Biosearch Nyika

FOREWORD

C. Peter Overton

Biosearch Nyika is a conservation research project involving international teams of enthusiastic professional scientists and amateurs working with the Malawi Department of National Parks and Wildlife, in the wilderness areas of the Nyika National Park in the north of Malawi. With a further two expeditions in 1999 we have now completed four in the current phase of exploration of the wilderness areas of the Nyika National Park. Added to earlier experiences in these remote regions we have now built up substantial experience working in the Park. Now, in partnership with The Scientific Exploration Society (SES), we have produced much information which we expect to be of great value to the Department of National Parks and Wildlife in Malawi, particularly on the extent of poaching. We have also published lists of insects, plants and small mammals. We have continued to provide new finds and extensions to the existing state of knowledge.

In 1999, at the request of the Nyika National Park management, we conducted this September expedition to the south-eastern part of the Park. This has similar challenges of inaccessibility to the northern hills, and it is closer to the settlements on the Rumphi rivers, increasing the chance of interaction with the people from below. Although the Juniper Forest Area itself has been previously studied by a handful of authors, the hills to the south and south-east remained almost entirely unresearched and inaccessible to the scouts. This expedition would not have been possible without the joint expertise of the two partners because of the very short time scale involved in its planning. S.E.S. has been involved in expedition planning for many years and was able to support the creation of a team right up to the last minute, whilst the intimate knowledge of Biosearch Nyika of working within Malawi and with the Parks department extended the deadlines to the limit to make this possible. The creation of a worthwhile project and the supply of good people to support it were the two key ingredients in this successful partnership.

For the September expedition we hired an excellent Malawian chef, who received the praise of all, and enabled an extension of the working programme, since no-one needed to be back in camp until just before dark. We constructed simple amenities within camp using local materials where possible, to avoid transporting loads of heavy equipment from overseas. Virtually everything but personal equipment has been purchased from within Malawi and that which was not consumed was left with Malawians at the end of the expedition. We have taken great care to minimise any negative environmental impacts in these pristine areas.

The excellent contributions of all the team members speak for themselves in this report. However, without doubt some of the physically most demanding work is done by the teams that ranged long distances to reach survey squares. The random plot analysis requires great discipline in trying to stick to it as faithfully as possible. This discipline, we know, is much appreciated by the Park management and scouts alike, helping them to research the remotest parts of the wilderness, producing valuable field data from year to year.

In all our work a key feature has been our partnership with Malawians in the teams, including of course, the game scouts who, as experts in game track identification, are a core part of the team. Many expeditioners, on returning from their wilderness experience, have said that they regard this aspect of the whole organisation of lasting value. Cultural exchange and, alas, experiencing extreme poverty at first hand in Malawi, when added to the wilderness experience make this project a two-way flow of benefit in terms of personal and institutional development.

The Directors of the Department of National Parks and Wildlife, the Museums of Malawi and the National Herbarium of Malawi have given us their full support and are looking for continuation and expansion of this work at the rate at which well-organised teams can be assembled. We also have the support of the Herbarium at Kew Gardens with whom we are working to extend Malawian training in Kew and to provide data and material for the developing *Flora Zambeziaca.* We are most grateful for the recognition given by The Royal Geographical Society. It is also clear that those on the ground in the Park look forward to our visits and consider them of great value to them in many ways. Our welcome has always been warm and we have found that they have done their best to support us, even when sometimes more urgent matters (such as fire control as mentioned elsewhere in this report) have become paramount.

Consideration was given to investigating the steep eastern escarpment, which lends itself to perhaps some of the most exciting discoveries. We would hope that future expeditions, if they can be timed appropriately will consider this difficult area as well worth researching. Also, our exploration to date has covered mainly the dry season months. The next step could be to work in the last quarter of the year. Even in the potentially very difficult wet months of January and February some valuable work could be done, especially in the lower woodlands to the north where there is a significant rain-shadow effect. Time spent there in February may often provide the experience of torrential rainfall, but it may be restricted largely to the hours of dark. One can also experience crystal clear, warm sunny days with a great abundance of flowering plants, rushing streams and copious delicious fungi to supplement the inevitably simple bush rations.

There have been a number of changes to the structure and management of the Nyika National Park over the past three years. It is very sad that some of these have been precipitated by the loss of good and experienced staff from the Parks Department. The fundamental problem remains; a lack of funding for sufficient trained and motivated staff for patrolling and continued unsanctioned incursions from the outside. The steep terrain and difficulty of access remain the Nyika's best protection for the time being. It also provides great opportunities for exploration and biodiversity research in a particularly attractive and healthy environment.

ACKNOWLEDGEMENTS

The exemplary quality and quantity of work that the expedition was able to carry out was greatly facilitated through the backing of the Foreign and Commonwealth Office, who sponsored four team members. They were two entomologists, Dr Sarah Donovan and Kit Cottrell, an aquatic ecologist, David Bowden and a veterinary practitioner, Philip Watson. The team were able to regularly transmit a photo diary to the Disney Tarzan website which enabled children around the world to access it. This was made possible through the kind sponsorship of Nera who provided the satellite phone and through Foresight New Media who provided the laptop and the new Sharp digital camera and who set up the Disney site. Fuji also generously provided the team with a digital camera. Both cameras were invaluable. A GPS kindly loaned by Measurement Devices Ltd. was used to map the transects and pinpoint the study areas.

The expedition was a great success. The team was of a very high calibre and coped magnificently with the many twists and turns inevitably thrown up by an expedition in Africa. The lasting impression is of a stunningly beautiful area that is under serious threat from poaching. This valuable work has enabled an unprecedented level of anti-poaching patrols in the southern part of the Park and provided sound evidence on which to base management practices and allocation of resources.

Our most grateful thanks go to:

Environment, Science & Energy Department, Foreign & Commonwealth Office
Fuji
Nera
Foresight New Media
Measuring Devices Ltd.

EXPEDITION LEADER'S REPORT

Montagu Halls

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INTRODUCTION

The Nyika Plateau is located in northern Malawi, and covers an area of some 3134 sq.km. The majority of the plateau itself ranges from approximately 2000-2600m in altitude, dropping sharply at the edges to as low as 600m. The remote nature of this vast area makes it a site of great potential for scientific exploration and research. Many of the habitats found throughout Malawi are present within the area of the plateau. Montane grassland predominates, with patches of evergreen forest, *Protea* scrub and *Brachystegia* woodland. The plateau is crossed by numerous small streams throughout, and these in turn have created unique catchments, which represent a wonderful opportunity for pioneering sampling.

Man's influence on the plateau appears upon superficial examination to be extremely limited. Evidence of regular incursions by local villagers into the interior of the Park is certainly present, however this influence would seem intuitively to be very small bearing in mind the dimensions of the Park. The truth is, however, considerably more complex and ominous. Organised poaching activity (i.e. poaching for profit not merely subsistence) is decimating the large mammal population of certain areas of the Park. The 25 scouts of the Parks Department are fighting overwhelming odds as they attempt to patrol this vast area, and it appears that the poaching influence above all others is the predominant factor shaping the plateau in 1999, with potentially catastrophic consequences in terms of the resident large mammal community.

The area of the Park south of Juniper Forest remains largely unexplored and unresearched. It is particularly notable that even the scouts that accompanied the 1999 expedition were unfamiliar with much of the terrain of this area, and that many of the poachers encountered appeared to move with impunity through the area, secure in the knowledge that very little Parks patrolling took place in the southern zone of the Park.

Thus Biosearch Nyika and the Scientific Exploration Society, in conjunction with the Malawi Department of Parks and Wildlife (DNPW) saw a pioneering scientific reconnaissance of the southern area of the Park as a priority in establishing baseline data for this unexplored area.

BACKGROUND

Although the need for an expedition was undeniable, turning this pressing requirement into an actual team on the ground in Malawi proved to major administrative undertaking. Although the relationship between Biosearch Nyika and the Scientific Exploration Society was established at an early stage, recruitment for the expedition proved problematic and almost resulted in cancellation of the project on several occasions. Melissa Dice at SES made heroic efforts and acquired a full quota of personnel from a well balanced range of scientific disciplines. That Melissa was unable to come on the expedition due to injury was a cruel blow indeed.

A further crucial factor in the ultimate success of the project was a generous offer of funding for four scientists from the Foreign Office. The timing of this offer was most helpful.

Recruitment at an earlier stage would have enhanced the level of research that was possible prior to departure and eased the logistical planning.

EXPEDITION AIMS

The aims of the expedition provided by Biosearch Nyika were:

- To enhance the international understanding of the wilderness areas of the Nyika National Park.
- To provide concrete data on which to base sustainable management plans for retaining the biodiversity of the region.
- To assist the Parks department in accessing and policing the remote areas of the National Park.

PERSONNEL

The expedition was most fortunate to have a broad range of experience to draw upon throughout the entire project. This included not only a range of scientific disciplines, but (crucial to any expedition) also a key range of practical skills that created a formidable team. The lasting impression of the expedition is that it was very much the personnel involved that made the project the outstanding success that it was.

Major Monty Halls BSc (Hons) RMR - Expedition Leader (32)

A Royal Marines Officer from 1988 to 1996, Monty has been involved in expeditions for seven years. Experience includes Java (1992), Belize (1997/1998), as well as leading a large project on behalf of the International Scientific Support Trust to Sulawesi in 1993. In 1994 he worked on the repatriation of the exiled guerrilla army of the ANC in South Africa, before leaving the Marines in 1996 to pursue a degree in marine biology, in which he gained a first class pass in 1999.

Andy Martin - Assistant leader & Scientific co-ordinator (49)

An ex Malawi resident (1950-1969), Andy developed a passion for herpetology whilst growing up in the country, collecting and recording 35 of the 54 recorded species in Malawi over an eight year period. This passion has remained with him during his career as a Royal Naval Officer and in the oil industry, and has led to a number of projects in W. Africa, Indonesia, and Borneo over the last twenty years.

Dr Rod Lindenbaum - Expedition Doctor (27)

Rod has acquired considerable experience in expeditions over the last three years, including mountaineering in Greenland (June-July 1998) and a spell as ships Doctor on the tallship "Malcolm Miller" (1998). He has backpacked in Peru/Bolivia, the Baltic States, Eastern Europe, South-East Asia, China and Borneo. His specialisation in Tropical Medicine and Hygiene in 1999 was a natural progression from this enthusiasm for exotic locations, and will doubtless lead to many other future expeditions and adventures!

Dr Sarah Donovan PhD - Entomologist (29)

Based presently at the Natural History Museum, Sarah's particular speciality is termites and social insects. Her interest in all that scuttles and co-operates has taken her to West Africa, Borneo and Australia. Adaptable and easy-going, Sarah is the ultimate team player. Just like a termite.

Dr Mark Bilsland PhD - Geologist (39)

In his capacity as a senior manager for Enterprise Oil, Mark has conducted reconnaissance work in Vietnam, Venezuela, Yemen and Siberia. His experience in geology has also taken him on field trips both in the UK and abroad. Mark proved absolutely invaluable as the co-ordinator of the IT link with the UK, and swiftly became the technological guru for the expedition. Participated in all aspects of the sampling programme with apparently boundless enthusiasm. Went almost 100% "feral" over the course of the expedition.

Mary-Anne Bartlett - Expedition artist (30)

Mary-Anne has previous experience in Malawi through a 1991 project with Cambridge University, which involved a 260 mile walk through the country along the path of the River Shire. Other travels have included time in both India and Turkey. Mary-Anne’s work as expedition artist has already been exhibited within the country itself. Mary- Anne stayed in Malawi on completion of the expedition, where she hopes to continue working full time as an artist.

David Bowden BA(Hons) Bsc(Hons) - Aquatic ecologist (40)

Joined the expedition at short notice to co-ordinate the aquatic science sampling strategy. Holding commercial Ocean Yacht master and HSE diving qualifications and first class honours degrees in Marine Biology and photography, David's background has been almost exclusively marine, with considerable experience in the Caribbean, the Mediterranean and throughout the North Atlantic. The Nyika expedition was thus an uncharacteristic departure from sea level

Tooni Mahto BSc (Hons) - Aquatic ecologist (28)

A recent graduate of Plymouth University, where she achieved an outstanding first class pass in Marine Biology, Tooni has scientific and expedition experience in both New Zealand (1998) and Tanzania (1996). Tooni established the aquatic sampling strategy for the expedition in conjunction with agencies within Malawi. She has remained in Malawi on completion of the expedition to pursue various employment options, as well as to continue her exploration of Southern Africa.

Philip Watson FRCVS (Vet) Large mammal survey (34)

Philip was recruited to the expedition via the Foreign Office funding, and proved an invaluable asset with his broad range of scientific knowledge coupled with his considerable ingenuity. Although he works at present as a Veterinary Investigation Officer, Phil has previous experience of Malawi through conducting an extensive period of research into parasitism of livestock in the country in the mid eighties. Extremely fit and a highly competent map-reader, Phil was a natural choice to lead the large mammal survey, although his boundless energy required a new team each week to keep up with him.

Claire Wells - Scientific assistant (21)

Claire came to the expedition with little experience of either scientific surveying or expedition life. She emerged from the project as the undoubted star of the entire venture. Hardworking, extremely intelligent, fit, resourceful, tenacious, Claire has all the elements required to adapt to any expedition environment. She made invaluable contributions to the overall scientific endeavours of the project, and appeared to have boundless energy that she applied with great vigour to everything she did. She has a great future in expeditions should she choose to follow this route on completion of her sociology studies in London.

Kit Cottrell - Entomologist (59)

Kit is based in Zimbabwe and is currently Head of the Entomological Department at Kutsaga Research Station in Harare. He has written numerous publications on subjects that include blowflies, Southern African butterflies and honey guides. He is currently working on the development of new, environmentally sound, techniques for the control of the arthropod pests of tobacco in seedbeds, lands, and in the cured product.

Raymond J. Murphy FRES - Entomologist (70)

Ray has worked in Australia, Brazil, Uganda, Kenya, Zambia and now resides in Malawi. He contributed to *The Butterflies of Venezuela* and is now assisting in the creation of the African Butterfly Research institute, together with the National Museum in Nairobi. An honorary research associate of the Forestry Research Institute in Zomba, he is building the only research collection in Malawi. He has donated public educational collections in Blantyre, Chelinda and Mzuzu and is working to publish books on certain insect groups.

Hassam I. Patel - Botanist (55)

Hassam has worked for many years at the National Herbarium of Malawi. He has an encyclopedic knowledge of botany within Malawi, as well as a fascinating grasp of herbal medicine. First worked with Peter Overton of Biosearch Nyika in 1972, and has been involved in most of the work since. This included being flown to the Royal Botanic Gardens at Kew to work on his Nyika plants collections. A tireless worker and fascinating trekking companion.

Staff of the Nyika National Park

No project of this nature could operate without local knowledge and assistance. All the staff allocated to assist the 1999 Nyika Plateau expedition were of a truly high calibre, with the boundless good nature by which the Malawian people are justifiable renowned backed by vast knowledge and professionalism. The debt of gratitude that the expedition owes all the local staff members cannot be overstated, and we unquestionably learned a great deal more from them than they did from us.

Park Manager	Mr Chisa Manda
Research Officer, Nyika Park	Mr Gibson Mphepo
Visiting scientist	Mr Muthetho Nlhemin
Ranger, Parks department	Mr Jones Mwalukomo
Scouts Manager	Mr Alex Chunga
Scouts in the field	Mr Symon Mughogho
	Mr Steven Gondwe
	Mr Grandson Simkoko
Field Cook	Mr Martin Chirwa

EXPEDITION DIARY

The expedition adhered reasonably closely to the programme and timings, organised by Biosearch Nyika, which was quite impressive. The vagaries of logistics and the inevitable toll on vehicles and personnel extracted by the rigors of the African bush produced a few minor alterations to the exact schedule, however the broad outline remained intact throughout.

Map sheets referred to are: Sheet No 1033D4 (Muhuju) and Sheet No 1033B2 (Rumphi)
Published by Department of Surveys, Blantyre, Malawi.

Date	Event	Logistics	Comments
4 Sep	Advance party arrives in Lilongwe (Monty & Andy)	Arrived at the Golden Peacock Hotel	A low budget hotel
5 Sep	Explore Lilongwe old town	Still in Golden Peacock	Frustration at inability to buy stores but much planning achieved.
6 Sep	Buying stores in Lilongwe "ptc" and old market. Meet Peter and Marianne Overton	Comprehensive list dropped off at ptc for later collection. General stores purchased cheaply in market. Moved to Imperial Hotel	Surprisingly pleasant day. Manager of ptc very efficient. Received a warm welcome and cold beer from the new hotel.
7 Sep	Continue buying stores, meet expedition cook. David Bowden arrives from UK.	Completed stores purchasing, now ready for collection. Maps obtained from Govt. office in Lilongwe.	
8 Sep	Marianne and Monty met the main party at Lilongwe Airport at 14.25.	Reception and briefings in Imperial Hotel.	Harry (the manager) is a great asset, thoroughly co-operative and enthusiastic.
9 Sep	Depart Lilongwe 09.00; pick up Hassam Patel in Mzuzu.	Move to Mzuzu, dinner in Mzuzu Hotel. Overnight in Mzuzu.	Safari bus - driven by New Zealander, Jason.
10 Sep	Arrival at Juniper Forest at 16.00 – GR965120	Unload stores, pitch tents establish camp.	Wooden stores hut with concrete base, fairly "Rolls Royce" facilities for a basecamp!
11 Sep	Establish basecamp, co-ordination and briefings on scientific strategies.	Briefings include safety, communications procedures, casualty evacuation chain, team operating procedures.	No scouts as yet.
	Phase 1		
12 Sep	Scientific work commences; Large mammals, aquatic survey, entomological teams.	Stores issued as required. Marianne and Peter depart and sort out scout difficulties.	Absence of scouts meant limited radius of operation and no overnight trips.
13 Sep	Survey work continues. Three scouts arrive.	Scouts trekked 30km to arrive at basecamp.	HF communications established, thanks to Symon Mughogho.
14 Sep	Full survey programme commences	Scouts accompany two outlying groups.	Overnight trips now possible, this made life considerably easier.
15 Sep	Survey programme continues	Large mammal and aquatic groups over-night SW of basecamp	Exact locations of groups recorded in basecamp.
16 Sep	Phase 1 completed. All survey work successful	All groups return to basecamp.	Debriefings for phase 1, preparation for initial re-

	within constraints of protocol and terrain!		supply run.
17 Sep	Re-supply run departs for Mzuzu. Remainder work up samples gathered to date.	Parks vehicle used for stores run.	Eight dusty, bumpy hours later, Monty and Andy award themselves a night in the Mzuzu Hotel.
18 Sep	Supply run returns. Briefings and discussions in preparation for phase 2.	Stores run demanding and time-consuming. Decide to make only one run, therefore return with a LARGE quantity of stores.	Decide to relocate basecamp for phases 2 and 3, for easier access to lower altitudes.
19 Sep	Recce of new basecamp by Andy & Symon in safety vehicle but track overgrown and impassable. Large mammal group departs on foot to new basecamp.	Recce completed too late for move that day. Further night at Juniper Forest. Martin Chirwa evacuated to Chelinda with chicken pox.	Many dramas as Recce party returned late, having found the road impassable, without cutting the trees and bushes growing on the road. A search by Kit and Monty (in Kit's vehicle) missed them by ten minutes. High emotion that simple communications equipment would have alleviated.
	Phase 2		
20 Sep	Remainder move to new basecamp (GR026035). Kit Cottrell and Ray Murphy return to palacial facilities at the Juniper basecamp.	Two vehicles (Ray's cavernous van as well as safety vehicle) required to move stores and eight personnel.	Epic load carry down to site of new camp (800m down precipitous hill). Frantic work rate saw the new camp completed by dusk.
21 Sep	Day in new basecamp, localised recces.	Survey plan established for new areas, teams prepared for departure the next morning.	In reality, all personnel used this period to recover from the physical demands of the previous day – time well spent.
22 Sep	Aquatic ecology group departs to sample local catchments, entomology group samples immediate local area. Large mammal group arrives in basecamp.	Shortened sampling period due to the move from Juniper taking longer than anticipated.	Terrific effort by large mammal group, <50 km in four days through tough terrain.
23 Sep	Aquatic group returns.	All personnel in basecamp.	Planning for phase 3 commences.
	Phase 3		
24 Sep	Aquatic group and termite group depart for final phase. Entomology continues in local area.	Local area only (with the exception of the large mammal group).	Termite group moved to position 12-15km to SW of basecamp.
25 Sep	Aquatic group return to camp. Write-ups commence.	Working up samples, only	limited analysis possible
26 Sep	Termite group in field.	Chelinda Camp visit to assess final arrangements for main party extraction.	Highly energetic contact with poachers and close scrape with a large fire heading for basecamp!
27 Sep	All groups return to basecamp.	Limited write-up facilities! earlier than arranged date	Decided to break camp of October 2nd.
28 Sep	Breaking down of basecamp commences.	Safety vehicle transports group to Chelinda.	Opportunity for this group to indulge in some game drives

	Initial group departs camp for Chelinda	Overnight at campsite.	on the plateau.
29 Sep	Main party departs basecamp for Chelinda	Safety vehicle and Parks vehicle used for final move.	Lack of room in vehicle mean two personnel (Dave & Monty) remain overnight with two scouts.
30 Sep	Final group (Dave & Monty) departs basecamp for Chelinda	All stores and personnel in Chelinda. Camping facilities used in camp. Smashed to smithereens by local soccer side (5-1)	Hot showers! Surprise birthday party for Dave – worst kept secret in expedition history.
1 Oct	Travel to Chinteche Inn	Safari bus used. Arrived Chinteche approximately 18.00.	Generous donation of vouchers from Oilcom refilled budget. Superb location at Chinteche - ideal site for R&R.
2 Oct	Chinteche Inn	Scuba diving blown out, forced to lie on beach and sip cold drinks.	
3 Oct	Chinteche Inn	Diving still blown out, forced to lie on beach sipping yet more cold drinks.	
4 Oct	Travel to Lilongwe	Overnight at Imperial Hotel.	Energetic day attempting to sell fuel vouchers.
5 Oct	Depart Malawi		

Team members for each phase

	Phase 1	Phase 2	Phase 3
Large mammal	Phil Watson Monty Halls Rod Lindenbaum Claire Wells Steven Gondwe	Phil Watson Tooni Mahto Mark Bilsland Mary-Anne Bartlett Steven Gondwe	
Aquatic ecology	Dave Bowden Tooni Mahto Hassam Patel Mary-Anne Bartlett Symon Mughogho	Dave Bowden Claire Wells Monty Halls Andy Martin Rod Lindenbaum Symon Mughogho	Dave Bowden Tooni Mahto Monty Halls Claire Wells Phil Watson Symon Mughogho
Entomology	Sara Donovan Kit Cottrell Ray Murphy Andy Martin Mark Bilsland Grandson Simkoko	Sara Donovan Hassam Patel Grandson Simkoko Kit Cottrell base I Ray Murphy base I	Sara Donovan base II Mary-Anne Bartlett " Andy Martin in field Mark Bilsland " Rod Lindenbaum " Hassam Patel " Grandson Simkoko " Steven Gondwe base II Kit Cottrell at base I Ray Murphy at base I

LOGISTICS

Logistics within Malawi proved surprisingly easy, with the "ptc" chain of supermarkets providing an accessible, relatively cheap range of foodstuffs and stores. Larger items such as cooking containers and general expedition "hardware" were purchased in the market in Lilongwe. Biosearch Nyika organised the expedition as a whole.

Food items

The expedition managed to stay well within budget during the purchase of food items. As already mentioned, only two major bulk food purchases were made. Both were made through the simple system of dropping off a list of supplies with the manager of the store in question, then collecting the goods the following day. On the whole, the list tended to reflect the contents of the resultant bags and boxes, with a few notable exceptions, which did not (fortunately) radically affect the stores balance of the expedition (we certainly weren't short of toilet roll during the expedition after an over-zealous ptc employee packed several hundred weight of Andrex).

The food list from the Biosearch Nyika 1998 expedition (Southampton OTC) proved invaluable, providing as it did an excellent breakdown of individual requirements as well as a summary of their overall demands for their entire expedition. Their expedition consisted of 15 individuals in the field for a 28-day period, and as such their ration demands were simply adopted wholesale as a guide for our purchases. This ensured a healthy diet throughout, with quantity rather than quality the theme of the day!

Food list

Item	Quantity	Item	Quantity
Tomato puree	35 tins	Corned beef	25 tins
Luncheon meat	20 tins	Tuna	30 tins
Rice	30 kg	Pasta	14 kg
Peanut butter	25 pots	Onions	8 kg
Jam	25 tins	Biscuits	65 packets
Crackers	30 packets	Pilchards	65 tins
Sardines	55 tins	Peanuts	10 bags
Groundnuts	5 kg	Raisins	30 bags
Pro-nutra cereal	25 boxes	Maize porridge	30 bags
Cornflakes	25 boxes	Soup	50 sachets
Coffee	8 jars	Tea bags	700
Milo	3 kg	Sugar	22 kg
Milk powder	17 kg	Salt	2 kg
Oil	6 litres	Eggs	50
Black pepper	1 packet	Paprika	100g
Nsima	20 kg	Nali sauce	10 bottles
Peas	10 tins	Dried beans	5 kg
Meat (various)	10 kg	Chickens	10
Butter	8 lbs.	Dried fish	2 kg
Malawi Gin	1 bottle	Carlsberg green	40 bottles
Tonic	24 bottles	Orange squash	4 x 2 l bottles

Additional fresh supplies were purchased on the supply run (i.e. tomatoes, cucumbers, lettuce, fresh fruit) and consumed on the night of the return to basecamp.

Other stores

The acquisition of stores once again proved to be relatively easy, with three energetic days scouring local markets providing the vast majority of items required. The purchasing of stores within the country ultimately proved useful, providing the opportunity to present what stores remained (and all expedition hardware) to the local assistants and Parks department employees as gifts. We had been provided with a large Icelandic tent and a smaller Vango Force 10 for secure storage of vulnerable items.

FIELD BUDGET SUMMARY

Introduction

A retrospective impression of running an expedition budget in Malawi is that it is extraordinarily difficult to run! The currency (Kwacha) is weak at present, inflation is soaring, and as such many of the purchases made require substantial amounts of cash. This makes the tracking of cash flow extremely difficult. This is combined with the inevitable problem of many of the purchases on the expedition coming from market stalls and local sources, where receipts are in short supply.

Despite these unavoidable drawbacks, receipts were always acquired for the major purchases made by the expedition (i.e. the two major stores runs and the R&R phase). Any shortcomings in the balance can be explained through acquisition of additional items locally for which receipts were not received.

During the R&R phase, a considerably larger amount was expended than anticipated in the initial plan of action, partly due to the earlier departure from basecamp. The expedition leader took the decision that expedition personnel paying upwards of £2500 for their four-week stay in Malawi should not be required to purchase lunches from their own money during the R&R phase and this was covered from the budget.

Wherever possible, receipts have been identified for relevant expenditure. Where this has not been possible, the budget sheet is marked accordingly.

Field Budget breakdown

Three major phases of spending took place. These were:

1. Initial stay in Lilongwe and purchase of stores (3-9 September).
2. Second stores run in Mzuzu (16-17 September).
3. R&R phase on completion of the expedition (30 Septemeber-4 October).

Breakdown of each of these phases is seen on the following sheets.

Phase 1: Initial period of expedition (advance party and stores purchasing)

Date:	Item/purchase	Amount	Receipt Number
Receipts 1-3 in UK			
28/8	Safety card printing	£8.29	1
28/8	Receipt books	£4.99	2
31/8	Stove for A. Martin[1]	£71.00	3
31/8	Travellers cheques charge	£7.80	None
Remainder in Malawi			
4-5/9	Meals at Korea Garden for advance party	£80	7-11
5/9	Accommodation at Golden peacock		
6/9	Stationery	K2081	12
6/9	Initial stores purchase	K16560	13
7/9	Taxi to collect D.Bowden	K1000	None
7/9	Maps	K580	14
7/9	Cooking implements	K2300	15
7/9	As above	K1405	16
7/9	Photocopying	K289	17
7/9	ID books	K1050	18
7/9	Food for first phase	K16942	19

8/9	Pay for cook	K1000	In receipt book
8/9	Bird books	K1870	20
8/9	Guidebooks	K170	21
8/9	Containers	K920	22
8/9	Final stores	K2828	23
9/9	Accom. at Imperial Hotel for advance party	K4458	24
Total		K66386.6 or £948.38	

Phase 2: Deployment in field / stores resupply (10-30 September)

Date	Item/purchase	Amount	Receipt Number
16/9	Battery for safety vehicle	K3134	25
17/9	Final food stores purchase	K37686.62	26
17/9	Diesel	K640	26
Total		K41460 or £592.28	

Phase 3: Removal from field, R&R phase (30 Sep-4 Oct)

Date	Item/purchase	Amount	Receipt Number:
19/9	Stay at Chelinda for Dr Lindenbaum	K2700 = US$60	27
29/30/1	Camping and meal[2]	K15300 = US$340	28
31/9	Guide book	K900	29
1-3/10	Stay at Chinteche Inn	K29700	30
1/10	Pay for cook	K2000	None
3/10	Final meal	K3000	None
4/10	Airport bus	K1800	None
4/10	Departure tax	K7200 = US$160	None
Total		K62600 or £894.28	

Grand total for expedition

Expenditure	Phase 1	K66386 or £948.37
	Phase 2	K41460 or £592.28
	Phase 3	K62600 or £894.28

Total = K170446 or £2434.94
Amount remaining £84-28 in account
Total Budget = £2599.22

COMMUNICATIONS TECHNOLOGY

Dr Mark Bilsland

INTRODUCTION

Planning for the expedition had always included the use of a satellite communication device for CASEVAC (casualty evacuation) use. A few days prior to departing a sponsor volunteered the portable computer and digital camera with the objective of receiving a regular e-mail diary from the field. The computer and satellite telephone were successfully configured in London before departure.

Images collected by the digital cameras were periodically downloaded onto the computer. Selected images were edited for e-mail transmission along with the associated diary commentary.

EQUIPMENT

The equipment loaned to the expedition was as follows;

Cameras

Fuji MX-2900 high quality digital camera (stills only)	Fujifilm UK
Sharp "pocket" digital camera (stills and movie clips)	Sharp

Laptop computer

DELL Inspiron 3500 Pentium 400 portable computer	Foresight

Satellite telephone

NERA Worldphone Inmarsat M satellite communication centre	NERA

GPS navigation device

Garmin 45 hand held GPS unit	Mr Stephen Ball, Managing Director of Measurement Devices Ltd., Aberdeen

COMPATIBILITY

Both the Fuji and the Sharp cameras used the same smart card media. This allowed for simple image downloads from either camera through a 3½" floppy drive adapter.

The satellite unit included an integral Hayes AT compatible modem that connected to the computer via a standard RS232 serial port. This configuration allowed a maximum data transmission rate of 9,600 Kb/sec.

Images were edited on the computer to reduce the image size prior to transmission via e-mail.

The Garmin GPS unit was used as a stand-alone navigation device, and was particularly useful given the nature of the terrain and consequent difficulties with conventional triangulation techniques using magnetic compass and topographic maps.

PERFORMANCE

In general the equipment provided performed well, however the obvious constraint on all components of the system was power.

The computer and satellite telephone each had a battery life in the order of 1½ hours. The satellite phone had two battery packs, with a requirement for at least half an hour of battery remaining at any time for CASEVAC purposes. The satellite telephone could also be powered from a 12 volt car adapter – when we had access to a vehicle. The constraining factor on the frequency of transmission was the computer battery life. In practice, after editing images and creating the e-mail messages, between three and four transmissions were possible before the computer required recharging. Recharging was only possible on the stores trips back to Mzuzu or Chelinda Camp.

The Fuji digital camera was powered by rechargeable batteries. Recognising the problems with accessing mains power, five pre-charged battery units were provided. This allowed extensive use of this camera for the full period in the field (about 15 days, or 300 images including play back/ viewing time). The Sharp camera was powered by four AA batteries which lasted for about a week of moderate use. A plentiful supply of AA batteries meant that power was not a problem for this unit.

The Garmin GPS unit was also powered by four AA batteries. These lasted for three or four days with moderate use, that is, way points every 30 minutes while trekking.

CONCLUSIONS AND RECOMMENDATIONS

The equipment provided was excellent, and lasted the trip without failure.

The capabilities of the portable computer were probably in excess of what was actually required, however it did provide a level of comfort given the volume of digital images recorded and processed.

The two cameras were fundamentally different, with the Fuji camera providing excellent quality images, but too large for inclusion in the e-mails. The Sharp unit provided usable but lower quality images and quite passable video clips. Again the video clips were too large for transmission via e-mail due to the relatively low transmission rate.

Typically the e-mails need to be less than 100 Kb for trouble free transmission. Multiple small e-mails are preferable to transmitting large packages due to the potential for communication interruptions. The sending of e-mails to the field from base needs to be similarly respectful of file size: At one point we were blocked by a large incoming e-mail taking over 30 minutes to download, using precious battery life!

For future expeditions, extra battery packs for the computer and satellite telephone would be highly desirable. A portable solar panel array would prove very useful, particularly if the units could be “field sustainable”.

Portable satellite communications are evolving rapidly. Clearly any improvement on the 9,600 Kb/sec transmission rate would be highly advantageous, allowing for higher quality images and video clips to be e-mailed.

MEDICAL REPORT

Dr Rod Lindenbaum

The perceived medical risks prior to departure were diarrhoea, skin infection, malaria, broken bones, R.T.A. and snake bite. The consequence of these would be increased by the remoteness of our location. Recommended inoculations, as discussed with the Liverpool school of Tropical Medicine, were tetanus, polio, typhoid, hepatitis A, and rabies. The malaria prophylaxis recommended was mefloquine.

The medical kit weighed roughly 7 kg, and was carried in 3 waterproof containers. It was obviously marked as medical supplies with a list of contents under the lid of each container and caused surprisingly few problems at customs in either direction.

The inventory included a range of antibiotics (amoxycillin, erythromycin, flucloxacillin, augmentin, metronidazole), painkillers (paracetamol, voltarol, codeine phosphate, tramodol, nalbuphine IV), malaria treatment (quinine, fansidar, doxicycline), rehydration sachets, fibreglass rolls for immobilising fractures, local anaesthetics for peripheral nerve blocks, 5 l of IV fluids, enough to resuscitate someone with a badly broken pelvis, diazepam, piriton IV, adrenaline and more.

Actual medical incidents were fortunately not as serious as this. Apart from a couple of isolated episodes, probably caused by Nali "Africa's hottest chilli sauce", there was very little diarrhoea. Water supplies were clean and we had a good hand-washing routine. The climate is relatively benign (if not a little cold at night) making the risk of serious skin infections low and the risk of malaria very low.

The terrain is rough and steep and the possibility that someone, tired after a days walking, could turn or break an ankle in an isolated situation. A more serious injury was unlikely unless someone went jumping out of trees or climbing boulders. This expedition would not have been recommended countryside, though, for people with restricted exercise tolerance due to cardiac or respiratory pathology as hard physical work is unavoidable.

River crossings were potentially wet and embarrassing but never dangerous.

Snakes at altitude were few and far between; to be bitten and envenomed by one would require an enormous stroke of bad luck.

Travelling on the roads in Malawi, as with travel in any African country, is a risk and you just have to put your trust in Malawian spatial awareness.

The emergency evacuation procedure was laid out in detail in the risk assessment given to us by Biosearch Nyika and discussed in Monty Halls' Leader Report. However, a few additional comments may be useful:

The evacuation of a casualty who was out trekking in the Park would be slow. They would first be stretchered back to basecamp, which would be difficult over steep ground and may take 24 hours or more. It would be sensible to send people ahead to basecamp to radio Chelinda early, requesting a plane to the airstrip there.

After stabilising the casualty at basecamp the next step would be transport in the emergency vehicle on the rough track for 2-3 hours to Chelinda. Road transport out of Chelinda continues to be slow and uncomfortable and it is probably advisable to wait for the plane if possible. The best acute medical service in the vicinity was likely to have been ourselves and the place we would have aimed for, once we had the plane, would have been Blantyre.

We felt it imperative to have an HF radio and a vehicle at basecamp. A satellite phone, as we had, to communicate with the UK and start help coming from that direction was an invaluable luxury.

During the trip three Malawians developed a fever and were treated for what was presumed to be malaria acquired at a lower altitude. During the first week in the field, one of them was Martin, our cook, which caused ripples of concern through the camp. After 48 hours he developed a papuler rash looking remarkably like chicken pox. He became quite feverish and unwell and I moved him to Chelinda for bed rest and warmth. Beds and log fires are easy enough to find there but food is another matter. Residents only go on shopping trips once a month and are reluctant to give up any of their precious supplies. Take plenty of your own supplies and make sure it doesn't get "magicked" away by enthusiastic helpers offering to cook. I left Martin at Chelinda after 24 hours to get better by himself with a supply of paracetamol and doxicycline as a blind treatment and within another 48 hours he was well and keen to come back and cook for us, which he did.

One of our group was burnt by fat from the fire so flamazine and suitable dressings are useful. She was also stung on the breast, which caused embarrassing itching.

Other complaints were splinters and cuts, the gleeful use of machetes providing the greatest opportunity for nasty lacerations.

All in all it was a safe event and there is no reason for it not to be, providing people remember they are in an isolated situation and don't do anything too silly.

SCIENTIFIC WORK: Introduction

Marianne J. Overton

BACKGROUND

Few have the opportunity to live and work in remote African wilderness, providing sound ecological data for the management and protection of a beautiful area, uninhabited by people. This we have.

The extraordinary diversity on the thin soils of the high plateau of the Nyika National Park is well known and has attracted considerable international interest, reflected in a long list of references, originally collated by Critchlow in 1996. However, the plateau drops down steep escarpments into a series of hills and valleys where there are no roads or tracks. These inaccessible areas are little studied and much new material has been discovered on each of the four expeditions. Because of the logistical difficulties, even scouts have had little opportunity to get deep into these vast areas of African bush. Thus partnership between Biosearch Nyika expeditions, scouts and other staff of the department of National Parks and Wildlife has been of enormous benefit to the Park.

In 1972 a successful expedition into the northern hills of Nyika was carried out by Wye College, London University. Three of those team members have collaborated in a further four expeditions(1997-9), thus spanning a total of 28 years and, in the last four years, involving a total of 120 people in the field; key scientists, amateur volunteers and Park Staff.

AIMS

The Nyika National Park is known to be beautiful and diverse, but under threat from poaching. This work seeks to identify what wildlife is present and thus demonstrate the significance of the area and also to raise its profile internationally. Also some projectwork has been specifically directed to demonstrating the impact of poaching or of the fires believed to be started by poachers.

It is important for the long-term protection of the northern hills to establish their significance in terms of wildlife. The wide range of research projects give indications of biodiversity, including the presence of rare or endemic species, the importance of the area to large mammals, birds and other wildlife and opportunities for low-key tourism. Data to assist with future management of the Park includes identification of sensitive areas, plants and wildlife.

A spin-off benefit is that the organisation provided by an expedition in these remote areas, enables scouts to get into the furthest reaches of this vast wilderness and to carry out their normal anti-poaching duties.

ACHIEVEMENTS 1999

Having two expeditons in 1999 gave the golden opportunity to research two remote wilderness areas in the same season. The July expedition was in the northern valleys, visited previously, and thus allowing for the first time, a direct comparison of large mammal activity in the same season of two consecutive years. This expedition was in partnership with the Leeds Officers' Training Corps (LUOTC), who concentrated on long distance travel to carry out the large mammal surveys in the same fifty kilometer squares as the previous year. Their data reveals that many large mammal populations are reduced, most notably Elephant and Kudu (Overton, 2000). Part of the team were entomologist, Raymond J. Murphy and Wilbert Chitaukali, Curator of the Museum of Malawi and small mammal specialist. Small mammals are crucial in the food chain and the resident species are important biogeographic indicators. A comparison of small mammal studies over three years in included in their report. New species are in the process of being described.

The September expedition was in partnership with the Scientific Exploration Society and covered a wide range of research projects. The significant aspects of the geology of the area are discussed and clearly illustrated by Dr Mark Bilsland. The biogeography of the terrain and main vegetation types is also well described in Kit Cottrell's introduction to his report. In brief, habitat types include montane grassland above about 6000 ft (1800 m), rich in diversity based on thin soils, evergreen patches, mountain streams and riparian vegetation and boggy, dambo areas where soil has slid into a hollow. Moving down in altitude, one finds a narrow and beautiful band of *Protea* scrub, below which is vast *Brachystegia* or miombo woodland, with a complete canopy and grass cover underfoot, based on eroded, sandy or silty soils.

Ants and termites had not been previously studied in the Park, despite their significant impact on the ecosystem and their importance as indicators of the state of the habitat. These were studied by two professional entomologists, C. B. Cottrell from Zimbabwe and Dr S. Donovan from the British Museum in London. Kit Cottrell's work on the composition of ant, soil arthropod and butterfly communities have indicated the significance of burning and he has made strong recommendations to retain forest fire breaks and allow a controlled mosaic approach to burning. Dr Donovan's pioneering work has identified a new genus of termite and illustrated the effect of altitude and burning on termite populations. Raymond Murphy's four expeditions and accompanying research in the major world museums for African invertebrates, has now culminated in the publishing here for the first time, the complete species list of invertebrates in the Nyika National Park.

The Nyika National Park is a major source of water for Malawi. This was one of the main reasons for keeping it pristine by excluding local populations by extending the Park border in 1976 to include the areas described for the first time in the 1972 report. Study of these waters was indentified as a priority in our 1997 report. Only one piece of work had been done in recent years and that was confined to the areas accessible by vehicle on the plateau and lower down on the Rumpi River, looking in particular at the effect of the introduction of trout, into streams some years ago. No trout were found in our study. The excellent work by David Bowden and Tooni Mahto, published here provides a baseline data for the Nyika streams, and can be compared with other Southern African highlands. Their work shows that the Nyika streams support a rich and diverse invertebrate fauna. The overall taxon-richness apparent in the samples suggests that the streams are as clean and undisturbed as might be expected in such a pristine environment. It had been suggested that burning might affect the acidity, but this was not indicated.

There has been some work on the herpetofauna of the Park but very little, if anything in the remoter regions. Andy Martin's work here is the first and a preliminary checklist for the Park is published here. Notable additions have been made to the list. No-one on the expedition claimed to be "bird expert" but a short list has been compiled.

Hassam Patel, a very experieinced botanist from the National Herbarium and Botanical Gardens, based in Zomba, joined the September expedition. The Juniper Forest Area has been previously studied botanically by previous authors, so the main thrust of Hassam's work was to travel and to locate new records for the Park and reference specimens for the Herbarium. Four hundred and twenty-five species were identified, 79 previously unrecorded by expeditions and probably new for the Park. These are listed here. This was the last expedition to contribute to the full checklist of nearly 1500 species, now published separately. Some quadrat studies were done to characterise the vegetation in the regions of the termite and other surveys.

Over two weeks, the Large Mammal Survey led by Phil Watson, accomplished almost fifty survey plots in the expedition area to the south of Juniper Forest. A comparison of burned and unburned plots shows a significant difference for some species. The relative abundance scores, based on tracks and signs of large mammal activity are much lower in the south-eastern hills than similar areas in the northern hills.

Signs of poaching activity were many in the south-eastern area, leaving some team members with the feeling that they would much rather be more directly involved in supporting the anti-poaching activity of the scouts, than carrying out ecological research!

The expedition enabled the scouts to get deep into the wilderness areas. The need for this work and the research needed to attract and justify the use of resources, becomes more urgent as the population of Malawi continues to expand, perhaps faster than elswhere in Africa. The demand for wood and other natural resources encourages more of the border zone population to encroach upon the National Park, especially in the remote valleys where we have clearly demonstrated adverse human activity.

We have found the Scouts and Wildlife Officers continue to be exceptionally well-trained, educated and dedicated officers, now well-equipped with appropriate arms. Biosearch Nyika has been pleased to support by provision of some basic field equipment. Resources such as fuel and vehicles continue to limit activity, especially at the end of the dry season, when much of their resources were this year spent in trying to extinguish the fires. The Park covers an area of some 3134 km^2. It is a valuable partnership with international teams who want to get into the wilderness and contribute positively to the scientific work, that so much more becomes possible.

ACKNOWLEDGMENTS

The voluntary work from many people has been enormous in support of this beautiful area. The expedition leaders kept their expeditions safe and on task. The project reports have been much discussed and amendments made. The process has been a long one, but worthwhile. Particular thanks to the project leaders and principal authors, and to all involved, many of whom so generously gave of their time and money to make a valuable contribution. All have just reason to be proud of their achievement.

Thanks to Andy Martin who has worked hard in collating and liaising on the reports. Thanks to Dr Dick Brummitt who felt the "recall of the Nyika" from a distance and has been tireless in his support in the preparation of vast quantities of data into a botanical species list.

GEOLOGY

Dr Mark Bilsland

INTRODUCTION

The Nyika Plateau is startling in its physical presence; a granitic rock mass rising from the shores of Lake Malawi to elevations of over 8000 ft.(2460 m) The physical and chemical properties of the granitic material clearly exert a major influence on the geomorphology, soil chemistry and hence the character, diversity and density of the flora and fauna.

During this visit to the Nyika Plateau no geological field sampling or mapping was undertaken. This section draws from field observations in as much as they might impact the overall conclusions of this study, and from a previous description of the area “The Geology of the Nyika Area” (E C Thatcher, 1974, Malawi Ministry of Agriculture and Natural Resources, Geological Survey Department).

AGE AND COMPOSITION

The rocks of the Nyika Plateau are comprised predominantly of Pre-Cambrian to Lower Palaeozoic Basement Complex with a minimum age of 1800 million years. The granitic nature of the rocks manifests itself as chemically stable, hard material that is extremely resistant to normal weathering processes.

The rock type in the Juniper Forest area was predominantly Cordierite Gneiss, essentially granitic in chemical composition, but demonstrating significant coarse mineral layering resulting in characteristic dark/light stripes in the rock.

Moving south to the area of our second basecamp, and typified by the Muchandisi Valley, the rock type is Biotite Gneiss, less chemically mature and hence more prone to weathering and soil formation.

OBSERVATIONS

Over geological time (hundreds of millions of years) moderately high rainfall and subsequent erosion has resulted in the deeply incised and soil poor character of the top of the plateau (figure a).

This characterises the area around the Juniper Forest Camp where the streams exist at the bottom of steeply incised valleys with little soil cover apart from the “dambo” areas at the head of each stream. These “dambo” areas are moist, organic rich boggy soils, but are very limited in extent. The immediate area of Juniper Forest is an anomaly in that a larger area of soil of variable organic content is preserved by the cover provided by the Juniper. This is particularly evident to the east, on the opposite side of the Uyagaiya River to our original basecamp (figure b).

Further south, particularly in the Muchandisi Valley the geomorphology is different as the increased susceptibility of the Biotite Gneiss to weathering manifests itself. This is particularly the case with the valley floors being wider and flatter (figure c), holding more sediment and soil. The soils tend to host more extensive areas of Brachystegia woodland (figure d), presumably having the potential to support more game.

The mature nature of the rock chemistry would suggest that the ground water should be mineral poor, probably most significantly impacted by the chemistry of the rainwater itself, and any subsequent exotic processes such as burning. There is unlikely to be any natural buffer to natural or induced acidity in the ground waters.

CONSERVATION IMPLICATIONS OF DIFFERENCES IN THE COMPOSITION OF THE ANT, SOIL ARTHROPOD AND BUTTERFLY FAUNAS OF THE FOREST AND GRASSLAND COMMUNITIES OF THE JUNIPER FOREST AREA, IN THE NYIKA NATIONAL PARK

C.B. Cottrell

SUMMARY

A survey of the ants, soil arthropods and butterflies of the Juniper Forest Area (JFA) of the Nyika National Park in Malawi was carried out. Sites with different levels of exposure to fire were sampled in the two major communities (grassland and evergreen forest) represented in the JFA. Preliminary results accord with the view that these two communities are very distinct and that measures to conserve the important Afromontane diversity of the Park *must* take into account their quite different sensitivities to fire. Evergreen forest communities are extremely vulnerable to fire damage. The JFA is of special conservation interest firstly because it encloses the last viable patches of Juniper Forest, and secondly because it represents the *only* completely successful implementation of a fire protection programme for a natural forest area on the whole plateau. Several types of evergreen forest, other than Juniper Forest, occur on the Nyika, but all are now represented by only a few very small patches. Carefully planned fire-protection systems are urgently needed to ensure the survival of the best remaining examples of representatives of *all* the different forest types. In contrast to the forest communities, the various grassland communities of the Nyika are relatively resistant to damage by fire. Nevertheless, the levels of fire damage that they are currently experiencing are too great to be withstood by some of their less resistant components. Burning regimes that are optimal (in terms of timing and frequency) for the preservation of grassland biodiversity need urgently to be determined and implemented in a mosaic fashion.

INTRODUCTION

On the Nyika, the transition between the Afromontane vegetation of the high plateau and the miombo woodlands that cover its lower slopes occurs at about the 6000ft (1800m) contour. The total area of 1800 km² that lies above this level is the largest montane complex in south-central Africa and constitutes an extremely important resource for the conservation of Afromontane biodiversity. Most of the high Nyika lies in Malawi but a small and important portion, delimited by the watershed between the Luangwa and Lake Malawi drainage systems and amounting to about 70 km², lies in Zambia. Both these high areas are included in National Parks of somewhat greater size.

Three broad terrestrial vegetation types occur above the 1800 m contour. More than 90% of the area is currently occupied by short montane grasslands; less than 3% by evergreen forest patches; and the remainder by boggy seepages and marshes (dambos) that lie in the hollows of the rolling topography and give rise to the streams. A number of endemic plant, vertebrate and insect species or subspecies is known from each vegetation type. This presumably indicates that these habitats have co-existed on the high Plateau for periods of time long enough to allow the evolution, within each of them, of unique endemic taxa.

The three communities may not always have occupied the proportions of the total area that they do now. Available evidence strongly supports the view that, in the absence of hot late season grassland fires at the frequency now being experienced, montane forest would be the natural climax vegetation over considerably larger areas than it now occupies. So small and fragmented are the patches of evergreen forest that exist on the Nyika at the present time that the biodiversity which they represent is in real danger of being eliminated from the plateau. After the frosts of July and August, the grasslands become extremely inflammable. When fires burning in them run up against the forest margins, they not only destroy their bracken/briar or other edges, eliminating whatever regeneration of pioneer species has occurred since the last fire, but they also seer and damage the actual forest trees, two or more meters inwards from the edges. Apart from *Parinari excelsa* (not present in the JFA) none of the evergreen forest tree species have any resistance to fire so that each peripheral searing of a forest patch creates permanent damage. Since only three or four of the forest patches on the plateau (as apart from those on its eastern escarpment, which are of a different composition), are over 50 ha in extent, frequent fires that cut a meter or two into their periphery and prevent regeneration, can be expected soon to destroy them. Once any portion is destroyed, the process of regeneration to full climax forest may take hundreds of years to achieve, and can occur only if pioneer plants and animals can find the site and further fire exposure is prevented.

All three of the main vegetation types on the Nyika occur in a number of variations. The characteristics of many of the evergreen forest communities have been described in an important paper by Dowsett-Lemaire (1985). Apart from a few scattered trees, the type known as Juniper Forest (for its most striking constituent, the conifer, *Juniperus procera*), is today represented by a very few relict patches in a small area of the south-east Nyika at altitudes of between 2135 and 2230 m. Apart from its inherent biological interest, the Juniper Forest area is of very special interest to conservationists in that it constitutes the *only* fully successful implementation of a fire-protection policy for any natural forest patch on the entire Nyika Plateau.

OBJECTIVES

Ants constitute the dominant arthropods in many ecosystems and can influence the ecology of many plants and animals, not least that of myrmecophils such as the larvae of certain lycaenid butterflies. Ants and soil arthropods appear never to have been studied on the Nyika. The aim of the work reported here was to make a preliminary survey of the ant and soil arthropod faunas of the Juniper Forest with a view to complementing Dr Donovan's termite studies. It was hoped to obtain information on:

(i) the diversity of the overall ant and soil arthropod fauna of the study area;
(ii) the extent to which the faunas of the more important habitat types within the study area differ from one another;
(iii) whether any differences that might be observed could be related to the effects of fire.

The Nyika butterfly fauna is comparatively well known and it was thought that information on the aerial adults would form an interesting contrast to the work on ants and soil arthropods. The food plants of many of the butterfly species are known and some of the species, being myrmecophilous in their early stages, interact directly with ants. Thus a listing of the species present can contribute substantially to an overall view of the ecology of an area.

SITE DESCRIPTIONS

Juniper Forest Area

The roughly rectangular Juniper Forest Area (JFA) is physically delimited by a system of firebreaks that were instituted by J.D.Chapman and have been regularly maintained since 1953. In the description that follows, the capital letters enclosed in brackets reference the sampling sites which are indexed and characterised in the next section. Regrettably it has not yet been possible to obtain a detailed map (or aerial photograph) from which to draft a sketch map to illustrate the following description.

The JFA lies in an east-west running part of the upper valley of the Uyagaiya (formerly spelt Uyaghaya) stream. Branches of this stream arise to the east and north-east in marshy areas (dambos) that are associated with minor forest patches, some containing Juniper trees. These patches are currently unprotected from fire. The stream, accompanied by a narrow but very interesting strip of riverine forest (A), enters the JFA at about the centre of its eastern boundary. The Watchman's hut and visitors' car park are located at this point.

Almost immediately after entering the JFA, the stream plunges over a series of small waterfalls (F) into a deepened valley from which the ground rises to form ridges to the north and to the south. The firebreak boundaries run along these ridges. On the north side, the breaks are at varying heights above the forest or riverine vegetation, whilst on the south side, the breaks run along the highest parts of the ridge. Enclosed within the area, and close to its eastern boundary, are two patches of unbroken Juniper Forest, neither of them greater than 9 ha in extent.

One patch, more or less triangular in shape, lies on the northern slope rising up from the stream to an apical high point (L) in the shallow valley that it occupies. Above this, and outside the firebreak, are some small forest patches, the bracken/briar edges of which (K) were observed to be burnt during the study period. The second Juniper forest patch (B), lies some distance above the stream on the southern slope, its eastern and southern boundaries coinciding with those of the JFA itself.

To the west of the second patch, and partially separated from it by grassy rocky outcrops, lies a patch of drier forest that includes some mature Juniper trees (G). Nursery-raised Juniper seedlings were planted (in the late 1950s and early 1960s) in various areas. One of these lies between the northern edge of the second patch of Juniper Forest and the vegetation along the stream; another lies to the northwest of the dry mixed forest area (H). Unfortunately, from a conservation point of view, the planting was done in an orthodox forestry manner, the trees being established in straight lines and too close together (in the absence of subsequent thinning) to allow the establishment of broad-leaved forest pioneer species between them, though a non-forest grass cover has persisted.

To the west of the dry mixed forest there is no distinct bracken/briar edge. The forest grades into fire-protected grassland that has been invaded by small trees and shrubs such as *Dodonea*, *Tecomaria* and young *Juniperus*. *Juniperus* itself does not regenerate within the mature forest. Similar fire-protected grassland lies to the west of the second planted patch.

A c. 2 m wide cleared path (O) runs from the Watchman’s hut westwards above the stream-associated vegetation on the lower part of the southern slope. It initially passes below the eastern-most area of planted Juniper, then below the rocky area, through the dry mixed forest and finally above the second Juniper planted area beyond which it meets a north-south running firebreak track in the shrub-invaded grassland. This latter track links the northern and southern firebreaks at about half their lengths and, north of the path junction, provides access to the Juniper Forest Hut (the site of the first Basecamp).

The extent to which the surroundings of the southern relict Juniper Forest patch have changed since the initiation of fire protection in 1953 and the planting of Juniper seedlings in the late 1950s and 1960s can be gauged from an important photograph (Photo 13 in Chapman and White, 1970). This is taken from high ground to the north-east of the present area and shows the riverine forest along the stream, together with the second mature Juniper forest patch and the dry mixed forest patch beyond the strip of rocky ground. These features are seen to be embedded in surrounding undifferentiated grassland without any sign of invasion by shrubs and trees and, of course, no sign of the planted Junipers that presently consolidate them into a single unit.

The firebreaks that protect the JFA consist of an approximately 2 m wide bare-earth track, with little if any topsoil, from which the vegetation is cleared annually. On its outer side, the track is flanked by a strip of burnt grassland at least 20 m wide, which is fired in July each year (C, M). In places, this regularly burnt strip is much wider than 20 m, the fire having been allowed to run to a convenient neighbouring track or road as was the case, in the present season, east of the eastern firebreak on the north slope of the valley (J).

Beyond the July-burnt strip, the surrounding typical Nyika grassland has a fire history that is unknown to me except where it had obviously been burnt earlier in the present season (J) or was actually seen burning during the study period (I).

Within the perimeter of the cleared firebreak track, an area of unburnt grassland (D), of variable width, intervenes in many places between the track and the bracken/briar (E) or other type of forest edge. Bracken/briar edges are an extremely important habitat resource for many forest animals especially diurnal lepidoptera and other flying insects, birds, and the elephant shrew *Rhynchocyon*. They also protect the moist, cool, still forest interior from desiccating wind and excessive solar radiation. This type of edge is well developed on the eastern and southern boundaries of the second forest patch but, is much less marked along the western and north-western edges of the dry mixed forest patch. There the forest tends to grade into the tree and shrub invaded grassland mentioned above. Along parts of the north-eastern and northern boundaries, the bare-earth firebreak track lies immediately against the forest edge.

Prior to the establishment of the JFA in the 1950s, fires had entered deeply into both of the mature Juniper Forest patches and many of the large growing trees are still severely damaged and distorted by deep fire scars. The trunks of fallen and felled trees lying in the two patches have been turned to charcoal to considerable depth but whether the trees were felled before or after being burnt is not known. Juniper timber from the patches was exploited by the Livingstonia Mission before and around the turn of the century and again during the second world war and in 1973-74.

Dowsett-Lemaire (1985) has estimated that, if strict fire-protection can be maintained, the JFA could eventually contain some 30 to 40 ha of Juniper forest - a pathetically small area on which to base ones hopes for the conservation of the biodiversity of one variety of the Nyika evergreen forests, but certainly better than the current two patches totalling less than 18 ha. No doubt her estimate assumes that the planted areas will develop into something resembling the composition and structure of the present relict patches but the current absence of broad-leafed regeneration in them makes this seem unlikely, except in the very long term.

Sampling site descriptions

Fifteen sites in the JFA, designated by the letters A to O, were sampled. Most sites were referable to particular vegetation types but F and O were not. For each site, the location, characteristics, and pre-sampling fire exposure (so far as this can be deduced) as well as the collecting methods used there, are outlined below.

Four collecting methods (described in the section on Materials and Methods) were used in the survey. Time did not allow all methods to be used at each site and those used at a given one are indicated using the following abbreviations:

PF - pitfall traps for 24 hours
PF2 - pitfall traps in same sites as PF for 6 days
TC - “Tulcot” funnels.
SC - selected collections.

The collecting methods actually used at the various sites are summarised under: “Results” / “Ants” / “Comparison of Ant Faunas as Represented in PF catches at different Sites” / “point (i)”.

A. *Riverine Forest*. Samples taken in the short and narrow (c. 20 m wide) strip along the stream close to the point where eastern firebreak of the JFA crosses the stream. Copious herbaceous ground vegetation growing on deeply shaded, cool, leached, damp soil, that is probably subject to occasional flooding. This section of the riverine forest strip has probably not been exposed to fire since the institution of the firebreak system but fire scars on old trees indicate that severe exposure had occurred before then. No termite mounds present. PF, PF2, TC.

B. *Mature Juniper Forest.* This site was inside the southern patch of forest and was easily accessible from the sign-posted forest walk. Forest floor fairly open, deeply shaded with mainly acanthaceous ground vegetation growing on deep, fine-textured, cool, dry, top-soil covered with litter and rich in organic matter. No termite mounds present. Fire exposure as for A. PF, PF2, TC.

C. *Annually July burnt grassland* situated on the southern slope of the eastern firebreak about 100 m from the Watchman’s hut and lying roughly in an east-west line with sites D, E, and B. Known to have been deliberately burnt annually in July as part of the Juniper Forest firebreak maintenance programme. At the time of the survey, many herbaceous plants (e.g. *Gnidia*, *Becium*) were in flower, growing on hard, sun-baked, capped, skeletal soil with very little organic matter, bare between the well spaced herbs and grass tufts. Extensive sheet erosion had removed much of the top soil leaving the herbaceous vegetation sprouting from small raised soil mounds held together by the subterranean parts of the plants. Many termite mounds present. Site separated from D by the 2 m wide firebreak track from which vegetation is cleared annually. PF, PF2, TC, SC.

D. *Unburnt grassland* situated on southern slope of eastern firebreak lying in an east-west line with sites C, E and B. No sign of recent fire and probably has never been burnt since the institution of the firebreak maintenance programme in 1953. Grass-cover moribund with much dead, very dry, herbage inhibiting fresh growth. The soil surface was more shaded than in C and showed less erosion. In strong contrast to the corresponding July-burnt site (C), very few herbaceous plants were in flower and there appeared to be fewer termite mounds. PF, PF2, TC, SC.

E*. Bracken/briar forest edge* on the east side of southern Juniper Forest patch. Shaded soil surface below shrubby vegetation was probably considerably warmer than that at B in the forest interior. Fire exposure as for A. No termite mounds present. PF, PF2

F*. Miscellaneous stream-side sites* near the centre of the eastern boundary. Individual pitfall sites very mixed in character so that their catches cannot be considered as sampling a homogeneous vegetation type but rather a series of very different micro-habitats positioned along the stream above and below the waterfalls. The five pitfalls above the waterfalls were in fairly sunny streamside sites with dry soil; those below the falls were more shaded and in very moist soil. Elements of the vegetation of sites A, B, C and D present to varying degrees. Fire exposure as for E. No termite mounds present. PF, PF2, SC.

G*. Mixed dry forest* to the north-west of the second (southern) patch of mature Juniper forest. Little acanthaceous ground cover but soil otherwise similar to that of B. Fire exposure probably as for A. No termite mounds present. PF, PF2, SC.

H. *Planted Juniper* north-west of G. This was undoubtedly grassland at the time of planting (c.40-45 y ago) and a moribund grass cover with the remains of moribund termite mounds similar to that of fire-protected grassland at sites D and N was still present between the Juniper trees. Little colonisation of the area by broad-leafed forest pioneer species had taken place. There was no indication of any exposure to fire since the time of planting. PF, PF2, SC.

I. *Very recently (September) burnt grassland* outside (i.e. to the east of) the JFA access road. This access road forms the eastern boundary of the extended patch of July-burnt grassland running from the northern half of the eastern firebreak. The site had probably not been affected by fire for several years before being severely burnt on 27 September. Pitfall trapping done, and soil for extraction taken, within 48 h of passage of fire. Soil similar to that of site C but somewhat less skeletal and eroded; covered with a layer of ash and burnt plant debris at time of sampling. Termite mounds present in small numbers. PF, TC.

J. *July-burnt grassland.* This site was at the eastern edge of the extended area of annually July burnt grassland running from the northern half of the eastern firebreak outwards to the JFA access road. It lay directly across the road (which stopped further progress westward of the 27 September fire) from site I and was sampled at same time. The soil was similar to I but bare between plants with little ash remaining. Termite mounds were present in small numbers. PF, TC.

K. *Burnt bracken/briar type forest edge* of small forest patch (not containing any Juniper trees) lying just outside and upslope of, the northern firebreak. Probably had not burnt for several years before being severely burnt on 27 September. Soil similar to that of site G but covered with a dense layer of ash at the time of sampling. Pitfall trapping done, and soil samples taken, within 48 hours of fire. No termite mounds present. PF, TC.

L. *Unburnt bracken/briar type Juniper forest edge* of the northern patch of mature Juniper forest lying just inside firebreak and with no unburnt grassland intervening between it and the cleared firebreak track that halted the 27 September fire. Within 100 m of site K and sampled at the same time. Similar to site K in that no Juniper trees were near the sampling site. No sign of any recent exposure to fire. No termite mounds. PF, TC.

M. *July-burnt grassland* situated at about the middle of the southern firebreak. Burnt annually in July as part of firebreak maintenance programme. Site of Dr Donovan's termite mound occupancy investigations made c.14-17 September which involved opening all the termite mounds in the sampling area. Samples were taken approximately 10 days later. Characteristics similar to site C. PF, SC

N. *Unburnt grassland* situated inside the cleared firebreak track at a point corresponding with site M. Not near any forest edge and grading into small tree and shrub colonised grassland. Termite mounds similarly recently opened by Dr Donovan. Characteristics similar to site D. PF.

O*. Selected samples* collected by hand from the cleared areas surrounding (a) the Watchman's hut and (b) the Juniper Forest Cabin and (c) from the length of the cleared path that extends between them as described in the previous section. Samples not referable to a particular vegetation type since the path runs alongside several types and the only common feature of the samples is that they come from areas of bare ground. Some old damaged termite mounds present. SC only.

DIARY

My arrival at the Juniper Forest to join the Expedition was on the evening of September 11. The period 12 to 17 September was spent in assisting Dr Donovan's termite transects, in making general collections of ants, and in becoming familiar with the JFA preparatory to beginning a more systematic sampling programme. After assisting the move of the main party to the second basecamp on 18 and 19 September, I returned to the Juniper Forest with Ray Murphy in order to carry out the sampling programme.

It was intended that this programme would comprise PC and TC samples from sites A to H and, if possible, M and N. However, on the evening of 26 September, a very large fire was seen in the east outside the Ushagayia Stream catchment. This fire reached the Juniper Forest Area on the 27 September and burnt along its northern and southern edges all day, continuing in some of the steep valleys outside the firebreak system on the northern slope for some hours after its front had swept westwards. By the following day, it had passed well beyond the western boundary of the JFA. This fire, while diverting my efforts from the completion of the TC soil extraction programme that had originally been envisaged, enabled an opportunistic assessment to be made of the immediate effects of a very hot late September burn on the ant and soil arthropod faunas of grasslands (sites I, J) and forest edges (sites K, L). My departure from the JFA was at noon on 1 October, Ray Murphy having departed some days before this.

MATERIALS AND METHODS

Sampling and Collecting Methods for Ants and Soil Arthropods

Pitfall traps (PF and PF2) consisted of 275 ml aluminium beer cans with their tops removed to give a trapping perimeter of 176 mm around the rim. After being set, each trap was filled with c.10 ml of dilute detergent solution. Ten traps, spaced about 3 m apart, were set in each site to be investigated and were then left in place for 24 hours. At the end of this period, the contents of the 10 traps at each site were combined for transport to camp. Fourteen sites labeled A-N were sampled in this manner (PF): only the path (O) was not. After the initial collection, the pitfalls in sites A-H were refilled and left in position for six days (PF2). In the absence of preservative, the catches from this second pitfall series were in a poor state of preservation when recovered and a few of the pitfalls had been interfered with by animals, but the results do provide a useful comparison with those from the initial 24 hour series.

***"Tulcot" funnels (TC*)** were a homemade version of Tulgren funnels that relied on sunshine to warm and dry the soil rather than electric lamps. A 12 x 12 x 12 cm bag of double thickness shade cloth was used to contain the soil sample to be extracted and, after filling, was suspended over a funnel made of clear polyethylene sheet which tapered to a collecting tube containing a small amount of dilute detergent solution. A battery of ten funnels was set up sheltered from the prevailing easterly wind, by the west-facing wall of the Watchman's hut. This site became very warm after midday. Five funnels were used to extract soil sampled from each site, the extraction time being 24 hours. The samples themselves represented small trowel-fulls of the top 10 cm of soil from about ten positions in the vicinity of the pitfall series set at that site. The individual soil samples were pooled in large plastic bags for transport to camp. At camp, large pieces of vegetable matter were removed, clods broken up and the soil mixed by hand before aliquots were loaded into the soil bags of five Tulcot funnels. In the case of sites A, B, C, D, I, J, K and L (but not E, F, G, H, M and N as had been originally intended) it was possible to back the PF samples with matching TC soil extractions.

Selected Collections (SC) were made by hand opportunistically, particularly in the period before 17 September. They proved very useful in allowing the association of the worker and soldier ant castes during subsequent sorting. At least some SC collections were made at, or near, sites C, D, F, G, H, M and O.

Winkler Bags. To provide some idea of the efficacy of the Tulcott funnels as compared to Winkler bags, a single combined sample of soil taken from the approximate vicinity of sites A, B, E and G was extracted using four borrowed Winkler bags.

In camp, arthropod material collected by these methods was sorted from debris and grouped into ants, spiders and other arthropods. These groups were then separately preserved in 70% ethyl alcohol. Separation of the ants into "morphospecies" (MS) was begun in camp and continued after return home. Prior to the start of the Expedition, an arrangement had been made for the ants to be authoritatively identified, but unforeseen circumstances prevented this, though some representative camp-sorted samples had already been dispatched. An alternative arrangement has now been made, but it will be some time before specific names are available. Arthropod material, other than ants has been partially sorted and counted.

Since this project was an initial survey intended to uncover questions of interest rather than to answer them definitively, it was thought better to sample as many habitats as possible in the time available rather than to replicate samples at the same sites. Regrettably, it was not possible to sample the soil fauna of marshy areas but none are enclosed within the JFA itself. In any follow-up project much closer attention will have to be paid to ensuring that replicated samples are taken from each of the habitat sites to be compared and that sampling intensities are standardised.

Collecting Methods for Butterflies

Butterflies seen in the JFA were visually identified where possible; alternatively they were netted or caught in traps baited with fermented bananas. The latter were operated from 24 September to 1 October after Ray Murphy had left. Representative specimens of most butterfly species were retained in paper triangles. No attempt at a quantitative recording of the fauna was made but notes were kept of the type of habitat in which the species were observed. Two brief visits were made to a marshy area (dambo) to the south east of the Juniper Forest area and records of the three species taken there are included here.

Analysis

It has not yet been possible to reprocess the representative samples of ants sent overseas for identification so that the figures for the numbers of individuals representing the different ant MS tabulated here are provisional. For this reason, no analysis, apart from some comments based on a visual examination of the table of provisional figures, will be presented. Since no replication of samples at the same sites was attempted, conclusions based on statistical probabilities are, in any case, not possible. No attempt will be made to discuss other soil arthropods since to date only a preliminary sorting, in camp, of some samples has been done. No bar graphs of numbers of species and individuals obtained at each site have been provided since these raw numbers are best considered in the light of the contents of the body of Table 1 rather than in isolation.

RESULTS

Ants

Composition of JFA Ant Fauna

Thirty one ant MS were recognised in the material from the JFA; a further three were collected during a brief visit to the second basecamp, but these will not be covered in this report.

At the time of writing, only morphospecies number one (MS1), one of the commonest grassland ants in the area, has received expert examination. It is thought to be "an undescribed species of *Tetramorium* in the *T.setigerum* group and closely related to *T. perlongum* and *T. dolichosum*, but not a convincing match for either" (Bolton, personal communication, 1 December 1999)

A very preliminary examination of the 31 ant MS recognised suggests the following subfamily composition and indicates some of the genera probably represented:

DORYLINAE - 1 MS of genus *Dorylus*;
FORMICINAE - 11 MS including members of the genera *Camponotus* and *Lepesiota*;
MYRMICINAE - 17 MS including members of the genera *Crematogaster, Meranoplus, Pheidole*, *Smithistruma*, *Strumigenys*, and *Tetramorium*;
PONERINAE - 2 MS

Comparison of Ant Trapping and Collecting Methods

(Note: PF as used in this section includes both PF and PF2)

Of the 31 ant MS recorded in the JFA, 30 (97%) were taken on at least one occasion by PF; 13 (45%) by TC; and 16 (52%) by SC. Of the MS taken on at least one occasion by PF, 5 (16%) were also taken by TC as well as SC; 7 (23%) only by TC; 11 (35%) only by SC; and 7 (23%) by no other method.

Of the 12 MS taken by both PF and TC, PF was unequivocally more efficient (in terms of the number of specimens caught) for three of the MS; TC is equally convincingly more effective for another three MS while for six MS the numbers caught by the two methods are similar and rather too low to decide on their relative efficiencies.

The single MS (MS48) that was collected only by TC was actually taken on only one occasion.

The second pitfall series in which the traps were left in place at sites A-H for six days collected much the same set of common MS as they had on the first occasion but at a diminished daily rate. They also captured 9 additional MS spread over 11 sites. All of these additional MS were in small numbers.

Comparison of Ant Faunas as Represented in PF Catches at different Sites

Provisional figures for the number of individuals taken by PF in the first 24 h series at the various sites are given in Table 1. Where a species was not taken by the initial PF series, but is known to occur at the site as the result of being collected later or by some other method (i.e. PF2, TC or SC) a letter indicating the method, rather than a zero, has been entered. This has enabled overall figures for the number of MS taken by PF as well as for the number of MS taken by *all* methods to be given for each site. The total number of individual ants taken by PF is also listed.

Table 1: Numbers of individuals of different morphospecies (MS) of ants captured at sampling sites over a 24 hour trapping period, using ten pitfall traps per site.

Where no individual of a given MS was captured but that MS is known to be present at the site as the result of captures made using other methods, the method involved is indicated by the abbreviations: PF(= 6 day pitfall series), TC(= Tulcot funnels) and SC(= Selective Collections). Letters A-N (and O) designate the sampling sites as defined in the Site Descriptions section. O was a path sampled only by SC.
For Grassland and Forest Edge (bracken/briar) sites, u = unburnt; b7 = July burnt; b9 = September burnt; for Forest sites, p = planted; d = dry, mixed; m = mature; r = riverine.
PF MS = number of MS taken by 24 h PF series at site; All MS = all MS taken at site; PF Ind = number of individual ants taken by 24 h PF series at site.

Morpho-Species (MS)	Path	Grassland						Forest Edge			Forest				Stream-side
		U	u	U	b7	b7	b9	u	u	B9	p	d	M	r	
	O	M	C	J	N	D	I	E	L	K	H	G	B	A	F
1	0	SC	525	124	0	94	50	16	0	0	0	0	0	0	0
2	SC	86	161	0	64	62	0	113	150	5	29	2	0	22	291
3	SC	43	56	0	4	0	0	0	0	0	0	0	0	0	0
4	SC	16	9	51	6	16	91	137	4	1	5	0	0	0	1
5	0	2	53	0	0	0	0	0	0	0	0	0	0	0	0
6	0	1	2	1	0	0	4	0	0	0	0	0	TC	0	0
8	0	1	PF	5	2	PF	7	6	0	4	13	1	0	0	6
11	SC	3	6	0	8	16	0	8	23	0	0	0	6	0	PF
12	0	9	PF	0	0	0	0	0	0	0	0	0	0	0	0
13	0	4	14	1	1	1	0	2	2	0	1	0	PF	0	0
14	0	0	0	0	0	0	0	PF	0	0	0	3	1	PF	0
15	SC	SC	0	11	0	9	15	0	34	9	0	2	1	0	0
16	0	0	0	0	0	0	0	0	0	0	0	PFSC	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	468	PFSC
18	0	TC	TC	4	0	3	2	0	0	TC	0	0	0	0	0
20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
21	0	1	TC	0	0	1	0	0	TC	0	0	5	TC	1	4
22	0	0	0	0	0	0	1	0	TC	0	0	0	TC	0	1
24	0	0	0	0	4	0	0	0	0	TC	0	12	TC	PF	0
25	SC	SC	0	148	0	0	5	0	0	0	3	0	0	PF	SC
26	0	0	0	0	0	0	0	0	TC	TC	1	0	TC	TC	0
27	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
28	0	2	1	0	11	0	9	0	0	0	1	0	0	0	0
34	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	TC	0	0	0	0	0	0	0	0	0	0	0
49	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
54	SC	57	0	4	0	0	3	0	0	0	0	0	0	0	0
56	SC	1	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	1	2	TC	0	TC	0	3	0	0	PF	0	PF	0	0
59	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PF MS	-	15	11	10	8	9	11	7	6	4	7	6	3	3	5
All MS	8	19	15	12	8	11	11	8	9	7	8	7	10	7	8
PF ind	-	238	830	351	100	203	188	285	214	19	53	25	8	491	303

In examining Table 1 the following points should be noted:

(i) the sampling intensities leading to the totals for all MS found at the sites are not all comparable. Those which are comparable are indicated below:

CD	based on PF, PF2, TC, SC
AB	based on PF, PF2, TC, -
FGH	based on PF, PF2, - , SC
E	based on PF, PF2, - , -
IJKL	based on PF, - , TC, SC
M	based on PF, - , - , SC
N	based on PF, - , - , -

(ii) MS17 (present at sites A and F) is an army ant (*Dorylus*) which, though it may be continually on the move in the rainy season, habitually concentrates in moist environments during the dry season. Although five other MS were recorded at A the presence of this predator in high numbers could have distorted the figures for other ant MS;

(iii) the streamside (F) pitfalls do not constitute a sample from a single habitat but rather represent a combination of catches from a series of very different microhabitats close to the stream. (No unique species were present and MS2 was abundant adjacent to cleared ground above the waterfall: MS17 was also taken there);

(iv) the MS tabulated under O were obtained only by SC and do not constitute a sample from any particular habitat, their only common feature being that they were collected from the bare ground of the path and the cleared areas around the Watchman's hut and the Juniper Forest Cabin;

Table 1 suggests the following very provisional conclusions for discussion and, if possible in the future, further investigation:

1. There are broad differences in the kinds of ant MS present, and the numbers of individuals that represent them, between the grassland and the Juniper forest ant faunas. Ant MS that may be found to be characteristic of, and numerous in, grassland (sites C, D, I, J, M and N) include MS1, MS3, MS4, MS8, MS11, MS15 and possibly MS5, MS13, and MS25: those that may be found characteristic of Juniper forest (G and B) include MS21, MS22, MS24, MS26 and probably MS14. These groups of species tend to overlap in the forest edge (bracken/briar) sites (E, L, K) where their habitats meet.

   The grassland group of ant MS tended to be taken in large numbers by PF whereas the forest MS did not. Indeed, the TC symbols shown in Table 1 for the MS of the forest group suggest that they require the rich top soil of the forest environment. These forest ants presumably tend to be slow-moving specialist food gathers rather than general surface scavengers that run over the soil surface and are tolerant of hard, baked soil surfaces.

2. The July-burnt grassland sites M, C, and J tended to produce more MS (totals of 19, 15, and 12) and higher totals of individual ants (238, 830 and 351) than did other sites.

3. In the case of the paired July-burnt/unburnt grassland sites (M/N and C/D), fewer species (8 and 11) and fewer individuals (100 and 203) were obtained in the unburnt (N and D) sites than in the burnt sites.

4. A comparison of the PF catches in grassland areas C and D with those from M and N (the latter being the corresponding sites in Dr Donovan's termite mound study area) suggests that while the destruction of termite mounds 12-14 days earlier may have somewhat reduced numbers of ant individuals and perhaps had a specific effect on MS1, the ant communities remained largely intact.

5. Unburnt bracken/briar type forest edge sites (E, L) produced a similar number of species (8 and 9) to the unburnt grassland (D,N) but rather more individuals (285 and 214).

6. The effect of sampling within 48 hours of the passage of a hot September fire is suggested by the catches from the paired sites J/I, for grassland, and L/K, for forest edge. While the number of species obtained in the unaffected site of each pair was only slightly higher than in the affected one (J/I=12/11, L/K=9/7) the number of individuals taken in the fire-affected plots was lowered by 50% in grassland and by 90% at the forest margin (J/I=351/188, L/K=214/19).

7. The planted Juniper site (H, MS=8 individuals=53) is not unlike unburnt grassland or bracken/briar forest edge, though clearly somewhat impoverished.

Butterflies

Sixty-seven species of butterflies were recorded in the JFA during the observation period. Five of these species do not appear in the lists of Nyika butterflies published by Johnson (1990) and Murphy (1999). There is no reason to suppose that any of these five species is peculiar either to the plateau as a whole or to the Juniper Forest in particular. One of them *(Neptis a. aurivillii*) is, however, an Afromontane forest endemic.

In the regularly July burnt grassland of the JFA firebreaks and adjacent burnt areas, an interesting assemblage of four species with wing patterns suggesting crypsis for burnt ground was observed. These were:

LYCAENIDA
Aloeides griseus
Euchrysops unigemmata
Actizeeria stellata

HESPERIIDAE
Platylesches langa

To the extent that the first three spring-flying insects are peculiar to the Afromontane regions of which the Nyika forms a part, their cryptic patterns support the view that some area of grassland subject to annual burning has existed on the Nyika (or at least in other Afromontane localities) for periods of time long enough to have allowed this crypsis to evolve.

Since this study is primarily concerned with ants, records of three myrmecophilous LYCAENIDAE were also of interest namely:
Spindasis mozambica - probable host ant a *Crematogaster*
Aloeides griseus - probable host ant a *Lepesiota*
Lepidochrysops nyika - probable host ant a *Camponotus*

Species of ants of these genera were undoubtedly included in the MS recovered from the JFA burnt and unburnt grasslands and forest edges.

The male and a female of *Lepidochrysops nyika* that were captured in burnt grassland are of some interest. This species is a Nyika endemic that was discovered by myself on the Zambian part of the Plateau in the 1950s and was described by Tite from the only two males then known. I am not aware of any subsequent records and the female seems never to have been described.

A listing of all the butterflies recorded by myself in the JFA and an adjacent marshy area is given in Table 2.

GENERAL OBSERVATIONS

The 27 September fire at the JFA

Fires on the Nyika plateau before and during the present visit were all too common and the significance of the fire that occurred on 27 September is not that it arrived at the area, passed it and burnt itself out somewhere far to the south-west, but that it tested the fire protection system of the JFA. This system kept the JFA safe without any active human intervention. In this way, the fire provided a most impressive demonstration of the usefulness of the protection system as well as of the wisdom of the Park authorities in maintaining a system originally put in place by professional foresters.

The State of the Western Nyika

Travelling to and from the JFA, the severe fire damage done in recent years to the important evergreen forest patches and their surroundings in the Zambian National Park and in the western part of the Malawi National Park was all too apparent from the road. The present condition of the area contrasted most unfavorably with my last views of it in the 1960s. At this time the condition of these patches had considerably improved following the institution of fire protection measures in the 1950s. The beginnings of regeneration then gained appear now to have been lost.

Game

By comparison with the situation that I saw on the Nyika in the late 1950s and early 1960s, present numbers of game animals are extremely low. A few Eland, Roan, Reedbuck and Warthog near Chelinda, and single Bushbuck and Roan near the JFA, were the sum total of game animals that I saw on the Expedition. Crawshay's Zebra was not seen at all. Clearly, current levels of poaching are a major area of concern. In the absence of any grazing by large ungulates, grassland fires are even more severe than they need be.

DISCUSSION

Differences between the Faunas of Grassland and Forest

The survey suggests that there are, as might be expected from such distinct habitat types, broad differences between the kinds of ant MS present and the numbers of individuals representing them in grassland and Juniper forest. The number of individuals taken in the different habitats shows a general decline corresponding to the degree of shadiness at ground level in the sampled sites. Since the degree of shade will affect ground level temperatures, ant activity, and hence their likelihood of capture by PF, could well be differentially affected. However, this cannot be a complete explanation of the recorded results since the catches in the bracken/briar forest edges were relatively high. Furthermore the difference in catches of ant MS by PF and TC in the two broad vegetation types, suggests important differences in their biology. The preliminary sorting of other arthropods that was carried out in camp gave a strong impression of the presence of a rich cryptozoic fauna in the forest soil litter that probably contains several taxa that are not represented, even at the ordinal level, in grassland.

As has long been known, the butterfly fauna of the Nyika is very clearly divided into groups of species that are associated with forest, grassland and marshland. Those associated with forest fall into two subgroups according to whether they usually fly and carry out their adult activities within the forest below its canopy, or above the canopy and along the bracken/briar edges. These behaviour patterns are related to the requirements of their specific larval food plants. Table 2 reflects these groupings.

The indications given by the survey strengthen the concept that in attempting to conserve the biodiversity of the Nyika National Parks the requirements of three quite distinctive communities must be taken separately into account. Accordingly, the far greater sensitivity to fire damage shown by the very endangered evergreen forest must be given priority consideration in any overall management plan for the area.

Response to Fire in Grassland Ants and Butterflies

The fact that the largest catches of individual ants and highest numbers of ant species were obtained in July-burnt grassland and that these were reduced in the grassland sites that had remained unburnt for perhaps 40 years, together with the rather minor impact of the September fire suggests that the grassland ant fauna of the Nyika is rather well adapted to surviving fire and, like the many spring flowering herbaceous plants of this habitat, may actually need some level of fire exposure to maintain full vigour. That burning every year will, in the long run, prove deleterious to the grassland fauna and flora is, however, evident from the sheet eroded and topsoil deficient conditions at sites C and M.

Moreover, there are other important components of the grassland (e.g. *Protea* species, the food plants of the endemic *Capys* butterfly taxon) that have been eliminated in the annually burnt strip. Probably most of the Nyika grassland is currently being burnt too frequently and it is important that the most desirable burning frequencies be investigated.

Comparison of the ant samples from regularly July-burnt grassland sites with those from unburnt grassland sites suggests that though the latter have fewer individuals overall, their ant communities are less dominated by very large numbers of one or two species. This absence of dominance by one or a few MS may well represent the more desirable condition from a conservation point of view. As has been noted under General Observations, there is currently, an almost complete absence of large grazing ungulates in the JFA. This results in the entire annual growth of the grassland becoming frosted in July and then persisting as a highly inflammable mass for the rest of the season.

Comparison of the grassland sample taken immediately after the passage of the September fire (J) with the adjacent sample from July-burnt grassland (I) suggests that the grassland ant community is little affected even by the passage of a very hot fire. However it is important to note that not all the components of the grassland community are so well protected. Some of the Nyika grassland butterflies have subterranean pupation sites (in the case of myrmecophilous species the sites are actually within the nests of their host ants) and this habit is obviously of value in surviving fires. Grassland species that pupate above ground or at the soil surface, such as many hesperiids and satirids, are in contrast, only able to survive from season to season in patches of grassland that remain unburnt between the times when the eggs are laid and the adults emerge. This is true, for instance, of the endemic Nyika species (or subspecies?) of *Capys* . Since it pupates in the buds of its host *Protea* and flies in spring, it can survive only in areas where the *Protea* bushes are not burnt in that season. This emphasizes the concept that in any management burning programme, a mosaic of relatively small area burns made at different times should be used.

Ant MS49 is a *Crematogaster* that builds an arboreal carton nest. A thriving colony occupying a large nest was found in a shrub in the fire-protected, shrub-invaded grassland near the forest margin to the west of the dry mixed forest patch. The only other collection was by PF in the unburnt grassland at site M. This may well be an ant that is particularly sensitive to fire.

Role of Termite Mounds in Survival of Grassland Ant Communities

The nests of grassland ants of many species are frequently discovered in the termite mounds that characterise the Nyika grasslands. However, the samples from sites M and N show that these refuges are not essential to the ants' survival. Whether this would be the case if the nests were destroyed immediately before a hot burn cannot be judged from present results.

Response to Fire in Bracken/Briar Forest Edge Ant and Butterfly Communities

The results from sites L and K suggest that fire is much more serious for forest edge ant communities than it is for grassland ones, as indeed it is for the forests themselves. This is undoubtedly also the case for forest edge butterflies whose larvae and pupae are found on the aerial parts of forest edge plants.

The Long Period Required for Forest Regeneration

The soil arthropod fauna and the soil under Juniper trees that were planted some 40 years ago (site H) is closer in character to those of the grassland that existed before planting took place than they are to those of mature Juniper forest. This confirms that very long periods of time are necessary to achieve the full regeneration of mature forest since, in Juniper, we are dealing with a relatively fast growing species that in fact regenerates only on forest edges and to that extent may be considered a pioneer.

Immediately Required Conservation Actions

The provisional results of the survey reported here tend to support the view that in attempting to conserve the Afromontane biodiversity of the Nyika the very different requirements of three main vegetation types must be borne in mind. Of the three, the evergreen forest types are in the most urgent need of protection. These forest communities are at least as highly threatened by fire as are the large ungulate species by poachers. Herds of game given adequate protection, can be built up in a matter of years, whereas the recovery of forest requires a time scale of a different order. Once the endemic forest taxa have been lost, they can never be recovered. This is not a new conclusion but one that has been reached by almost every serious observer of the Nyika environment.

Because of the enormous asymmetry between the extreme rapidity with which forest can be destroyed by fire and the great lengths of time that are required for its regeneration, it is vital that the few forest patches surviving on the Nyika be accorded immediate rigorous fire protection in order to preserve their biodiversity. Firebreak systems along the lines of that protecting the JFA need to be designed to enclose not just the surviving patches of forest but also any areas between them that show the least signs of having once been forest and of still possessing any remnant of the original forest top soil. Such areas can fairly readily be recognised by their vegetation and by the presence of isolated forest trees. Dowsett-Lemaire (1985) has mapped their distributions around existing forest patches in a valley in the Zovochipolo area of the western part of the Malawi Nyika and for the main forests (Chowo, Manyenjere and Kasoma) of the Zambian part. The creation of such maps should be considered as a priority exercise before designing and creating the systems of firebreaks and plans for mosaics of early burnt patches that must be the basis of any fire management plan. Obviously, serious consideration must be given to optimising the effort through careful selection of the biologically most important of the relict patches and their surroundings. It is to be noted that protection of forest areas together with the bracken/briar and shrub invaded grassland surrounding them will also provide temporary refuges for the less fire tolerant components of grassland and so will give much needed time in which to carry out the task of determining optimum fire regimes for grassland maintenance.

The well designed fire protection afforded the Juniper Forest Area is a unique success story which deserves to be much more widely known and appreciated. The Nyika National Park authorities deserve to be congratulated for maintaining the required degree of protection through a most difficult period. One would like, however, to see funding and resources available for a second firebreak system surrounding the entire upper Uyagaia catchment so as to protect its stream sources. This should be accompanied by vigorous efforts to develop and maintain comparable protective systems for the important (and more biologically diverse) forests of the western and southern Nyika (Chisanga Falls, Kasaula, Zovochipolo and Nkonjera in Malawi and Chowo, Manyenjere and Kasoma in Zambia). The very diverse and important *Ocotea-Ficalhoa* forests of the Eastern escarpment (Mwenewembwe, Kasaramba-Vitumbi and Nyankowa), present a somewhat different conservation problem in that it is their lowermost slopes that are currently in need of protection from destruction. Their conservation must also be given high priority.

Just as management plans for conserving the biodiversity of the Nyika will need to take into account the differences between the different types of evergreen forest represented there, so also will they need to take account of the currently little explored differences between the different grassland types.

ACKNOWLEDGEMENTS AND THANKS

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I wish to thank Melissa Dice (Expeditions Manager of SES) for her efforts to obtain the Foreign Office sponsorship that gave me the opportunity to join the expedition; my wife Meriol, for a great deal of help in the preparation of Tulcot funnels and other collecting and camping equipment; Ray Murphy for good companionship and hospitality on the homeward journey; Dr Sarah Donovan for much useful e-mail discussion and advice before, during and after the expedition, as well as for the use of four Winkler bags and a field microscope on the expedition; and the Leader and Deputy Leader of the expedition for allowing me to remain at the Juniper Forest with Ray Murphy when the rest of the group moved to the second basecamp. Dr B. Bolton kindly examined and commented on ant morphospecies number one. Marianne Overton (Biosearch Nyika) offered useful suggestions for the improvement of the draft of this report.

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Table 2. List of Butterfly species recorded in the Juniper Forest Area by C.B.Cottrell.

Key to Habitat and other Symbols
F = within Forest;
E = bracken/briar or shrub-invaded grassland forest Edge or opening such as a path through the forest;
G = Grassland;
D = Dambo/marsh.

* = apparently New record for Nyika.

HESPERIODEA		
HESPERIIDAE		
PYRGINAE	*Eretis djaelaelae* (Wallengren, 1857)	E
	Erestis. melania (Mabille, 1891)	E
	Spialia spio (Linnaeus, 1764)	G
HESPERIINAE	*Kedestes wallengrenii fenestratus* (Butler, 1894)	G
	Acleros mackenii (Trimen, 1868)	F
	Gorgyra johnstoni (Butler, 1894)	E
	Platylesches langa (Evans, 1937) [previously listed as *P. ayers*]	G
	Zenonia zeno (Trimen, 1864)	E
	Gegenes niso brevicornis (Plotz, 1884)	G
PAPILIONOIDEA		
PAPILIONIDAE	*Papilio demodocus demodocus* (Esper, [1798])	E,G
	Papilio jacksoni nyika (Cottrell, 1963)	F
	Papilio mackinnoni isokae (Hancock, 1984)	F
	Papilio thuraui cyclopis (Rothschild & Jordan, 1903)	E,F
	Graphium angolanus angolanus (Goeze, 1779)	G
PIERIDAE		
COLIADINAE	*Catopsilia florella* (Fabricius, 1775)	G
	Colias electo hecate (Strecker, 1900)	G
	Eurema brigitta brigitta (Stoll, [1780])	G
	Eurema mandarinula (Holland, 1892)	F

PIERINAE	*Belenois creona severina* (Stoll, [1781])	G
	Mylothris agathina agathina (Cramer, [1779])	E
	*Mylothris crawshayi crawshay*i (Butler, 1896)	F
	Mylothris ruepellii rhodesiana (Riley, 1921)	E
	Mylothris sagala dentatus (Butler, 1896)	F
NYMPHALIDAE		
ACRAEINAE	*Acraea goetzei* (Thurau, 1903)	E
	Acraea caldarena caldarena (Hewitson, 1877)	G *
DANAINAE	*Danaus chrysippus aegyptius* (Schreber, 1759)	G
SATYRINAE		
ELYMNIINI	*Aphysoneura pigmentaria obnubila* (Riley, 1923)	F
	Henotesia ubenica ubenica (Thurau, 1903)	E
ARGYNNINAE	*Issoria smaragdifera smaragdifera* (Butler, 1859)	E, M
NYMPHALINAE	*Salamis anacardii nebulosa* (Trimen, 1881)	E
	Junonia octavia sesamus (Trimen, 1883)	G
	Junonia orithyia madagascarensis (Guenee, 1865)	G
	Cynthia cardui (Linnaeus, 1758)	G
	Antanartia schaeneia dubia (Howarth, 1966)	F
	Byblia ilithyia (Drury, [1773])	G
	Neptis aurivillii aurivillii (Schultze, 1913)	F *
	N. incongrua incongrua (Butler, 1896)	F
	N. laeta (Overlaet, 1955)	E
CHARAXINAE	*Charaxes ameliae amelina* (Joicey & Talbot, 1925)	F *
	Charaxes ansorgei levicki (Poulton, 1933)	F
	Charaxes aubyni australis (Van Someren & Jackson, 1957)	F
	Charaxes baumanni whytei (Butler, 1894)	F
	Charaxes druceanus proximans (Joicey & Talbot, 1922)	F
	Charaxes fionae Henning, 1977	F
	Charaxes guderiana guderiana (Dewitz, 1879)	F(woodland)
	Charaxes macclouni (Butler, 1895)	F
	Charaxes *pollux geminus* (Rothschild, 1900)	F
LYCAENIDAE		
THECLINAE		
APHNAEINI	*Spindasis mozambica* (Bertolini, 1850)	G
	Axiocerces bambana (Grose-Smith, 1900)	E
	Aloeides griseus (Riley, 1921)	G
	Capys disjunctis connexivus (Butler, 1897) [previously listed as *C. connexivus connexivus*]	G
	Cupidopsis cissus (Godart, [1824])	G
	Lampides boeticus (Linnaeus, 1767)	G
	Uranothauma crawshayi (Butler, 1895)	F,E
	Cacyreus virilis (Stempffer, 1936)	E
	Cacyreus palemon (Stoll, [1782])	D
	Harpendyreus juno (Butler, 1897)	D
	Zizeeria knysna (Trimen, 1883)	G
	Actizera lucida (Trimen, 1883)	G *
	Actizera stellata (Trimen, 1883)	G
	Zizula hylax (Fabricius, 1775)	G,E *
	Eicochrysops messapus mahalakoena (Wallengren, 1875)	G
	Eicochrysops malathana (Boisduval, 1833)	G
	Eicochrysops subpallida (Bethune-Baker, 1923)	G
	Eicochrysops unigemmata (Butler, 1895)	G
	Lepidochrysops nyika (Tite, 1961)	G
	Leptotes pirithous pirithous (Linnaeus, 1767)	E

COMPLETE SPECIES LIST OF INVERTEBRATES IN THE NYIKA NATIONAL PARK

Ray Murphy

RHOPALOCERA (BUTTERFLIES)

E = endemic to Nyika
1999-1 July expedition 1999-2 September expedition
Date on the right is the date first recorded in the Park by R. J. Murphy or C. B. Cottrell.

Superfamily HESPERIOIDEA

Family HESPERIIDAE

Abantis paradisea (Butler) 1870
Abantis zambisiaca (Westwood) 1874
Aceda biseriatus Mabille 1898
Acleros mackenii (Trimen) 1868
Ampittia capenas capenas (Hewitson) 1863
Artitropa reducta Aurivillius 1925
Borbo borbonica borbonica (Boisduval) 1833
Borbo fallax (Gaede) 1916
Borbo gemella (Mabille) 1884
Borbo micans (Holland) 1896
Borbo perobscura (Druce) 1912
Borbo sirena (Evans) 1937
Calleagris hollandii (Butler) 1897
Calleagris jamesoni jamesoni (Sharpe) 1890
Celaenorrhinus handmanii Berger
Celaetioffhinus galenus (Fabricius) 1793
Celaetiorrhinus zanqua Evans 1937
Chondrolepis telisignata (Butler) 1896
Coeliades forestan (Stoll) 1872
Coeliades pisistratus Fabricius 1793
Eagris sabadius ochreana Lathy 1901
Eretis djaelaelae (Wallengren) 1857
Eretis melania Mabille 1891
Gegenes niso brevicornis (Plötz) 1884
Gorgyra bibulus Riley 1929
Gorgyra johnstoni (Butler) 1894
Kedestris callicles Hewitson 1868
Kedestris limalina Evans 1956
Kedestris barberae barberae (Trimen) 1873
Kedestris brunneostriga (Plötz) 1884
Kedestris wallengrenii fenestratus (Butler) 1894
Metisella decipiens (Butler) 1896
Metisella forrnosus formosus (Butler) 1894
Metiselia media nyika Evans 1837
Metiselia orientalis orientalis (Aurivillius) 1925
Metisella perexcellens perexcellens (Butler) 1896 E
Metisella quadrisignatus quadrisignatus (Butler) 1894
Parosmodes morantii morantii (Trimen) 1873
Platylesches ayresii Trimen 1889
Platylesches lamba Neave 1910
Platylesches picanini (Holland) 1894
Platylesches rasta rasta Evans 1937
Platylesches robustus robustus Neave 1910
Sarangesa arela (Mabille) 1891

	Sarangesa astrigera Butler 1893	
	Sarangesa lucidella lucidella Mabille 1891	
	Semelea pulvina (Plötz) 1879	
	Spialia depauperata depauperata (Strand) 1911	1999-2
	Spialia dromus (Plötz) 1884	1999-1
	Spialia spio (Linnaeus) 1764	
	Teniorhinus harona Westwood 1881	
	Zenonia zeno (Trimen) 1864	

Superfamily PAPILIONOIDEA

Family Papilionidae	*Papilio dardanus tibullus* Kirby 1880	
	Papilio pelodurus vesper Le Cerf 1924	
	Papilio mackinnoni isokae Hancock 1984	
	Papilio thuraui cyclopis Rothschild & Jordan 1903	
	Papilio nireus lyaeus Doubleday 1845	
	Papilio phorcas nyikanus Rothschild & Jordan 1903	
	Papilio ophidicephalus mkuwadzi Gifford 1961	
	Papilio demodocus demodocus Esper 1798	
	Papilio jacksoni nyika Cottrell 1963	
	Graphium angolanus angolanus (Goeze) 1779	
	Graphium leonidas leonidas (Fabricius) 1793	
Family Pieridae	*Appias sabina phoebe* (Butler) 1901	
	Belenois aurota aurota (Fabricius) 1793	
	Belenois creona severina (Stoll) 1 781	
	Belenois rubrosignata kongwana Talbot 1943	
	Belenois thysa thysa (Hopffer) 1855	
	Belenois zochalia agrippinides (Holland) 1896	
	Catopsilia florella (Fabricius) 1775	
	Colias electo hecate Strecker 1900	
	Colotis antevippe gavisa (Wallengren) 1 857	
	Colotis dissociatus (Butler) 1897	
	Colotis eris eris (Klug) l829	
	Colotis euippe omphale (Godart) 1819	
	Colotis evenina casta (Gerstaecker) 1871	
	Colotis regina Trimen 1863	1999-1
	Eurema brigitta brigitta (Stoll) 1780	
	Eurema desjardinsii marshalli Butler 1898	
	Eurema hecabe solifera (Butler) 1875	
	Eurema mandarinula (Holland) 1892	
	Mylothris agathina agathina (Cramer) 1779	
	Mylothtis crawhayi crawshayi Butler 1896	
	Mylothris rueppellii rhodesiana Riley 1921	
	Mylothris sagala dentatus Butler 1896	
	Nepheronia thalassina sinalata (Suffert) 1904	
	Nepheromia argia mhondana (Suffert) 1904	
	Pinacopteryx eriphia eriphia (Godart) 1819	

Superfamily NYMPRALOIDEA

Family Nymphalidae

Subfamily Charaxinae	*Charaxes achaemenes achaemenes* Felder & Felder 1867	
	Charaxes guderiana guderiana (Dewitz) 1879	
	Charexes brutus natalensis (Straudinger) 1885	
	Charaxes ansorgei levicki Poulton 1933	
	Charaxes pollux geminus Rothschild 1900	

	Charaxes druceanus proximans Joicey & Talbot 1922	
	Charaxes macclounii Butler 1895	
	Charaxes baumanni whytei Butler 1894	
	Charaxes aubyni australis Van Someren & Jackson 1957	
	Charaxes nyikensis Van Someren 1975	
	Charaxes violetta melloni Fox 1963	
	Charaxes xiphares eudovici Rousseau-Decelle 1933	
	Charaxes bohemani Felder & Felder 1859	
	Charaxes varanes vologeses (Mabille) 1876	
	Charaxes acumimatus nyika Van Someren 1963	
	Charaxes canidope canidope Godart 1824	
	Charaxes dilutus veneris White & Grant 1989	
	Charaxes dowsetti Henning 1989	
	Charaxes castor flavifaciatus Butler 1895	
	Charaxes fione Henning 1977	
	Charaxes nichetes leoninus Butler 1895	
	Charaxes protoclea azota (Hewitson) 1877	
	Charaxes ameliae amelina Joicey & Talbot 1925	1999-2(Cottrell)
Subfamily Limenitinae	*Bebearia orientis orientis* (Karsch) 1895	
	Byblia anvatara acheloia (Wallengren) 1857	
	Crenidomimus concordia (Hopffer) 1855	
	Cymothoe cottrelli Rydon 1980	
	Cyrestis camillus sublineata Lathy 1901	
	Euphaedra crawshayi Butler 1895	
	Eurytella dryope angulata Aurivillius 1898	
	Eurytella hyarbas lita Rothschild & Jordan 1903	
	Hamanumida daedalus (Fabricius) 1775	
	Harma theobene blassi (Weymer) 1892	
	Neptis aurivillii Schultze 1930	1999-2(Cottrell)
	Neptis incongrua incongrua Butler 1896	
	Neptis laeta Overiaet 1955	
	Neptis melicerta (Drury) 1773	
	Pseudacraea deludens murphyi Hecq 1991	
	Pseudacraea lucretia expansa Butler) 1878	
	Pseudargynnis hegemone (Godart) 1819	
	Sallya amulia rosa (Hewitson) 1877	
	Sallya boisduvali boisduvali (Wallengren) 1857	
	Sallya garega (Karsch) 1892	
	Sallya moranti moranti (Trimen) 1881	
Subfamily Nymphalinae	*Antanartia dimorphica dimorphica* Howarth 1966	
	Antanartia schaeneia dubia Howarth 1966	
	Cynthia cardui (Linnaeus) 1758	
	Junonia antilope (Feisthamel) 1850	
	Junonia archesia (Cramer) 1779	
	Junonia artaxia Hewitson 1864	
	Junonia cuama Hewitson 1864	
	Junonia hierta cebrene Trimen 1870	
	Junonia natalica (Felder) 1860	
	Junonia octavia desamus (Trimen) 1883	
	Junonia orithya orithya (Linnaeus) 1758	
	Junonia terea elgiva Hewitson 1864	
	Junonia touhilimasa Vuillot 1892	
	Junonia tugela aurorima Butler 1894	
	Salamis anacardii nebulosa Trimen 1881	
	Salamis parhassus (Drury) 1782	
Subfamily Argynminae	*Issoria smaragdifera smaragdifera* (Butler) 1895	

	Lachnoptera ayresii Trimen 1879	
	Phalantha ethiopica Rothchild & Jordan 1903	
Subfamily Acraeinae		
ACREA GROUP	*Acraea aganice nicega* (Suffert) 1904	
	Acraea scalivittata Butler 1896	
	Acraea epaea melina (Thurau) 1903	
	Acraea leucopyga Aufivillius 1904	
ACTINOTE GROUP	*Acraea pharsalus pharsaloides* Holland 1892	
	Acraea anacreon bomba Grose-Smith 1889	
	Acraea eponina (Cramer) 1780	
	Acraea venture vetura Hewitson 1877	
	Acraea goetzei Thuron 1903	
	Acraea acuta Howarth 1969	
	Acraea johnstoni johnstoni Godman 1885	
	Acraea caecilia pudora Aurivillius 1910	
	Acraea pudorella detecta Neave 1910	
	Acraea periphanes Oberthür 1893	
	Acraea insignis insignis Distant 1880	
	Acraea calderena calderena Hewitson 1877	1999-2
	Hyalites (Auracraea) parei orangica Henning 1996	
	Pardopsis punctatissima (Boisduval) 1833	
Subfamily Danainae	*Amauris albimaculata latifascia* Talbot 1940	
	Amauris crawshayi Crawshayi Butler 1897	
	Amauris echeria serica Talbot 1940	
	Amauris ellioti junia (Le Cerf) 1920	
	Danaus chrysippus aegyptius (Schreber) 1759	
	Tirumala formosa formosa (Godman) 1880	
Subfamily Satyrinae	*Aphysoneura pigmentaria obnubila* Riley 1923	
	Bicyclus anynama anynama (Butler) 1879	
	Bicyclus campina campina Aurivillius) 1901	
	Bicyclus cooksoni (Druce) 1905	
	Bicyclus cottrelli Van Someren 1952	
	Bicyclus danckelmani (Rogenhofer) 1891	
	Gnophodes betsimena diversa (Butler) 1880	
	Henotesia simonsii (Butler) 1877	
	Henotesia ubenica Thurau 1903	
	Melanitis leda helena (Westwood) 1851	
	Melanitis libya Distant 1882	
	Physcaenueura pione Godman 1880	
	Neita extensa (Butler) 1898	
	Neocoenyra gregorii Butler 1894	
	Ypthimomorpha itonia (Hewitson) 1865	
Family Lycaenidae	*Actizera lucida* (Trimen) 1883	1999-2(Cottrell)
	Actizera stellata (Trimen) 1883	
	Alaena nyassae major Oberthür 1888	
	Alaena reticulata Butler 1896	E
	Alaena sp nova	E
	Aldeides conradsi angoniensis Tite & Dickson 1968	
	Aloeides griseus Riley 1921	
	Anthene lunulata Trimen 1894	
	Aphnaeus erikssoni rex Aurivillius 1909	
	Aphnaeus marshalli Neave 1910	

Axioceces tjoane tjoane (Waffengren) 1857
Axiocerces amanga amanga (Westwood) 1881
Axiocerces nyika Quickelberge 1984 E
Axiocerces punicea (Grose-Smith) 1889
Azanus jesous Guerin 1847
Azanus mirza (Plötz) 1880
Azanus moriqua (Wallengren) 1867
Azanus natalensis (Trimen) 1887
Cacyreus lingeus Stoll 1782
Cacyreus palemon (Stoll) 1782
Cacyreus virilis Stempffer 1936
Deudorix camerona katanga 1953
Deudorix kafuensis Neave 1910 1998
Eicochrysops eicotrochilus Bethune-Baker 1924
Eicochrysops messapus mahallakoaena (Wallengren) 1867
Epamera violacae Riley 1928
Euchrysops barkeri (Trimen) 1893
Euchrysops dolorosa (Trimen) 1893
Euchrysops subpallida Bethune-Baker 1923 1999-2(Cottrell)
Euchrysops unigemmata Butler 1895
Harpendyreus hazelae Stempffer 1973
Harpendyreus juno (Butler) 1897
Hatpendyreus marungensis maningensis (Joicey & Talbot) 1924
Hypolycaena auricostalis auricostalis (Butler) 1897
Hypolycaena buxtoni Hewitson 1874
Hypolycaena pachalica Butler 1888
Hypolycaena philippus philippus (Fabricius) 1793
Iolaus bowkeri nyasana (Talbot) 1935
Iolaus caeculus caeculus Hopffer 1855
Iolaus congdoni Keilland 1985
Iolaus helenae Henning & Henning 1985
Iolaus lalos lalos (Druce) 1896
Iolaus nasisii (Riley) 1928
Iolaus pamelae Heath 1983
Iolaus sidus Trimen 1864
Iolaus silanus silanus Grose Smith 1889
Iolaus silarus Druce 1885
Iolaus violacea (Riley) 1928
Lachnocnema bibulus Fabricius 1793
Lepidochrysops chalceus Quickelberge 1979 E
Lepidochrysops cupreus (Neave) 1910
Lepidochrysops intermedia cottrelli Stempffer 1954 E
Lepidochrysops nyika Tite 1961 E
Lepidochrysops pampolis Druce) 1905
Leptot,es marginalis (Stempffer) 1944
Leptotes jeanneli (Stempffer) 1935
Leptotes pirithous pirithous Linnaeus 1767
Lipaphneus aderna spindasoides (Aurivillius) 1916
Mimacraea marshalli marshalli Trimen 1898
Ornipholidotos peucetia peucetia (Hewitson) 1866
Pentilla tropicalis Boisduval 1847
Phylaria heritsia virgo (Butler) 1896
Spalgis lemolea Druce 1890
Spindasis homeyeri (Dewitz) 1887
Spindasis mozambica (Bertolini) 1850
Spindasis natalensis (Westwood) 1851
Spindasis victoriae Butler 1884
Tuxentius calice calice (Hopffer) 1855 1999-1

	Tuxentius ertli (Aurivillius) 1907	
	Uranothauma antinorii felthami (Stevenson) 1934	
	Uranothauma nubifer (Trimen) 1895	
	Uranothauma vansomereni Stempffer 1951	
	Uranothauma williamsi Carcasson 1961	
	Uranotheuma falkensteini (Dewitz) 1879	
	Urenothauma poggei (Dewitz) 1879	
	Zizeeria knysna (Trimen) 1862	
	Zizula hylax (Fabricius) 1775	1999-2(Cottrell)
Family Riodinidae	*Abisara dewitzi* Aurivillius 1898	

HETEROCERA (Moths)

Family Agaristidae	*Crameria amabilis* (Drury) 1773	
	Ovios septentrionis Hampson 1913	
	Pseudopais nigrobasalis Bart	
	Teurta rema Druce	
Family Arctiidae	*Aganais speciosa* (Drury) 1773	1999-2
	Amerila bubo (Walker) 1855	
	Argina amanda (Boisduval) 1847	
	Cyana pretoriae (Distant) 1897	1999-2
	Diacrisia sulphurea Butler	
	Eilema notata Moore	
	Lithosia natara Moore 1859	1999-2
	Macrosia chalybeata Hampson	
	Secusio doriae (Oberthür) 1880	1998
	Seriarctia metaxantha Hampson 1909	
	Spilosoma lutescens Walker	
	Spilosoma scioana Oberthür	
Family Cossidae	*Azygophleb coffea* Aurivillius	
	Sp. near *Eulophonotus obesus* Karsch	
Family Geometridae	A*ngyrophora variabilis* Kruger 1999	
	Ascotis reciprocaria (Walker) 1860	
	Asthenotricha dentatissima Warren 1899	1998
	Celidomphax anaplaga Warren	1999-2
	Chiasmia johnstoni (Butler) 1894	
	Chiasmia procidata semispurcata (Walker) 1863	
	Chiasmia rectistraria (Herrich Schaeffer) 1854	
	Chlorosterrha semialba Swinhoe	1998
	Cleoclaria divisaria (Walker) 1860	
	Cleora sp.	
	Cophophlebia olivata Warren 1894	
	Epigynopterix maeviaria (Guenée) 1857	
	Argyrophora trophonia (Cramer) 1779	
	Larentia bitrita (Felder) 1875	1999-2
	Larentia sublesta Prout	1998
	Lophorrhachia rubricorpus (Warren) 1898	1999-2
	Mimoclysta annulifera Warren	1998
	Nopia flexilinea Warren	
	Oedicentra albipennis Warren 1902	
	Omphacodes punctlineata (Warren) 1897	
	Pingasa abyssinaria (Guenée) 1857	1998
	Pingasa murphyi Henbulot 1994	
	Pracinocyma nereis Townsend	1999-2
	Pseudolarentia megalaria (Guenée) 1858	
	Psilocera pulverosa (Warren) 1894	

	Semiothisa subcurvaria Mabile 1897	1998
	Sphingomima virissa Prout	
	Taeda gemmans Felder	
	Xanthis tarsispina Warren	
	Xylopteryx interposita Warren	1998
	Zamarada dentigera Warren 1909	1998
	Zamerada glareosa Bastelberger 1909	1998
Family Hepialidae	*Antihepialus keniae* Holland	
	Gorgopsis abbottii Holland	1998
	Gorgopsis caffra Walker	1998
Family Hipsidae	*Digama strabonis* (Hampson) 1910	1999-2
Family Lasiocampidae	*Bombycopsis indecora* Walker 1865	1998
	Dipluriella songeana Strand	1998
	Ndiasa cuneata (Distant) 1897	1999-1
	Streblote vesta Druce	
Family Limacodidae	*Lembropteris neglecta* Hering	
	Omocena dolmani Westwood	
	Panoctenia gemmans Felder 1868	
	Susicina pyrocausta Hampson	
Family Lymantriidae	*Agyrostagma niobe* Weymer	
	Aroa discalis Walker	
	Barlowia sp.	
	Bracharoa ap.	
	Dasychira curvivirgata Karsch 1895	
	Dasychira sp.	
	Euproctis monosticta (Butler)	1999-2
	Hyaloperina erythroma Coll	
	Laelia bifascia Hampson	
	Laelia fracta Schaus & Clements 1893	
	Leucoperina impucta Butler	
	Orgyia basalis (Walker) 1856	1999-2
	Psalis pennatula (Felder) 1874	
	Rhypopteryx rhodalipha Felder	
	Stilpnaroma venosa Hering	
Family Noctuidae	*Achaea finita* (Guenée) 1852	
	Agrotis segatum (Dennis & Schiffermuller) 1776	
	Agrotis sp. near *contiguens* Warren	
	Amazonides sp.	
	Amphridina sp.	
	Anomis flava (Fabricius) 1775	
	Anomis sobulifera Guenée 1852	
	Anticarsia irrorata (Fabricius) 1781	
	Audea fatilega (Felder) 1874	
	Blenina albifascia Pinney	
	Blenina squamifera (Wallengren) 1860	
	Bomolocha potamistis Hampson	
	Borolea torrentium (Guenée) 1852	1999-2
	Borolia lacuna (Felder) 1874	
	Borolia uncinatus Gaede	
	Busseola fusca (Fuller) 1901	
	Busseola fusca Hampson 1910	
	Callopistria maillardi (Guenée) 1862	
	Callopistria yerburii Butler 1884	
	C*alpe emarginata* Fabricius	

Caranilla angularis Boisduval 1883	
Chasmina tibialis Fabricius	
Chiasmia tibialis (Fabricius) 1775	
Chrysodeixis acuta (Walker) 1857	
Cirphis prominenus Walker	
Conservula alambica Gaede 1915	1999-2
Conservula minor Holland 1896	1999-2
Cuculia ochribasis Gaede	
Cyligramma latona (Cramer) 1779	
Davea humeralis (Hampson) 1902	1999-2
Diaphone eumela (Stoll) 1782	1999-2
Dicerogastra lampra Karsch	
Eulelia leucographia Hampson 1905	
Euxootera sp.	
Amyna punctum (Fabricius) 1794	
Halochroa eudela Fletcher 1963	1999-2
Heliophysma croceipennis (Walker) 1857	
Heliothis armigera (Hubner) 1803-8	
Heliothis flavescens Janse	1999-2
Heliothis xanthia Walker	
Hypocala deflorata (Fabricius) 1792	1999-2
Magusa versicolora Saalmüller 1891	
Masalia sp. Walker	
Maxera nigriceps Walker 1858	
Meliana sp. near tenebra Hampson	
Mentaxya atritegulata	
Mentaxya ignicollis (Walker) 1857	1999-2
Metaretia lateritia Herrich-Schaffer	1998
Micragrostis sp.	
Micragrotis sp.	
Mocis repanda Felder	
Mocis undata Felder	
Nagia sacerdotis Hampson 1926	
Namangana castaneotincta Hampson	
Nyodes sp.	
Ozarba heliastis (Hampson) 1902	1998
Ozarba megaplaga Hampson	
Ozarba sp.	
Pacidara venustissima Walker 1865	1999-2
Phalerodes cauta Hampson	
Phlerodes cauta (Hampson) 1902	
Plusia limbiralea Guenée	
*Plusio*calpe sp.	
Polia speyeria Felder & Rogenhofer	
Raparna tritonias Hampson 1902	
Rhandiphora cinctigutta (Walker) 1862	
Rougeotia praetexta Townsend	
Serrodes partita (Fabricius) 1775	
Sphingomorpha monteironis Butler	
Spodoptera littoralis (Boisduval)	
Syngrapha circumflexa (Linnaeus) 1767	1998
Tathorhynchus plumbea	
Tathorhynchus plumbea	
Thria robusta Walker	
Thyretes negus Wallengren	1998
Tricaplusia orichalcea (Fabricius) 1775	
Trigonodes hyppasia anfractuosa (Cramer) 1780	1999-1
Ulothrichopus hardyi Clifton	
Ulotrichopus primulina (Hampson) 1902	

Family Notodontidae	*Antheua simplex* Walker 1855	
	Cerura esmeralda Hampson	
	Chadisna ochrirasalius Hampson	
	Chlorocalliope calliope (Hampson)	1999-2
	Desmeocraera thalassina Hampson	
	Polienus albescens Gaede	
	Scalmicauda bicolorata Gaede	
	Scalmicauda tessmanni Strand	
	Trotonctus bettoni Butler 1898	
Family Pterophoridae	*Acipitilia candidalis* (Walker) 1864	
Family Pyraloidea	*Ampulalonia sp.* Crambidae	
	Ancylomia sp. Crambidae	
Family Phycitidae	*Ephestia cautella* (Walker) 1863	
Family Pyralidae	*Aglossa rhodalis* Hampson	
Family Pyraustidae	*Bocchoris impersalis* (Zeller) 1852	
	Calamochrous flavimarginalis Hampson	
	Eurrhyparodes confusalis Warren	
	Filodes costivitialis Guenée	
	Lokostega venustalis Cramer	
	Marasmia sp.	
	Maruca vitiata Fabricius	
	Marvitzia centiguttalis Gaede	
	Pagyda traducalis (Zeller) 1852	
	Palpita unionalis (Hubner) 1796	
	Panotima angustalis Hampson	
	Pilocrocis dichocrosialis Guenée 1854	
	Pyrausta incoloralis Hampson	
	Spoladea recurvalis Fabricius	
	Syllepte ovalis Walker 1859	
	Uresiphita gilvata (Fabricius) 1794	1999-2
	Noorda margaritalis Hampson	1999-2
	Syllepte purpurascens Hampson	1999-2
	Syngamia convulsa Meyrick	
	Tschnurges lancinalis Guenée	
Family Saturniidae	*Athletes gigas* Sonthonnax 1904	
	Athletes semialba Sonthonnax 1904	
	Bunaeopsis jacksoni Jordan 1908	
	Decachorda fulvia (Druce) 1886	
	Decachorda rosea Aurivillius 1898	
	Gonimbrasia conradsi Rebel 1906	
	Imbresia ertli Rebel 1904	
	Imbresia macrothyris (Rothschild) 1906	
	Ludia delegorguei (Boisduval) 1847	
	Ludia orinoptena Karsch 1892	
	Ludia sp nova	
	Micragone joiceyi nyasae Rougeot 1962	
	Nudaurelia nyassana Rothschild 1907	
	Nudaurelia wahlbergi Boisduval 1847	
	Pseudaphelia flava Bouvier 1930	
	Pseudaphelia manowiana Bouvier 1930	
	Pseudobunaea callista Jordan 1910	
	Pseudobunaea tyrrhena maculata Bouvier 1930	
	Tagoropsis hanningtoni Butler 1893	
	Tagoropsis ikondae Rougeot 1974	

	Cirina forda orientalis Bouvier 1927	
	Epiphora imperator Stoneham 1933	
	Gonimbrasia rectalineata Sonthonnax 1899	
	Nudaurelia macrops Rebel 1917	
	Ubaena dolabella (Druce) 1886	
Family Sesiidae	*Adixoana sp*	
Family Sphingidae	*Acherontia atropus* (Linnaeus) 1758	
	Agrius convolvuli (Linnaeus) 1758	
	Andriasa contraria contraria Walker 1856	
	Andriasa mitcheli Hoyes 1973	
	Basiothia medea (Fabricius) 1791	
	Basiothia schenki Moschler 1872	
	Cephanodes hylas virescens (Wallengren) 1858	
	Chaerocina doherty meridionalis Carcasson 1968	
	Coelonia mauritii (Butler) 1876	
	Daphnis nerii Linnaeus 1758	1999-2
	Dovania poecila Rothschild & Jordan 1916	
	Euchloron megaera Linnaeus 1758	
	Hippotion celerio (Linnaeus) 1758	
	Hippotion eson (Cramer) 1779	
	Hippotion osiris (Dalman) 1823	
	Lephostethses dumolinii dumolinii (Angas) 1849	
	Leptoclanis pulchra Rothschild & Jordan 1903	
	Leucostrophus alterhirundu D'Abrera 1986	
	Macroglossom trochilus (Hubner) 1824	
	Macropoliana ferax (Rothschild & Jordan) 1916	
	Macropoliana natalensis (Butler) 1875	
	Nephele accentifera Beauvois 1805	1999-2
	Nephele comma Hopffer 1857	
	Nephele lannini Jordan 1926	
	Nephele vau (Walker) 1856	
	Polyptychus coryndoni Rothschild & Jordan 1903	
	Pseudoclanis kenyae Clark 1928	
	Rhodafra marshalli Rothschild & Jordan 1903	
	Sphingonaepiopsis ansorgei Rothschild 1904	
	Temnora elegans polia Rothschild 1904	
	Temnora funebris (Holland) 1893	
	Temnora plagiata fuscata Rothschild & Jordan	1999-2
	Temnora pseudopylas Rothschild 1894	
	Temnora pylades tanganyikae Clark	
Family Thyretidae	*Automolis laterita* Herrich-Schaffer 1855	
	Automolis pallens Bethune-Baker	
	Thyretus negus Oberthür 1878	
Family Yponomeutidae	*Yponomeuta strigillata* Zeller 1852	

COLEOPTERA (Beetles)

Family Buprestidae	*Hoplistura disjuncta* F
	Psiloptera albomarginata Herbst
	Psiloptera coleopteroides Sol
	Sterapsis amplennis Fahreus
	Sternocera orissa variabilis Kerremans 1886
Family Cantharidae	*Lycus murrayi* Bourg
	Lycus sp.

	Lycus sp.	
Family Carabidae	*Callistomimus rufiventris* Brett	
	Cypholoba graphipteroides Guer	
	Cypholoba tenuicollis Horni	
	Eccoptoptera cupricollis Chandois	
	Eccoptoptera sp.	
	Psecadius obertheuri Gestro	
	Scarites senegalensis Dej	
	Sterestoma stuhlmanni Kolbe	
	Thermophilum burchelli maculatum Sternb	
Family Cerambycidae		
	Callichroma leucorhapnis Gerst	
	Ceroplesis thunbergi Fabraeus	
	Oligomerus limbalis Harold	
Family Cetoniidae	*Chondrorrhina picturata* Harold 1878	
	Cosmiophaenia rubescens Brancsik 1914	
	Daedycorrhina bidenticornis Allard 1985	
	Diplognatha gagates Forster 1771	
	Gnathocera lurida sub sp.	
	Gnathocera sp. indet	
	Heteropseudinca wentzle heckmannae Kolbe 1901	
	Heteropseudinca moseri Hauser 1904	
	Leucocelis amoena Peringuey 1907	1998
	Pachnoda sp. nova	
	Poecilothila sp.	
Family Chrysomelidae	*Bradlema neavei* Heinze	
	Chrysomela saegeri Burgeon 1941	
	Phaedoria areata (F)	
Family Cicindelidae	*Cylindera marshallisculpta* (W Horn) 1913	
	Dromica gracillis W Horn	
	Dromica mauchi marshalli Peringuey 1894	
Family Cleridae	*Dieropsis 4 maculatus*	1998
Family Coccinellidae	*Epilachna ardiosiaca* Sic	1998
	Epilachna dregei Mulsant	
	Lioadalia intermedia Crotch	
Family Curculionidae	*Amphitmetus sp.*	
	Dicasticus sp.	
	Lixus areicatus	
Family Dynastidae	*Pychnoschema scrofa* Harold	1999-2
Family Eumolpidae	*Corynodes sp.*	
	Corynodes dejeani Bertol	1998
Family Galerucidae	*Asbecesta duvivieri* Jac	
	Gastrida abdominalis Chap	
	Hyperacantha deverani Wse	
	Idacantha conifera Fairm	
Family Histeridae	*Hister jeanneli* Desbordes	
	Hister mechowi Schmidt	
	Kissister congoensis Burgeon	

	Tribalus floridus Vienna	
Family Lagriinae	*Chrysolagria sp.*	
	Lagria villosa F	
Family Lucanidae	*Nigridius laticornis* Boileau 1911	
Family Meloidae	*Coryna mylabroides* Lap	
	Decatoma sobrina Per	
	Coryna katonensis Pic	
	Mylabris amplectens Gerstaecker	1999-1
	Mylabris holosericea Klug	
	Mylabris tripartita Gerstaecker	1999-1
	Mylabris tristigma Gerstaecker	
	Zonitoschema eborina Fahr	
Family Melonthinae	*Euphoresia sp.* (not in BMNH or NMK)	
Family Melyridae	*Ebaeus confluens*	
	Melyris atricornis Champ.	1998
	Melyris nigripes Hav.	
Family Prionceridae		
	Idgia dimidiata var. tripartita Pic	
Family Scarabaeidae	*Anachalcos procerus* Gerstaecker 1874	
	Aphodius bucolicus Bordat	
	Aphodius ciprianii Balthasar	
	Aphodius critchlowi Bordat	
	Aphodius gorillae Bordat	
	Aphodius humilis Roth	
	Aphodius kanemicus Enrödi	
	Aphodius kaszabi Enrödi	
	Aphodius koracsi	
	Aphodius lacunosus Schmidt	
	Aphodius leoninus Schmidt	
	Aphodius malawiensis Bordat	
	Aphodius noehaematiticus Landin	
	Aphodius nyika Bordat	
	Aphodius pauliani Enrödi	
	Aphodius pseudourostigma Balthasar	
	Aphodius punctiger Enrödi	
	Aphodius rothschildi Schmidt	
	Aphodius schoutedeni Boucomont	
	Aphodius strangularis Bordat	
	Aphodius teter s.l. Roth	
	Caccobius inconspicuus Fahraeus 1857	
	Caccobius ocellipennis D'Orbigny 1913	
	Catharsius mossambicanus Ferreira 1960	
	Catharsius satyrus Kolbe 1893	
	Copris amyntor Klug 1855	
	Copris dudleyi Cambefort	
	Copris insidiosus Peringuey 1900	
	Copris integer Reiche 1847	
	Copris mesacanthus Harold 1878	
	Diastellopalpus fulleborni (Kolbe) 1900	
	Diastellopalpus thomsoni (Bates) 1888	
	Garreta malleolus (Kolbe) 1895	
	Heliocopris hamifer Harold 1878	
	Heliocopris hermes Gillet	

	Lorditomaeus horni (Balthasar)	
	Notocaulus machatshkei Enrödi	
	Notocaulus schoutedeni Boucomont	
	Onitis sulcipennis Felsche 1907	
	Onitis vanderkelleni Lansberge 1886	
	Onthophagus abruptus D'Orbigny 1913	
	Onthophagus albipodex D'Orbigny 1902	
	Onthophagus biconifer D'Orbigny 1905	
	Onthophagus cinctipennis Quedenfeldt 1884	
	Onthophagus clitellarius D'Orbigny 1908	
	Onthophagus cribripennis D'Orbingney 1902	
	Onthophagus crucenotatus D'Orbigny 1905	
	Onthophagus dinoderus D'Orbigny 1913	
	Onthophagus foraminosus D'Orbigny 1902	
	Onthophagus gradivus Balthasar 1966	
	Onthophagus granosus D'Orbigny 1913	
	Onthophagus laminidorsis D'Orbigny 1902	
	Onthophagus naevius D'Orbigny 1913	
	Onthophagus parumnotatus Fahraeus 1857	
	Onthophagus perniger Boucomont 1930	
	Onthophagus quadrimaculatus Raffray 1877	
	Onthophagus simulator D'Orbigny 1905	
	Onthophagus subhumeralis D'Orbigny 1902	
	Popillia bipunctata (Fabricius)	1999-1
	Popillia browni Kolbe	
	Proagoderus biarmatus D'Orbingney 1908	
	Proagoderus brucei Reiche 1847	
	Proagoderus chrysopes (Bates) 1888	
	Proagoderus dudleyi Cambefort 1980	
Family Staphylinidae	Sp. near *Hasmus ertli* Brnk	
	Philonthus sp.	
Family Sylphidae	Species not found in BMNH or NMK	
Family Tenebrionidae	*Catamerus rugosus* Gahan	1999-1
	Catamerus sulcatus Fabricius	1999-1
	Distretus variabilis Glb	
Family Trogidae	*Trox nyansanus* Haaf	
	Trox caffer liliana Scholtz	

DIPTERA (Flies)

Family Bombyliidae	*Bombylius haemorrhoidalis* Bezzi	
	Lithorrhynchus basalis Ricardo	
	Bromophila caffra Macq	
	Dejeania bombylans Fabr	
	Exoprosopa magnipennis Bz	
	Litorhina allothyris Bz	
	Mydidae sp.	
Family Asilidae Laphriini	*Lamyra gulo* (Loew)	
	Laxenocera albicincta (Loew) 1852	
	Senapsis dibapha Walker	

HETEROPTERA (Bugs)

Family Coreoidea	*Anoplocnemis dallasiana* L & S	

	Anoplocnemis montandorii Distant	
	Latimbus sp. L & S	
	Mirperus tongorma	
	Serinetha amieta Germar	1999-1
	Petascelisca remipes Fabricius	
	Plectronemia sp. L & S	
Family Pentatomoidae	*Agonoscelis pubescens* Thunberg	1999-1
	Antestiopsis cincticollis Schaum	1999-1
	Atelocera attenuata Dist	
	Dalsira sp.	
	Dismegistus sp. Dist	
	Encosternum delegorguei Scopoli	
	Nazara viridula var torquata Fabr	
Family Reduviidae	*Coranopsis vittata* Horvath	1999-1
	Cosmolestes sp.	
	Ectomocoris cruciger F	
	Etrichodia crux (Thunberg)	1999-1
	Rhinocoris erythrocnemis Germ	
	Rhinocoris albopunctatus Stál	
	Rhinocoris neavei Bergoth 1912	
	Vitumnus scenicus Stál	

HOMOPTERA (Plant Bugs)

Family Cicadidae	*Orapa nyassana*	
Family Circopoidae	*Hemitrilcphora sp* not in BMNH	
	Locris jugalis Jacobi	
	Ptyelus flavescens Fabricius	
	Ptyelus grossus Fabricius	

HYMENOPTERA (Bees and Wasps)

Family Anthrophoridae	*Amegilla torrida* Smith	
	Amegilla acraensis Fabricius	
	Mesotrichia flavorufa D&G	
	Mesotrichia sp.	
	Anthophora plumipes Fabricius	1999-1
	Xylocopa corinata Smith	
	Xylocopa flavobicincta Grib	
	Xylocopa senior senior Vaehal 1899	1999-1
	Xylocopa caffra Linnaeus 1767	1999-1
	Xylocopa lugubris Gerst 1857	1999-1
	Xylocopa nigrita (Fabricius) 1775	1998
Family Apoidae	*Apis mellifera scutellata* Lepeletier	
	Apis mellifera monticola Smith	
	Thyreus calceatus (Vachal)	1999-1
Family Brachonidae	*Serraulax sp*	1999-2
	Serraulax decemmaculatus Szepligeti 1911	
Family Eumenidae	*Ancistrocerus lineaticollis* Cam	
	Eumenes maxillosus De Gear	
	Odynerus ardens var junodi Gribodo 1895	
	Odynerus radialis Sauss 1854	
	Odynerus ventralis Sauss	
	Synagris prosperina nyassae Stadel	1999-1

Family Ichneumonidae	*Netelia sp.*	
(all spp. in BMNH not named)		
	Asprynchotus gueinzii (Tasch)	1998
[Phygadeuontinae]	*Zonocryptus sp no.1*	
	Zonocryptus sp no 2	1999-2
Family Megachilidae	*Chalicodoma bombiformis* (Gerstaecker) 1857	1998
	Chalicodoma pseudomegackile kigonserana (Friese) 1903	1999-2
	Megachile felina Gerstaecker	1999-1
	Megachile sp.	
Family Pompilidae	*Anoplius fuscus*	
	Cyphononyx sp.	
	Cyphononyx sp.	
	Cyphononyx sp.	
	Hemipepsis dedjas Guérn	
	Hemipepsis imperialis Smith	
	Hemipepsis ochropus Stal	
	Hemipepsis tamisieri Guérn	
Family Scoliidae	*Megameris labilis* Schulz 1906	
	Scolia morio Fab	
Family Sphecoidea	*Ammophila beniniensis* (Pal de B)	
	Ammophila punctaticeps (Arn)	
	Chalybion clypeatum (Fairmaire)	
	Chalybion laevigatum Kohl	
	Liris haemorrhoidalis Fabricius	
	Liris pempesiana Birsch	
	Philanthus triangularis diadema Fabricius	
	Sceliphron spirifex Linnaeus	
Family Vespidae	*Belognaster clypeata* Kohl	1999-1
	Belognaster dubius Kohl 1894	
	Belognaster fascialis du Buysson 1906	
	Belognaster filiventris (Saussure) 1853	
	Belognaster griseus (Fabricius) 1775	
	Belognaster vasseae du Buysson 1906	
	Icaria nobilis Gerstaecker	
	Polistes marginalis Fabricius	1999-1
	Polistes smithi Saussure	

NEUROPTERA (Lacewings/Ant lions)

Family Ascalaphidae	*Thesibasis lacerata* Hag	
Family Myrmeleontidae	*Acanthoclisis lineatipennis* Per	
	Formicaleon roseus Fraser	
	Hagenomyia lenthifer Walker	
	Palpares sparsus Mclach	
Psychopsidae	*Silveria marshalli* Mq	

ODONATA (Dragonflies)

Family Aeshnida	*Aeshna ellioti usumbarica* Forster 1906	
	Anax separatus Hagen 1867	1998
	Hemianax ephipigger (Burmeister) 1839	1998
	Orthetrum caffrum caffrum (Burmeister) 1839	

	Orthetrum julia falsum Longfield 1955	1998
	Trithemis annulata (Beauvois) 1805	1998
	Trithemis arteriorosa (Burmeister) 1839	1998
	Trthemis werneri Ris 1912	1998
Family Agriidae	*Phaon iridipennis* (Burmeister) 1839	1998
Family Chlorocyphidae	*Chlorocypha consueta* (Karsh) 1899	1998
Family Gomphidae	*Notogomphus zernyi* (St Quentin) 1942	
	Paragomphus cognatus (Rambur) 1842	
Family Lestidae	*Chlorolestes conspicua* Selys	1998
	Lestes pallidus Rambur 1842	1998
Family Libellulidae	*Atoconeura biordinata* Karsch 1899	1999-2
	Crocothemis sanguinolenta (Burmeister) 1839	1998
	Pantala flavescens Fabricius 1798	1998
	Tramea basilaris Palisot de Beauvios	
Family Protoneuridae	*Chlorocnemis marshalli marshalli* Ris 1921	1998

ORTHOPTERA (Grasshoppers)

Family Acrididae	*Cyrtacanthacris septemfasciata* (Serville) 1838
	Gastromargus africanus (Saussure) 1888
	Gastromargus sp.
	Trilophidia sp.
Family Mantidae	*Metentella mervensis* Sj
Family Pyrgomorphidae	*Maura bolivari* Kirby 1902
Family Tettigoniidae	*Enyaliopsis sp.*
	Ruspolia vicinus Walker
	Zabalius orientalis Karsch

TERMITES

Dr Sarah Donovan

Termite workers:

Andy Martin, Mark Bilsland, Kit Cottrell, Rod Lindenbaum, Grandson Simkoko.

INTRODUCTION

The Nyika Plateau lies between about 10° 15' - 10° 50' S and 33° 35' - 34°05' E, predominantly in Malawi. It is the largest montane complex in south-central Africa with an area of some 1800 km^2 above the 1800 m contour, which usually makes the zone of transition from woodland to montane grassland and forest. The Plateau is protected within the boundaries of National Parks, though the Zambian sector is not well managed and poaching and uncontrolled fires are a problem. The area above 2000 m has never been permanently inhabited by man (Dowsett-Lemaire 1985).

There are three seasons in Malawi: the rainy, the cool and the dry, running from November to April, May to July and August to October respectively. Mean monthly temperatures at Chelinda (2300 m) vary between 11°C and 16° C (Dowsett-Lemaire 1985). Rainfall is variable across the plateau but averages 1250 mm/annum, and is not correlated with altitude (Table 1). The areas of highest rainfall are on the eastern, and to a lesser degree, western sides of the Nyika. Much of the high plateau above 2200 m has low rainfall, with even lower levels in the north, in the shadow of the high peaks of Nganda and Domwe.

The macroinvertebrate soil faunas of the tropics are usually dominated by termites, especially in humid forests (Wood & Sands 1978, Collins 1983, Bignell & Eggleton 2000). In such habitats they may constitute as much as 10% of all animal biomass (Wilson 1993) and up to 95% of soil insect biomass (Watt *et al*. 1997), with densities occasionally exceeding 100 g m^{-2} (Eggleton *et al*. 1996). At this level of activity and biomass it is agreed that termites function as "ecosystem engineers" (Black & Okwakol 1997, Brussaard *et al*. 1997, Lavelle *et al*. 1997, Bignell & Eggleton 2000), with a major influence on soil structure and properties, as well as the expected contribution to plant decomposition, carbon mineralisation and the stimulation of microbial activity (Lee & Wood 1971, Lobry de Bruyn & Conacher 1990, Lavelle *et al*. 1997).

Termites have been shown to decrease in abundance and biomass with increasing altitude (Collins 1980), and in SE Asia the altitudinal limit for termites appears to be 1900 m. Set against this is the fact that Africa has the highest termite density of all biogeographical regions. They are known to occur at higher altitudes and can be extremely abundant. For example, dense populations of *Cubitermes* mounds can be found at 3000m (Sands 1998).

Nyika National Park is largely unsurveyed for termites and our aim was to catalogue the termite fauna from the habitats found on the plateau. Additional aims were:

(a) to include an altitudinal aspect, using standardised termite transects (Jones & Eggleton, in press);
(b) to assess the relative importance of other soil invertebrates (ants, beetles and earthworms) within one of the termite transects, and
(c) to estimate the abundance of termites and ants in termite mounds in areas of unburned and burned grassland.

METHOD

Transect

The transect protocol that has been developed by the termite research group (TRG) at the Natural History Museum (NHM), London (Jones & Eggleton in press) was used. The TRG is amassing a global database of termite distribution through this method (e.g., Davies 1997, Eggleton *et al.* 1997, Gathorne-Hardy *et al.* submitted) and the results of this project will be added into the global analysis.

Each transect is 100 m long x 2 m wide divided into 20 consecutive sections, each 5 m x 2 m. One hour of sampling effort per section is used to search for and collect termites from all known termite microhabitats: dead wood, soil, termite nests, runways, sheeting and leaf-litter etc. up to a height of 2 m above ground. All termites collected are labelled appropriately, and stored in 80% alcohol. This method is fully described in Jones & Eggleton (in press).

Transects were run in three areas, all in the south east area of the plateau:

1. *Juniper Forest:* elevation 7250 ft / 2210 m, 10°44'51" S 33°53' E, within the firebreak. This relatively small forsest fragment is a combination of natural and old-growth Juniper forest. It has a good canopy, a thick leaf litter and root layer and peaty soil. Our transect location was on a slope.

2. *Vitumbi Area:* elevation 6250 ft / 1905 m, 10°49'08" S 33°56'05" E. This is an area of *Brachystegia speciformis* woodland, with low trees and lots of grass. There is not much leaf litter and plenty of bare earth, baked to a crust. It had been burned at some point, but not recently (more than one year ago). This location was on a steep slope.

3. *Tewira River/Murchandisi River Confluence:* elevation 5500 ft / 167 6m, 10°51'24" S 33°51' E. This is an area of mixed *Brachystegia* woodland, with very dry grass cover (*Eragrostis* sp. and *Themeda* sp.). There is no evidence of recent burning (i.e. within the past 3 years).

Soil Invertebrates

In addition, soil macrofauna were sampled in the second transect, the Vitumbi area. Ants and beetles were collected using Winkler bags. Leaf litter from $1m^2$ in each of the 20 sections of the termite transect was collected and sorted. Earthworms were hand-sorted from soil pits, each 25 x 25 x 30cm, one from each of the 20 sections. All specimens were stored in 80% alcohol and brought back to the NHM for identification.

Termite/Ant abundance in unburned and burned grassland

Juniper Forest is enclosed within a firebreak, with grassland included within this area. A 50 m x 50 m plot in the unburned area was sampled. Immediately adjacent to this, on the other side of the firebreak, was an area of recently burned (within 3 months) grassland, where an area of 25 m x 50 m was sampled. We destructively sampled every mound within these two areas. From each mound we collected representatives of all termite and ant species found, and stored in 80% alcohol.

Casual collecting

During the course of the expedition, we also sampled termites as and where appropriate.

Identification and sorting of samples

We identified the termite specimens at the NHM, through the use of appropriate keys (Sands 1972, 1998), and reference to voucher specimens in the collections. The ants and other invertebrates have not yet been identified.

RESULTS

Transects

Termites were collected on 6, 103 and 81 occasions in transects one, two and three respectively. The highest altitude also had the lowest diversity (2 species of Macrotermitinae), but the highest diversity, 22 species, was found at mid-altitude. The lowest altitude had 11 species (table 2). All species belonged to the family Termitidae (the higher termites), in the subfamilies Macrotermitinae, Apicotermitinae and Termitinae (table 3), predominantly in the Apicotermitinae. Transects 2 and 3 were dominated by soil-feeding termites (groups 3 and 4 of Donovan [1999]) (table 4). In addition, a new genus was found in the *Anoplotermes*-group, near to the genus *Aderitotermes*.

Soil Invertebrates

The winkler bags were not altogether successful, because they are designed primarily for use in rainforests (i.e. wet leaf litter). The study areas had little leaf litter and were very dry. Few ants and still fewer beetles were collected. No earthworm were found at all.

Termite/Ant abundance in unburned/ burned grassland

Forty and 106 mounds in the unburned and burned areas respectively (table 5) were found. Time has not permitted identification of the termites from the mounds to be fully identified, but the primary occupants of the mounds were almost certainly *Cubitermes* sp. (Sands 1998), with other *Cubitermes*-group (Termitinae) and *Anoplotermes*-group (Apicotermitinae) species as secondary occupants. All of these species are soil-feeders (groups 3 and 4 of Donovan [1999]). A larger percentage of the mounds in the unburned area than the burned had ant colonies in them (table 5). In both areas very few mounds were unoccupied. Many of the mounds contained more than one species of termite (data not shown).

Casual Collecting

Not all of this material has been identified yet, but *Odontotermes* sp. was found on the skin of a dead Common Duiker at Vitumbi. These termites were almost certainly utilizing this as an extra source of nitrogen to supplement their diet, which has a high carbon to nitrogen ratio. We found *Macrotermes* sp. at Vitumbi and Tewira foraging in large numbers above ground. There was also indirect evidence of *Macrotermes* sp. near Juniper Forest, where some of the group detected vibrations underfoot. Termites commonly communicate through vibrations made by the soldiers striking their heads against their subterranean tunnels.

DISCUSSION

The paucity of termites at the highest altitude (Juniper Forest) may be due in part to the season (i.e. end of the cold, dry season), but it is more likely that forest termites are not well adapted to life at this altitude. It would still be worthwhile surveying this area again at a more favourable time of year for termite activity, as there was a lot of evidence of termite activity in the form of runways on trees, sheeting etc.

However, the highest diversity was not found at the lowest altitude. There are at least two possible reasons for the species richness peak at mid-altitude: Firstly, we may have recovered the mid-altitude peak, as described by Olson (1994) for leaf-litter invertebrates in the neotropics, and secondly, the lower altitude may well have suffered historically from greater fire disturbance, mediated by poachers. This is known to favour the Macrotermitinae (Collins 1981, Davies 1997, Trapnell *et al*. 1976), which were abundantly represented in the lowest altitude transect, both in terms of biomass and proportional species richness. Another known effect of burning is to reduce biodiversity.

We have provisionally named the new genus "Koronotermes nyikensis". The workers are characterised by a very long P1 (see Sands 1998 for terminology of gut morphology), the loop of the colon encircling the crop (figs. 1 - 7), and the extended ridges of the enteric valve forming a coronet-like structure (not shown). It belongs to the group 4 feeding group (true soil-feeders), and has typical soil-feeder mandibles (fig. 8). This genus will be formally described in a subsequent publication.

The biomass of soil-feeding termites in these upland grasslands is extraordinarily high, with up to 800 mounds ha^{-1}. This compares with mounds of *Cubitermes testaceus* occurring at densities of 160 ha^{-1} at Kaazi, Uganda (Okwakol 1976, but see also Sands 1998). The discrepancy of numbers of mounds between the burned and unburned grassland is almost certainly due to missing many mounds in the former, that were hidden by the dense grass sward.

Soil-feeding termites are pivotal to many ecosystem processes, e.g., altering physical and chemical soil properties (Donovan *et al*. submitted, Lobry de Bruyn & Conacher 1990) and providing shelter for inquilines (Dejean & Ruelle 1995, Dejean & Bolton 1995, Eggleton & Bignell 1997). Their high abundance in the Nyika Plateau will have a profound effect on the functioning of this unique ecosystem, and the results of this survey will allow more informed decisions on the Parks management strategies.

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Table 1: Annual rainfall at stations on and near Nyika Plateau.
Taken from Dowsett-Lemaire (1985).

Station	Approximate altitude (m)	Annual rainfall (mm)	
		mean	min-max
Nganda-Domwe	2400	1103	890-1405
Nganda road	2300	899	877-1099
Nganda road	2300	898	787-1016
N. Rukuru bridge	2250	1133	887-1309
near Dembo bridge	2275	1021	789-1355
Kaperekezi	1550	1588	1287-1840
Zovochipolo	2200	1530	1314-1881
Zovochipolo east	2225	1213	934-1459
Chelinda	2300	1204	788-1614
Chelinda east	2350	1082	724-1409
near Chosi	2225	1109	774-1511
Kasaramba road	2400	1166	742-1477
near Chelinda Hill	2400	1160	793-1589
Lusero	1925	1320	993-1657
Mwaivitithza	1925	1585	1229-2094
Mbuzinandi	2280	1051	705-1301
Kasaramba road	2500	1353	763-1915
Nchenachena stream	2325	1513	1327-1924
Kasaramba	2400	1687	863-2447
Thazima	1600	1588	1426-1785
Nchenachena	1200	1203	-

Table 2: Termite species found at three sites at three different altitudes in Nyika National Park, Malawi. Feeding groups based on Donovan (1999), with 4 being soil-feeders.

Species	Juniper forest 2140 m	Vitumbi area 1900m	Tewira River 1680 m	Feeding group
MACROTERMITINAE				
Odontotermes sp. 1		X		2
Odontotermes sp. 2	X	X	X	2
Odontotermes sp. 3	X			2
Pseudacanthotermes militaris			X	2
Macrotermes nr. *vitrialatus*			X	2
APICOTERMITINAE				
Adaiphrotermes sp. n. 1		X		3
Adaiphrotermes choanensis		X	X	3
Adaiphrotermes scapheutes		X	X	3
Alyscotermes kilimandjaricus		X	X	3
Anenteotermes improelatans		X		3
Astalotermes ? *murcus*			X	3
Astalotermes sp. n. m1		X		3
Astalotermes sp. 2		X		3
Astratotermes mansuetus		X		3
Astratotermes sp. 1		X		3
Astratotermes sp. n. 2			X	3
Astratotermes sp.				3
Ateuchotermes muricatus		X		4
Ateuchotermes rastratus		X	X	4

Ateuchotermes nr. *rastratus*		X		4
Ateuchotermes sp. n. nr. *Muricatus*		X		4
Gen. et sp. nov. nr. *Aderitotermes*		X	X	4
TERMITINAE				
Cubitermes pallidiceps		X	X	4
Cubitermes sankurensis		X		4
Cubitermes umbratus		X		4
Cubitermes sp.		X		4
Noditermes sp.		X		4
Microcerotermes sp. 1		X		3
TOTALS	2	22	11	

Table 3: Termitidae subfamilies present in each transect expressed as a percentage of total number of species.

	Macotermitinae	Apicotermitinae	Termitinae
Juniper Forest, 2140 m	100	0	0
Vitumbi area, 1900 m	9	64	27
Nr. Tewira River, 1680 m	27	64	9

Table 4: Feeding groups per transect, expressed as percentage of total.
Feeding groups based on Donovan (1999).

	Feeding group		
	2	3	4
Juniper Forest, 2140 m	100	0	0
Vitumbi area, 1900 m	9	45.5	45.5
Nr. Tewira River, 1680 m	27.5	45	27.5

Table 5: Occupation of mounds expressed as percentage of total.

	Termites, no ants	Termites and ants	Ants, not termites	No termites nor ants
Unburnt	49	45	3	3
Burnt	15	83	0	2

Figures 1 - 8

FRESH WATER AQUATIC SURVEY

Dave Bowden & Tooni Mahto

Field workers: Claire Wells, Monty Halls, Mary- Anne Bartlett, Andy Martin, Rod Lindenbaum, Phil Watson and Symon Mughogho

ABSTRACT

Six streams from two regions in the remote south-eastern sector of the Nyika plateau were sampled for macro-invertebrates for the first time. A semi-quantitative sampling method with identification to family level was used, based on the South African Scoring System (SASS 4) stream index protocol. Basic stream physicochemical properties of depth, width, flow-rate, pH and conductivity were recorded. Data was analysed by means of univariate community measures (abundance, taxon richness, Shannon-Wiener diversity ($H'log_e$), species richness (Margalef's D) and evenness (Pielou's J')) and multivariate clustering and ordination techniques. In addition SASS4 and the average SASS4 score per taxon, (ASPT) scores were calculated yielding mean values of 130 and 8.2 respectively. All sites were generally similar in terms of both physical and biotic makeup but differences were found between regions in total abundance of invertebrates, pH and conductivity, all of which increased with decreasing altitude. This study is seen as being a preliminary survey supplying base-line stream invertebrate data for this area of the Nyika. Directions for further study are discussed.

INTRODUCTION

Studies in both marine and freshwater habitats have shown benthic macroinvertebrate communities to be sensitive to environmental change. In Britain and other countries, univariate indices of biotic community structure have been developed to act as measures of the health status of streams and rivers, particularly with reference to anthropogenic impacts (see e.g. Rutt *et al.* 1990; Karr, 1991; Dallas, 1997; Harris and Silveira, 1999). Although such indices are necessarily fairly crude measures and are subject to variation in response to entirely natural environmental factors such as altitude, pH and differing stream-bed geology, they can provide an objective reference against which effects of disturbance, pollution or changes in land use can be assessed. Before any such indices of stream health can be validly applied to an area, however, it is necessary to gather base-line data from healthy, unimpacted streams within the area in question (Dallas 1997).

There have been few published studies concerning the invertebrate ecology of streams in tropical and sub-tropical areas of the world yet, with current rapid rates of development and population increase, these regions are likely to be subject to increasing environmental disturbance and pollution. The objective of the present study was to gather base-line macroinvertebrate community data from previously unsampled, high-altitude streams in the South-eastern part of the Nyika plateau. By adopting the sampling methodologies and scoring scheme of the existing South African Scoring System (SASS4) it is hoped that the data gathered will be directly comparable to existing data from southern Africa.

SITE DESCRIPTION

The south-eastern sector of the Nyika plateau is an area of rough, high-altitude grassland intersected by numerous stream catchments (see M. Bilsland, this volume for geological description) above 1800m. This upper landscape is characterised by grassland with marshy and evergreen patches, particularly along the water-courses, but a great diversity of other plant species is found (see H Patel, this volume). Recently-burnt upland areas of grassland were widespread at the time of the study. It is reported that such burning is predominantly initiated by game poachers.

The region below about 1800m (6000ft) is characterised by much drier, fairly open *Brachystegia* woodland, with grassy understorey (see C. B. Cottrell, this volume). Perennial streams with riverine vegetation were fairly common in this much folded-terrain.

The streams sampled were situated in two regions, accessed from the two expedition base-camps, separated by approximately 10km laterally and by about 1000ft in altitude. For this analysis the region around the Juniper forest camp is referred to as Region I and that around the more southerly camp, Region II. Three streams in each region were sampled, with three sampling sites approximately 1km apart in each stream. None of the sample sites was more than 10km from the stream source, as marked on the map and as sampling took place during September, at the end of the dry season, the distance from source was often somewhat less than this.

The streams sampled are identified, by grid reference and altitude, from Malawi government map sheets (1985) CHELINDA 1033D2 and MUHUJU 1033D4 (Table 1). The three streams in the northern region (Region I, streams A-C) are tributaries of the *Chelinda* river. Streams sampled in the southern region (Region II, streams D-E) represent the three principal tributaries of the *Luviri* river.

MATERIALS & METHODS

Physicochemistry

Stream width and depth at each sampling point were recorded and an assessment of the substratum composition was made in terms of approximate percentages of the stream-bed over the sampled area. Flow rate was estimated by timing floating objects over a measured distance. Water clarity was assessed on a subjective scale from excellent to poor. Water pH and conductivity (µS) were measured using a hand-held electronic meter which was calibrated with standard solutions before and after, but not during, the expedition. No significant change was noted between calibration readings before and after the expedition. Brief descriptions of the surrounding vegetation, degree of shading and the extent of burning in the catchment were also noted.

Macroinvertebrates

A semi-quantitative sampling method, based on the protocols described in standard SASS4 sheets, was used to collect stream macro invertebrates. Animals were collected from riffle areas at each site by means of a two-minute kick sample (1mm mesh net). Marginal vegetation and bank overhangs were swept, back and forwards, for two minutes, stones out of current, sand or gravel substrates, and any other biotopes present were sampled for a maximum of half a minute each. Net contents were emptied into a sorting tray and live organisms were picked by hand and preserved directly in 70% alcohol. The sorting technique differed from the SASS4 protocol in that all samples were picked, on site, by two workers for a period of one hour, as opposed to the 15 minutes stipulated. It was felt that many taxa were significantly under-sampled or missed entirely when the shorter time was employed.

Field conditions limited identification to simple counts of overall abundance at the order level. On return to the UK, samples were further identified to family level using European fauna keys. Previous studies have shown that family level identification is sufficient for assessing important ecological patterns at the community level (e.g. Rutt *et al.*, 1990; Rundle *et al.,* 1993; Chessman, 1995) and that the macro invertebrate families present in streams are remarkably consistent across all the major continents with the exception of Australia, allowing accurate identification to this level in the absence of specific, local keys. Only in the case of Diptera, were there significant numbers of specimens which were not identified to family level, due largely to limitations of time. As all samples were preserved complete, abundance was recorded as full counts rather than as the log abundance categories used in the SASS protocol.

Data analysis

Univariate and multivariate statistical techniques were used to examine the data. Before proceeding with univariate analyses both physical and biotic data were log(x +1) transformed, where necessary, to normalise variances. Multivariate analyses were performed on both the fourth root transformed and presence/absence data.

Univariate analysis consisted of one-way ANOVAs between streams, conducted on measures of total abundance, total number of taxa, Shannon-Wiener diversity (H'log$_e$), species richness (Margalef's D) and evenness (Pielou's J') using sites as replicates. Where significant these were further investigated by correlation analyses (Spearman rank and linear regression) between biotic and physico-chemical variables.

Multivariate analyses were performed using the PRIMER (Plymouth Routines in Multivariate Ecological Research, Plymouth Marine Laboratory UK) package. Sites were compared by means of dendrograms and non-metric multidimensional scaling (MDS) ordinations based on similarity matrices constructed from Bray-Curtis similarities (Clarke and Warwick, 1994). The relative contribution of individual taxa to dissimilarity between samples was investigated with the SIMPER programme in the PRIMER package.

RESULTS

Stream chemistry and physiography

The six streams (eighteen sampling sites) were generally very similar in physical characteristics, being small (<5 m wide), shallow (<0.5 m) and fast flowing (c. 2 ms^{-1}), with extremely clear water and few pools or areas of soft substrate. All sites were more or less overgrown by vegetation (mature trees, shrubs, grasses and bamboo) and allocthonous plant material (that is, debris from outside the stream,) was abundant in all samples.

pH varied in the range 5.9 to 7.9. This is comparable with the range in the northern region of the Park which was 5.0 to 8.0, the latter only after heavy rain (Ludlow, 1997). There was no rain during this survey. Significant differences were found in pH and conductivity measurements between streams in the two regions sampled (Table 1.); streams in Region II having less acidic waters and higher conductivity than those in Region I (ANOVA $P<0.05$). The general pattern of increasing pH and conductivity has been reported in other studies of highland streams (e.g. Rundle *et al.* 1993; Clenaghan *et al*, 1998) but the conductivity values recorded here are considerably lower than comparable values from streams in the Himalaya (Rundle *et al.* 1993) and the Andes (Turncotte and Harper, 1982). Indeed, in streams of Region I no measurable conductivity was recorded. It may be that minor differences in the geology of catchments or relative distance from the stream source may be significant factors affecting conductivity. It should be stressed, however, that the conductivity meter used here, while consistent, was not as accurate as more sophisticated devices. Therefore, while the recorded values can confidently be used to identify relative differences between streams in this study they may not suitable for absolute comparisons with data from other studies. It was also considered possible that physico-chemical properties may be related to the effects of burning but no correlation was detected between observed levels of burning in the catchments and pH, conductivity or the physical appearance of the six streams sampled.

Distribution and abundance of macroinvertebrates

A total of thirty-four invertebrate taxa including one species of grapsid crab were recorded in the samples. A single species of catfish (Bagridae?) was also found at many sites. Full data are presented in appendix 1. With the exception of the fish and crab species, all taxa found were the larvae and adults of insects. The mean number of taxa per sample was 16.27±2.98(sd). SASS4 values ranged from 86 at site B3 to 181 at site D1 with a mean of 130±29.9(sd) across all sites. ASPT ranged from 5.9 at site E2 to 10 at site D1 with a mean of 8.18±1.05(sd) (Table 2).

Mayfly and caddis larvae were the numerically dominant organisms; Baetidae (Ephemeroptera) and Hydropsychidae (Trichoptera) being the most numerous and ubiquitous families. Five families of Ephemeroptera were found including Ephemerellidae and Prosopistomatidae, which are considered to be indicative of clean, undisturbed sites. Greatest taxonomic diversity at the family level was among the Trichoptera which were represented by nine families including Philopotamidae, several morpho-species of Hydropsychidae, and some very large (c. 40 mm) specimens of the Polycentropodidae.

Univariate analyses

Of the univariate indices of community composition considered, the only statistically significant differences found were in total number of individuals per sample (abundance). This was significantly higher overall for sites in Region II than for those in Region I (ANOVA, $P<0.05$) and further analysis indicated a significant correlation between total abundance and altitude (Spearman rank and Fisher's r to z, $P< 0.05$) (fig.1). As both pH and conductivity were also correlated with altitude it is not possible here to determine the ultimate cause of increased abundance but it has been demonstrated in previous studies that both the abundance and species richness of freshwater macroinvertebrate communities increase with increasing pH (e.g. Rundle *et al.* 1993; Clenaghan *et al.* 1998 and refs therein). The measures of diversity, richness and evenness tested showed no significant difference between streams or regions, nor correlation with any of the physical parameters considered.

Multivariate analyses

Both the dendrogram and the MDS plot of Bray-Curtis similarities generated from fourth root transformed data show a weak tendency for sites to cluster by region. In the MDS plot it can be seen that Region I sites (A, B and C) with the exception of site A1 are towards the lower left sector of the ordination space, whereas Region II sites (D, E and F) are towards the upper right sector (fig.2). However, the stress value of the ordination (0.19) is relatively high suggesting that the regional distinction is less clear cut even than it appears. This is confirmed by the dendrogram (Fig. 3) which shows a broad differentiation of two clusters at the 42% similarity level. However, although each cluster consists predominantly of sites from a single region, there is considerable overlap, sites A1, B1 and C1, for instance, showing greater similarity with Region II sites than other sites in Region I. This suggests that there is little appreciable difference in community make-up across the eighteen sites sampled. Further analysis using the SIMPER (similarity percentages procedure, Clarke and Warwick 1994) programme suggested that the distinction between regional groups was largely due to increases in the abundance of Simulidae, Elmidae and Ephemerellidae in the lower altitude sites.

DISCUSSION

The results from this limited study indicate that the streams in the South-eastern Nyika support a rich and diverse invertebrate fauna. The overall taxon-richness apparent in the samples, particularly the diversity of Trichopterid taxa present and the presence of the Ephemeroptera families Prosopistomatidae and Ephemerellidae suggests that the streams are as clean and undisturbed as might be expected in such a pristine environment. Both univariate and multivariate analyses indicate that invertebrate communities are generally consistent in composition across the area sampled. This is perhaps to be expected as all but one of the invertebrate taxa present were insect species which possess the ability to fly as adults and may disperse widely. It would be of interest in future studies to investigate the wider distribution of these taxa to see whether they are constrained by the high-altitude conditions found on the Nyika or represent a continuum of lower level communities.

In terms of the SASS4 and ASPT indices calculated from our samples, no conclusions can be drawn here without comparison with data from other studies of South African stream fauna. Unfortunately, such data have not been readily accessible in the UK. Thus we can only present our findings here as base-line data which might be of value for comparison both with subsequent studies of the Nyika and with other highland stream areas in Southern Africa. Harris and Silveira (1999) have noted the importance of data from "ideal", undisturbed sites for the calibration of biotic indices, and Williams and Hynes (1971) have concluded that there is a close similarity amongst the macroinvertebrate fauna of swift-water streams across large areas of Southern Africa. The streams sampled here would, therefore, appear to be eminently suitable as a reference datum for such comparisons.

The most appropriate application of our data, however, is likely to be as a biotic baseline against which the health status of streams on the Nyika plateau itself may be monitored by future sampling. To expand on this preliminary survey we suggest that subsequent studies should aim to assess variability in macroinvertebrate community structure both spatially, across the plateau, and temporally, across seasons. Dallas (1997) has noted variability of SASS scores due to regional variations, temporal variations and local biotope availability. Thus, in order to arrive at reliable base-line SASS4 scores for the Nyika it will be necessary to combine our data with the results of the follow-up studies suggested above.

It may also be of interest to assess changes in community structure along the course of individual streams. It has been noted that introduced trout have spread through much of the *Chelinda* river causing changes in both fish and invertebrate communities (K. Heasman, personal communication) and such studies might be of use in determining the extent to which they have invaded its tributaries. To complement such biological sampling and in order to identify the causal relationships between physico-chemical variables and invertebrate community structure, future studies could perform more thorough water analyses including assessment of specific ions such as silica, calcium, and nitrate which have been shown to vary with altitude in other high-altitude stream systems and to influence invertebrate species (e.g. Ormerod *et al* , 1994).

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Table 1: Stream sampling sites and physicochemical data

Region	Stream	Site	Grid reference	Altitude (m)	pH	µS
I	A	1	WD 971115	2164	6.1	0
		2	WD 958127	2057	6.9	0
		3	WD 125943	1981	6.1	0
	B	1	WD 987085	2126	6.7	0
		2	WD 976081	2096	5.9	0
		3	WD 972071	2057	6.9	0
	C	1	WD 957148	2103	7.7	0
		2	WD 948147	2027	7.4	0
		3	WD 939134	1981	6.7	0
II	D	1	XD 008029	1852	7.6	10
		2	XD 003017	1798	7.4	10
		3	XD 005008	1753	7.4	10
	E	1	WD 992028	1806	7.6	20
		2	WD 995017	1775	7.4	20
		3	WD 995008	1745	7.6	30
	F	1	XD 025035	1882	7.3	10
		2	XD 017017	1791	7.9	10
		3	XD 008011	1760	7.9	10

Table 2: South African Scoring System (SASS) and Shannon-Weiner diversity (H'log$_e$) values for samples from six Nyika streams.

Stream	Site	SASS 4 score	Number of invert.taxa	ASPT	H'log$_e$
A	1	161	21	7.7	2.61
	2	175	20	8.8	2.62
	3	103	12	8.6	1.98
B	1	165	17	9.7	2.11
	2	104	13	8.0	2.32
	3	86	11	7.8	2.04
C	1	137	14	9.8	2.13
	2	141	16	8.8	2.40
	3	92	13	7.1	2.25
D	1	181	18	10.0	2.67
	2	141	19	7.4	2.52
	3	103	12	8.6	2.00
E	1	150	19	7.9	2.33
	2	101	17	5.9	2.21
	3	98	14	7.0	2.15
F	1	121	16	7.6	2.34
	2	133	16	8.3	2.11
	3	148	18	8.2	2.44
Mean ±sd		130±29.9	16.27±2.98	8.18±1.05	2.29±0.22

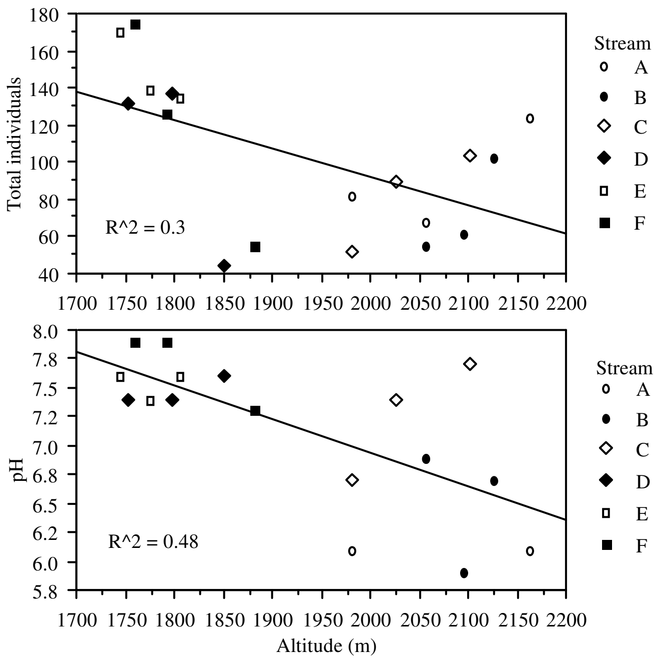

Figure 1: Regressions of total number of macro invertebrate individuals per sample and pH against altitude. Streams are marked A to F; Streams A-C represent Region A (Juniper camp), streams D-F represent Region B (second base-camp).

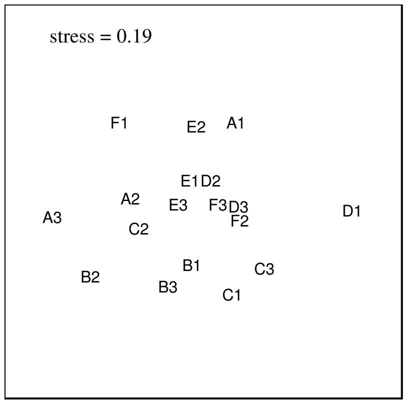

Figure 2: Non-metric multidmensional scaling plot (MDS) of 18 macroinvertebrate samples from Nyika streams. Streams are identified by letters (A-F), sampling sites by number (1-3 for each stream). Distances between samples are in proportion to their relative Bray-Curtis similarities. Thus, closer samples are more similar than distant ones. Region I sites are mostly grouped towards the lower left half of the ordination space, Region II sites towards the upper right.

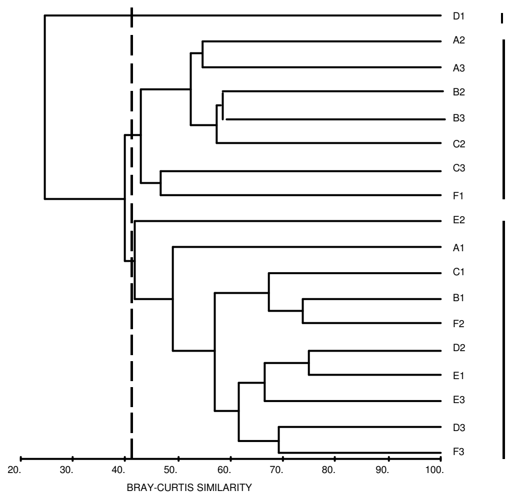

Figure 3: Dendrogram of Bray-Curtis similarities showing the relationships between macroinvertebrate samples from Nyika streams. Two main groupings are indicated at the 42% similarity level. Streams and sites are identified as in figure 2.

Table 3: Abundance and distribution of taxa found in six Nyika streams. For key to sample locations see Table 1.

	Sample																	
Taxa	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	F3
Perlidae	5	2	0	10	3	3	14	2	2	1	7	14	5	5	13	0	10	10
Baetidae	6	17	17	17	15	20	25	19	9	2	10	13	17	16	54	7	23	29
Heptageniidae	7	3	4	9	6	4	15	2	1	1	9	11	3	1	7	0	7	16
Ephemerellidae	0	6	7	3	0	7	8	7	10	1	22	39	20	10	21	1	11	27
Caenidae	12	9	5	4	0	0	0	0	0	4	7	2	11	15	5	2	4	3
Prosopistomatidae	0	0	0	3	0	0	7	0	0	1	1	0	0	0	0	0	0	0
Gomphidae	10	1	3	0	1	2	0	3	0	0	6	0	1	18	6	2	0	3
Aeshnidae	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	1
Libellulidae	0	1	2	1	2	0	0	5	1	0	2	0	2	8	5	2	0	0
Coenagrionidae	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Calopterygidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Veliidae	4	1	0	0	0	0	0	0	0	0	1	0	1	3	0	0	0	0
Hydropsychidae	23	2	0	38	9	6	20	16	9	1	22	29	21	7	28	12	44	21
Philopotamidae	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Polycentropodidae	1	2	1	2	2	4	2	0	0	1	0	0	1	0	1	0	2	0
Leptoceridae	3	2	31	2	8	0	0	8	0	0	0	0	0	0	0	1	0	0
Phryganeidae	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae	4	0	0	1	0	0	4	2	8	5	1	2	1	1	0	0	4	9
Helicopsychidae	0	4	0	0	0	0	0	0	0	1	2	1	2	0	0	3	1	5
Odontoceridae	0	3	5	1	4	0	0	2	0	1	0	0	3	0	3	13	0	9
Psychomyidae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Hydrophiloidea	1	2	0	1	0	0	0	3	2	1	1	0	1	1	0	1	1	1
Dryopoidea	2	0	2	1	1	0	1	2	0	0	1	2	2	1	4	1	0	3
Elmidae	22	1	0	0	0	0	3	0	3	0	24	1	28	1	16	3	3	5
Gyrinidae (adult)	1	2	0	0	0	0	0	0	0	3	1	0	0	2	0	1	3	0
Gyrinidae (larvae)	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Scirtidae (larvae)	12	5	0	0	0	0	0	6	3	0	0	0	0	0	0	2	1	0
Dixidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulidae	2	1	1	0	0	3	0	11	1	3	3	13	14	45	1	2	10	27
Chironomidae	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Limoniidae	0	1	0	2	3	2	1	1	1	6	0	0	0	0	0	0	1	2
Athericidae	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera indet.	3	0	0	0	0	3	0	0	0	0	6	4	1	0	0	2	1	2
Crab indet.	0	0	0	6	5	1	0	0	1	8	9	0	0	3	5	0	0	2
Catfish (Bagridae?)	0	1	1	0	2	0	0	0	1	1	1	0	0	0	1	0	0	0

HERPETOLOGY

Andy Martin

INTRODUCTION

Very little herpetological research has been carried out within the Nyika National Park, particularly in the more inaccessible valleys. There are potentially important and varied habitats amongst the myriad that make up Nyika, varying in both altitude (1250 – 2600m) and type including *Brachystegia* woodland, high montane grassland, granite outcrops, dambo marsh and relatively isolated tropical forest patches. During the expedition, we planned to look at each area visited in a structured way, whilst being aware that reptiles, particularly snakes, may present opportunities for observation outside normal surveying activities.

As a former resident of Malawi, I was aware that this was not an ideal time of the year (end of dry, cold season); temperatures during the day were warm enough, but the nights were still very cold with heavy dew. This meant that many reptiles would be only just emerging for brief thermoregulation periods, which was likely to result in a dearth of recordings.

Prior to departure to Nyika we had planned to look extensively in the south/south-eastern quadrant of the Park. Lower elevations and higher temperatures may have given us more observation opportunities. However the lowest elevation reached was 1660m/5500ft, visited briefly during the third week.

METHODS

The following methods were combined with other activities such as fresh water sampling, entomology and ornithology.

We selected a small area 25 – 50 m^2, representative of the habitat. Bushes and trees were searched first using binoculars, then the area was searched for 30–60 minutes, paying particular attention to bushes or trees any rocky crevices, termite workings, rotting wood, standing water or riverine areas. Where possible this process was repeated at different times of the day and night. It was essential to adopt a soft rolling heel/toe walk and to move smoothly, stopping regularly to observe, as reptiles are extremely sensitive to vibration and lizards and frogs have sharp eyesight. Observation of any reptile activity such as snake or lizard trails in sand or near termite workings, and collection of faeces or sloughed skins, where these were identifiable, were recorded.

Prior to identification, amphibians were placed in zip-up plastic bags with moisture and air, whilst snakes and lizards were confined to cloth bags. Once specimens were been positively identified they were photographed and released. There were no unidentifiable or uncertain specimens that needed preservation for further work.

In addition to the above search method, all groups were encouraged to look for evidence, such as sloughed skins, faecal matter, possible sightings or photographic evidence, and to record the location and habitat descriptions. Particular attention was paid to all roads and tracks for fatalities and recently burned areas for smoke victims.

Pitfall traps were considered, but due to the transient nature of our fieldwork I decided that these would be impractical.

RESULTS

The following tables denote individual specimens recorded by location:

Amphibians

Species	Location	Altitude	Number	Date
Long-toed Grass Frog. *Rana fasciata fuelleborni* Nieden	Juniper Area WD972115	2179m	1A	15.9.99
Cricket Frog *Phrynobatrachus ukingensis mababiensis* FitzSimmons	Juniper Area WD972115	2179m	1A	15.9.99
Cricket Frog *P. ukingensis mababiensis* FitzSimmons	Dambo marsh WD 972100	2179m	1Sa	15.9.99
Long-toed Grass Frog. *R. fasciata fuelleborni* Nieden	Uyagaiya Str. WD 958127	2057m	1A	16.9.99
Cricket Frog *P. ukingensis mababiensis* FitzSimmons	Upper Luviri XD 008029	1859m	20+ A+Sa	21.9.99

Reptiles

Species	Location	Altitude	Number	Date
Grey-bellied Grass Snake *Psammophylax variabilis variabilis* Günter	Juniper Area WD968112	2224m	1	15.9.99
Dwarf Gecko *Lygodactylus sp.*	Juniper Cabin WD966120	2179m	2	15.9.99
Striped Skink *Mabuya striata striata*	Juniper Path WD 965122	2179m	2	16.9.99
Dwarf Gecko *Lygodactylus sp*	Beehives XD015025	1981m	5	22.9.99
Montane Herald Snake *Crotaphopeltis tornieri* Broadley 1968	Basecamp 2 XD024027	1828m	1*	23.9.99
Large-scaled Grass Lizard *Chamaesaura macrolepis miopropus*	Juniper Chelinda Rd(rb)	2285m	2	24.9.99
Grey-bellied Grass Snake *P. variabilis variabilis* Günter	Chelinda Forest drive	2194m	1	25.9.99
Variable Skink *Mabuya varia nyikae*	Much/Tewira WC929999	1676m	4	26.9.99
Boomslang *Dispholidus typus typus* A. Smith	Tewira river WD 948033	1780m	1 –Skin	27.9.99

Key: * - New record Nyika A = Adult, Sa = Sub Adult, rb = recently burned. Str = Stream.

DISCUSSION

Although we did not record either an abundance of specimens or species, what was recorded is of interest.

The Cricket frog, *Phrynobatrachus ukingensis mababiensis* was common down to 1676m (the lowest elevation visited) and could be heard calling from any location where there was slightly marshy well-covered ground. They sound just like crickets, hence their common name. Sub adults, although similar in size to adults, exhibit a well-marked, cream-coloured dorsal stripe. This is probably Africa's smallest frog. The Long toed grass frog *Rana fasciata fuelleborni* was identified from two adult specimens, sex undetermined, and is undoubtedly quite common in dambo and marshy areas. It is however difficult to find during the day which accounts for the low number of recordings.

Three snake species were recorded, including the montane herald snake *Crotaphopeltis tornieri,* a new record for Nyika. This species is found in Malawi in similar habitat but was previously unrecorded in the Nyika National Park. This snake surfaced in Gibson Mphepo's tent at our second basecamp.

Gibson was paying us a field visit and confessed a loathing for reptiles. Unfortunately this specimen crawled into his tent during the night probably looking for warmth, a move that proved fatal (for the snake). Gibson folded up his sleeping bag in the morning and produced a rather flattened *C. tornieri* for identification. The specimen is now in the Parks preserved collection. *C. tornieri* has 17 dorsal scales at mid body, and is distinguished from *C. hotamboeia* which has 18-21. A Boomslang *Dispholidus typus typus* was identified from an almost complete skin. This snake is recorded in "The Preliminary Checklist of Reptiles of the Nyika National Park" (Appendix 1), which was presented to me by Gary Brown at Chelinda camp. It appears from this list that D.P.Critchlow is in the process of writing this up; this new record confirms its presence from another location within the Park boundary.

Lizards on Nyika are more problematic. *Lygodactylus angularis angularis* is listed in appendix 1. However, specimens collected during this expedition resemble *L. bonsi* in scalation and features, although no photograph of *L. bonsi* is available for comparison of pattern and markings. *Mabuya striata striata* is also listed in the checklist but it is possible that this may be a sub species, *M striata punctatissima*. This sub species is usually associated with the highland areas of Zimbabwe, Zambia and Malawi. Appendix 1 also lists *M. varia*, which I have noted as *Mabuya varia nyikae* as this is the race usually associated with Nyika. I have done this with reservation, as the differences between *M. varia* and *M.v. nyikae* are poorly defined. One specimen was heavily gravid. Two specimens of *Chamaesaura macrolepis miopropus* were collected from a recently burned area approximately half way between Juniper and Chelinda by Gary Brown. They were smoke victims and otherwise undamaged.

It is obvious from the above results that much work needs to be done in order to properly classify the Reptiles and Amphibians of this region. Further intensive collecting during the right season, taxonomic and DNA work will be required. I know that Gary Brown at Chelinda camp continues to collect and record whenever the opportunity presents itself. However, further field trips specifically directed at herpetology are desirable on an ongoing basis. The herpetofauna of the Nyika National Park has already proved to be both interesting and exciting, I am sure that with the right, properly managed approach, in time, the Park will surrender its herpetological secrets.

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APPENDIX 1

Preliminary Checklist of reptiles of the Nyika National Park

English Name	Latin Name	Location
Striped Skink	*Mabuya striata striata*	M*, Z
Variable Skink	*Mabuya varia*	M, Z
Large-scaled Grass Lizard	*Chamaesaura macrolepis miopropus*	M, Z
Zimbabwe Girdled Lizard	*Cordylus rhodesianus*	M
Nile Monitor	*Varanus niloticus*	M*
Ground Agama	*Agama aculeate armata*	M*
Tree Agama	*Agama atricolis*	M*
Flap-neck Chamaeleon	*Chamaeleo dilepis dilepis*	M*
Nyika Chamaeleon	*Chamaeleo goetzei nyikae*	M, Z
Ntchisi Leaf Chamaeleon (Pitless Pigmy Chamaeleon)	*Rhampholeon nchisiensis*	M
Angle-throated Gecko	*Lygodactylus angularis angularis*	M, Z
Moreau's Tropical House Gecko	*Hemidactylus mabouia*	M*
African Rock Python	*Python sebae natalensis*	M*, Z
Wolf Snake	*Lycophidion capense capense*	Z
Shire Slug-eater	*Duberria lutrix shirana*	M, Z
Mole Snake	*Pseudaspis cana*	M, Z
Grey-bellied Grass Snake	*Psammophylax variabilis variabilis*	M, Z
Rufous Beaked Snake	*Rhamphiophis oxyrhynchus rostratus*	M, Z
Spotted Bush Snake	*Philothamnus semivariegatus*	M*
Boomslang	*Dispholidus typus typus*	M*
Rhombic Egg-eater	*Dasypeltis scabra*	M, Z
Tiger Snake	*Telescopus semiannulatus semiannulatus*	M
Black-necked Spitting Cobra	*Naja nigricolis nigricolis*	M
Rhombic Night Adder	*Causus rhombeatus*	M*
Puff Adder	*Bitis arietans arietans*	M*
Rungwe Bush Viper	*Atheris nitschei rungweensis*	Z
Montane Herald Snake	*Crotaphopeltis tornieri*	M**

* Indicates unpublished records to be written up by D.P. Critchlow
** Indicates unpublished records to be written up by A. J. Martin

M = Malawi Nyika National Park
Z = Zambia Nyika National Park

List excludes records of Boulenger (1897) Proc. Zool. Soc. Lond. 1897:800-803

BIRD LIST

Andy Martin, Rod Lindenbaum, Mark Bilsland

One person in each group recorded birds seen whilst in the Nyika National Park (10-29 September 1999). The following list, in vous order, is as they appear in the Checklist of the Birds of Malawi (Medland, 1994) and is an amalgamation of all positive identifications made.

Grey Heron
Hamerkop
Lappet-faced Vulture
White-backed Vulture
Gabar Goshawk
Augur Buzzard
Steppe Buzzard
Martial Eagle
Black Eagle
Yellow Billed Kite
Red-necked Francolin
Common Quail
Helmeted Guineafowl
Denham's Bustard
Dusky Turtle Dove
Cape Turtle Dove
Blue-spotted Wood Dove
Schalow's Loerie
Purple crested Loerie
Grey Loerie
White-browed Coucal
Grass Owl
Scops Owl
Spotted Eagle Owl
Mountain Nightjar
Pennant-winged Nightjar
African Palm Swift
Bar-tailed Trogon
Malachite Kingfisher
Carmine Bee-eater
Lilac-breasted Roller
Hoopoe
African Grey Hornbill
Trumpeter Hornbill
Black-collared Barbet
Olive Woodpecker
Fork-tailed Drongo
African Golden Oriole
Pied Crow
White-necked Raven
White-winged Black Tit
Black-eyed Bulbul
Olive-breasted Mountain Bulbul
White-browed Scrub Robin
Cape Robin
Heuglin's Robin
African Yellow Warbler
Singing Cisticola
Spotted Flycatcher
White-tailed Blue Flycatcher
African Paradise Flycatcher
Grey-headed Bush Shrike
African Pied Wagtail
Grassveld Pipit
Fiscal Shrike
Souza's Shrike
Lesser Blue-eared Starling
Plum-coloured Starling
Green-headed Sunbird
Scarlet-chested Sunbird
Greater Double-collared Sunbird
Miombo Double-collared Sunbird
Yellow White-eye
African Masked-Weaver
Spectacled Weaver
Black Widowfinch
Broad-tailed Paradise Whydah
Common Waxbill
Golden-breasted Bunting

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LARGE MAMMAL SURVEY AND POACHING REPORT

Phil Watson and Marianne Overton for analysis and comparison of data

Field Workers: Monty Halls, Tooni Mahto, Rod Lindenbaum, Mark Bilsland, Claire Wells, Mary-Anne Bartlett and Steven Gondwe

ABSTRACT

Five 1km square plots were surveyed from the Juniper Forest basecamp in the first week. Randomly allocated sub-plots (100 m x 100 m) were used to obtain RAS values as described in previous years reports. In the second week, 20 sub-plots (of size equivalent to 100 m x 100 m) were surveyed during a five day trek from the Juniper Forest basecamp to the new basecamp at the south-east edge of the Plateau (Vitumbe area). No surveys were conducted in the third week, although a group visited a third area of the Park. (Tewira/Muchindisi confluence).

Poaching activity was high with numerous campfires, drying areas, shelters, snares, etc discovered throughout the three weeks in the field. Shots were fired at poachers on five occasions and in one incident a handmade shotgun and dried meat confiscated.

Fires apparently started by poachers became widespread in the third week, with large areas burnt within a few hours. Burnt carcasses of small mammals were confiscated with the dried meat.

The DNPW scouts rarely visit the southern part of the Park. This situation is unlikely to change unless access is improved and more scouts employed to patrol the Park. The success of the Park – both financial and ecological – is highly dependent on adequately resourced, motivated game scouts. It is also important that the local population surrounding the Park is concurrently given a financial stake in the success of the Park.

The expedition encountered a number of significant problems with the RAS system. Many of these problems were discussed in the 1997 expedition report. The information obtained by several expeditions to date has proved useful in helping to highlight the severe poaching pressures. Direct measures to reduce poaching should now receive the highest priority.

INTRODUCTION

The Nyika Biodiversity Expedition 1997 developed a semi-quantitative scoring system – relative abundance score (RAS) - for the estimation of large mammal populations in the Nyika National Park. RAS values cannot be directly related to animal population size, but can be used for comparing animal populations – geographically (i.e. between locations) and temporally (i.e. within same location, but over time).

Previous expeditions have surveyed the northern hills and the plateau near Chelinda. This expedition surveyed an area within the southern extension of the Park created in 1972. In the first week, twenty-five 1000 m^2 subplots were surveyed over five days. Scouts were unavailable for the first two days, and the group retained samples for further identification. In the second week, twenty subplots of 1000m^2 were surveyed en route from Juniper forest to the new basecamp over five days. Game scouts very rarely visit this part of the Park. The terrain proved to be physically demanding and progress could be very slow. In the third week, no surveys were conducted in order to complete other projects. All groups recorded evidence of poachers throughout the expedition.

AIMS

To assess the large mammal population and obtain RAS scores for the southern extension to the Nyika National Park.

To assess the level of poaching and suggest possible future strategies for the Park.

METHODS

Surveys – faeces, tracks and signs were recorded as previously described. It was decided not to do random squares, but to select kilometer squares that appeared to be representative of the terrain. Thus fewer squares would be needed to obtain a representative sample. Previous work using random plots has suggested that 50 plots of 100 m x 100 m, in about 10 x 10 km within a valley of about 10km x 10km square would obtain a reasonably representative sample. The terrain, habitat type and state of the vegetation could profoundly affect the group's ability to survey the area. For example, the suggestion that the area should be marked out with poles may be useful in grassland plots, but is of no use in dense vegetation and forest. It is also almost impossible to survey dense forest vegetation and these areas were avoided. In the second week, time constraints were overcome by surveying 200m x 50m plots selected en route.

Week 1 – Juniper Forest
5 randomly selected 1 km^2 plots were surveyed from the initial basecamp at Juniper forest. These plots were assessed by surveying 5 randomly selected subplots of 100m x 100m per 1 km^2 plot.

Week 2 – Trek to New Basecamp
20 plots of 100mx100m were surveyed during the 5 day trek. These subplots were not selected randomly, but were chosen en route as representative of the surrounding habitat.

A total of 43 plots were surveyed. These were in 10 separate kilometer squares, spread over approximately 100 $km^{2.}$ Fourteen of the plots had been recently burned and another one was half-burned. Almost all of these burned plots were in three kilometer squares, mainly high altitude grassland, near the Juniper Forest basecamp and ranged in altitude from 6850ft to 7350ft. A further 28 plots were surveyed in an altitude range of 6000ft to 7700ft.

RESULTS

The Relative abundance scores for large mammals is shown in Table 1.

Table1: Relative Abundance Scores for large mammals in 100mx100m plots.

Plot	Map Ref.	Habitat	Burn	Alt (ft)	Ela	Ro	Rb	Bb	D	Kp	W	Bp	Le	Se	Hy	Ci	J	Ba
1	94/09	Mx G,B,T,S	Recent	6900 – 7350	3		4											
1		Mx G,B,R	Recent		2	1	10		1	4			1		1			
1		Mx G,B	Recent			1		4				1						
1		Mx G,R	Recent						25									
1		Mx G,B,MW	Recent		2		1	1	1									
				Total	7	2	15	5	27	4	0	1	1	0	1	0	0	0
2	92/08	W	Unburnt	6600 – 7000	1				45			3	1		1			
2		Mx W,G	Unburnt			1			1									
2		W	Unburnt			1			49									1
2		W	Unburnt						4						1			
2		W	Unburnt						5									
				Total	1	2	0	0	104	0	0	3	1	0	2	0	0	1
3	98,08	Mx G,B	Recent	6900 – 7200				3	8		1							
3		Mx G,B,MW	Recent						9		3				1			
3		G,P	Recent						6		1							
3		G,M,S	Unburnt					4	1			1				2		
3		G, B	Unburnt															
				Total	0	0	0	7	24	0	5	1	0	0	1	2	0	0
4	97/06	Mx G,B,MW	Recent	6850 – 7300	3				4									
4		Mx B,G,MW	Recent		3				9		1					1		
4		G	Recent						7									
4		G,T	Recent															
4		Mx G,B,MW,P	Recent					1	5									
				Total	6	0	0	1	25	0	1	0	0	0	0	1	0	0
5	99/10	G	Unburnt	7250 – 7700			1		2		4							
5		G,MW	Unburnt						2		1							
5		G,MW	Unburnt				1	2	3									
5		G	Unburnt					2	4								1	
5		G,B,R	Unburnt						4	2								
				Total	0	0	2	4	15	2	5	0	0	0	0	0	1	0

Table 1: Continued

Plot	MapRef.	Habitat	Burn	Alt (ft)	Ela	Ro	Rb	Bb	D	Kp	W	Bp	Le	Se	Hy	Ci	J	Ba
6	90/08	Mx G,W	Unburnt	5900 – 6500		2			1			1						3
6		W	Unburnt		1				2			9					1	3
6		Mx G,W	Unburnt						1			5						3
6		G	Unburnt		2													
6		G	Unburnt		1							1						
				Total	4	2	0	0	4	0	0	16	0	0	0	0	1	9
7	88/05	G,B	Unburnt	6000 – 6600					2			1						
7		G,P	Recent					4	4									
7		Mx W,F,G	Unburnt						3		1	4						7
				Total	0	0	0	4	9	0	1	5	0	0	0	0	0	7
				Adjusted Total	0	0	0	7	15	0	2	8	0	0	0	0	0	10
8	88/01	W	Unburnt	5500 – 5900					4			1						1
8		W	Unburnt						9			1						
				Total	0	0	0	0	13	0	0	2	0	0	0	0	0	1
				Adjusted Total	0	0	0	0	33	0	0	5	0	0	0	0	0	3
9	91/03	Mx G,W,B,V	Unburnt	5750 – 6250					25		1							
9		Mx W,G,V	Unburnt		1	2		1	4			3						
9		W,F,V	Unburnt						10		1	2						3
9		W	Unburnt		1				14			3						3
9		W	Unburnt						17		3	9						2
				Total	2	2	0	1	70	0	5	17	0	0	0	0	0	8
10	95/04	Mx W,F,G	Unburnt	6250-6850					4		2	4						
10		G,B,T	Unburnt									3						
10		G,W	Unburnt						18									
10		G,P	50% Recent					1	2									
10		G,B,T	Recent		3			6	10									
				Total	3	0	0	7	34	0	2	7	0	0	0	0	0	0

Key:
Mx = habitat mixed together indistinctly
(otherwise habitats have distinct boundaries)
G = grassland
B = bush/scrub
P = protea
MW = montane woodland = evergreen forest
T = scattered trees
W = *Brachystegia* woodland

F = fruit trees
R = rocks
S = stream
M = marsh
V = village site

Ela = Eland
Ro = Roan
Rb = Reedbuck
Bb = Bushbuck
D = Duiker (Common and Red)
Kp = Klipspringer
W = Warthog
Bp = Bushpig
Le = Leopard

Ci = Civ
Se = Se
Hy = Hy
J = Jack
Ba = Ba
P = Porc
Aa = Aa
Mg = Mo
G = Gen

Figure 1: Comparison of large mammal activity visible in burned and unburned areas in the SE of the Nyika National Park

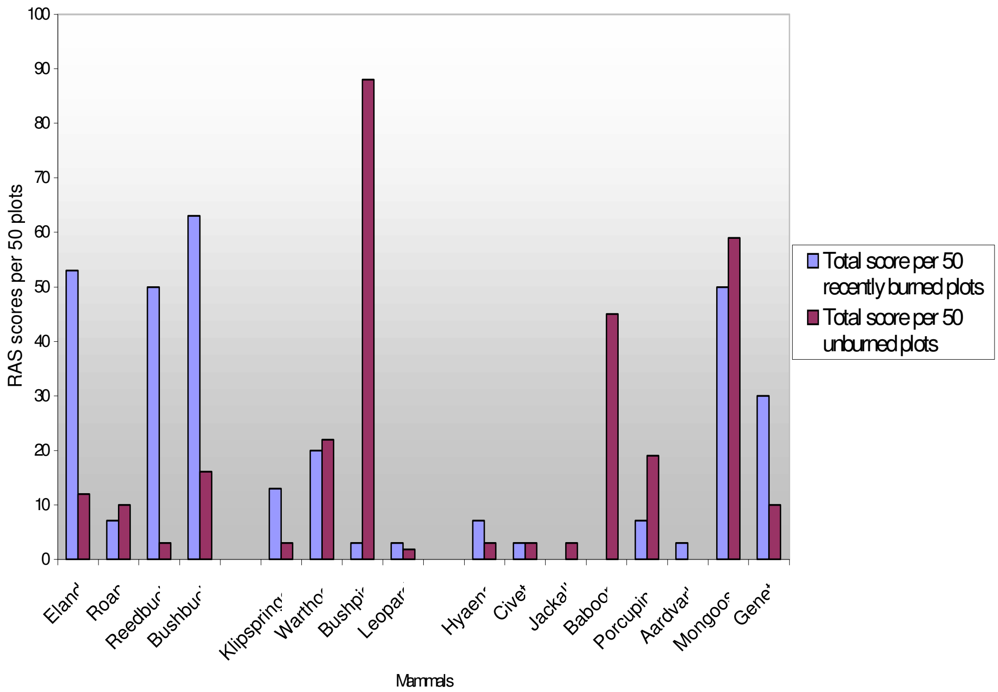


Table 2: Comparison of burned and unburned areas using the RAS scores of activity per 50 plots.

	Burned	Unburned
*Common Duiker	318	418
Total all other species	336	311
Total of all species	654	729

*Signs of the Common Duiker are overwhelmingly the most common and were therefore excluded from the graph but included here.

Comparison of visible large mammal activity in recently burned and unburned areas

The overall number of signs for all species is much the same in burned and in unburned areas as shown in Table 2 . However, figure 1 shows that signs of some species are noticeably more common in areas that have been recently burnt. These are the Kudu, Reedbuck, Bushbuck and Genet. (Records of the Aardvark, Klipspringer, Jackal, Porcupine and Leopard were recorded in too few plots for meaningful comparison.)

Either these four species are more active in the recently burned areas, or the signs are simply more easily detected. The grass had not yet greened and was not much attraction for grazing. Some signs, such as grazing and damage, would be destroyed by burning, whilst others, such as droppings, would not.

Signs of some species are noticeably more common in the unburned areas, particularly the Duiker, Baboon and Bushpig. Presumably they are avoiding the recently burned areas, where they would be visible to predators. The Common Duiker does produce many scattered droppings giving it high RAS scores, which would remain even after burning and would account for the high score in these areas.

Comparison of data with previous expeditions

Biosearch Nyika have carried out a number of large mammal surveys on previous expeditions.

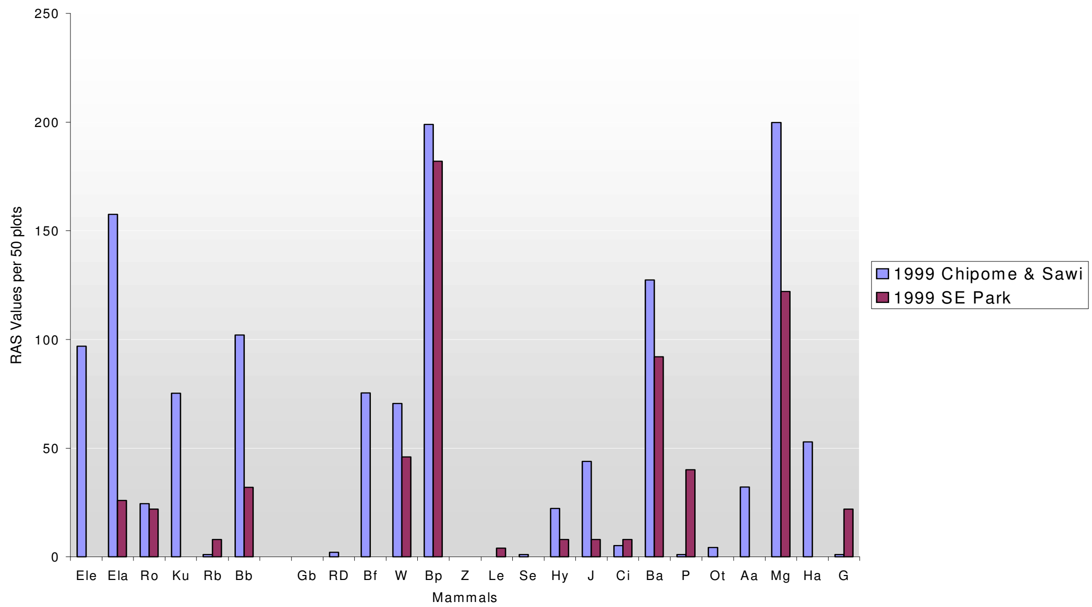
Table 3: Number of plots surveyed previously

Year	No. of plots	Natural Zone	No. of plots
1997	110	Nganda	57
1998	137	Chipome	147
1999	97	Sawi	105
		Area between Chipome and Nganda	25
		Plateau	10
Total	344	Total	344

In the case of each species, the relative abundance scores (RAS) for each plot have been added to a total for each zone. The aim was to do 50 plots in each zone. Where this has not quite been achieved, the total score has been weighted to an RAS score per 50 plots, thus enabling direct comparison of total scores for each species.

In particular, a separate expedition carried out the same survey procedure earlier in the same season, but in the northern hills off the edge of plateau at the opposite end of the Park. In figure 2, the relative abundance scores per 50 plots are shown for each species. This is based on survey data from 44 plots in the south-eastern hills of the Park and 97 plots in the northern hills of the Chipome and Sawi Valleys. Symbols key as in Table 1.

Figure 2: Comparing evidence of large mammal activity in two areas



For most species, the relative abundance scores are much lower in the south-eastern area than the northern area, with some species being absent altogether.

In the south-eastern area signs of Elephant, Eland, Kudu, Bushbuck, Buffalo, Warthog, Aardvark and Hare appeared to be much fewer. Notably, Elephant, Kudu and Buffalo were not recorded at all. Fewer species overall were recorded in the south-east area (16), than in the northern area (22).

Only the Bushpig, Baboon and Mongoose showed fairly similar levels of activity in the two areas.

The species that scored highest of all in all studies was the Common Duiker, more common in the south-eastern area. (RAS score of 836, compared to 634 in the northern area). The name Duiker comes from the Afrikaans for "diver" referring to its habit of bounding into hiding. It is known to survive well close to human habitation, protected from predators and able to hide from humans. A large Duiker population could indicate a lack of predators. More work on the leopard populations would be useful. The Duiker is a species taken by poachers, but perhaps other predators are more important in shaping their populations. As in the previous graph, this species is extracted from the graph for clarity. Baboon populations could also be similarly affected by a lack of leopard predators.

Reedbuck, Grysbok, Red Forest Duiker, Zebra, Leopard, Serval, Civet, Otter and Genet were recorded in too few plots for meaningful comparison of abundance. Poached remains of a dead Zebra was found in the south-eastern area, but it is possible that it was carried there from the plateau. Zebra is believed to move down into the valleys in the dry season (Johnson 1990) but populations were certainly too low to be recorded and no signs appeared in any of the plots.

Poachers

There were four sightings of poachers during the expedition and the game scout fired shots on each occasion.

In one incident, involving a group of nine poachers, a home-made shotgun and rounds were confiscated. Some meat and other artefacts were also recovered. Zebra, Eland and Duiker had been killed and butchered. Some small mammals, which had been burnt in a fire, were also recovered. A grassland fire, which had probably been started by this group of poachers, burnt an area of approximately 10km by 5km. This fire spread extremely quickly – there had been no evidence of fire in this area which had been traversed by an expedition group only 3 hours earlier. Extensive grassland fires covering very large areas of the Park were seen regularly throughout the expedition, but became particularly numerous in the third week in the south-east of the Park.

Other evidence of poachers was also widespread: campfires, pottery, snares and tracks were discovered in all the areas covered by the expedition and are shown in Table 4.

Generally during week three there was numerous evidence of poachers, in the form of tracks and campfires and the main evidence is listed in Table 4.

During week three we observed evidence of the following game: Common Duiker, Bushbuck, Bush pig, Porcupine, Roan tracks and three sighted and Baboon sighted. A general comment would be that there was far less evidence of game in the southern area than in the Juniper Forest Area and far more evidence of human activity.

A personal view of the poaching problem: P. Watson

Nyika NP should have two main aims: (a) to maintain a balanced and varied ecosystem; and (b) to generate income for the local and National economies. The two are interlinked; ecotourism has great potential for generating income and attracting investment. Nyika offers an unusual combination of tourism opportunities: pony-trekking, walking, wilderness camping, and game viewing in an environment that is relatively safe and benign for overseas visitors.

Table 4 :Anti-poaching patrol report

Week	Grid Reference	Sign of Poachers
1	WD 941/098	Campfire, maize, pottery
1	WD 945/094	Trail, snare
1	WD 949/091	Old campfire, pottery, cut stick
1	WD 934/090	Campfire, pottery
1	WD 974/068	Recent footprints
1	WD 965/075	Well worn trail
1	WD 997/100	Maize
1	WD 995/080	Four poachers sighted, shots fired
1	WD 955/146	Drying racks
2	XD 008/027	Campfire, drying racks
2	XD 015/036	Campfire, hut, drying racks
2	XD 008/011	Campfire, spoon
2	WD 980/035	Campfire
2	WD 917/037	Diggings, tracks
2	WD 911/032	Tracks, cut tree
2	WD 020/090	Hut, campfire, pottery, drying racks
2	WD 885/015	Tracks
2	WD 900/085	Tracks
2	XD 030/010	Illegal honey collection
2	XD 024/027	Three poachers sighted, shots fired
3	Kasaramba Forest area	Nine poachers, meat and shot-gun confiscated, Shots fired
3	Juniper forest Chelinda road	Two poachers sighted, Shots fired
3	WD 962/032	Illegal Honey near disused village
3	WD 965/015	Fresh poachers footprints following fresh Roan tracks
3	WC 955/995	Poachers drying racks, campfire inside huge termite mound – indestructible.
3	WD 942/027	Poachers shelter/drying rack – destroyed
3	WD 951/032	Poachers shelter/drying rack – destroyed

The status of a National Park and the impact on a visitor is often judged on the presence and abundance of large mammals. Undoubtedly, the high density of poachers has had a significant impact on the numbers of game and its ease of viewing. Inevitably, this reduces the attractiveness of the Park and hence the number of visiting tourists. Consequently, income from the Park cannot be maximised.

Previous habitation of the Park may have had some effect on the attitude of local people to the Park – probably leading to a deep-rooted tradition in utilisation of the Park's resources. In the past, game hunting was apparently for family consumption only, whereas now poaching is driven by financial gain. The poaching pressure is therefore unlimited.

It is hoped that people in surrounding villages could raise some income through ecotourism, rather than through killing the game. It may take generations and extensive education to have a significant impact. The programme of educating and involving children from an early age is perhaps the best safeguard the future of the Park.

The National Park could perhaps act as a focus and as a marketing tool for local produce to the overseas market. Nyika NP could become a brand name for local crafts and open a market that would otherwise be closed to people in northern Malawi. I would like to see this type of trade greatly expanded to include not only visitors to the Park, but visitors to Malawi and wider through charitable organisations (such as WWF and Oxfam) and perhaps companies (e.g. Body Shop). Partnerships with villages in the production of goods could allow a greater percentage of the final sale price to return to the local population. Co-operation and the involvement of villages could be linked to the protection of the Park and absence of poaching.

In the meantime, the role of scouts and their extended families could be enhanced. The scouts are central to any anti-poaching strategy. This should be recognised by making the game scout a highly respected position - by salary and fringe family benefits e.g. enhanced family education. Bonuses should be paid for successful operations - confiscation of firearms, arrests, number of days in the field, etc. Engendering a feeling of ownership and giving a long-term stake in the future will provide healthy motivation to see the Park succeed. National Park employees' families are an important human resource that should be developed fully to serve all the future needs of the Park – scouts, tourism, crafts, etc.

There should also be severe repercussions (demotion, loss of post or prosecution) for any abuse of the position or incompetence. A culture of high reward for good performance should be paramount. This could also be assessed externally so as to prevent favoritism, nepotism or corruption. At present, the number of scouts is inadequate. Large areas of the Park are unpatrolled, and the morale of the scouts will be affected by the knowledge that anti-poaching efforts are sub-optimal.

The area's status as a National Park helps to prevent severe environmental degradation. However, the greatest threat to the maintenance of a balanced ecosystem is the widespread yearly fires, which may have a significant effect on the distribution of vegetation. It seems that poachers start the vast majority of these fires as an aid to hunting. Therefore, in the long term, poaching activity may have a significant impact on the environmental balance in addition to directly threatening the large mammal populations.

The anti poaching measures therefore have two aims – (a) increasing large mammal populations to attract more tourists; and (b) to reduce the numbers of fires so as to safeguard the balanced ecosystem and prevent logging.

The privatisation of the tourist facilities at Chelinda appears to have had a positive effect on increasing tourism and tourist revenue. Expansion of the facilities at Chelinda is in progress and this should bring more paid work derived from ecotourism. The extra income paid to the Parks authority is needed in the Nyika National Park, if the resource is to be conserved.

The large mammal population appears to be most dense around the tourist facilities, perhaps as a result of increased protection. Increased tourist activity in other areas of the Park would probably help provide wider protection and increase large mammal populations elsewhere.

Nyika National Park offers a variety of habitats in one location, unlike many African game Parks. The potential for attracting tourists to Nyika and northern Malawi is great. However, the paucity of game in comparison to other Parks and the inaccessibility of the different ecosystems away from the grassland plateau would significantly hamper tourism. Improvement in the road infrastructure within the Park so as to include a variety of ecosystems and the reintroduction of previously endemic wildlife (for example rhinoceros) and enhanced protection of large mammal species present in low numbers would help increase tourism in the long-term. Nyika NP requires resources and people with skill, imagination and determination to make the area a success.

RECOMMENDATIONS

The number of scouts, their rewards and career structure is fundamental to the anti-poaching strategy. Resources should be increased in support of the anti-poaching effort. The number of scouts should be at least doubled and a system for rewarding good performance should be implemented.

The scouts should be trained in map reading. Plotting of poachers' tracks and camps would help in the strategic deployment of patrols.

Sub camps and mobile observation posts at strategic points should be reconsidered if reliable support in terms of transport, pay, food etc can be provided.

A reproducible, reliable system would facilitate park management decisions and enable better monitoring of interventions and outcomes. However, it should be recognised that all ecological sampling techniques are inherently variable. Ground conditions, season, vegetation and animal behaviour may all affect the RAS scores. In addition, the use of untrained expedition personnel as recorders and trackers may lead to variation in the accuracy of the surveys. Therefore, a large quantity of data needs to be obtained to allow an accurate assessment of animal populations. This would require significantly more resources - time and personnel, which Nyika NP does not posess. However, it is vital that all areas of the park are patrolled and a simpler less time consuming survey technique would be beneficial in this regard.

If the scouts were visiting an area perhaps monthly, they could record recent tracks, fresh faeces and mammal sightings, in order to give a more fluid picture of animal movement and utilisation of the Park that may be of interest to visitors.

Visitors should be encouraged to maintain an interest in the Park by the production of a trust/membership club that could produce annual newsletters, etc. This would help to promote the Park and could potentially generate additional resources. It could also be used as advertising material for local companies (safari operators) and produce from village co-operatives. This could be coordinated by the Wildlife Society of Malawi or other interested body.

BOTANY

Hassam I. Patel and Marianne J. Overton

ABSTRACT

Three weeks fieldwork in the south-eastern part of the Nyika National Park have identified a further seventy-nine species to add to the species list for the Park. A few quadrats were studied in each of three natural areas covered by the expedition to help characterise the vegetation and thus assist the Termite and Freshwater aquatic studies also reported in this volume. Four hundred and twenty-five species were identified and 103 specimens were added to the reference collection at the National Herbarium and Botanic Gardens at Zomba. The fieldwork was done by Hassam Patel.

INTRODUCTION

There was a successful nine - week scientific expedition to the remote northern hills of the Nyika National Park in 1972. (Wye College, 1972). Three of that team have again collaborated on the botany on a further three expeditions, now culminating in a species list for the Park. They are Peter Overton who also initiated and organised the current project, Dr Dick Brummitt, of The Royal Botanic Gardens at Kew and Hassam Patel of the National Herbarium and Botanic Gardens at Zomba in Malawi, now based in Mzuzu. This expedition was the last prior to production of the full species list to date. The list covers just under 1,500 species confirmed by personnel of the herbaria at Kew in the UK or Zomba, in Malawi and includes a few specimens yet to be named and formally described. This full list is published separately and is available from Biosearch Nyika.

Produced here is the botanical work from the most recent expedition in September 1999 to the south-east of the Park from Juniper Forest Area working from the plateau and away to the hills of the south and south-east.

AIMS

The forest communities of the Juniper Forest Area of the Nyika National Park has been previously studied in some detail, notably by Dowsett-Lemaire (1985) and also Chapman and White (1970). Robson in 1958 made collections from the areas accessible from the plateau and including the Zambian side of the Park. Dr R. K. Brummitt made additional collections in 1970 and 82. Three previous expeditions by Biosearch Nyika collected records and specimens from the northern hills (1997, 1998 and 1999).

This fourth expedition by Biosearch Nyika aimed at contributing to establishing a species list for the Nyika National Park. This meant emphasis on noting any previously unrecorded species and collecting botanical material to supplement the reference collections in Malawi. Some indication of the species common in each of the three areas visited in the south-eastern part of the Park was obtained using quadrats in a limited way, mainly to assist other projects.

SITE DESCRIPTIONS

A good overview is given in by C. B. Cottrell earlier in this report. The quadrat data was collected in the vicinity of the termite transects providing an additional benefit in supplementing that study. The locations of the termite transects were selected as representative of the local habitats. These descriptions are based on those given earlier by S. Donovan and discussions with A. Martin.

Juniper Forest

Elevation 7250 ft/ 2210 m, 10°44'51"S 33°53'E (OS Grid ref. 965 120 Map Sheet 1033 – D4 Muhuju) within the firebreak, which is effective. This relatively small (18 ha) forest fragment is a combination of natural regeneration and mature Juniper forest. Adjacent are afromontane grasslands. The forest has a complete canopy, a thick leaf litter and root layer, peaty soil and is on a slope. The grassland is much more open, with little leaf litter and eroded soil.

Vitumbi Area

Elevation 6250 ft/ 1905 m, 10°49'08"S 33°56'05"E. (OS Grid ref. 026 035 Map Sheet 1033 – D4 Muhuju) This is an area of miombo or *Brachystegia speciformis* woodland, with low trees and mainly grass beneath. There is little leaf litter and much eroded bare earth, baked to a crust. It had been previously burned, probably more than a year before. This location was on a steep slope.

Tewira River/Murchandisi River Confluence

Elevation 5500 ft/ 1676 m, 10°51'24"S 33°51'E. (OS Grid ref. 928 998 Map Sheet 1033 – D4 Muhuju) This is an area of mixed miombo or *Brachystegia* woodland, with very dry grass cover (*Eragrostis* sp. and *Themeda* sp.). There is no evidence of burning within the past 3 years.

METHOD

To help define vegetation communities in the northern hills on previous expeditions about forty random quadrats, sized 5 m x 5 m have been used in each habitat area. On this expedition, the same method was applied, but using only a fifteen quadrats, just to give a indication of the vegetation type. New reference specimens were collected and pressed. Painstaking care was taken to ensure the paper leaves between specimens were changed and dried daily to ensure the most rapid possible drying of the specimens and thus the best preservation.

RESULTS

Although the quadrats give an impression of the vegetation, not enough were completed this time to make conclusions. The number of species in each of the three areas studied was not dissimilar. 191 at Juniper Forest, 160 in the Vitumbi area, and 218 in the Tewira/Murchandisi confluence. The species most commonly recorded in each habitat area are shown in tables 1-4.

Seventy-nine species were identified that had not been previously recorded in the Park. These are listed in Table 5. Thirty of these are amongst the specimens collected on this expedition and now placed at the National Herbarium and Botanic Gardens in Zomba, Malawi.

Table 1: Species most common in the Juniper Forest Area
(recorded in at least three of the six plots)

Acanthus montanus
Agauria salicifolia
Artemisia afra
Buddleja salviifolia
Diospyros natalensis
Diospyros whyteana
Dissotis princeps
Halleria elliptica
Heteromorpha trifoliata
Inula glomerata
Maesa lanceolata
Myrica salicifolia
Myrica serrata
Mystroxylon aethiopicum
Osmunda regalis
Pittosporum viridiflorus
Pteridium aquilinum
Rapanea melanophloeas
Rhus longipes
Schefflera abyssinia
Syzygium cordatum
Syzygium guineense

Table 2: Species most common in the Vitumbi area
(recorded in at least three of the four plots)

Aeschynomene nyassana
Alectra sessiflora
Allophylus chaunostachys
Blepharis grandis
Brachystegia spiciformis
Erythrocephalum
zambesianum
Helichrysum kirkii
Hyparrhenia cymbaria
Hypericum revolutum
Imperata cylindrica
Inula glomerata
Macrothloma axillare
Philippia benguelensis
Protea angolensis
Psychotria mahonii
Pteridium aquilinum
Rubia cordifolia
Smilax kraussiana
Syzygium guineense
Temnocalyx obovatus
Themeda triandra
Vernonia cinerea

Table 3: Plants most common at the confluence of the Tewira and Murchandisi Rivers (recorded in at least three of the five quadrats)

Allophylus chaunostachys
Aspilia kotschyii
Aspilia mossambicensis
Becium grandiflorum
Beckeropis uniseta
Brachystegia boehmii
Brachystegia longifolia
Brachystegia spiciformis
Brachystegia utilis
Clematopsis chrysocarpa
Combretum molle
Cryptosepalum maraviense
Cucumis sp.
Dolichos kalimandscharicus
Dombeya rotundifolia
Droogmansia pteropus
Erythrina abyssinica
Erythrocephalum zambesianum
Exotheca abyssinica
Faurea saligna
Gardenia subacaulis
Helichrysum kirkii
Hyparrhenia cymbaria
Hyperthelia dissoluta
Indigofera fuscosetosa
Indigofera lyallii
Inula glomerata
Maytenus senegalensis
Melinis minutiflora
Monotes africana
Ozoroa insignis
Phoenix reclinata
Protea madiense
Psychotria kirkii
Schrebera trichoclada
Themeda triandra
Uapaca kirkiana
Vernonia cinerea
Vernonia poskeana
Vicoa auriculata
Ziziphus mucronata

Table 4: Species most common in all three areas
(recorded in at least seven out of 15 quadrats)

Agauria salicifolia
Brachystegia spiciformis
Dissotis princeps
Erythrocephalum
zambesianum
Faurea saligna
Helichrysum kirkii
Hyparrhenia cymbaria
Inula glomerata
Syzygium cordatum
Themeda triandra
Vernonia cinerea

Table 5: Species new to the Nyika National Park found in the south-east of the Park in Sept. 1999

Family	Species name
Acanthaceae	Acanthus montanus
Aquifoliaceae	Ilex mitis (L.) Radlk.
Chrysobalanaceae	Parinari excelsa
Compositae	Crepis hypochaeridea (DC.) Thell.
Compositae	Dicoma plantaginifolia O.Hoffm.
Compositae	Erlangea abyssinica
Compositae	Felicia boehmii O.Hoffm.
Compositae	Helichrysum laxifolium
Compositae	Helichrysum tillandsiifolium O.Hoffm.
Compositae	Lactuca inermis Forssk.
Compositae	Mikania cordata
Compositae	Nidorella wightii
Compositae	Sonchus eminii
Compositae	Spilanthes mauritiana (Rich. ex Pers.) DC.
Compositae	Vernonia nestor S.Moore
Crassulaceae	Kalanchoe lanceolata Pers.
Cyperaceae	Coleochloa sp.
Cyperaceae	Cyperus adenophorum
Cyperaceae	Cyperus aethiops Ridley
Droceraceae	Drosera madagascariensis DC.
Ebenaceae	Diospyros natalensis
Ebenaceae	Euclea crispa
Erythroxylaceae	Erythroxylum emarginatum
Escalloniaceae	Choristylis rhamnoides Harv.
Euphorbiaceae	Croton magalobotrys
Fern	Cyathea dregei
Fern	Dryopteris sp.
Flacourtiaceae	Aphloia theiformis (Vahl) Benn.
Gramineae	Acroceras macrum
Gramineae	Agrostis sp.
Gramineae	Beckeropis uniseta
Gramineae	Festuca abyssinica
Gramineae	Oplismenus burmannii
Gramineae	Stereochlaena cameronii
Gymnosperm	Podocarpus milanjiana
Hypoxidaceae	Hypoxis villosa
Labiatae	Haumaniastrum callianthum (Briq.) Harley
Labiatae	Leucas martinicensis
Labiatae	Pycnostachys schweinfurthii
Leguminosae-Papilionoideae	Aeschynomene rubrofarinacea (Taub.) F.White
Leguminosae-Papilionoideae	Crotalaria natalitia
Leguminosae-Papilionoideae	Eriosema englerianum Harms
Leguminosae-Papilionoideae	Indigofera thomsonii Bak.f.
Leguminosae-Papilionoideae	Kotschya aeschynomenoides (Welw.ex Bak.) De Wit & Duvign.
Leguminosae-Papilionoideae	Lablab purpureus (L.) Sweet subsp.uncinatus Verdc.
Leguminosae-Papilionoideae	Tephrosia sericea
Leguminosae-Papilionoideae	Vigna axillaris
Leguminosae-Papilionoideae	Vigna luteola (Jacq) Benth
Malvaceae	Hibiscus panduriformis
Meliaceae	Lepidotrichilia volkensii
Melianthеaceae	Bersama zombensis
Menispermaceae	Cissampelos mucronata
Oleaceae	Schrebera schellenbergii
Orchidaceae	Herschelianthe baurii (H.Bol.) Rausch.
Palmae	Phoenix reclinata

Piperaceae	Peperonia tetraphylla (G.Forst.) Hook & Arn.
Ranunculaceae	Clematopsis scabiosifolia
Restionaceae	Restio sp.
Rhamnaceae	Rhamnus ricinocarpa
Rosaceae	Pygeum africanum
Rubiaceae	Keetia guenzii
Rubiaceae	Lasianthus kilimandscharicus
Rubiaceae	Lelya prostrata (R.Good) W.H.Lewis var.prostrata
Rutaceae	Teclea nobilis Del.
Santalaceae	Osyris compressa (Berg,) A.DC.
Santalaceae	Thesium cymosum A.W.Hill
Sapindaceae	Lecaniodiscus fraxinifolius
Scrophulariaceae	Buchnera speciosa Skan.
Scrophulariaceae	Lindernia comosa
Scrophulariaceae	Orobanche sp.
Scrophulariaceae	Selago thomsonii Rolfe var. whyteana (Rolfe) Brenan
Scrophulariaceae	Sutera sp.
Sterculiaceae	Melhania randii Bak.f.
Tiliaceae	Grewia macrantha
Ulmaceae	Trema orientalis
Umbelliferae	Heteromorpha trifoliata
Verbenaceae	Clerodendrum buchananii
Verbenaceae	Clerodendrum capitatum
	Stachys aulesta

CONCLUSIONS

This is the first time Biosearch Nyika has studied the Juniper Forest Area. September is late dry season and much burning was seen on the upper slopes. Yet, there has been considerable addition to the records. The four species with only a genus noted are those which have no match in the herbarium at Zomba and may be new species, yet to be confirmed.

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