this appeal who contributed as follows: Messerli Foundation 44%; FZS 22%; Alfred Kikoti of Kilimanjaro Elephant Research Project 14%; Ingela Jansson of Serengeti Lion Project 12%; Serengeti researchers Grant Hopcraft and Tiziana Lembo 5% ,and Sian Brown 3%. We collected the money from these other sources, combined it with the Messerli Foundation's own contribution and paid the student's one year tuition and boarding account at the college – a total of nearly US$ 3000.

8.4 Publicity to the tourism industry

8.4.1 Research talks to the tourism industry

There is a widespread acknowledgement that understanding and relations between people involved in the different sectors of the wildlife industry - namely management (e.g. TANAPA, WD and NCAA) research (e.g. TAWIRI) and tourism (e.g. mobile tour companies and lodge operators) - need to be substantially improved. There is an element of misunderstanding and mistrust prevailing in some quarters that is very damaging and which occasionally spills over into the popular press (e.g. see section 4 - wild dogs). This sentiment came across clearly during discussions at the TAWIRI annual conference in 2007.

Accordingly, we proposed developing a lecture series by TAWIRI research projects to tour drivers in Serengeti and took the lead in this initiative by asking for simple illustrative (Powerpoint) talks from the other research projects at SWRC, organising a convenient venue, contacting TANAPA to participate, and obtaining a list of all tour companies' addresses from their national association (TATO). The emphasis is on talks in a very simple format justifying the relevance of wildlife research to management of protected areas and wildlife in Tanzania. TANAPA and TAWIRI both welcomed the proposal. The first talks were scheduled for early 2008.

8.4.2 Leaflet on snare removal from animals

Sian Brown designed and prepared the draft of an illustrated leaflet on removal of snares from wild animals and discussed it with relevant sections of TAWIRI and TANAPA. The ideas is that this leaflet can be handed out to tour drivers as it explains a procedure to follow upon encountering a snared animal, and has all the contact numbers for the TANAPA and TAWIRI veterinarians in Serengeti National Park. The idea has received enthusiastic endorsement to be tried in 2008. If adopted this might be extended to other national parks.

8. TRAINING & EDUCATIONAL ACTIVITIES

Top: TAWIRI employee Elias Kalumbwa, accompanying the veterinary programme on a lion darting. His sponsorship to attend the Certificate Course offered by the College of Africa Wildlife Management was arranged by us in 2007.
Bottom: SUA Veterinary students attending lion immobilization as part of their field practical in Serengeti.

9 REPORTING, PUBLICATION AND PUBLICITY

9.1 Journal publications

2007 Publication on the ecology of NCA ticks and their control – see section 1.

Ecology and control of ticks as disease vectors in wildlife of the Ngorongoro crater, Tanzania
Robert D. Fyumagwa[1 *], Victor Runyoro [2], Ivan G. Horak[3] and Richard Hoare [1] (2007)
South African Journal of Wildlife Research, 37(1): 79 – 90.

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Abstract
Wild mammals in Africa mostly have high levels of innate resistance to haemoparasites and the tick vectors that transmit them. Occasionally though, biotic and abiotic factors combine to alter this relationship and tick-borne disease is diagnosed in wildlife. We postulate an interrelationship between anthropogenic and natural factors that resulted in wildlife mortality, attributable to disease transmission associated with a gradual build-up of large numbers of ticks. Suppression of grassland fire for 27 years in a distinct ecological unit promoted a gradual expansion of areas covered by tall grass. Changes in composition of the pasture led to improved tick survival, which was further boosted by the availability of increasing numbers of a coarse grazing species and preferred tick host, African buffalo. Alternating climatic cycles then appeared to precipitate an outbreak of tick-borne haemolytic disease by subjecting ticks and their herbivore hosts to ideal conditions (in wet years) followed by starvation and immune suppression (in dry years). Evidence supporting the hypothesis was gathered retrospectively in the present study through systematic sampling of tick density and correlating life stages of ticks to season, grass species and height of the grass sward. Tick host preference was noted by collection from immobilized wild animals and sympatric livestock. A long series of census data confirmed the changing composition of resident wild herbivores in the Ngorongoro Crater. To reduce the tick challenge, prescribed burning of the crater grassland was reintroduced; tick numbers fell rapidly and three years of subsequent monitoring confirmed the success of this strategy.

*Keywords***:** tick density, buffalo, climate variation, fire, wildlife diseases
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Publication on management of trypanosome infection – see section 3.1

This paper documented two and a half years of research on trypanosome infection in domestic horses kept by a tourist company in a tsetse-infested area adjacent to Serengeti National Park (see section 3.1). As horses are a species exotic to Africa they are extremely susceptible to trypanosomes, and in a sense are a good 'sentinel' species for detecting these parasites. Only two previous papers have ever been published on trypanosomiasis in horses, both many years ago, and so this paper represents the latest available information on detection, treatment and control. There are no drugs registered for trypanosome treatment and prophylaxis in equids and the paper also made important recommendations on that new topic.

Health management of horses under high challenge from trypanosomes: a case study from Serengeti, Tanzania. Harriet Auty[1*], Alison Mundy[2], Robert D. Fyumagwa[3], Kim Picozzi[1], Susan Welburn[1] and Richard Hoare[3] **In press Veterinary Parasitology. (2008) doi:10.1016/jvetpar2008.02.034**

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2: Singita-Grumeti Reserves Ltd, P.O. Box 65, Mugumu, Tanzania.
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***** corresponding author – Tel: 0131 650 6269, Fax: 0131 651 3903, E mail: h.k.auty@sms.ed.ac.uk

Abstract
Horses kept for recreational riding purposes by a wildlife tourism company in a heavily tsetse fly-infested region of north-western Tanzania were systematically monitored to investigate the occurrence, presentation and management of tsetse-transmitted trypanosomosis. During a 23 month period, 18 clinical cases were diagnosed (*Trypanosoma brucei* or *T. congolense* were identified) and treated and trypanosomes were implicated of involvement in four deaths. Pyrexia consistently aided early detection (17 cases). Delaying treatment by more than 10 days from the onset on clinical signs significantly increased the likelihood of death ($p<0.01$). Ataxia, weight loss and anaemia were seen in chronic cases and conferred a poor prognosis. Early detection, prompt treatment, thorough post-treatment health monitoring and rigorous prophylactic measures helped keep clinical cases to manageable levels, but re-infection remained a constant, insidious threat.

Collaborative publication on rabies – with other researchers, see section 3.

Exploring reservoir dynamics: a case study of rabies in the Serengeti ecosystem. Lembo, T., Hampson, K., Haydon, D.T., Craft, M., Dobson, A., Dushoff, J., Ernest, E., Hoare, R., Kaare, M., Mlengeya, T., Mentzel, C. and Cleaveland, S. **In press 2008 Journal of Applied Ecology**

Summary

1. Knowledge of infection reservoirs is critical for effective disease control, however, identifying reservoirs of multi-host pathogens is challenging: no single approach may unequivocally identify a reservoir, though combined approaches can provide powerful inference. Here, we synthesise several lines of evidence to identify rabies reservoirs in complex carnivore communities of the Serengeti, northwest Tanzania, where the disease has been confirmed in twelve carnivore species.
2. Long-term surveillance data suggest that rabies persists in high density domestic dog populations (> 11/km²) and occurs only sporadically in other populations, including lower density dog (< 5/km²) and wild carnivore populations.
3. Genetic data show that a single rabies virus variant belonging to the group of southern Africa canid-associated viruses (Africa 1b) circulates in a range of species. There was no evidence of species-specific virus-host associations and inferred transmission pathways were consistently from dogs to other species.
4. High-resolution incidence data indicated that rabies cases in wild carnivores and domestic cats were linked with domestic dog outbreaks and relatively clustered. The most plausible explanation for the observed epidemiological patterns is that intraspecific transmission in dogs predominates and infrequent spillover from dogs into other carnivores causes short-lived chains of infection.
5. *Synthesis and applications*. The balance of evidence suggests that the reservoir of rabies in the Serengeti ecosystem is a complex multi-host community where dogs are the only population essential for persistence. Other carnivores contribute to the reservoir as non-maintenance populations. Control programmes targeting dog populations should therefore eventually eradicate rabies from all other species. However, spillover and transient chains of infection in other species may prolong persistence by increasing the effective size of the susceptible population and act as a source of re-infection for dog populations, which is likely to increase the vaccination coverage required to control rabies above that predicted for dog populations alone. This study provides a framework for identifying reservoirs of multi-host pathogens that can be applied to any disease system.

Key-words: Carnivore, disease, rabies, reservoir, Serengeti, Tanzania, transmission

9.2 Papers in advanced stages of preparation

A collaborative publication on equid (zebra) virus isolation (see section 5) was submitted and awaits a journal decision. This work has been going on in the veterinary programme since 1998 and a previous paper was published about exposure to EHV-9 in 2005 (Borchers *et al* 2005). This paper reports the first isolation of this virus from wild equids, that was achieved by our collaborator in Germany in 2006.

Detection of Equid herpesvirus 9 DNA in the trigeminal ganglia of a Burchell´s zebra from the Serengeti Ecosystem. Kerstin Borchers[1)*], Dietmar Lieckfeldt[2)], Arne Ludwig[2)], Hideto Fukushi[3)], George Allen[4)], Robert Fyumagwa[5)] and Richard Hoare[5)] **The Journal of Veterinary Medical Science** Manuscript No. 7298N

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Abstract.
EHV-9 is a neutropic alphaherpesvirus causing fatal myeloencephalitis in gazelles. The natural host of this EHV-1 related virus is unknown, but zebras are suspected to be the source for infection of gazelles by virus transmission between these species sharing grazing areas. To prove this hypothesis, we analyzed 43 sera from Burchell´s zebra and Thomson's gazelles for neutralizing antibodies. Five out of 19 zebra sera collected in 2004 from the serengeti ecosystem and 2 out of 24 zebra sera sampled in 2005 were positive for EHV-1, EHV-9 and two EHV-1 like herpesviruses isolated from zebras. In contrast, none of the 21 gazelle sera collected in 2004 had neutralizing antibodies against EHV-1, EHV-9 or the zebra isolates. Trigeminal ganglia of 17 Burchell's zebras and from one gazelle, most of them killed by predators, were tested by EHV-9 gB and EHV-1 ICP0 specific nested PCR. One zebra ganglion was unequivocally EHV-9 PCR postive as confirmed by an independent laboratory, by sequencing of the PCR product and comparison with sequences of EHV-1 and EHV-1 related strains from zebras. Taken together, our serological and sequencing data support that Burchell´s zebras are exposed to EHV-9 and are latently infected. As typical for alphaherpesiviruses, EHV-9 seems to be latent in trigemenial ganglia of Burchell's zebra which may serve as the permanent biological reservoir for the virus.

Key Words: equid alphaherpesvirus 9, Burchell´s zebra, trigeminal ganglia, latency

In 2007 we worked extensively with our laboratory collaborator in the USA who had processed one last batch of samples from Serengeti that revealed the agent causing baboon genital infection (see section 5). The comprehensive paper presents 30 years of data from several baboon research studies in both Kenya and Tanzania by leading international primate researchers, and highlights the importance of recent discoveries from Tanzania - in Gombe, Manyara and Serengeti National Parks. The relevant samples, taken by our programme in 2004, changed the whole outcome of the investigation and enabled the infectious agent of baboons to be placed in a phylogenetic tree of the *Treponema* genus, which in turn supported new hypotheses on the evolutionary development of this family of human and animal pathogens.

Emergence of a sexually transmitted *Treponema pallidum* infection in free-ranging baboons: new light on the origin of human treponemal disease. Kristin N. Harper[1*], Robert D. Fyumagwa[2], Richard Hoare[2], Philemon N. Wambura[3], Dorian Coppenhaver[4], Robert Sapolsky[5,6], Susan Alberts[7], Jenny Tung[7], Fabian H. Leendertz[8], and George J. Armelagos[9]

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Molecular detection of haemotropic mycoplasmas in ixodid ticks collected on lions (*Panthera leo*) from Ngorongoro crater, Tanzania Robert D. Fyumagwa[1,2,*], Pascale Simmler[3], Barbara Willi[3], Marina L. Meli[3], Armin Sutter[3], Richard Hoare[1,2], Gottfried Dasen[3], Regina Hofmann-Lehmann[3], Hans Lutz[3]

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This paper is the second from Robert Fyumagwa's research on tick-borne disease in the NCA

Abstract
Haemotropic mycoplasmas (haemoplasmas) are pathogens that can cause hemolytic anemia in susceptible mammalian species worldwide. The cause of haemolysis is not known whether direct damage of erythrocytes or indirect damage through immune mediated mechanisms when the pathogens come into contact with erythrocytes. A molecular study was conducted to determine the presence of feline haemoplasma species in different tick species collected from Ngorongoro crater, Tanzania. The TaqMan real-time PCR was used in the analysis of DNA pools (n=507) derived from 11 tick species. *Mycoplasma haemofelis* and '*Candidatus* M. haemominutum' were detected in *Rhipicephalus appendiculatus* and *R. sanguineus* tick species. On average 0.6% and 0.24% of the tick population in the Ngorongoro crater was PCR-positive for *M. haemofelis* and '*Candidatus* M. haemominutum', respectively. Presence of *M. haemofelis* in the crater with the known pathological effects of severe acute and fatal hemolytic anaemia in domestic cats will probably have undesirable effects to wild cats like lions (*Panthera leo*). Therefore, a concerted effort towards a tick control regime has to be considered.

Keywords: TaqMan real-time PCR, haemoplasmas, ticks, Ngorongoro Crater, lions

9. 3 Proceedings of meetings, manuals, web documents and reports

The following reports were produced on the subject of human-elephant conflict (HEC – see section 1.). The first is an overview of new approaches to addressing HEC in Africa and the second is how these ideas might be implemented in practice, in this case using Tanzania as a 'focus country' for the model that other countries can adopt.

Hoare R. E. (2007) ***New developments in the research and management of human-elephant conflict in Africa.*** In: Proceedings of a symposium on Mitigating Human-Elephant Conflict: Case Studies from Africa and Asia. Editors Matt Walpole & Matthew Linkie (Eds) Fauna and Flora International, Cambridge, UK. ISBN: 9781903703267. (Meeting in Nairobi, Kenya 2006)

Hoare , R. E. (2007) ***Vertically integrated human-elephant conflict management system in Tanzania : background and next steps***. IUCN African Elephant Specialist Group, P O Box 68200 Nairobi 00200 Kenya. http://www.iucn.org/themes/ssc/sgs/afesg/hec/pdfs/heccstzvertint.pdf

Richard Hoare reviewed and approved corrections to the following two documents, produced by a team from the IUCN AfESG for the mitigation of human-elephant conflict in Africa (see section 1.). These manuals are used on a course in Zambia that trains African researchers and managers in the new approach of community-based HEC mitigation techniques.

Parker G.E., Osborn, F.V., Hoare R.E. and Niskanen, L.S. (Eds.) (2007): ***Human-Elephant Conflict Mitigation: A Training Course for Community-Based Approaches in Africa.*** Trainer's Manual. Elephant Pepper Development Trust, Livingstone, Zambia and IUCN/SSC AfESG, Nairobi, Kenya. http://www.iucn.org/themes/ssc/sgs/afesg/hec/hecreviews.html

Parker G.E., Osborn, F.V., Hoare R.E. and Niskanen, L.S. (Eds.) (2007): ***Human-Elephant Conflict Mitigation: A Training Course for Community-Based Approaches in Africa.*** Participant's Manual. Elephant Pepper Development Trust, Livingstone, Zambia and IUCN/SSC AfESG, Nairobi, Kenya. http://www.iucn.org/themes/ssc/sgs/afesg/hec/hecreviews.html

One hundred hard copies of the previous year's annual report were produced and distributed in Tanzania and abroad. There were many colour and black and white illustrations and the document was very well received.

Hoare R. E. & Fyumagwa R.D. 2006 ***TAWIRI Messerli Foundation Wildlife Veterinary Programme Annual report 2006.*** 52pp**.**

9.4 Illustrated talks given at meetings and submitted for proceedings:

9.4.1 Wildlife Disease Association Annual Meeting of Africa, Middle East Section 2007 (in Queen Elizabeth National Park, Uganda)

Robert Fyumagwa attended and delivered the following presentation:
"***Sero-prevalence of Brucella abortus in Buffalo and Wildebeest in Serengeti Ecosystem, Tanzania."***
Robert D. Fyumagwa[1*], Philemon N. Wambura[2], Lesakit S.B. Mellau[3], Samson Mkumbo[4] and Richard Hoare[1]

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Abstract
A sero-survey was conducted in buffalo and wildebeest in Ngorongoro Crater and Serengeti National Park (SNP) to establish the level of exposure to *Brucella arbortus*. Rose Bengal Plate Agglutination test and competitive ELISA were used serially in the analysis of 205 serum samples. The results indicated that 24% and 17% of buffalo and wildebeest populations are exposed to the bacterium respectively. The difference in the level of exposure of these herbivores to the bacterium in Ngorongoro Crater and SNP was insignificant ($P>0.05$), suggesting that probably the infection is sustainable in the ecosystem. Because wildlife has high interaction with livestock in Ngorongoro Conservation Area, it is likely that livestock is at risk of exposure to the infection. More studies are recommended to understand its epidemiology and isolate the bacterium for characterization. A close monitoring of the wildlife populations in the two protected areas is important to establish the impact of the infection on the reproductive performance. Furthermore public awareness to the communities in the interface should be strengthened to reduce the risk of human exposure to *Brucella* infection.

9.4.2 Society for Conservation Biology (SCB) Annual Meeting 2007 in South Africa. This was the first time this leading conservation body has held a meeting in Africa and the very successful event provided a broad and very useful forum for conservationists from the continent.

Richard Hoare attended and participated in a symposium ("***Appropriate intervention levels for management of large African Ecosystems"***) with wildlife agencies of Tanzania (TAWIRI, TANAPA, Mweka College, FZS). He wrote the abstract and co-authored a presentation entitled ***"What are the consequences of animal-orientated intervention?"***

Abstract
Human interventions in African ecosystems orientated towards animals themselves are most usefully classified as major or minor actions in the long term. Major interventions affect the populations of key ecosystem species and tend to operate on long timescales; minor interventions are targeted at relatively low numbers of individuals but their effects are more immediate. Population regulation exercises are potentially major interventions with long-term consequences. Removal of 'problem animals' is generally relatively minor. Reintroductions of rare or locally extinct species, whilst often a high-profile activity, is mostly a relatively minor intervention at the larger ecosystem scale - except with keystone species like elephant or large predators. Veterinary interventions can have major consequences if they involve abundant key species or target pathogens causing epidemics. Research interventions like immobilization of individual animals are relatively minor. The most important pre-requisite for animal intervention is the prevailing level of understanding ecosystem processes. This includes the dynamics of pathogens and disease. Examples of other necessary factors are sources of reintroduced animals and the capability for collaborative monitoring and evaluation by biologists and managers. Opponents of such legal interventions should consider how the effects of illegal interventions, principally poaching, have been massively greater.

9.4.3 Illustrated talks given at the 6th TAWIRI scientific conference, Arusha 2007

"Detection Of Cyanobacterial Toxins in Tissues of Lesser Flamingo from Empakaai Crater, Lake Manyara, and Lake Natron".

Robert D. Fyumagwa[1] (presenter), Donald G. Mpanduji[2], Robinson H. Mdegela[3], Samson S. Mkumbo[4], Athanas Nyaki[4], Richard Hoare[1] and Stephen Pflugmacher[5]

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[4]Ngorongoro Conservation Area Authority (NCAA) P. O. Box 1 Ngorongoro, Aursha, Tanzania.
[5]Leibniz-Institute of Freshwater Ecology and Inland Fisheries, AG Detoxication and Metabolism, Muggelseedamm 301, 12587 Berlin, Germany.

Abstract
During the mass die-off of lesser flamingo in soda lakes in Tanzania 2002 and 2004, clinico-pathological and toxicological investigations were made in order to elucidate the likely cause of mortalities. Water and tissue samples were collected from the lakes and from dead flamingos respectively. While water samples were analyzed for pesticide residues, tissues were analyzed for pesticide residues and cyanotoxins. The significant lesions observed in fresh carcasses included edema in lungs, enlarged liver, hemorrhages in liver with multiple necrotic foci, hemorrhages in kidneys and hemorrhages in intestines with erosion of inner lining (mucosa). Analysis of cyanotoxins revealed presence of neurotoxin (anatoxin-a) and hepatotoxins (microcystins LR and RR). Concentrations of microcystins LR were significantly higher ($P = 0.0003$) in liver than in other tissues. Based on clinicopathological findings and concentrations of the detected cyanotoxins, it is concluded that cyanobacterial toxins together with severe drought spell and secondary bacterial infection were the likely cause of the observed mortalities in flamingos.
Keywords: Cyanobacteria toxins, anatoxin-a, microcystins (LR, RR), lesser flamingo

"The Effective and Ethical Use of Radio-Telemetry in Wildlife Research in Tanzania"

Richard Hoare (presenter) and Robert Fyumagwa
TAWIRI - Messerli Foundation Wildlife Veterinary Programme

Abstract
A number of existing and new wildlife research projects are being granted permission to deploy tracking devices on animals. The effective use of radio-tracking involves considerable planning to choose from a wide range of equipment and to fund the expense of deployment, regular relocation of study animals and removal of collars after a study. The use of this powerful study aid brings many unexpected frustrations and problems and it should only be employed when the research commitment to time, expense and effort is justified in either (a) producing data that cannot be collected in a simpler way or (b) collecting data that otherwise could not be obtained. Problems with radio-telemetry can be broadly classified as (i) technical: e.g. allocation of frequencies; failure of equipment (ii) practical: e.g. difficulties with deployment; tracking 'lost' animals (iii) ethical: e.g. suitability of the tracking device; removal of device from the animal; unpopularity with tourism and (iv) scientific e.g. efficiency of sampling. Global environmental effects on natural ecosystems may create more demand for studies seeking to use radio-telemetry and if so, biologists will in future probably increasingly have to justify and defend their limited use of this semi-invasive technology. Their approach should be to have well-refined study objectives, address current inefficiencies in the use of telemetry, and educate detractors about its scientific credentials. The relevant wildlife authorities must also produce an enlightened policy on the use of radio-telemetry in animals.

9.5 Other visual material for publicity

Sian Brown who assists the veterinary programme in a voluntary role, produced a large amount of illustrated material in 2007 that helped both ourselves and our collaborators and partner organisations to record and publicize activities and outputs. This material, mostly in the form of digital compact discs (CDs), power-point presentations and printed photographs, have almost become a regular 'service' of outputs from the veterinary programme.

- Sokoine University course: one CD (per two students) of photographs of the veterinary students field practical; T shirt for each student; printed photographs of the classes attending for each student
- Kilimanjaro Elephant Research Project: CD of photographs of all elephant radio-collaring operations; pictures and power point presentation on the work of the project for fund-raising purposes
- Tarangire Elephant Research Project: CD of photographs of elephant radio-collaring operation and identity photographs of elephants in Ngorongoro crater
- Serengeti Trypanosomiasis Research Project: one CD of photographs of veterinary immobilization and warthog immobilization and sampling
- Zimbabwe Veterinary Association: updated CD of photographs of annual training course on wild animal immobilization
- Hwange Lion Research Project, Zimbabwe CD of photographs of lion immobilization in Tanzania.
- Researchers assisting with wire snare removal (section 6): CDs of photographs of individual cases
- Design of a draft leaflet to involve tourist operators in reporting snared animals in Serengeti National Park (see section 8.4)
- Digital photography collections of disease investigations and post-mortem examinations to assist veterinary diagnostic work by collaborating scientists
- 2008 pictorial calendars with the veterinary programme logo to thank those helping our activites
- Business cards, compliment slips and special data recording forms are also produced 'in-house' and not commercially printed, to save costs and time

After concerns expressed at the TAWIRI conference about the serious misunderstandings existing among personnel in the wildlife management authorities in Tanzania (TANAPA, WD and NCAA) all research projects under TAWIRI were asked by the Director-General to produce a very simply expressed one to two page justification of their work. We did this and have found it an extremely useful and much-appreciated output of our programme, which we regularly hand out to visitors.

We also made contact with all tourist camps in outlying areas of the Serengeti ecosystem and gave the camp managers a copy of our 2006 annual report, plus explained in person what their staff should do if they see unusual mortality in wild animals or animals with wire snares.

Short talks on the work of the wildlife veterinary programme and how it fits into the conservation landscape in both Serengeti and Tanzania were given to three groups of foreign students visiting SWRC

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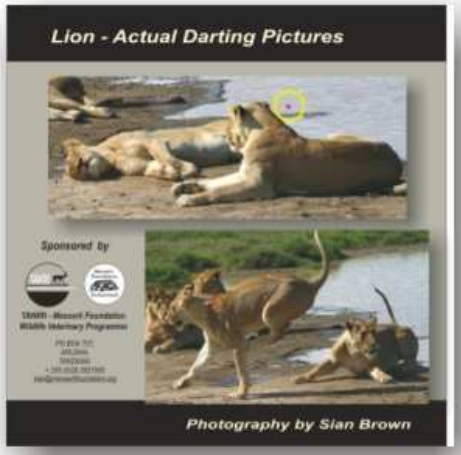

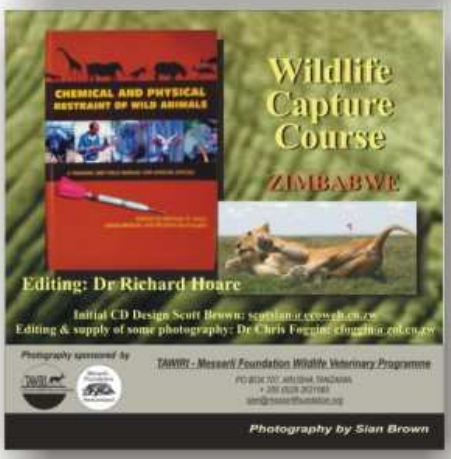

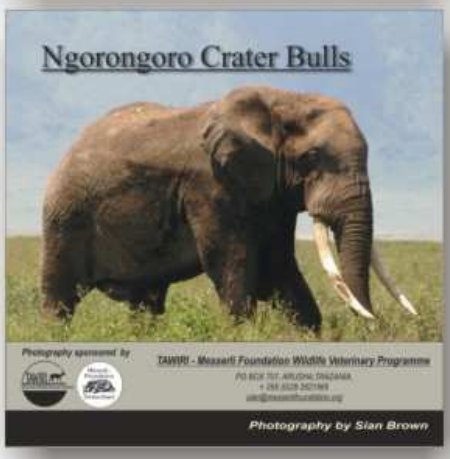

9 - REPORTING , PUBLICATION & PUBLICITY

A selection of some of the CD'S of photographs and illustrated talks, produced for other researchers and projects.

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9 - REPORTING, PUBLICATION & PUBLICITY

Above and centre: TAWIRI Annual Scientific Conference in Arusha
Below: SUA vet students at introductory power point programme presentation and lecture
In SWRC library, Serengeti.

10 PROGRAMME ADMINISTRATION

MoU

In 2006 it was felt that after 14 years of collaboration, the time had come to update and renew the Memorandum of Understanding (MoU) between TAWIRI and the Messerli Foundation. A draft was produced and first discussed at board meetings of the foundation. When they were happy with their final version, it was submitted to the TAWIRI Director-General by the programme manager. The process will be finalized in 2008. Most foreign-based organizations that have MoU's with government agencies do so for a period of ten years at a time and TAWIRI proposed this period as appropriate.

Energy supply

SWRC has no power system and research projects each have to provide their own independent energy supply. Since the start of this programme in 1992, solar power has been used for refrigeration and to operate office and laboratory equipment. It has continually lagged behind in capacity as the programme expands and as such has placed an increasingly valuable frozen sample collection (now 10 years of material) in danger. The solar power system at the Herta Messerli Laboratory is the most essential component of the building and it was with great relief that in 2007 we learned about a knowledgeable and professional technician opening a renewable energy business in Arusha.

The technician was contracted to undertake a full assessment of our specialist energy requirements and quote for an upgrade with the most suitable new technology. In the first phase during 2007, he reorganized and rewired the power system with additional solar batteries, charge control regulators, safety equipment and fuses, and a small 'back-up' diesel generator. The value of these improvements was Ourselves and a local builder undertook the building of two small rooms adjoining the laboratory building, one to properly house the solar battery bank and the other for the diesel generator – the latter for use during times of the year when sunshine is diminished by cloud or haze. The value of all these improvements was around US$8000.

Our energy demand is particularly high because of operating three (12 volt) refrigeration units (two of which run for about 14 hours a day), and numerous special machines like incubators and heaters for tissue sample processing. A second phase of upgrading and improvement, involving increasing the solar panels to charge more batteries, is planned for early 2008.

Water supply

In the absence of groundwater around Seronera, there is no water supply at SWRC except rainwater collection. The laboratory is adequately supplied by a 65 000 litre rainwater storage tank built at the start of the project in 1992, but domestic water supply shortages are a continual problem in the dry season. In 2007 three out of four of our staff domestic housing units were fitted with roof guttering and extra rainwater gathering tanks. All equipment was transported from Arusha on our vehicles.

Office equipment

Due to our normal training commitments and regular requests for lectures, plus our planned expanded educational work (see section 7), we purchased a digital data projector for illustrating these technical presentations. One replacement laptop computer was purchased so that the laboratory sample records could be better recorded and managed.

Dart gun

We purchased another dart gun (Pneudart), so that each veterinarian has one of each type for the many specialized situations he may encounter (see section 6). Immobilizing animals involves special drugs, running 4WD vehicles and maintaining a lot of equipment, all of which are constantly increasing in cost, plus huge amounts of time, so trying to ensure success of these operations is vital.

TAWIRI aircraft
After flying the refurbished TAWIRI aircraft briefly in 2006, programme manager and pilot Richard Hoare negotiated with the Director-General to have the machine based at Serengeti and for the veterinary programme to take over the management of it from March 2007. This also meant that we took on financial responsibility for its running costs. The maintenance contract was immediately changed to a better company and the missing elements of its legal paperwork were attended to. There were many 'teething' problems to overcome in the management of the aircraft that had not been used for five years, but about 100 hours were flown in the period March-December 2007. The engine is new (2006) and is sound, but the airframe is old and regularly requires expensive replacement parts.

From the outset the ability to travel to remote places by air revolutionized travel for the programme, in some cases cutting vehicle travel times by 80-90% and allowing us to expand coverage of our veterinary services and save on vehicle maintenance costs caused by appallingly bad roads. In addition to use on our programme, Richard Hoare has helped other wildlife research projects that required occasional flying, especially those employing radio-collars on animals like the Serengeti and Tarangire Lion Projects and the Kilimanjaro Elephant Research Project. Responding to calls to remove snares (see section 6) became much more efficient and in a number of cases a vehicle was able to pick up the veterinarian at a nearby airstrip, so that immobilization and snare removal could be completed quickly – i.e. within the same day and before the animal disappeared from view. Other benefits of having an aircraft were also realised – for example reporting bush fires in the protected areas to TANAPA or WD; aerial photography; spatial surveys of inaccessible human-wildlife conflict zones, and assisting another aircraft that crashed in a remote area.

Richard Hoare distributed a short proposal document requesting supplementary funding for the aircraft in the upcoming year (2008), to other potential sponsors. It emphasises that the aircraft which was donated to TAWIRI seven years ago by a Japanese university professor and president of the Japan Wildlife Conservation Society, is at last fulfilling its intended purpose of being available to help several different wildlife conservation activities in Tanzania.

Supplies from Arusha
We privately purchased a second-hand shipping container and had it refurbished, in order to safely hold supplies and equipment that have to be procured, repaired, temporarily stored etc. in Arusha. FZS kindly allowed us to place it at their conveniently situated rented premises in the town. Together with a person now employed to do errands and all kinds of project administrative business in town, this dual arrangement has vastly improved the efficiency of the massive logistics of running a highly specialized operation like ours in a very remote location – situated seven hours drive from its main supply town, that itself has to be mostly supplied from afar.

Permits and samples
A more effective procedure for obtaining permits, especially those for sample exports, was adopted by streamlining some of the steps involved. Sample export procedure was changed by the freight agent to enable most formalities to be done at Kilimanjaro International Airport, thus attempting to reduce the delays, congestion and problems of distant Dar es Salaam.

SWRC improvements
Once Robert Fyumagwa had been appointed to the directorship of SWRC and immediately began making improvements to the research station, we were prepared to help this process more readily than before. Our programme first paid for some minor improvements to the TAWIRI staff canteen. We will continue to explore ways to assist other developments. Along with other projects, we contributed US$ 2000 to a fund, organized by Prof. Sinclair of the Serengeti Biodiversity Programme and TAWIRI D-G Dr Mduma, to purchase a new diesel generator big enough to supply electricity for the entire research centre.

10 - PROGRAMME ADMINISTRATION

Top & middle left: Plastic water tanks transported on the seven hour drive from Arusha, and installed on staff housing.
Top right: Solar water heater on roof at staff housing
Middle right and below: Battery and generator rooms for power system upgrade at the laboratory built with concrete blocks made on site.

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10 - PROGRAMME ADMINISTRATION - Tawiri aircraft

Use of the TAWIRI aircraft has resulted in huge savings in travel time and vehicle wear and tear, especially in Maasai pastoral areas of Northern Tanzania where there are very few roads.
Middle right: A young maasai herd girl, curious to see the plane up close, carrying one of her "charges" - a new born goat kid.

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Mrs Herta Messerli, President of the Messerli Foundation, Dr Heinz Schweizer, the Vice President, and the members of the Messerli Foundation Board of Directors have been the most important supporters of this programme through their willingness to make available the necessary financial support for all its activities over a very long period of time.

Within Tanzania, we express our gratitude to the following: the Minister for Natural Resources & Tourism, the Hon. Prof. Jumanne Magembe (MP) and the co-ordinator of NORAD projects in the MNRT, Mr Iddi Mfunda; the Director of Tanzania National Parks, Mr Gerald Bigurube and his staff; the former Director of Wildlife Mr Emmanuel Severre and his staff in the Wildlife Division; the Chief Park Warden of Serengeti National Park, Mr Martin Oloiboki and his staff; the Acting. Chief Conservator of Ngorongoro Conservation Area Authority, Mr Bernard Mrunya and his staff members, Mr Victor Runyoro, Mr Bruno Kawasange, Mr Tlaa Amiyo, Dr Samson Mkumbo and Mr Athanas Nyaki.

We sincerely thank the following people from TAWIRI for assistance in very many ways during the year: the Acting Director-General Dr Simon Mduma; the Director of Research, Dr Julius Keyyu; the former Acting Director of Serengeti Wildlife Research Centre, Mr Lucas Malugu, the former Acting Director of Njiro Wildlife Research Centre, Angela Mwakatobe, as well as Dr Julius Nyahongo, Grayson Mwakalebe, Noel Alfred, Habiba Mkwizu, Esther Makacha, Kezia Oola and all their colleagues in the Tanzania Wildlife Research Institute.

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Finally, Sian Brown's large and invaluable contribution to the veterinary programme is very sincerely acknowledged, in particular her work in the following areas: maintaining a continual and archived photographic record of all activities; graphic design assistance with illustrated presentations, reports, CDs, maps and T shirts; organizing the printing of this report; plus much assistance with fieldwork, travel logistics, special events, visitors and general administration.

There are many people to acknowledge so we apologize if anyone has been forgotten, and ask that they bring this to our notice.

With thanks

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