Sustainable Biodiversity Management in Wetlands of Northern Zambia

Glasgow/ Aberdeen Universities Zambia Expedition 2008

GAUZE08

Expedition Report

October 2008

GAUZE08 expedition team with colleagues of the Kasanka National Park and University of Zambia

Contents Page(s)

GAUZE08 Summary by Expedition Leader: Alexis Pridmore

The GAUZE08 expedition returned to Scotland in September 2008 after three months in Zambia collecting extensive ecological data within the Kasanka National Park, surrounding Kafinda Game Management Area, and nearby Bangweulu wetlands. With the support of organisations and individuals both in Scotland and the host country, this expedition proved extremely successful and all research themes were investigated as planned.

The varied nature of the research ensured that a wide range of topics were addressed within the framework of the expedition's assessment of biodiversity and ecological habitat condition in the region. Substantial data sets were collected during the expedition and although much of the analysis remains to be completed (in both Glasgow and Aberdeen) our research is already showing promising results. The progress of each research theme is outlined in this preliminary report. Further detail will be made available in the coming months as analysis is completed and conclusions are drawn.

Figure 1. Frank Willems, park ecologist, preparing equipment for an iBats survey.

In addition to the primary research undertaken, the expedition team also introduced the UK-based iBats programme (www.ibats.org.uk) to Kasanka National Park to facilitate the launch of an ongoing bat monitoring scheme in the area. Two transects – one dry season and one year-round – were identified in collaboration with park staff and trial surveys conducted successfully (Figure 1). The continuation of the scheme is currently under discussion and all parties involved are keen to ensure the success of the programme in the park.

Finally, it was our pleasure to deliver a sizeable package of school supplies to local primary schools located in the vicinity of Kasanka National Park (Figure 2). The lack of such resources in the area is widely recognised and the donation was gratefully received.

Figure 2. A class at Kapepa Community School.

Without the aid of our supporters the expedition would not have been possible and we remain very grateful for all contributions.

Further queries are welcomed by the expedition team and may be directed to Alexis Pridmore (a.pridmore.05@aberdeen.ac.uk), or P. Lang (p.lang.1@research.gla.ac.uk).

GAUZE08 Financial Review by Expedition Co-leader and Treasurer: Pauline Lang

In total, GAUZE08 successfully managed to raise **£16,050** for our research expedition to Zambia (June-September 2008).

Of the total funds raised, research sponsors provided the majority of the funding with £13,200 of the expedition budget financed from these sources. Misc-fundraising activities undertaken jointly by Glasgow and Aberdeen Universities raised £1,750, and personal or private donations amounted to £1,100.

Please refer to Tables 1 and 2 for sponsorship details and a breakdown summary of expedition expenditure, respectively.

SOURCE OF FUNDING	DONATION (£ Sterling)
1. Zoological Society of London	3000
1. Carnegie Trust for the Universities of Scotland	2000
1. Royal Geographical Society (with IBG): *Worshipful Company of Goldsmiths*	2000
1. Glichrist Educational Trust	1500
1. Aberdeen University Court	1140
1. Glasgow University Court	1060
1. Alice McCosh Trust	1000
1. Alumni Fund	1000
1. Royal Scottish Geographical Society	500
2. Misc-fundraising (jointly Glasgow & Aberdeen Universities)	1750
3. Pridmore family	500
3. Miss Dora Bromley	500
3. Ms. Janet Lomax	50
3. Cathedral Church of St. Machar, Aberdeen	50
Total expedition funds raised	**16050**
1. Research sponsor	*13200*
2. Misc-fundraising activities (various): combined efforts of Gla & Abdn Universities	*1750*
3. Personal donations	*1100*

Table 1. GAUZE08 sponsorship details

Details of expedition expenditure	Amount (£ Sterling)
Vehicle Hire (2 x 4WD)	6000
Accomodation + Subsistence (food, fuel etc.)	8600
Flight over Kasanka National Park (to facilitate aerial photography of sampling sites using GPS coordinates)	370
ZAWA research permit	100
Visas	360
First aid training, medical provisions and supplies	270
Disposables (including research materials)	300
Donation to local zambian primary school (stationery etc.)	50
Total GAUZE08 Expenditure	**16050**

Table 2. GAUZE08 expenditure summary

GAUZE08 Expedition Report: Part I

Freshwater ecology of waterbodies in Kasanka National Park and adjacent areas of northern Zambia

Julissa Tapia Grimaldo

University of Glasgow, Glasgow G12 8QQ, Scotland

Aim:

This study aimed to describe benthic organism assemblages (emphasizing macrophytes) and a way to use them as indicators of freshwater environmental impacts in Kasanka National Park and adjacent areas of northern Zambia; and to create a baseline of knowledge for further studies in the region.

Research overview:

Figure 3. Master's student Julissa Tapia Grimaldo and Dr. Kevin Murphy recording vegetation state variables from a *Phragmites mauritianus* population in Kasanka.

Vegetation state variables (e.g. height, leaf area index etc.) were collected from the *Phragmites* population by hand using a ruler and metre stick: Figure 3. Otherwise, a grapnel was used to sample aquatic macrophyte vegetation from 38 sampling sites between Kasanka National Park and the Bangweulu Wetlands: Figure 4. The abundance of macrophyte vegetation was measured as % frequency of occurrence by scoring the presence (hits) of individual macrophyte species, divided by the total number of grapnel samples obtained. The GPS co-ordinates of each sampling site were recorded and the following environmental variables were measured therein: underwater light attenuation coefficient (K: m^{-1}), euphotic depth (Z_{eu}: m^{-1}), ratio of Z_{eu} to depth (Z_{eu}:D) using a Skye PAR meter. Conductivity (Cond: µS cm^{-1}) and pH were recorded using a Schott Handylab pH/LF 12 meter. Mean current velocity (Flow: m s^{-1}) was obtained by averaging multiple readings that captured the range of velocities at each sampling site, using a Tamar Digital Stream meter. Gran Alkalinity (µEq/l) was measured by standard titration methods in the lab (data not presented). Two-Way Indicator Species Analysis: TWINSPAN (Hill 1979) was used to classify samples based on similarity indices of species composition at 4 cut levels of abundance: 1, 0%; 2, 25%; 3, 55%; and 4, 85%. Detrended Correspondence Analysis: DCA (Hill & Gauch 1980) was used to facilitate sample ordination.

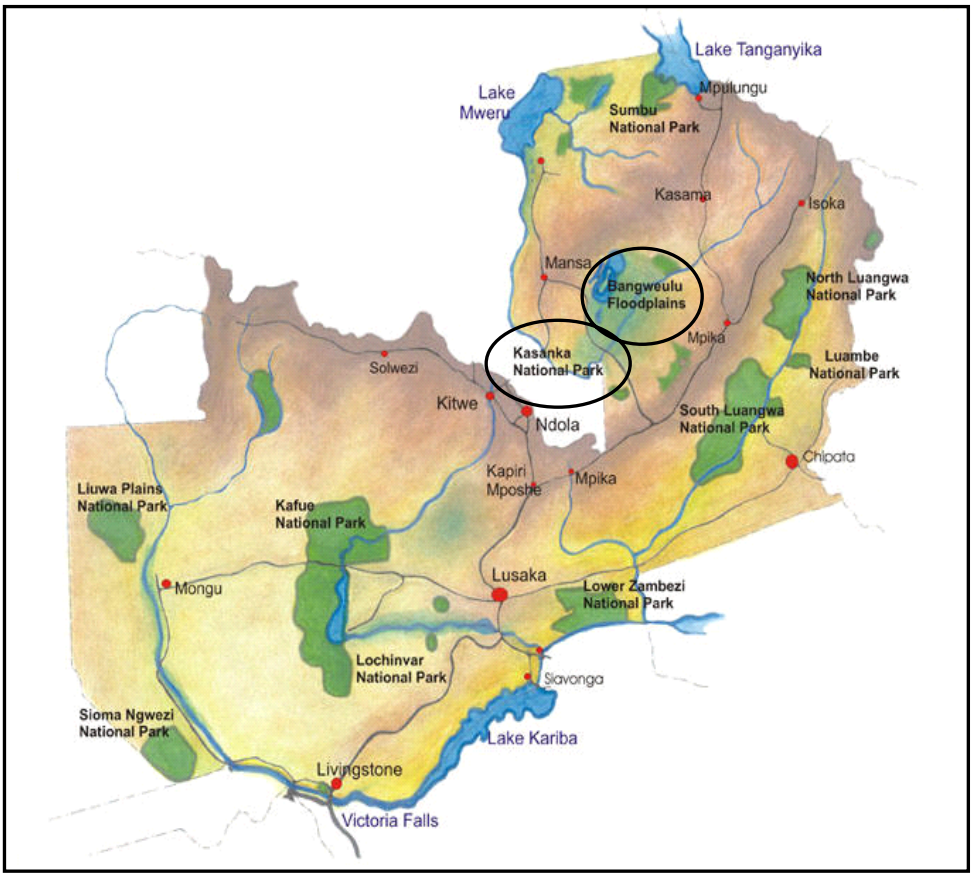

Figure 4. Map of Zambia showing locations of Kasanka National Park and Bangweulu Wetlands, as circled above (Web 1).

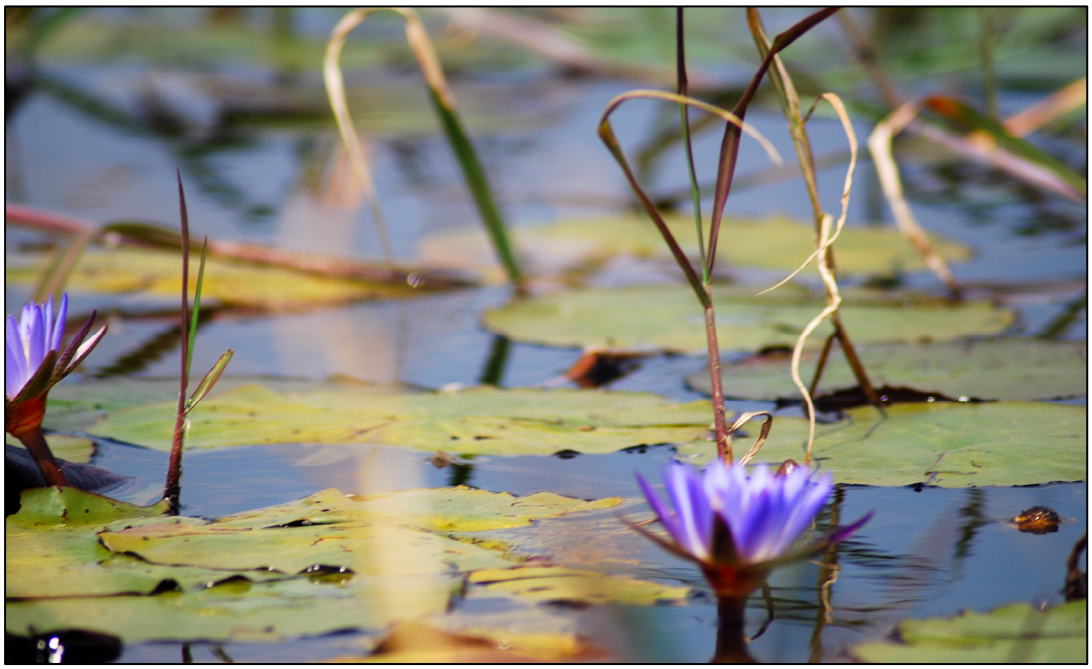

Figure 5. *Nymphaea nouchali* var. *caerulea* population, Bangweulu Wetlands [photograph courtesy of James Burgon]

In total c. 65 aquatic macrophyte species were identified from 38 sampling sites during the course of the 2008 study of waterbodies in Kasanka National Park and its surrounding catchment area including the Bangweulu Wetlands. *Nymphaea nouchali* var. *caerulea* (Nymcar) was found to be dominant at the majority of sampling sites: Figures 5 and 6, and was hence an almost ubiquitous species as indicated by TWINSPAN analysis (data not shown).

Figure 1. *Nymphaea nouchali* var. *caerulea*

Our findings provide both a baseline against which future change can be assessed in these water systems and also a methodology for monitoring and predicting the impacts of river regulation of regulated subtropical rivers such as KNP and adjacent northern areas of Zambia's river system. Furthermore the two linked approach taken in this study gave an insight of how the inclusion of different benthic organisms can be used to indicate the ecological health of freshwater systems. In summary, is extremely important to monitor and conserve the health of freshwaters to protect habitat condition and native biodiversity, especially for species endemic to these areas, for example the semi-aquatic Sitatunga and Black Lechwe antelope, *Kobus leche*: Figure 7.

Figure 7. Black Lechwe antelope, endemic to the Bangweulu Wetlands [photograph courtesy of James Burgon]

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Web 1 http://www.kachelotravel.com/images/zambia%20map20final-kachelo.jpg

GAUZE08 Expedition Report: Part II

Aquatic plants of the South Bangweulu Basin, Zambia

Kevin J. Murphy

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Aim:

The aim was to produce an illustrated identification guide (with sample locations in the area, identified using GPS) to the c. 65 macrophyte species encountered during field work at Kasanka, Shoebill and other sites in the South Bangweulu Basin, during expedition fieldwork in 2006 and 2008.

Research progress to date:

To date the work is c. 90% complete, and is anticipated to be finished by early November 2008. Identification keys are ready, and a one page outline for each species is being prepared. A glossary of botanical terms will also be included.

Shown is the title page, an example of one of the identification keys, and an example of a completed page for one species.

Aquatic plants of the South Bangweulu Basin, Zambia

Kevin Murphy[1], Julissa Tapia Grimaldo[1], Michael Kennedy[2], Magdi Ali[3], Adam Hastie[1] & Pauline Lang[1]

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Nymphaea nouchali var. *caerulea* in the Bangweulu Swamp: August 2008

Study part-funded by UK Department for International Development DelPHE Project 2.38 CAPACITY BUILDING FOR SUSTAINABLE BIODIVERSITY MANAGEMENT IN ZAMBIA

November 2008

Ottelia verdickii Gürke
Family: Hydrocharitaceae
KEY 3. FLOATING PLANTS

Identification notes:
Has both submerged and (less commonly) floating leaves, ovate to lanceolate, gradually narrowed into petiole. Submerged leaves at least partially translucent, may reach or break surface. Showy white flowers. Slightly prickly cylindrical spathes.

Habitat notes:
In flowing water and flooded swamp areas

Sample locations in South Bangweulu Basin:
Musola River at Fibwe weir (KNP): S 12° 35.138'; E 30° 14. 211'

Regional distribution:
Tropical Africa

Outstanding tasks:

The work will be completed by early November 2008, and made available shortly thereafter. Multiple copies of the Guide will be produced and sent to stakeholders in Zambia (including Kasanka Trust and ZAWA). We want to develop the interest shown by local KT rangers, especially at Shoebill Island in learning more about aquatic plants of the area, and will ensure that several copies are made available to them for this purpose.

References:

In developing the Guide we used in particular the excellent "*Aquatic and Wetland Plants of Southern Africa*" (Cook 2004), together with the database on world freshwater macrophytes compiled by Chambers *et al* (2008). Other works consulted include van Bruggen (1973), Bolnick (1995), Lye (1989), Martins (2008 in press), and Cook *et al* (1984).

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GAUZE08 Expedition Report: Part III

A Sitatunga behavioural study

Elaine Benzies

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Aim:

The aim of this study was to continue an observational study of Sitatunga antelope (*Tragelaphus spekei*) behaviour, including their movements across the feeding area and interactions between individuals and groups, utilising the same methods and observational area used by ECCO ZAMBIA 07. This will provide additional data, over a second season, to confirm or modify conclusions drawn in 2007.

Research progress to date:

The study was conducted during the dry season (August) from Fibwe hide, located 18m high in an African mahogany tree (*Khaya* sp.) on the edge of the mushitu forest. The hide allows a clear view over the Kapabi Swamp, where Sitatunga antelope are often observed: Figure 8.

Figure 8. A Sitatunga antelope photographed from Fibwe hide located above the Kapabi Swamp in Kasanka National Park, Zambia [photograph courtesy of James Burgon].

The Sitatunga were observed using 12 x 50 binoculars during periods of 6 hours per day, in two 3 hour blocks from 0600 to 0900 and 1500 to 1800 over 8 days, resulting in 48 hours worth of data (Figure 9). Scan sampling was used, with 20 minute intervals between each sample.

Figure 9. Glasgow University Zoology Honour's student and GAUZE08 member Elaine Benzies observing the Sitatunga antelope from Fibwe hide, Kasanka.

Each Sitatunga was allocated a number which was used when referring to that individual for the remaining 3 hour period (e.g. F1, M1). To record the location of each Sitatunga, the swamp was divided, using features in the vegetation, into 5 sections labelled A – F. These natural features were also used to roughly mark out 50, 100 and 150m away from the hide so as to mark the position of each individual in more detail. In addition to this, every 20 minutes, the age-sex class of each Sitatunga was recorded as either an adult male, adult female or a juvenile. Events between samples, such as the arrival or emergence of a new individual was also recorded along with the time of arrival, how many individuals there were and which direction they came from. With regards to behaviour and interaction, the location in which the interaction takes place, the time and duration, the number of individuals involved, the behaviour type of each individual before and after the interaction and the interaction itself, were all recorded. Data was also collected on any groups of Sitatunga present; the proximity of one individual to another was estimated in terms of Sitatunga body lengths.

Outstanding tasks:

The data will be analysed in the same way as the data collected by ECCO ZAMBIA in 2007, to determine whether the Sitatunga behaviour is consistent with the conclusions drawn by Aberdeen University last summer. The results of this study will be presented in a subsequent GAUZE 2008 report.

GAUZE08 Expedition Report: Part IV

Biodiversity, parasitic burden and habitat ecology of dry season bats in Kasanka National Park and its surrounding Game Management Area

Alexis Pridmore

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Aim(s):

i). To assess the presence of *Trypanosoma* haemoparasites and ectoparasites in the dry season bat population of Kasanka National Park and surrounding Kafinda Game Management Area (GMA), thus potentially identifying a role of bats as a wildlife reservoir of the deadly human disease trypanosomiasis, and determining the extent of parasitic burden on the bat population.

ii). A second aim was to conduct a preliminary assessment of the bat biodiversity and their habitat ecology within the protected national park and developed, agricultural land in the surrounding Kafinda Game Management Area.

Research progress to date:

During the field period in Kasanka National Park and surrounding Kafinda GMA, 130 bat specimens were captured across 25 nights of net placement. Six sites were attended across three habitat types: riparian forest, miombo forest and developed agricultural land. Recaptures were identified through temporary tattoos on the wing membrane. Five shelf Ecotone mist nets were used (2.5m x 9m) and erected at ground level to a maximum height of 4m using solid poles within the selected sampling sites: Figure 10.

Figure 10. Expedition members erecting poles to facilitate mist netting: Leanne Irvine (left, at distance), Kim Weng Tan (centre) and Rachael Boden-Hall (right).

The following biometric data was obtained from each capture using Pesola light line precision spring scales (20g, 100g or 500g as appropriate) and digital callipers (resolution 0.1mm/0.01”, accuracy ±0.2mm): weight, forearm length, sex, species, ear width, head length, tail length, upper palate configuration, foot length, half wingspan, age category and reproductive status (Figure 11).

In addition, small blood samples were obtained using Monoject Monlet lancets and Na-heparinised haematocrit capillary tubes (80iu/ml, 1,15 x 1,55 x 75mm) and spotted onto Whatman® FTA cards for transport to suitable laboratory facilities in Aberdeen (Figure 12). Blood films were also made on 1,0-1,2mm glass slides for subsequent analysis. Visible ectoparasites were also removed from infested individuals and stored in alcohol until identification can take place. Tissue biopsies were obtained from wing membranes (using Stiefel 3mm biopsy punches) from a selected number of individuals for subsequent genetic analysis to help overcome difficulties in identifying species accurately in the field. These were submitted to the University of Aberdeen's School of Biological Sciences for subsequent analysis.

Figure 11. Physical examination of bat specimens

Figure 12. Collection of blood samples in the field, with Alexis Pridmore and Rachael Boden-Hall in action.

Figure 13. Surveying vegetation at Pontoon, a riparian forest sampling site within Kasanka, with park guide Clifford helping with plant species identification.

All vegetation >1m in height at each of the six sampling sites was identified to species level, diameter at breast height (DBH) recorded and the vegetation layout mapped to confirm the habitat type (riparian, miombo or agricultural): Figure 13. The diversity of vegetation will be incorporated into the statistical analysis of parasite incidence and bat condition. A portable GPS was also used to record the precise location of each site to aid future investigation(s).

The genetic analysis of bat blood samples is currently underway using polymerase chain reaction (PCR) methods employing ORPHON, TBR and SRA primers to identify the presence of trypanosome parasites in individuals. Culture titrations will also be performed to determine the level of parasitemia required for detection. Blood films will be examined to support any positive findings.

From the collected biometric data, the condition of individual bats was established using a common condition index method (weight/forearm length) and will be statistically analysed in relation capture habitat condition as well as ectoparasite and haemoparasite burden.

Outstanding tasks:

Currently, the PCR analysis of collected blood samples is prioritised and is expected to be completed by the conclusion of November. Initially, only ORPHON primers have been employed to identify the presence of any *Trypanosoma* species. Where positive results are located, further analysis will be undertaken using TBR and/or SRA primers to classify whether the parasites are human infective subspecies *T. brucei rhodesiense* or *T. brucei gambiense*. Ectoparasite specimens collected in the field are also to be identified. Once accomplished, data will be statistically examined in relation to habitat type, vegetation diversity and bat condition. All findings will made available to the appropriate managing bodies to aid in the development of suitable plans to support dry season bat populations and may have implications in the management of trypanosomiasis in the region. The results of this work will be presented in a subsequent report.

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GAUZE08 Expedition Report: Part V

Environmental drivers of algal biodiversity in major catchments of the upper Congo River basin, Northern Zambia

Pauline Lang

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Aim:

To characterize the environmental habitat conditions driving freshwater diatom biodiversity and community composition between two major sub-catchments, Kasanka and Bangweulu, of the Upper Congo basin in Northern Zambia.

Research progress to date:

Diatoms and other algal groups were sampled from 17 sampling sites between two catchments of the upper Congo River basin (Kasanka National Park and Bangweulu Wetlands: Figures 14 and 15, respectively) in Northern Zambia.

Figure 14. Pauline Lang sampling periphyton from Musola Stream within Kasanka.

Figure 15. Post-sampling navigation of Bangweulu wetland habitat by canoe at dusk, with expedition members: Julissa Tapia Grimaldo (left), James Burgon (centre) and Elaine Benzies (right), with our boatman Emmanuel (background).

A phytoplankton net and/or toothbrush were used to harvest benthic periphyton material from mineral substrata and/or macrophyte foliage (Figure 16). Algal specimens were dispensed into sterile sampling bottles using distilled water upon collection, and thereafter preserved with Lugol's Iodine solution. Sample bottles were kept refrigerated until microscopic analysis could be conducted.

Figure 16. Sampling of periphyton from aquatic macrophyte foliage

Figure 17. Dr. Mike Kennedy with a GPS, amongst tall *Vossia* vegetation.

A portable GPS (Figure 17) was used to record the geographical coordinates of the 17 sampling locations where periphyton communities were collected. A range of environmental variables were measured at each sampling site including underwater light attenuation coefficient (K: m^{-1}) and other aspects of underwater light climate: euphotic depth (Z_{eu}: m^{-1}) and the ratio of Z_{eu} to depth (Z_{eu}:D), were measured using a Skye PAR meter. Conductivity (Cond: µS cm^{-1}) and pH were recorded using a Schott Handylab pH/LF 12 meter. Mean current velocity (Flow: m s^{-1}) was obtained by averaging multiple readings that captured the range of velocities at each sampling site, using a Tamar Digital Stream meter. Gran Alkalinity (µEq/l) was measured by standard titration methods in the lab.

Figure 18. Pauline Lang undertaking initial microscopic identification of algal specimens in the Mulaushi research centre, Kasanka.

Initial observations of algal community composition were undertaken using a compound light microscope made available at Mulaushi (Kasanka) shortly after sampling in the field: Figure 18. A Sedgewick-Rafter Counting Chamber was used to estimate relative abundance as % frequency of algal groups other than diatoms (e.g. green filamentous algae) by scoring species presence (hits), divided by the total number of Sedgewick-Rafter grid units examined. Algal groups other than diatoms were identified to generic level using Belcher & Swale (1976a, b).

Diatom specimens were chemically digested with hydrogen peroxide on a hotplate for 2 -3 hours, and mounted permanently onto slides using Naphrax™, in accordance with standard procedures (Kelly *et al*. 2001).

Outstanding tasks:

Jan/Feb 2009: Cleaned diatom specimens will be inspected at higher magnification to determine species composition according to Krammer & Lange-Bertalot 1986-1991. This data will be analysed using TWINSPAN and other multivariate analyses.

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Acknowledgements

We thank the staff of Kasanka National Park for their excellent assistance including Kim and Edmund Farmer, Fredrick Mbwule, and Frank Willems, as well as Kingford, David and Beth-Sheba for taking care of us whilst staying at Mulaushi Camp. Thanks to scouts: Felix, Benson and Marle, as well as Kasanka volunteers: Graeme and Hedwig, all for their assistance with fieldwork involving nocturnal bat sampling activities, and Clifford for his expertise in the mapping of terrestrial vegetation. We also thank Emmanuel and Cotton for guiding us around the Bangweulu Swamp habitats and for being patient with us whilst sampling. Thanks also to Dr. Henry Sichingabula and his students of the University of Zambia for academic support and accompanying us on the expedition. We are extremely grateful to the Zambian Wildlife Authority for granting us our permit [receipt no. 353305] and supporting our research objectives.

We wish to express special thanks to our sponsors, without whom this expedition would not have been possible: especially the Zoological Society of London, Carnegie Trust for the Universities of Scotland, Royal Geographical Society (with IBG), Gilchrist Educational Trust, Alice M^{c}Cosh Trust, Alumni Fund, Royal Scottish Geographical Society, Courts of Glasgow and Aberdeen Universities, the generous people of Glasgow and Aberdeen for their never-failing support of student fundraising activities, as well as Miss Dora Bromley, the Pridmore family and Ms. Janet Lomax for their generous personal donations in support of our work in Zambia. We also thank staff of the Cathedral Church of St. Machar in Aberdeen for their contribution, which enabled us to donate vital stationery and other educational supplies to local Zambian primary schools located on the outskirts of Kasanka National Park. Finally, we thank all of our family and friends for their understanding and support whilst we were working on this project.

Kasanka at sunrise