TAWIRI - Messerli Foundation

Wildlife Veterinary Programme

ANNUAL REPORT 2008

By Drs. Richard Hoare & Bugwesa Zablon

Photography by Sian Brown

Elephant capture team operating in Maasailand, comprising the veterinary programme, Kilimanjaro Elephant Conservation Project, Tanzania Game Trackers Safaris Ltd, helicopter and game capture pilot from Singita Grumeti Reserves Ltd, District Game Officer, camp staff and local scouts.

TABLE OF CONTENTS

Photographs and Illustrations

Tables

Abbreviations

ADRI	Animal Disease Research Institute
AfESG	African Elephant Specialist Group (part of IUCN)
CVL	Central Veterinary Laboratory (part of MLDF, formerly ADRI)
FZS	Frankfurt Zoological Society (international conservation NGO)
GPS	Global Positioning System
GR	Game Reserve (administered by WD)
HEC	Human-elephant conflict
HWC	Human-wildlife conflict
IUCN	International Union for Conservation of Nature
MLDF	Ministry of Livestock and Fisheries
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 SNP Serengeti National Park
SUA	Sokoine University of Agriculture, Morogoro Tanzania
SWRC	Serengeti Wildlife Research Centre – 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
VHF	Very High Frequency (for radio-collars)
VIC	Veterinary Investigation Centre, (MLDF – zonal laboratories)
WD	Wildlife Division, (MNRT, responsible for Game Reserves)

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

Director-General

Tanzania Wildlife Research Institute

Date: 29th April 2009

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, 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. To reduce the vulnerability of the entire sample archive being in one place in our laboratory at Serengeti, we make use of a back-up facility for long-term cold storage of duplicate archive biological samples at the University of Zurich in Switzerland.

The year 2008 was the third in a longer-term plan to focus investigative effort on disease conditions 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:

- Micro-parasites isolated from ticks (Veterinary Parasitology & SA Journal of Wildlife Research)
- Trypanosomiasis (Veterinary Parasitology)
- Viruses present in wild equids (zebra) (The Journal of Veterinary Medical Science)
- Rabies - contributing data to collaborators for epidemiology study (Journal of Applied Ecology)

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 2008 our immobilization work was slightly less than previous years, because of there being only one veterinarian for much of 2008. Some 57 animals from seven wild mammal species were however immobilized for diverse reasons: disease surveillance, radio-collar deployment, removal of wire snares or student training. 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.

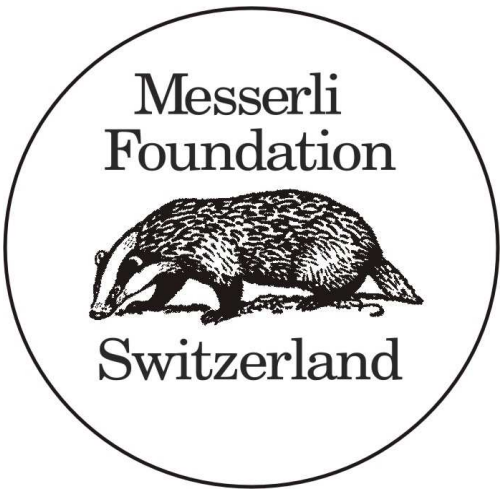
In addition to scientific publications we try to publicise our work and disseminate our results in simpler and more focussed, practical ways. Advisory 'services' both for conservation authorities and for individuals continued in 2008. A training programme similar to that in previous years was followed with the field practical for veterinary students from 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. 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 is totally self-sufficient in water and electric power, provided respectively from rainwater collection and solar sources. In 2008 we completed 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 late 2007 TAWIRI appointed substantive directors to each of its four wildlife research centres in Tanzania. It was a source of great pride that the person selected for this post at SWRC was Dr Robert Fyumagwa, who worked in the veterinary programme since 2000. We are particularly happy that he did not move far away and in 2008 he continued his involvement with certain selected activities within the programme. His place was taken when the programme partners appointed Dr Buwesa Zablon who started work in September 2008. Therefore, for most of the year under review the professional capacity was down to one veterinarian Dr Richard Hoare, and as a consequence of him carrying most of the programme's large administrative burden, field activities were less than 2007.

The wildlife veterinary programme marked its 17th year of operation in Tanzania in 2008. 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. This was embodied in the signing of an updated MoU between Messerli Foundation and TAWIRI in 2008. For the initial vision and continued support over such a long period, both Mrs Messerli and the board are sincerely and gratefully acknowledged.



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.

Micro-organisms are important ecological factors in natural populations and ecosystems. Despite this, current knowledge of the ecological role of potential pathogens is rudimentary, and evolutionary associations between pathogens and their wildlife hosts are poorly understood (Kock 2005, Munson & Karesh 2002). 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 management action is required. 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 micro-organisms 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. Dr Fyumagwa moved to be Director of SWRC from December 2007 and his place was taken in September 2008 by Dr Bugwesa Zablon. Thus the programme employs two veterinarians, a laboratory technician and two support staff based at the laboratory facility in Seronera, SNP.

An extensive upgrade of facilities at the Herta Messerli Laboratory from 2004-2008 has 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 16 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 – in freezers or liquid nitrogen. A new field of sample processing, however, was fully established in 2006: a facility to prepare formalin-fixed histological sections for microscopic pathology investigation. Specialist equipment provided by a collaborative donor was adapted to the SWRC circumstances and 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 SUA. 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 seven categories of activity, and all monthly and annual progress reports including this one, are divided into those categories:

1. Disease research
2. Human – wildlife conflict research
3. Animal handling
4. Advisory services
5. Training activities
6. Reporting, publicity and publication
7. Programme administration

Under this workplan, the focus of disease surveillance and research that the programme concentrates 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. Human-wildlife conflict research is especially focussed on human-elephant conflict (HEC) issues. Animal handling involves the provision of specialist services to other research projects or conservation agencies, or is employed for the collection of our own samples and information. Advisory and training categories ensure that our expertise and knowledge is best used to the advantage of natural resource conservation. 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 (see p.44.).

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 8

Dr. Bugwesa Zablon joined the Vet Programme in September 2008, replacing Dr Robert Fyumagwa who became the Director of SWRC.

Top: Dr Zablon and field assistant Kitoi Sarakikya removing a snare from an immobilized zebra.

Bottom: Drs Bugwesa Zablon and Richard Hoare in the field.

2 DISEASE RESEARCH

One of our main activities is to monitor disease conditions that have some involvement with wildlife. Because the terminology and details of such infectious conditions are complicated, the following is a simple tabular summary of the different diseases which can afflict different categories of mammalian hosts.

Table 1 Host susceptibility of infectious disease conditions monitored by the wildlife veterinary programme

INFECTIOUS CONDITION	CAUSATIVE AGENT (Transmission)	DOMESTIC & LIVESTOCK		HUMAN		WILDLIFE	
		Illness	Death	Illness	Death	Illness	Death
Tuberculosis	**Bacterium** (Contagious)	+++	++	+++	++	+	+
Trypanosomiasis	**Protozoan** (Tsetse fly)	+++	+++	+	+	_	_
Anthrax	**Bacterium** (Environmental)	_	+++	+	+	?	+
Tick-borne haemo-parasites	**Protozoa** (Ticks)	+++	+++	_	_	+	+
Rabies	**Virus** (Contagious)	++	++	+	+	_	+
Distemper	**Virus** (Contagious)	++++	+++	_	_	+	+
Rift Valley Fever	**Virus** (Mosquito)	++	+	+	+	?	_
Brucellosis	**Bacterium** (Contagious)	++	_	++	_	?	_
African Swine Fever	**Virus** (Tick / Contag.)	+++	++++	_	_	_	_
Foot and Mouth Disease	**Virus** (Contagious)	++	_	_	_	_	_
Malignant Catarrhal Fever	**Virus** (Contagious)	++	++	_	_	_	_

+ to ++++ = semi-quantitative measure of 'commonness'
- = nil; ? = unknown

'Commonness' of conditions is subjectively measured, but what is striking is how relatively greater it is through the increased susceptibility of domestic livestock. Wildlife is generally resistant to indigenous 'pathogens' that are components of African ecosystems, while humans being primates, are not so susceptible to the range of pathogens in ungulates, and also are able to be treated.

Although vaccines have been developed to help combat some of these diseases in animals (TB, Anthrax, Rabies, Distemper, RVF, Brucella, FMD) the effectiveness of many are quite low, either because of varying strains of the organisms, problems producing antigenicity, or the enormous logistics or impracticality of achieving sufficient vaccination coverage, especially in ecological systems involving wildlife and pastoral livestock under only extensive management. Similar constraints apply to treatments in extensive livestock systems. Of the zoonoses, vaccines can only help protect humans from TB and Rabies.

2.1 Sample bank and sample processing

When the sample list for 2007 was closed off, we had 11 complete years of wildlife samples kept in the national wildlife sample bank (1998 - 2007 inclusive). There are still some samples remaining from the pre-1998 period although the list is not complete. There can be very few places in Africa where so much existing and potential information is stored in this form. This reference collection is unique and constantly increasing in value as more varied or sophisticated tests are developed in laboratories.

Internal sample processing

Our laboratory technician prepared fully stained and mounted microscopic tissue sections from selected cases of diagnostic interest that exist in the formalin sample archive (the first stage is wax embedding of tissue that is now also done in our laboratory). Some sections were sent to the pathology section at the CVL for interpretation by a pathologist. The species that were first reported back were domestic horse, wild dog, black rhino, flamingo and buffalo. Results from other more routine investigations are pending.

Assisting preparation of samples for other research

Our laboratory is now widely used to assist other researchers prepare their biological samples. This is just a first step before exporting them for full examination. This assists their studies and often means we retain duplicate samples and keep their reagents or equipment for future use. They provide their own materials and helpers, so our laboratory technician merely facilitates this work.

A fairly new non-invasive technique for isolating reproductive and other hormones from animal faeces began to be used by several other research projects. Individual samples thus processed are in dry tubes and so easy to transport, as they are light and do not require special storage like refrigeration.

A total of 326 faecal samples from herbivores were processed for hormone analysis in our laboratory by a researcher studying migratory animals (mainly zebra) in the Serengeti.

We assisted a Tanzanian researcher Dr Ernest Eblate studying the genetic diversity of wild antelopes (for conservation genetics) with processing 170 faecal and blood samples prior to export.

Other Serengeti researchers made use of our laboratory facilities for sample processing: one prepared 100 sera (mainly from cattle) for TB; a second examined over 100 domestic dog blood samples and some faecal samples from Wild Dogs were also handled that will be tested for stress hormone levels.

Supply of our samples to others

We supplied a very large batch of 323 duplicate archived samples to SUA, following a request from the Dean of the veterinary faculty. The researcher (Dr M. D. Maziku) has selected 120 of these (all brain or salivary tissue) for Rabies virus typing.

More FTA blood cards (for PCR testing) were made available to the Serengeti Trypanosomiasis Research Project from 4 additional wild species. Unconfirmed reports suggest that project might have isolated a new Trypanosome species. FTA card sampling was started in Ruaha NP`by involving the TANAPA veterinarian.

We supplied wild animal hair samples to a research project that studies nutrient tracking in the Serengeti ecosystem.

Samples from Wild Dogs that died in Loliondo District in 2007 were separately examined at the CVL and a laboratory in Germany. Initial interpretation of the results from this very complex mortality investigation were dealt with in a report written and circulated by Robert Fyumagwa (Fyumagwa *et al* 2008)

Increasing the collection and usage of samples

We put aside all tick samples taken from lions that exist in the sample bank and found nearly 30 cases. This is not a large number compared to the total previously handled, but all lions immobilized are now being routinely sampled for ticks. Robert Fyumagwa is interested in pursuing analysis of these samples to compare Serengeti tick-borne pathogens with those from his extensively published work in Ngorongoro Crater.

Reference blood samples were taken again in 2008 from two Black Rhino (*Diceros bicornis*) re-introduced from an overseas zoo by Grumeti Reserves Ltd. We also sent sample packs to the veterinarian immobilizing black rhino in Ngorongoro Crater but he only managed to capture one animal because most rhinos were not in accessible terrain. We need to increase the number of rhino samples in our serum and tissue bank and the exercise will be repeated in 2009.

A researcher gave us a small kit for taking Giraffe skin samples for genetic sampling. The Giraffe Specialist Group of the IUCN is working to compare the genetic distance of populations in different parts of Africa. Live animals can be sampled via biopsy darts that cut out a tiny skin sample and then drop out; but additional samples can be taken from carcasses. Samples are particularly needed from southern Tanzania so we supplied the equipment to obtain carcass samples to a TAWIRI researcher working in Selous Game Reserve and a TANAPA veterinarian in Ruaha National Park .

Table 2 Details of wildlife sample releases from the veterinary laboratory in 2008

SAMPLE RELEASES FROM THE LABORATORY, 2008					
TEST / REASON	**No. SPECIES**	**No. SAMPLES**	**SENT TO**	**POSITIVES**	**See Section**
RVF	**13**	**418**	**Tanzania**	**yes**	**2.10**
Rabies	**various**	**323**	**Tanzania**	**pending**	**2.9**
ASF	**1**	**61**	**Spain**	**pending**	**2.8**
Nutrients		**35**	**Netherlands**		**1.1**
Tryps		**11**	**UK**	**Yes**	**2.3**
TOTAL		**848**			

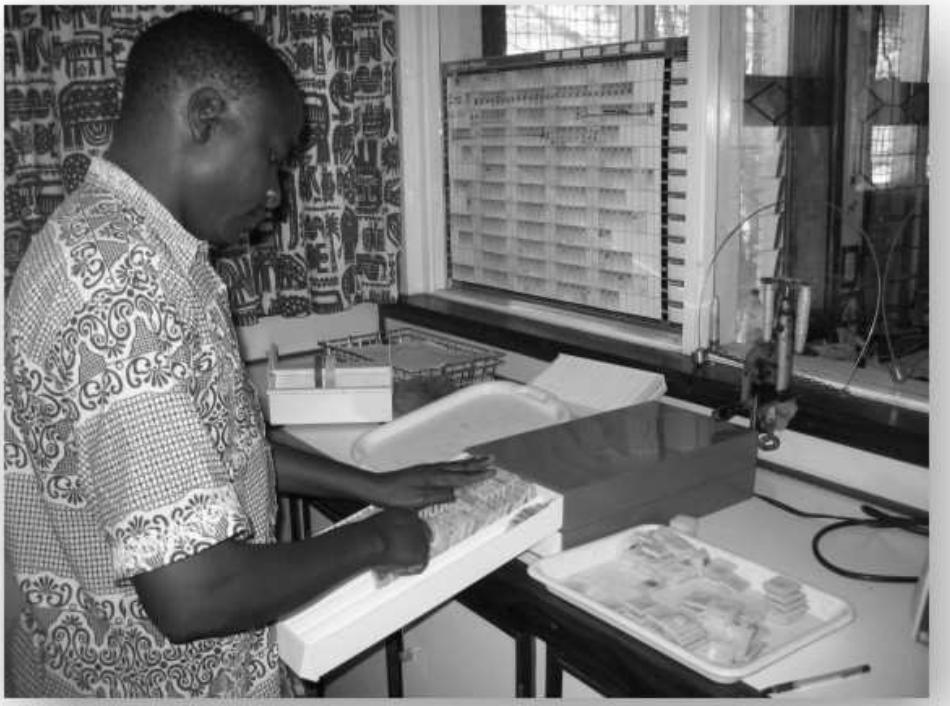
TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 12

Disease Investigation

Euthanasia and day-long post mortem examination and sampling of a valuable horse at Singita- Grumeti Reserves Ltd. A CD of photographs of this case history, and subsequent post mortem showing detailed photographs of whole procedure and organs etc. (shown below) was prepared by the vet programme to assist the diagnostic laboratory at Ondestepoort in South Africa. The CD is surrounded in the picture by wax-embedded organ tissue samples, also prepared by the vet programme, and sent as well.

The diagnostic laboratory pathologists examined these tissues. In this case the samples and photographs we provided enabled a confirmatory diagnosis of neurological trypanosomiasis to be made.

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 13



Disease Investigation

Top: The sample bank at SWRC. Laboratory technician Mr Maulidi Mdaki sorting wax embedded tissue samples.

Bottom: Maulidi Mdaki and Kitoi Sarakikya and Dr Tiziana Lembo performing routine sampling of a jackal carcass.

2.2 Tick-borne haemo-parasites

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 (Nijhof *et al* 2003; Fyumagwa *et al* 2004) or strongly suspected. 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.

Activity in 2008

Dr Fyumagwa completed the laboratory analysis component of his Dr Med Vet degree project, visiting Zurich University for a fourth time. The haemo-parasites (Penzhorn 2004) isolated from NCA ticks included one that is an undescribed species (Mycoplasma spp.) in lions. Publication of one manuscript on tick ecology (Fyumagwa *et al* 2007) was thus supplemented in 2008 by one describing tick-borne haemo-parasites in carnivores (Fyumagwa *et al* 2008) and another in herbivores (Fyumagwa *et al*, 2009) in two international journals. This completes a very important applied research study started in 2001, that has had demonstrable benefits for management of the Ngorongoro Crater ecosystem.

2.3 Trypanosomiasis

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 uses sensitive molecular methods (PCR) for the detection of genetic material of trypanosomes to determine the species, in particular distinguishing those causing animal trypanosomosis and human 'sleeping sickness'.

Activity in 2008

Our main achievement in trypanosomiasis in 2008 was publication of our collaborative research on domestic horses in a respected scientific journal based in the UK (Auty *et al.*2008 - see section 6).

The trypanosome work on domestic horses at Grumeti-Singita Reserves Ltd took an unexpected turn in 2008 – the fourth year of our involvement. One of their most valuable thoroughbred horses developed a strange, progressive illness with nervous symptoms that lasted six weeks, continually testing negative for trypanosome parasites in the blood. Our veterinarians repeatedly visited and got very involved in the case because of the implications for continuing to keep these animals in a tsetse fly area, if indeed trypanosomes had escaped clinical detection. Eventually the animal collapsed, was euthanazed by us and then a very thorough post-mortem examination with extensive tissue sampling was carried out – a job that lasted over six hours.

At our laboratory we processed many samples very carefully (including embedding the tissues in wax for histological sections) and produced an accompanying CD with 100 digital pictures of the post-mortem examination, to help the pathologists at Onderstepoort Veterinary Institute, South Africa with diagnosis of any condition involving nervous symptoms in a horse. We also sent stored tissue samples from another case of a horse at Grumeti that we had examined post-mortem after it showed severe nervous symptoms in 2005.

The pathologists praised the high standard of preparation of these samples plus the quality of photographs and the detailed history supplied by Grumeti, and so were able to provide a very professional and thorough diagnostic service. They found almost identical microscopic histo-pathology in the nervous systems in both cases. With PCR tests *Trypanosoma brucei brucei* was present in the central nervous system (spinal fluid) in the recent case, and in the older one West Nile Virus (a mosquito-borne disease that is also a zoonosis) was found. However, WNV was considered an opportunistic infection because *Trypanosoma brucei* although not isolated was suspected to be involved, and all trypanosome infections are known to be immuno-suppressive. These cases will be very significant and are potentially publishable because both neurotropic Trypanosoma that are not detectable in blood, and recent small outbreaks of West Nile Virus in horses around the world, are new and unusual subjects.

In 2007 in consultation with outside experts we drew up a prophylactic regime against trypanosome infection for two Black Rhino re-introduced from an overseas zoo by Grumeti Reserves Ltd. Our veterinary plan for 'trickle exposure' to provide Trypanosomiasis immunity appears to be working during 2008.

Tsetse fly traps that were obtained from the TANAPA veterinary office in Serengeti were deployed around the research centre by our field staff, who spray them at intervals with insecticide (Decatix – deltamehtrin 5%). The specially designed traps do not affect other species and are only deployed around habited areas in the park to reduce the risk of human 'sleeping sickness'.

2.4 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 indicated.

Activity in 2008

No positive cases were seen in 2008 but routine sample collection adds to our ability to conduct surveillance. We helped a researcher who borrowed and fully tested our portable incubator to prepare blood samples for tuberculosis testing at SUA. She reported that it worked very well.

2.5 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 Tanzania only strains A, O, and SAT1 have been detected in livestock. 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 2008

No outbreaks were noticed or reported in 2008. We have however contributed to a collaborative proposal to raise funding to increase FMD research and control efforts in Tanzania.

2.6 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 2008
There was one positive case in an elephant found dead in Serengeti National Park. The blood sample was brought to us by TANAPA staff.

2.7 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. We have only a preliminary idea of exposure levels in Serengeti wildlife (Fyumagwa et al 2007).

Activity in 2008
A large batch of 255 serum samples from 17 species was tested (Rose-Bengal Test) by our technician for antibodies to Brucellosis. The last time we did this was in 2004, so these results helped to further quantify the prevalence of this pathogen in wildlife. This time positives were seen in both herbivores (Buffalo, Topi, Wildebeest, Thomson's Gazelle and Elephant) and carnivores (Lion and Cheetah). In a reasonable sample of lions (n = 60), five were positive (8%). Previous sero-positives and tissues sent to Sokoine University laboratories were negative for bacterial isolation.

2.8 African Swine Fever

Background
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 Africa. Control relies entirely on detection because there is no vaccine. Authorities in Europe are particularly concerned because the virus has crossed the Mediterranean and given problems in southern Europe. It is not a zoonosis.

Activity in 2008
After several years we had finally reached a meaningful sample size from warthogs (51 cases; 46 cases from live animals, and five from dead ones) and so set them aside for testing. Whilst having discussions with ILRI in Kenya about a training course in ASF diagnostic methods (see section 5) we arranged official permits for these samples to be sent to a reference laboratory in Spain. ILRI facilitated this process.

2.9 Rabies

Background
Rabies is a 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 2008
A large batch of rabies testing was carried out in 2007 (see publication section 7.3) so in 2008 we were routinely adding carnivore samples to our bank to build up the numbers again. More than a dozen small carnivores either found dead in the field or killed on roads in Serengeti National Park were processed. We released many duplicate samples from our archive to a researcher at SUA for viral typing (see 2.1).

2.10 Rift Valley Fever

Background
Rift Valley Fever (RVF) is a mosquito-borne virus disease of livestock that can also occasionally affect humans, with fatalities. It is typically seen in extremely wet years and an outbreak was experienced across East Africa in the 2006 / 7 season after exceptionally heavy rainfall. Human fatalities were almost exclusively amongst pastoralists who closely handled or ate infected livestock. There is very little known about any role wildlife might play in RVF but it has so far been suspected to be minimal. In Kenya in 2007 a number of wild species that were tested showed antibody levels, which on its own only shows exposure to the virus.

Activity in 2008
A large number of sera (418) were sub-sampled from 13 wild species in the sample collection, and the batch was listed and set aside for testing for exposure to RVF. They were sent to the Central Veterinary Laboratory (CVL) in Dar es Salaam. The CVL cautioned that the interpretation of RVF tests in so many different species is difficult because there are no benchmarks for them. Another problem is that in our sample archive each species has different numbers of cases. The significant finding was that Buffalo, Zebra, Wildebeest, Topi and Spotted Hyaena showed exposure to the virus, but overall exposure status in wildlife was very low (3%).

Other conditions

A black rhino calf died suddenly in Mkomazi National Park and Robert Fyumagwa carried out a post-mortem investigation. The cause of death was not immediately obvious but tissue samples were taken, embedded in wax at our laboratory and submitted to pathologists at the CVL. The kidneys, lungs and heart showed abnormalities, the origin of which could not be determined. One suspected cause is that the animal suffered a fatal snake bite. No further problems have been reported in the rhino population.

Suspicious carnivore deaths in Serengeti National Park (one Cheetah and one Lion**)** with strange nervous symptoms were investigated in 2007. Tests in 2007 eliminated diseases like rabies or distemper, eliminated poisons, and revealed a viral encephalitis, and so the pathogenic agent is still being tested for. No further progress towards an aetiological agent was made at external laboratories in 2008, but no such new cases were seen in the field.

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 18

Disease Investigation

Clockwise from top left: Lioness with erosive facial lesion.
Roadkill African Wild Cat.
Post Mortem of Dwarf Mongoose
Roadkill Striped Hyaena

2 HUMAN – WILDLIFE CONFLICT RESEARCH

National level initiatives

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 (Dublin & Hoare 2004). He started a national initiative on investigating this topic in Tanzania (AfESG 2004) and this has been included into the activities of the veterinary programme since 2004 (Hoare 2007). 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. In the last five years human-elephant conflict (HEC) research has been conducted around protected areas in Serengeti, Tarangire, west Kilimanjaro, Mikumi, Selous (Malima *et al* 2005) and Ruaha while carnivore conflict has been studied near Tarangire and Ruaha. Following recommendations made in 2007 by Richard Hoare for a post to be created for an experienced Tanzanian to deal specifically with the wildlife authorities on improving the management of human wildlife conflict, a suitable candidate was finally found.

Activity in 2008

Mr Enock Chengullah, a person with extensive experience in the wildlife sector was appointed and hosted by the NGO called Tanzania Natural Resources Forum (TNRF) in Arusha. Mr Chengullah began by visiting all the projects in the country that work on HWC and familiarizing himself with the personnel and issues involved.

In consultation with a fellow member of the IUCN African Elephant Specialist Group, Dr Charles Foley of the Tarangire Elephant Research Project, plans were discussed to hire a consultant to summarize all the relevant data and experiences with HEC in Tanzania into a format that can be used to assist the government's policy formulation process in 2009.

Local projects

Background

Richard Hoare continued to act as an advisor to the TAWIRI project on HEC in western Serengeti. In 2008 it moved fully into a phase of implementing conflict mitigation measures against problem elephants in 22 villages in Serengeti and Bunda Districts. Strategic use of an irritant chilli extract helps to deter crop-raiding elephants and low technology elephant damage mitigation measures of the IUCN – EPDT are now being widely employed by subsistence farmers in many African countries (www.elephantpepper.org). Very hot and irritant dry chilli extract is ground up and placed in used engine oil smeared on simple string fences or used in brickettes that are burnt around crop fields to give out a noxious smoke. Both applications have showed good results in this area, consistent with the beneficial effect found elsewhere in Tanzania, and in other areas affected by 'problem elephants' around Africa.

Activity in 2008

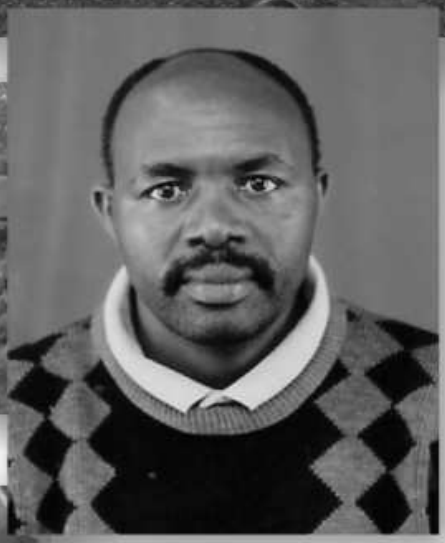
The number of demonstration plots (using low-tech chilli-based and improved vigilance measures to deter elephants from entering crop fields) was expanded and many village meetings were held to give conflict data feedback to villagers (data from 2005-2008) and explain the new elephant deterrent measures.

Support for the project was co-ordinated between FZS, the Grumeti Fund and TAWIRI, and Richard Hoare was also approached by another potential donor for HEC mitigation work, WSPA (the World Society for Protection of Animals) whose Africa headquarters are in Dar es Salaam.

A feedback meeting on the farmer-based elephant deterrent measures was held in the local small town, followed by an interesting visit to a new chilli growing project that will supply chillies to farmers to help deter elephants from raiding their crop fields. There are two chilli farms established in the project area and more planned.

In the second half of 2008 the project executant from 2005-2008 Mr Lucas Malugu, handed over to caretaker Mr Ally Nkwabi before taking a year of study leave at SUA. Mr Malugu will return in 2009 to do the practical year of his MSc course on the project

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 21



Human Elephant Conflict (HEC) & Management

Top: Visit to a farm that sells chilli to farmers who prepare a concentrated extract to help deter elephants from entering crop fields.

Centre left: Elephant near human habitation in Selous

Centre right: Mr. Enock Chengullah Wildlife Programme Officer for Tanzania Natural Resources Forum, working mainly on governance issues concerning human-wildlife conflict

Bottom: Human Wildlife conflict situation!

4 ANIMAL HANDLING

Table 3 Wildlife species immobilized and handled in 2008

WILDLIFE IMMOBILIZATIONS in 2008		
Species	**No.**	**Reasons**
Elephant	27	Radio-collars, snare removal
Lion	14	Radio-collars, disease sampling, snare removal
Zebra	8	Snare removal, radio-collars, training
Buffalo	3	Disease sampling, training
Baboon & Monkey	3	Disease sampling, training
Giraffe	2	Snare removal
Total	**57**	

4.1 Elephants

Elephants were the species on which we did the most immobilization work – a total of 27 were handled. This was because the Kilimanjaro Elephant Research and Conservation Project (Mr Alfred Kikoti) had completed a phase of monitoring a number of animals whose radio-collars were due to expire. Through TAWIRI we have constantly stressed the need to remove radio-collars from study animals and insist that projects have a budget for doing this. In the northern Tanzania elephant population range there are few roads and the terrain can be very rough, so as with radio-collar deployment two years previously, again a helicopter was used for darting for collar removal (cover picture).

Two other elephant research projects, one from Tarangire National Park and another just west of Serengeti National Park also made use of the helicopter and veterinary team – the former for removal of three radio-collars from elephant bulls and the latter for deployment of three on elephant cows in Ikorongo Game Reserve. In Grumeti Game Reserve three elephant cows were immobilized from vehicles, after spotting suitable animals from TAWIRI's light aircraft.

Operations involving capture of elephants are a remarkable exercise in co-operation and co-ordination by teams of specialized people on the ground and in the air. In remote areas without roads and where elephants are not habituated to vehicles, their capture without a helicopter is almost impossible. Research projects are assisted by commercial safari companies and local people are also employed. The government is represented by the respective District Game Officers.

On one operation a small elephant calf was seen limping from a wire snare around its foot, which had caused a very deep flesh wound. The wire was removed by first darting the mother from the air and then the calf on the ground. The mother also had an old injury to the leg that might have been from a snare.

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 23

ANIMAL HANDLING

Top: Dr Richard Hoare darting elephant from a helicopter in West Kilimanjaro.

Bottom left: Sian Brown removing wire snare from a zebra.

Bottom right: Dr Richard Hoare, Dr Bugwesa Zablon (partly obscured) and Sian Brown treating the leg wound of a snared elephant calf.

4.2 Lions

Fourteen lions were immobilized and handled, mostly for lion researchers using radio-collars. Twelve were captured in Serengeti National Park and two in Tarangire National Park. One lioness was immobilized to deploy a radio-collar and we attempted unsuccessfully to dart her companion who was suffering from a severe erosive lesion on the face. This is the second lion in four years seen with a similar problem.

One young male lion was treated for terrible snare wounds in Serengeti National Park. When examining it we noticed it had injuries from the wire noose as well as many deep bite wounds and concluded that it had been attacked while held by the snare, either by other lions or hyaenas. His trachea (windpipe) was cut right through so he was breathing through the neck wound (fistula), and most of the skin on top of his head was missing due to a massive struggle in the trap. We fear the chances of survival for this lion was slim, unless he reunited quickly with his pride. But unfortunately a follow-up is virtually impossible to determine the fate of such an animal after it moves off in a remote part of a national park.

4.3 Other species

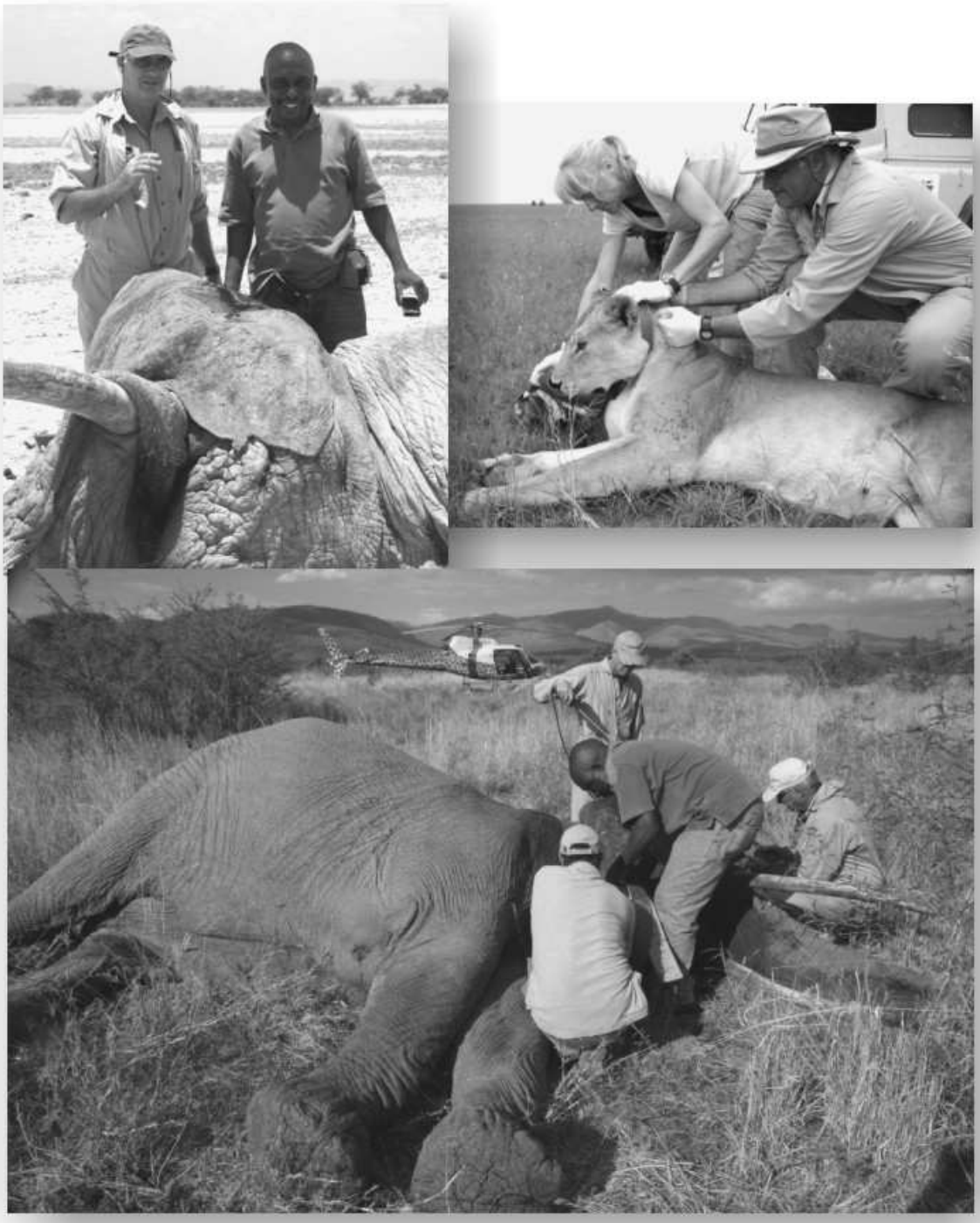
We participated along with many other conservation people in an operation in July to examine the feasibility of capturing wild dogs in conflict with pastoralist Maasai in Loliondo (an area adjacent to Serengeti National Park) for possible translocation into the park. Unfortunately logistical delays meant that the denning season had just finished so the capture of an entire wild dog pack with puppies was not possible. It was however a very good experience for all to do a 'dummy run' for a possible repeat in the future. A team of two wild dog experts from Zimbabwe came to participate and advise on the whole procedure and we accompanied them to the one hectare fenced holding facility ('boma') being built at the release site, which they inspected and gave practical advice upon.

We were asked to help immobilize buffalo for a disease sampling near Ruaha National Park in south-central Tanzania. This research project into Tuberculosis is a collaborative effort between a university in the USA (UC Davis) and one in Tanzania (SUA) and has been successful in its components involving livestock and human health. Unfortunately the wildlife component that we went to assist with, encountered problems. Permission to sample buffalo in the national park was denied by TANAPA, even though they also have their own veterinarian stationed there. Immobilization and sampling was only granted for the adjacent community wildlife area (called a wildlife management area – WMA). But the WMA buffalo occur in low numbers in difficult terrain and trophy hunting is allowed there which really disturbs them, so they were impossible to find or approach and we caught no animals in a three day operation.

However, some positives were achieved. We were able to teach two Tanzanian veterinarians the theory of immobilizing buffalo plus give them some instruction about using their own new dart gun. Also some other future collaborative sampling was initiated: blood from wildlife carcasses for trypanosome research and genetic samples from giraffe. A future link with this project and its university connections will create a much-needed and more workable wildlife veterinary presence in southern Tanzania.

4.4 Snare removal

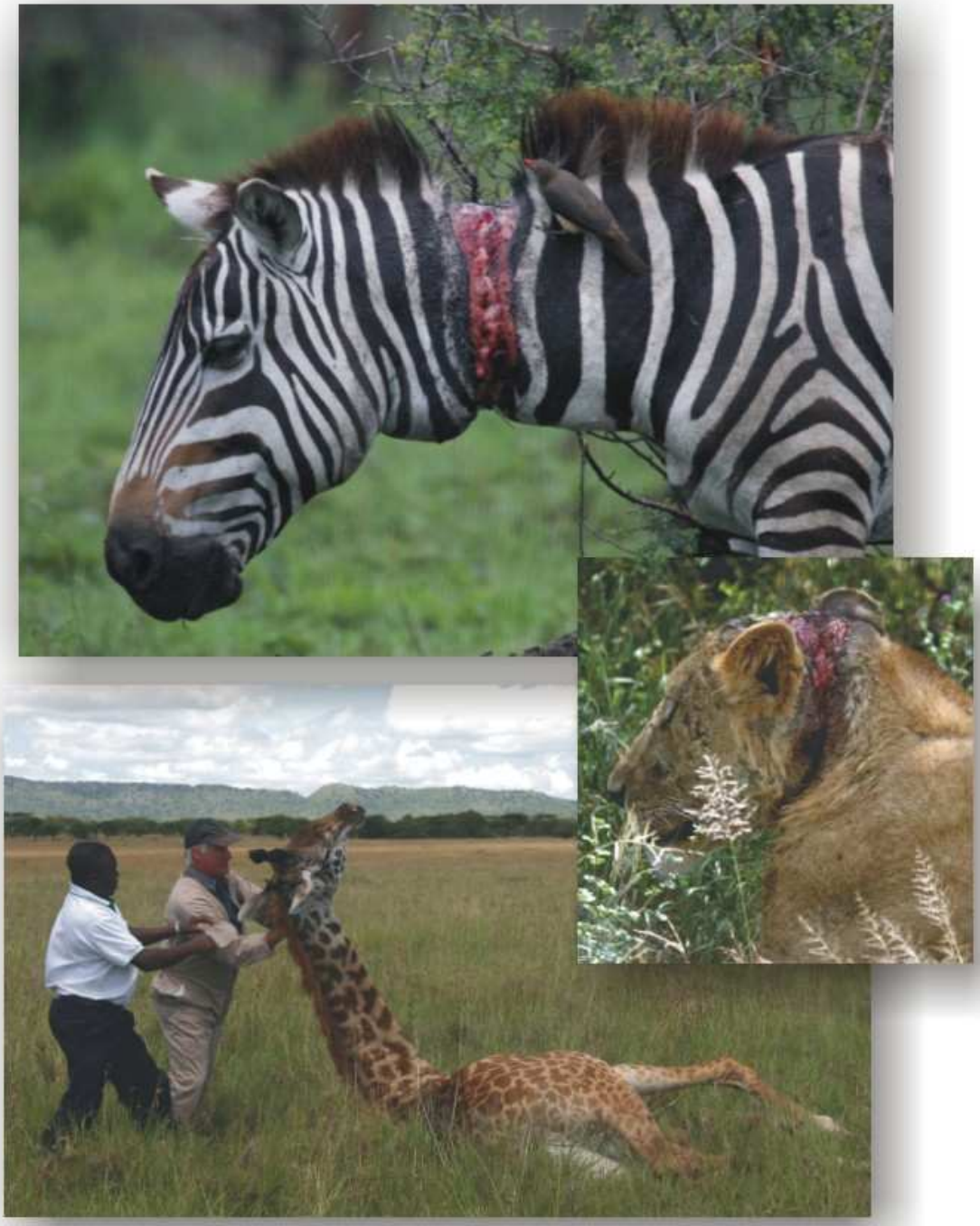
Snares were removed from the following captured animals in Serengeti National Park : four zebra, two giraffe, one elephant and one lion (above).



ANIMAL HANDLING

Top left: Dr Richard Hoare and elephant researcher Alfred Kikoti removing radio collar from elephant bull in West Kilimanjaro.
Top right: Dr. Richard Hoare and Ingella Jansson of Serengeti Lion Project fitting a radio collar to lioness in SNP.
Bottom: Replacing radio collar on an an elephant cow at Manyara Ranch

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 26



6. ANIMAL HANDLING - Snare removal

Snare removal in Serengeti National Park.
Top: Zebra with a deep wound before successful capture and treatment.
Centre: Deep snare wound on the neck and head of a young male lion.
Bottom: Revival of a giraffe after snare removal with Dr Richard Hoare and Dr Morris Kilewo
(TANAPA Vet Unit.)

5 ADVISORY SERVICES

Radio-telemetry
Due to the programme's involvement with numerous research projects that use radio-telemetry, we continued to push for improvements in the use of this study-aid. When TAWIRI asked for contributions and comments for an update of their research guidelines document (last edition 2001) Richard Hoare submitted some 'policy recommendations' on wildlife radio-telemetry based on a talk given at the last TAWIRI conference (see annual report 2007). One of the ways that the important question of removal of radio-collars can be addressed is by ordering collars that contain an automatic release ('pop-off') mechanism, activated either by an electronic signal or via a timer device. One researcher studying migratory herbivores in the Serengeti ecosystem successfully removed several radio-collars by approaching his collared study animals (zebra) and using an electronic signal beamed from a hand- held radio device. The biggest problem in the current use of radio-telemetry is associated with the gradual transition from VHF to GPS radio collar technology that has introduced a whole new set of technical problems.

Because we have so much to do with research projects that use radio-telemetry, we have organized all relevant equipment to allow study animals radio-collared by other research projects, to be tracked both from the air and ground. This helps especially when collared study animals are 'lost' – either due to unusual dispersal, death or radio failure. Richard Hoare established a system whereby animals are grouped onto three different frequency bands according to species groups, each of which necessitates a different receiver and antennas. The relevant researchers contributed most of the equipment and some was added that came from one of Richard Hoare's own previous projects. Some equipment had to be sent to the USA for reprogramming, and other Serengeti researches helped considerably with payments and carriage. This co-operation is greatly appreciated. The veterinary programme also took over responsibility for advice on and management of the radio-tracking equipment that may be deployed on wild dogs in Loliondo and NCA.

Other
In 2008 Richard Hoare reviewed manuscripts at the request of the editors of the following scientific journals: Animal Conservation; Biological Conservation; Oyrx; Pachyderm; and South African Journal of Wildlife Research. Robert Fyumagwa reviewed a manuscript for the African Journal of Ecology.

Wildlife-livestock disease control measures were requested by and supplied to a hunting safari company wanting to set up a small, enclosed peri-urban 'game park' near its offices on the outskirts of Arusha.

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 28

ADVISORY SERVICES

Discovery of several skinned zebra carcasses poached for the illegal skin trade.
Case location and samples, along with detailed photographic evidence, and verbal evidence obtained from the Maasai children, were reported to the relevant authorities in the Wildlife Division.

6 TRAINING AND EDUCATIONAL ACTIVITIES

6.1 Staff

Robert Fyumagwa received funding from the Messerli Foundation and an agency of the Swiss government which enabled him to visit Zurich University again in 2008, to finish off writing and submitting scientific papers on his laboratory work on tick diseases, ongoing since 2001 (see section 7).

Our new veterinarian Dr Bugwesa Zablon attended a 10 day course on African Swine Fever in East Africa, held in Uganda. Travel, accommodation and teaching were all sponsored by two international livestock research institutes, one in Kenya (ILRI) and one in Spain (CISA). A lot of up to date diagnostic techniques and control measures were covered.

6.2 Veterinary students

The annual field practical course for final year veterinary students at Sokoine University was conducted as usual in June. Sixteen students attended, divided into two groups for a week each. The small numbers ensured greater individual attention than in some year's previous large classes. As usual the training involved much practical handling of wild animals and was enjoyed and appreciated by the students and the university alike.

6.3 Tourism industry

We started the first in a series of educational presentations about wildlife research to tour drivers and tourist guides in Serengeti National Park. This is co-ordinated by us in the veterinary programme and is intended to be an ongoing activity to improve understanding between the research community and both wildlife management personnel and the tourism industry. Because of the tour drivers' daytime work schedules, the event was held in the evening hours in the TAWIRI staff canteen, where it was hoped an informal atmosphere would promote attendance. Despite wide publicity, attendance was fairly small on the first occasion but the enthusiastic response from those tour guides who did come was very encouraging. TANAPA participated, represented by their Serengeti warden tourism who gave the first presentation. Robert Fyumagwa then explained what TAWIRI is and what it does. Two research projects then presented simple explanations of their activities and their relevance to conservation. Most local TAWIRI staff also attended and learned a lot.

The exercise was repeated during daytime at the TANAPA conference room which is near the main tourist facility in Seronera – the visitor's centre. Attendance was far higher but few tour drivers could remain for the duration of all the presentations due to demands of the safari schedule for their guests. Plans were discussed for holding these talks at different venues in 2009.

7 REPORTING, PUBLICITY AND PUBLICATION

7.1 Lectures and CDs

Illustrated lectures involving 'powerpoint' presentations, sometimes accompanied by practical demonstrations of darting and laboratory procedures were given to groups from the following institutions:

- Two visiting groups of 30-40 students from different universities in the United States of America. Other Serengeti research projects also participated.

- A class of 90 diploma students from the College of African Wildlife Management (Mweka), who annually visit Serengeti for field studies. They also heard lectures from other research projects but showed a very keen interest in what we do and asked many questions. Mweka is the college where in 2007/8 we contributed to sponsoring the training of a junior employee of TAWIRI.

- A large class of 120 students from the institute that trains game rangers (PASIANSI). They had to be split into four groups of 30 so the same material was repeated four times.

- A visiting medical team from the Google Foundation**,** interested in zoonosis research in Tanzania in collaboration with the carnivore viral transmission dynamics research project.

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.

- Horse death from trypanosomiasis – pictures of post mortem and samples to assist external laboratory diagnosis.

- Three elephant radio-collaring operations for two separate projects (copies for the researchers, one potential donor to one of the projects, the helicopter operating company, the helicopter pilot and its engineer, and the wildlife section at Grumeti Reserves Ltd).

- Research project involving radio-collars on Serengeti migratory herbivores.

- Visit to west Serengeti human-elephant conflict zone for a potential donor.

7.2 Local publicity material

We designed a simple, illustrated leaflet for distribution on the procedure to follow if people see a snared animal in Serengeti. The TANAPA veterinary unit had its input since both contacts for their veterinary personnel and ours were mentioned. The park authorities gave the go-ahead for its production on trial basis and by agreement with TANAPA it has been distributed to tour company drivers and guides (the main target), tourist lodges, researchers, wildlife management personnel and others who live or work in the Serengeti ecosystem. All are encouraged to keep the leaflet in their vehicle or camp for reference; it is not designed to be a 'hand-out' to tourists who only visit for short periods. The idea has been well received but it is still too early to judge its actual impact via increased responses.

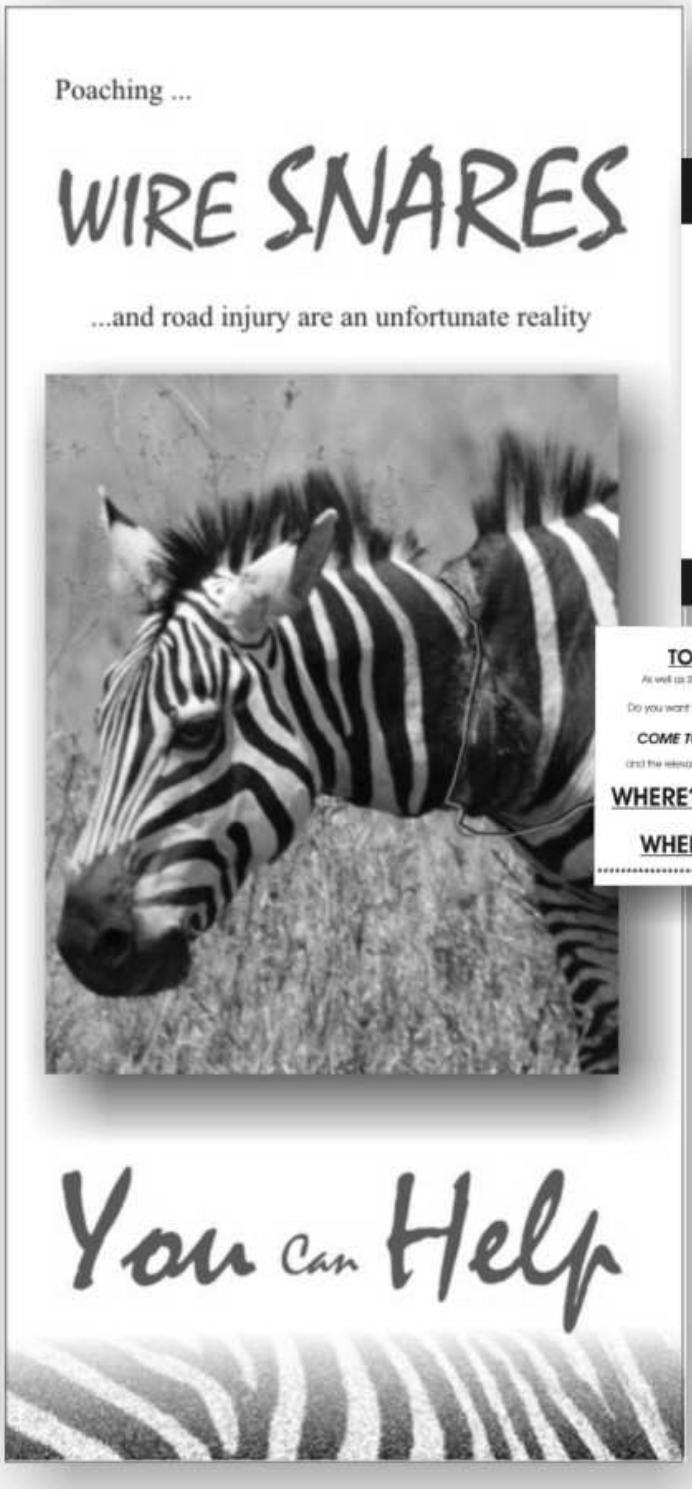
We again visited tourist camps in the Serengeti ecosystem to educate them about our 'services', especially removal of wire snares (the above leaflets) and investigating wildlife deaths, so that their employees could act as additional lookouts for these problems in their areas of operation.

8. TRAINING & EDUCATIONAL ACTIVITIES

Top: Handling of a buffalo for veterinary training of SOKOINE University Students attending annual wildlife field practical at SWRC, SNP.

Bottom: Lectures were given to 120 trainee wildlife rangers from PASIANSI College.

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 32



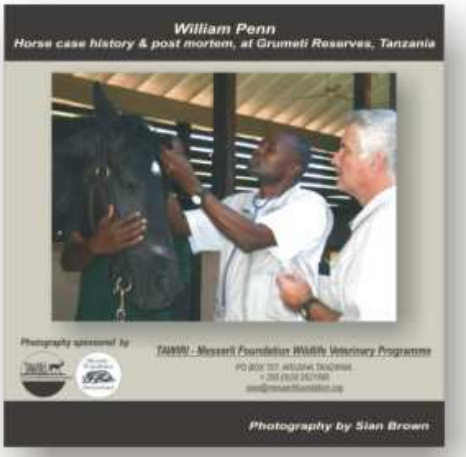
Education & Publicity material.

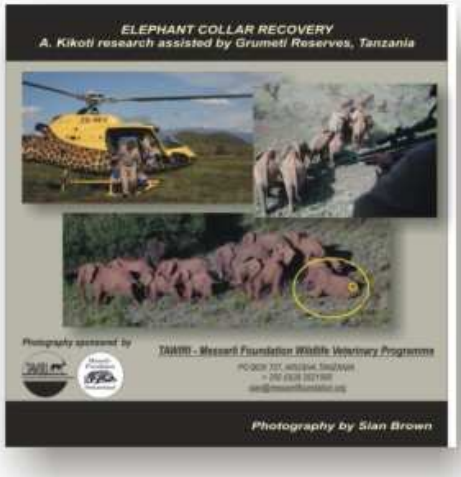
Left: SNARE Leaflet with information and contacts for reporting snared animals in order to obtain veterinary help from both the TAWIRI Messerli Foundation Wildlife Veterinary Programme and the TANAPA Vet Unit.

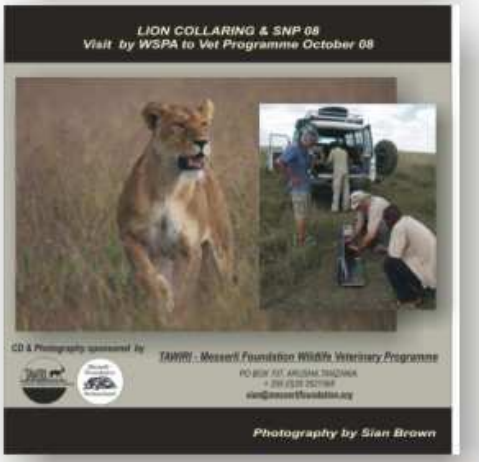
Above top: CD given to participants of Sokoine University filed practical course, containing photographs of all activities especially wild animal immobilization, handling and sampling.

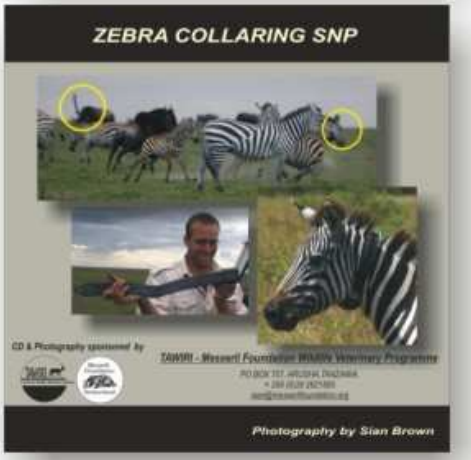
Above bottom: Posters and leaflets advertising research projects giving illustrated talks to tour drivers and other SNP staff.

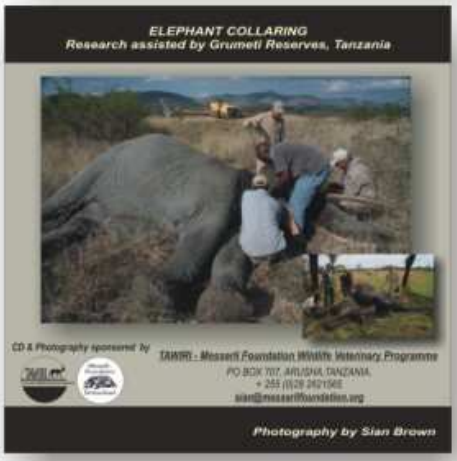
TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 33

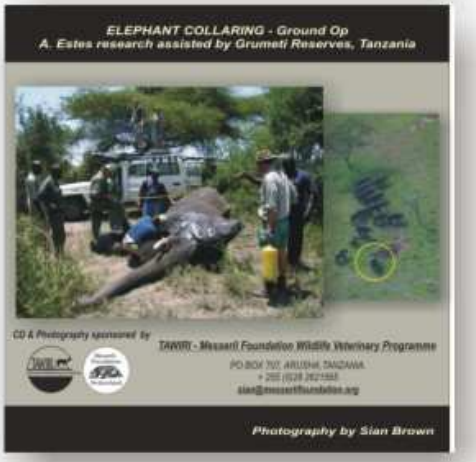












9 - REPORTING , PUBLICATION & PUBLICITY

A selection of some of the CD'S of photographs produced for other researchers, projects, stakeholders:
Horse case and post mortem; three separate elephant capture operations; zebra research project;
Lion darting procedure for visiting veterinarians from WSPA.

7.3 Journal publications

A total of five major publications involving our programme appeared in very reputable international scientific journals in 2008. This is a remarkable achievement for such a small programme (with only two scientists), and reflects both a high level of internal effort as well as strong links and wide collaboration with other scientists who are experts in their respective fields. The publications were all concerned with aspects of microbial pathogens or potential pathogens (protozoa, mycoplasmas or viruses) found in wildlife, or domestic species in contact with wildlife. The journals involved were Veterinary Parasitology (two papers), South African Journal of Wildlife Research, Journal of Applied Ecology and Journal of Veterinary Medical Science (one each). The subjects were tick-borne pathogens, trypanosomes, rabies virus and a virus found in equids, and resulted from our emphasis upon research into economically important or zoonotic diseases, especially those of herbivores.

The citation list of these publications:

Robert D. Fyumagwa, Pascale Simmler, Barbara Willi, Marina L. Meli, Armin Sutter, Richard Hoare[1], Gottfried Dasen, Regina Hofmann-Lehmann, Hans Lutz (2008). **Molecular detection of haemotropic mycoplasmas in Rhipicephalus sanguineus tick species collected on lions (Panthera leo) from Ngorongoro Crater, Tanzania.** South African Journal of Wildlife Research, 38(2):117-122.

Harriet Auty, Alison Mundy, Robert D. Fyumagwa, Kim Picozzi, Susan Welburn and Richard Hoare (2008) **Health management of horses under high challenge from trypanosomes: a case study from Serengeti, Tanzania**. Veterinary Parasitology 154: 233 -241 doi:10.1016/jvetpar2008.02.034

Kerstin Borchers, Dietmar Lieckfeldt, Arne Ludwig, Hideto Fukushi, George Allen, Robert Fyumagwa and Richard Hoare (2008) **Detection of Equid herpesvirus 9 DNA in the trigeminal ganglia of a Burchell´s zebra from the Serengeti Ecosystem**. Journal of Veterinary Medical Science 70(12):1377-1381.

Tiziana Lembo*, Katie Hampson*, Daniel T. Haydon, Meggan Craft, Andy Dobson, Jonathan Dushoff, Ernest, Eblate, Richard Hoare, Magai Kaare, Titus Mlengeya, Christine Mentzel and Sarah Cleaveland (2008). **Exploring reservoir dynamics: a case study of rabies in the Serengeti ecosystem**. Journal of Applied Ecology 45:1246-1257. doi:10.1111/j.1365-2664.2008.01468.x *These authors contributed equally and were awarded the Southwood Prize for the best paper in the Journal of Applied Ecology 2008 (British Ecological Society).

Abstracts of these publications:

Robert D. Fyumagwa, Pascale Simmler, Barbara Willi, Marina L. Meli, Armin Sutter, Richard Hoare[1], Gottfried Dasen, Regina Hofmann-Lehmann, Hans Lutz (2008). **Molecular detection of haemotropic mycoplasmas in Rhipicephalus sanguineus tick species collected on lions (Panthera leo) from Ngorongoro Crater, Tanzania.** South African Journal of Wildlife Research, 38(2):117-122.

ABSTRACT. Haemotropic Mycoplasma species are pathogens that can cause haemolytic anaemia in susceptible mammalian species worldwide. The cause of haemolysis is due to membrane damage through stimulation of IgM cold agglutinins production, which induces autoimmune haemolysis of infected erythrocytes. A study was conducted to establish the prevalence of Mycoplasma haemofelis, 'Candidatus Mycoplasma haemominutum' and 'Candidatus M. turicensis'in ticks and the diversity of tick species that are possible vectors of the pathogens that can transmit the infection to wildlife in Ngorongoro Crater. Three real-time PCR assays were used for the analysis of DNA pools (n = 507) derived from 11 tick species.Mycoplasma haemofelis and 'Candidatus M. haemominutum' were detected in Rhipicephalus sanguineus. On average 19.7% and 12.9% of R. sanguineus were PCR-positive for M. haemofelis and 'Candidatus M. haemominutum', respectively. This tick species therefore represent an important reservoir for feline haemotropic Mycoplasma species in the crater. These organisms with their known pathological effects are probably one of the factors potentially exacerbating the severity of infection during the disease outbreak in wildlife and can have undesirable outcome to wild cats like lions when under nutritional stress or in case of concurrent infection. KEY WORDS: haemotropic Mycoplasma, lions, Ngorongoro Crater, real-time PCR, ticks.

Harriet Auty, Alison Mundy, Robert D. Fyumagwa, Kim Picozzi, Susan Welburn and Richard Hoare (2008) **Health management of horses under high challenge from trypanosomes: a case study from Serengeti, Tanzania**. Veterinary Parasitology 154: 233 -241 doi:10.1016/jvetpar2008.02.034

ABSTRACT. Horses kept for recreational riding purposes by a wildlife tourism company in a heavily tsetse fly-infested region of northwestern 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 Trypanosoma congolense were identified) and treated and trypanosomes were implicated of involvement in four deaths. Pyrexia consistently aided early detection (17 cases). Ataxia, weight loss and anaemia were seen in chronic cases and conferred a poor prognosis. Delaying treatment by more than 2 days from the onset of clinical signs led to prolonged disease course and more severe anaemia. 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. KEY WORDS: Horse; Tanzania; Trypanosoma spp.

Kerstin Borchers, Dietmar Lieckfeldt, Arne Ludwig, Hideto Fukushi, George Allen, Robert Fyumagwa and Richard Hoare (2008) **Detection of Equid herpesvirus 9 DNA in the trigeminal ganglia of a Burchell´s zebra from the Serengeti Ecosystem**. Journal of Veterinary Medical Science 70(12):1377-1381.

ABSTRACT. Equid herpesvirus 9 (EHV-9) was isolated from a herd of Thomson's gazelles affected by encephalitis. The natural host of EHV-9 is unknown, but zebras are suspected to be the source of infection in gazelles. To prove this hypothesis, we analyzed 43 sera from Burchell's zebras (*Equus burchelli*) and 21 Thomson's gazelles (*Gazella thomsoni*) from the Serengeti ecosystem for neutralizing antibodies. Seven zebra sera were positive for EHV-1, EHV-9 and EHV-1 from Grevy's zebra strains T965 and T616. The trigeminal ganglia of 17 other Burchell's zebras and one Thomson's gazelle were tested by EHV-9 gB and EHV-1 ICP0-specific nested polymerase chain reaction (PCR). PCR sequencing confirmed that one zebra ganglion was positive for EHV-9. These results suggest that the Burchell's zebras were exposed to EHV-9 and latently infected.

KEY WORDS: Burchell's zebra, Equid herpesvirus 9, latency, trigeminal ganglia.

Tiziana Lembo*, Katie Hampson*, Daniel T. Haydon, Meggan Craft, Andy Dobson, Jonathan Dushoff, Ernest, Eblate, Richard Hoare, Magai Kaare, Titus Mlengeya, Christine Mentzel and Sarah Cleaveland (2008). **Exploring reservoir dynamics: a case study of rabies in the Serengeti ecosystem**. Journal of Applied Ecology 45:1246-1257. doi:10.1111/j.1365-2664.2008.01468.x *These authors contributed equally and were awarded the Southwood Prize for the best paper in the Journal of Applied Ecology 2008 (British Ecological Society).

SUMMARY

1. Knowledge of infection reservoir dynamics is critical for effective disease control, but identifying reservoirs of multi-host pathogens is challenging. Here, we synthesize several lines of evidence to investigate rabies reservoirs in complex carnivore communities of the Serengeti ecological region in northwest Tanzania, where the disease has been confirmed in 12 carnivore species.

2. Long-term monitoring data suggest that rabies persists in high-density domestic dog *Canis familiaris* populations (> 11 dogs km) and occurs less frequently in lower-density (< 5 dogs km) populations and only sporadically in wild carnivores.

3. Genetic data show that a single rabies virus variant belonging to the group of southern Africa canid-associated viruses (Africa 1b) circulates among a range of species, with no evidence of species-specific virus–host associations.

4.Within-species transmission was more frequently inferred from high-resolution epidemiological data than between-species transmission. Incidence patterns indicate that spill-over of rabies from domestic dog populations sometimes initiates short-lived chains of transmission in other carnivores.

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 domestic dogs are the only population essential for persistence, although other carnivores contribute to the reservoir as non-maintenance populations. Control programmes that target domestic dog populations should therefore have the greatest impact on reducing the risk of infection in all other species including humans, livestock and endangered wildlife populations, but transmission in other species may increase the level of vaccination coverage in domestic dog populations necessary to eliminate rabies.

KEY-WORDS: carnivore, infectious disease, multi-host, phylogeny, rabies, reservoir, spill-over, transmission

Journal publications pending

Anthrax (with collaborative researchers)
Patterns of anthrax infection in the Serengeti vary widely between species and between outbreaks
Lembo T. (1,2), Packer C. (3), Fyumagwa R. (4), Hoare R. (4), Beesley C. (5), Stamey, K. (5), Ernest E. (6), Mentzel C. (6), Mlengeya T. (7), Hampson K. (8), Wilkins P. (5), Cleaveland S. (1)

(1) Boyd Orr Centre for Population and Ecosystem Health, University of Glasgow, UK (2) Davee Center for Epidemiology and Endocrinology, Lincoln Park Zoo, Chicago, USA. (3) Department of Ecology, Evolution, and Behavior, University of Minnesota, USA. (4) Tanzania Wildlife Research Institute-Messerli Foundation Wildlife Veterinary Programme, Arusha, Tanzania. (5) Centers for Disease Control and Prevention, Atlanta, USA. (6) Carnivore Viral Transmission Dynamics Project, Tanzania Wildlife Research Institute, Arusha, Tanzania. (7) Tanzania National Parks, Arusha, Tanzania. (8) Department of Animal and Plant Sciences, University of Sheffield, UK

This paper provides a descriptive summary of our studies on anthrax in the Serengeti ecosystem, including the spatial and temporal occurrence of cases in human, livestock and wildlife species since 1996, and age-seroprevalence data for a range of wildlife and domestic animal species. Anthrax occurred in many species, including wildebeest, buffalo, impala, zebra, giraffe, hippo, elephant, topi, cattle, sheep, goats and humans, with cases occurring annually since records became available. However, disease patterns varied widely between years, both in terms of outbreak size and the species affected. Large outbreaks were associated with extreme weather conditions, including low and high rainfall periods. Hospital records of human anthrax were typified by sporadic reports of non-fatal cutaneous anthrax from a few localities. However, small-scale household questionnaire surveys conducted in villages where livestock and wildlife anthrax outbreaks had occurred indicated several human fatalities as a result of the disease. Seroprevalence was measured using a species independent ELISA that detects anti-PA antibodies. Seroprevalence patterns varied widely among animal species, with high seroprevalences in carnivores, including lions, spotted hyaenas and domestic dogs. A very high seroprevalence in dogs was recorded in areas with a high incidence of livestock cases, and age-seroprevalence data indicated that outbreaks had also occurred in villages where anthrax had not been previously detected. Among ungulates, the presence of seropositives among wildebeest and buffalo showed that infection was not invariably fatal. In contrast, the lack of seropositives among zebra suggested high susceptibility of this species to fatal infection. The wide variation in anthrax patterns suggests that several possible environmental, genetic and host-related factors could be important determinants of infection in the Serengeti.

This paper will be orally presented at :The Twelfth Conference of the International Society for Veterinary Epidemiology and Economics (ISVEE XII) will be held from 10 - 14 August 2009 in the city of Durban, South Africa. The full manuscript will be submitted for publication

Baboon disease (with collaborative researchers)
Syphilis in the wild
Kristin N. Harper[1], Sacha Knauf, Robert Fyumagwa[2], Richard Hoare[2], Philemon N. Wambura[2], Dorian Kopenhaver[3], Robert Sapolsky[4], Susan Alberts[5], Jeanne Altmann[6], Jenny Tung[5], Fabian Leendeertz, and George J. Armelagos[7]

The laboratory-based researcher in the USA who took charge of writing up all the research on baboon venereal disease has contacted the German research team at the University of Giessen (who further investigated the condition in Manyara National Park, and they have mutually agreed to combine all their data to update and strengthen the publication. Although this means another delay the final result will be a very interesting publication where our project will be associated with some big names in the world of primate research. This is because a lot of preliminary data was from 30 years of primate health research in Kenya, but it was baboon samples from our programme in Tanzania during the last five years that enabled the *Treponema* organism to be genetically sequenced.

8 PROGRAMME ADMINISTRATION

MoU renewed
A new and more comprehensive MoU was signed between the Messerli Foundation and TAWIRI in 2008 to replace the less detailed previous one that had expired.

Laboratory
The most significant development in our laboratory was a long-awaited, very extensive upgrade of the solar power system – hopefully the last for some time. After the first big upgrade in July 2007 things improved, but we found that the energy demands of refrigeration for storing our big sample bank were still not being met. There are now two separate systems with their own battery banks: three refrigeration units (that run up to 14 hours a day) are now powered by a total of 9 solar panels and the office and laboratory electrical equipment is powered by another 8 solar panels. The financial investment in this has been considerable, but it is justified for a number of reasons, the most important of which is safe storage of 11 years of samples (1998-2008 inclusive) plus some dating from pre-1998 - a unique collection that has taken huge resources of time, expense and effort to collect.

Housing and accommodation
The SWRC has seen a number of substantial improvements in the first year under its new director, Robert Fyumagwa. One of the most important of these was funded by the Messerli Foundation. The foundation donated a sum to refurbish old accommodation that will be used to house groups of visiting students. Up to 20 can be housed and catered for in shared accommodation, and the first group has already used it. This development will make the logistics of managing our annual veterinary field practical course (see 5.2) very much easier.

Expansion and refurbishment work funded by the veterinary programme was carried on staff housing for the programme manager and one of the junior employees. We now have three employees (one laboratory technician and two project assistants) housed together in one block in the TAWIRI ‘staff village’. The new veterinarian has been allocated to an ‘intermediate grade’ house in SWRC which we will assist with some improvements to it in 2009.

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 39

PROGRAMME ADMINISTRATION

Top: Vet Programme staff erected and continue to re-spray over thirty cloth tsetse targets (supplied by the TANAPA Vet Unit) to attract and kill tsetse flies around human habitation at SWRC in SNP.
Centre: Dr Richard Hoare testing radio telemetry receiving equipment, obtaining signal locations from radio collared animals.
Bottom: In the dry season in SNP, water for building work has to be carried some distance to the site in portable tanks.

Aircraft

Managing all aspects of the upkeep, running and maintenance of the TAWIRI aircraft takes a great deal of time and effort. The benefits, however, of using it in remote areas do fully justify this, both for expanding wildlife veterinary services and providing flights to other research projects or conservation causes. For example;

- We made two trips from the Serengeti base to southern Tanzania (Selous and Ruaha) in the aircraft for animal handling (see section 4). This involved a three and four hour flight respectively, that avoided at least two and a half to three days (one way) on the road.

- In Grumeti Game Reserve three elephant cows were immobilized from vehicles, after prior location of suitable herds from the aircraft. The operation which could otherwise have taken three or more days, was shortened to one day as a result of using a spotter aircraft (see section 4.1).

- The aircraft has also been very useful for aerial photography illustrating conservation problems such as: sensitive habitats burnt in bush fires that have got out of control in protected areas; wildlife corridors and 'hard edges' of natural habitat adjoining agricultural areas; human-wildlife conflict zones.

- A conservationist and book author was assisted by flying him around to photograph the wildebeest migration in Serengeti National Park. He is producing a book on all the UN natural world heritage sites in Africa, emphasizing how many of them are now suffering serious conservation threats. Serengeti National Park and Ngorongoro Conservation Area are both United Nations World Heritage Sites.

TAWIRI - Messerli Foundation Veterinary Programme Annual Report 2008 41

10 - PROGRAMME ADMINISTRATION
TAWIRI aircraft

The TAWIRI aircraft is operated by Dr Richard Hoare of the Wildlife Veterinary Programme, both to greatly increase the programme's own mobility, capacity and efficiency and to provide many invaluable services to other researchers and for general conservation work.
Top: Masaai women at Loliondo airfield viewing the plane.
Centre: Flying past erupting Rift Valley volcano, Ol Doinyo Lengai, on the way to field work in northern Tanzania.
Bottom: Plane assisting helicopter operation for elephant research.

ACKNOWLEDGEMENTS

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 former and present Ministers for Natural Resources & Tourism, the Hon. Prof. Jumanne Magembe (MP) and the Hon. Shamsa Mwangunga(MP); the Director of Tanzania National Parks, Mr Gerald Bigurube and his staff; the Director of Wildlife Mr Erasmus Tarimo and his staff in the Wildlife Division; the Chief Park Warden of Serengeti National Park, Mr Martin Loibooki 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, the late 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 Director-General Dr Simon Mduma; the Director of Research, Dr Julius Keyyu; Director of SWRC Dr Robert Fyumagwa, Mr Lucas Malugu, Angela Mwakatobe, Noel Alfred, Habiba Mkwizu, Esther Makacha, Kezia Oola and all their colleagues in the Tanzania Wildlife Research Institute.

Valuable veterinary assistance was provided by collaboration with the Ministry of Livestock Development and Fisheries through: Dr G. Mwakasungula of the Animal Health Department (Zoo-sanitary section) and Drs Swai, Mbise and Moshi from the Veterinary Investigation Centre (VIC) Arusha.

We thank our colleagues at the Sokoine University of Agriculture, the Dean Prof Philemon Wambura and his staff, Dr Donald Mpanduji, Prof Eliott Phiri, Prof Lesikit Mellau and the late Prof Paul Mlay for collaboration on student training activities.

Those who have professionally collaborated with us from outside the country include: Dr Kristin Harper of Emory University, USA; Dr Kerstin Borchers, Institute of Virology, Free University, Berlin, Germany; Dr Sarah Cleaveland of the University of Edinburgh, UK.

We wish to express thanks to others who have assisted in our fieldwork, provided samples or given practical assistance in various ways: Dr Morris Kilewo of TANAPA veterinary unit; Serengeti researchers Dr Ernest Eblate, Dr Tiziana Lembo, Dr Harriet Auty, Emmanuel Masenga, Emilian Mng'ong'o, Ingela Jansson, Patrik Jigsved and John Stewart; Anna Estes; FZS staff Dr Markus Borner, Dr Chris Schelten, Grant Hopcraft and Dr Karen Laurenson and Felix Borner; Alfred Kikoti and his staff from the Kilimanjaro Elephant Research Project and Keith Roberts from Freidkin Conservation Fund. For valuable professional interactions we wish to thank Dr Andrew Williams of the TNRF, plus Dr Charles Foley of WCS Tanzania Program.

Thanks are also due to Brian Harris, Barbara Schachenmann-Suter and Sue van Rensburg of Grumeti Fund as well as Alison Mundy, Martin Dodwell, Glenton Combes and Humphrey Carter of Singita-Grumeti Reserves Ltd. for varied assistance and collaboration.

Mr Elibariki Mollel of Wakulima Engineering Ltd, Arusha is very gratefully acknowledged for repair work on our vehicles. The assistance of Serengeti Balloon Safaris Ltd is also acknowledged for emergency vehicle repair work.

In Arusha town we commend our extremely efficient administrative agent Mr Baptisita Filipatali for invaluable service and assistance. We also sincerely thank Clive Jones of Power Providers Ltd, the staff of Outpost Lodge, Mr Nico Msuya of Arusha Freight Agency, the staff of KwikPrint Ltd especially Tazim Sonecha, Paul and Fini Strebel of Agro-Ventures Ltd, Alex Righolt and his staff at A&A Computers Ltd, Pharmacists Mr H.B. Shakir and Mr Gulamabbas Mohamedali, Dr M. H. Sheriff of Ithnasheri Charitable Hospital and taxi driver Iddi Kido.

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

TAWIRI
Tanzania Wildlife Research Institute

TAWIRI - Messerli Foundation
Wildlife Veterinary Programme

Serengeti Wildlife Research Centre
Tel: + 255(0)28 2621565 (office)
Mobiles +255 (0)784 381 004
+255 (0)787 237 703
PO Box 707, Arusha, Tanzania.

E Mails: richard@messerlifoundation.org
rfyumagwa@yahoo.com

Messerli-Foundation
Switzerland

PROGRAMME PERSONNEL AND CONTACT DETAILS

Dr Richard Hoare BVSc. MSc. DPhil. (Programme Manager and Research Scientist)

Dr Bugwesa Zablon BVM. MSc. (Research Veterinarian)

Mr Maulidi Mdaki (Laboratory Technician)

Mr Jimmy Koromba (Project Assistant)

Mr Kitoi Sarakikya (Field Assistant)

Physical address:

The Herta Messerli Veterinary Laboratory

Serengeti Wildlife Research Centre

Serengeti National Park

Tanzania

Postal address:

P O Box 707, Arusha, TANZANIA

E mail: richard@messerlifoundation.org

bugwesa2002@yahoo.co.uk

Telephone: +255 (0)28 2621565
Mobiles: +255 (0)784 381004
+255 (0)784 687178
+255 (0)754 834340

Report text compiled by:
Dr. Richard Hoare

Photography and graphic design of report:
Sian Brown

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