Status of Vegetation, Disturbances and Threats to Habitats in the Malagarasi-Muyovozi Ramsar Site (Tanzania)

Results from an Aerial Survey

by

Paul L.A. Erftemeijer

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Technical Report for the Project on Sustainable and Integrated Management of the Malagarasi-Muyovozi Ramsar Site (SIMMORS)

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Executive Summary

This report documents the results of a Systematic Reconnaissance Flight (SRF) aerial survey of the Malagarasi-Muyovozi Ramsar Site (Tanzania), conducted from 17th-28th November 2001. The survey was made as part of the Danida-funded project on Sustainable and Integrated Management of the Malagarasi-Muyovozi Ramsar Site (SIMMORS), which aims at assisting the Wildlife Division of the Ministry of Natural Resources and Tourism to fulfil its obligations under the Ramsar Convention on Wetlands.

The aerial survey provided a successful rapid assessment of the status and distribution of wildlife, vegetation & wetland types and their status in the Malagarasi-Muyovozi Ramsar Site. The present report only presents the results of the observations on the status of the vegetation, disturbances and threats to habitats from human activities in the Ramsar Site. The results of the wildlife census and waterbird observations are presented in a separate and final report. This report provides a detailed account of vegetation types observed, their extent and a general qualitative description of their plant species composition, based on aerial survey results and literature.

The following vegetation types occur in the Ramsar Site, in order of their approximate dominance: miombo woodland and forest (65%), wooded grasslands (17%), floodplain grasslands (9%), permanent swamps (3.2%), bushland (2.8%). The remaining 3% was made up of cultivation and open water. Permanent swamps cover about 130,000 – 160,000 hectares in the Ramsar Site while papyrus stands make up not more than 50% of this (covering about 48,000 – 90,000 hectares). These figures are substantially lower than previous estimates (320,000 hectares permanent swamp, 200,000 hectares papyrus) reported in documents and literature on the site.

The overall size of the Ramsar Site appears to be in the order of 4 million hectares rather than the estimated 3.25 million hectares reported earlier. The status of the vegetation and wetland habitats within the three game reserves (Kigosi, Muyovozi and Ugalla) is significantly better than outside these protected areas, while the Forest Reserves in turn appear to be in a better shape than the unprotected areas within and adjacent to the site. Mountainous terrain, rocky cliffs & hills and a generally poor accessibility in the western part of the Ramsar Site form a natural buffer zone. Forest Reserves within and adjacent to the Ramsar Site also serve as a buffer zone to the core wetland habitats of the site.

Major human activities observed within the boundaries of the Ramsar Site include livestock grazing on floodplain grasslands, burning of grasslands and swamp vegetation, logging in woodlands, hunting and poaching, agricultural cultivation, human settlements and numerous vehicle tracks and footpaths. Of particular concern are the illegal poaching and logging within the Kigosi, Muyovozi and Ugalla River Game Reserves, and the overall increasing pressure on the natural resources in the Ramsar Site from neighbouring centres of concentrated human settlements (especially in the NE, Central Zone and SW of the study area). Overlaps between Forest Reserves and Game Reserves within the Ramsar

Site cause confusion over administrative and legislative control, which should be addressed urgently, as it has resulted in widespread illegal logging inside the Game Reserves.

The impacts of the timing and frequency of burning of the grasslands and swamps on fire-sensitive vegetation and wildlife, and impacts of the significant numbers of livestock that are grazing in the area on wildlife numbers and incidences of pests and diseases should be further studied and monitored. The needs for further research and recommendations for management are also discussed in this report.

1. Introduction

1.1 The Ramsar Site

In August 2000, the Government of Tanzania became a contracting party to the Ramsar Convention on Wetlands with the Malagarasi-Muyovozi wetland area as the country's first designated Ramsar Site. The Project for the Sustainable and Integrated Management of the Malagarasi-Muyovozi Ramsar Site (SIMMORS) with support from Danida aims at assisting the Wildlife Division of the Ministry of Natural Resources and Tourism to fulfil its obligations under the Ramsar Convention on Wetlands (SIMMORS, 1999). This project started in 2000 and operates from an office in Urambo.

1.2 The Aerial Survey

In order to assist with the issue of boundary demarcation and buffer zones, evaluate land use and other human activities in the area and identify threats to the Ramsar Site, a comprehensive aerial survey was carried out during November 2001. This aerial survey focussed on wetland habitat types and land use issues as well as wildlife and birds, aiming to provide baseline data on the ecological character of the site. Although some earlier aerial surveys were carried out of parts of the area for a census of wildlife (i.e. of Ugalla, Muyovozi and Kigosi Game Reserves in 1998 and 2000), the present survey is the first comprehensive aerial survey of the whole Ramsar Site, and the first survey of its kind which also addresses vegetation, land-use and boundary issues. The present report only presents the results of the observations on the status of the vegetation, disturbances and threats to habitats in the Malagarasi-Muyovozi Ramsar Site. The complete results of the aerial survey, including the wildlife census and waterbird observations are presented in a separate final report (by TWCM).

1.3 Consultancy Brief

The terms of reference for the vegetation/land-use observer for the aerial survey included the following duties and responsibilities: [1] to participate in initial aerial survey briefings; [2] to participate as a front seat observer in the aerial survey with main responsibility for vegetation and land use, with particular emphasis on threats to the Ramsar Site from such activities as encroachment by people, agriculture or pastoralists, burning of swamps and floodplains, exploitation of forests and woodlands (of particular importance in this regard are the boundary areas and adjacent areas just outside the area; [3] transcription of daily observations onto datasheets and participation in daily debriefing sessions; [4] writing of a report on the status of vegetation, disturbances and threats to habitats, with recommendations for priorities of buffer zone areas; [5] assist the team leader from TAWIRI with data analysis and the production and editing of the draft final report.

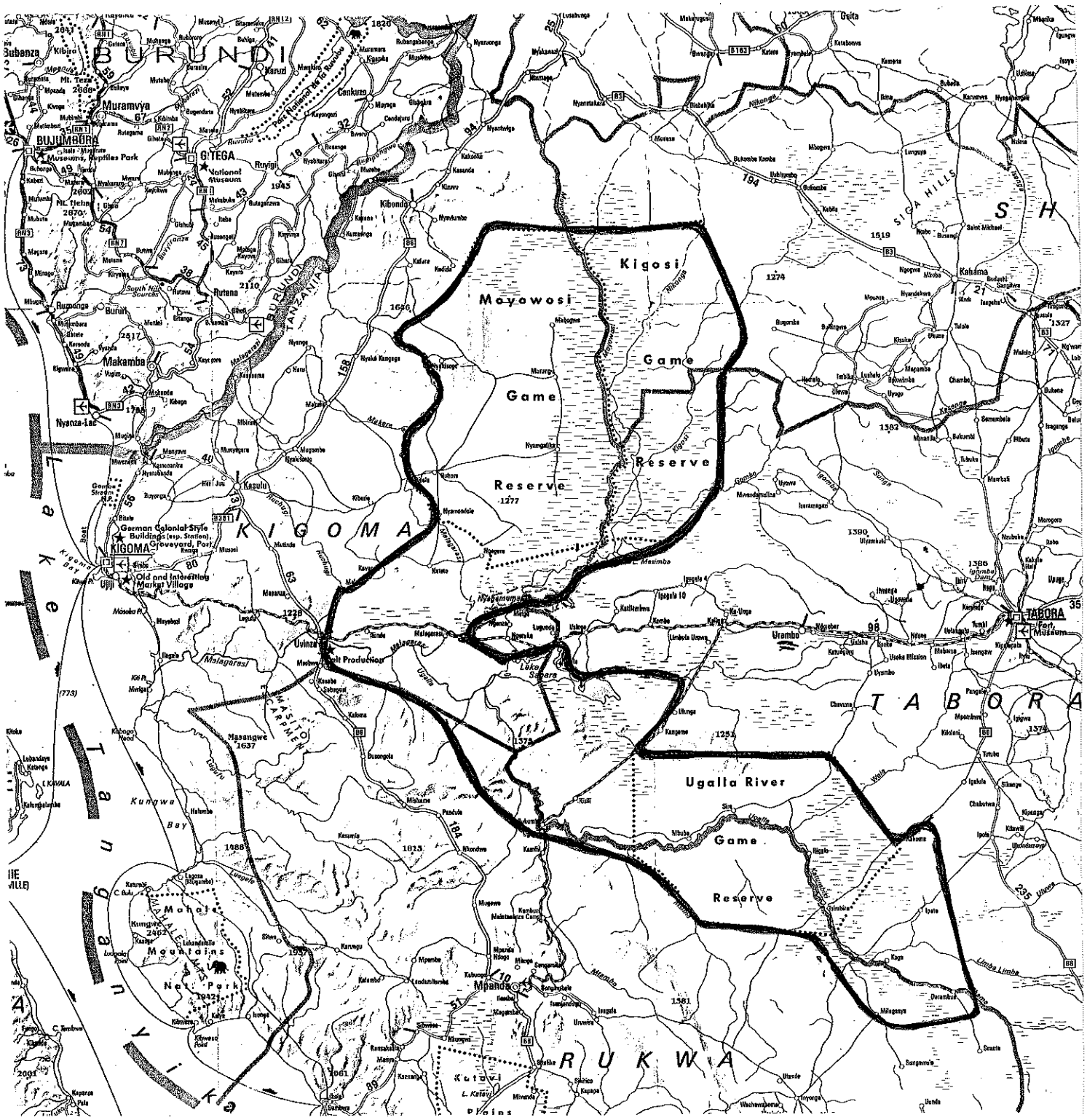

Figure 1. General map of the Ramsar Site and its boundaries, showing the location of the main rivers, lakes, towns and railway, as well as the boundaries of the Game Reserves located within or overlapping with the Ramsar Site.

1.4 Objectives of the Aerial Survey

The aerial survey of the Malagarasi-Muyovozi Ramsar Site aimed to establish the current land use situation, the range and extent of wetland habitats, and a trend of internal and external threats to the system. The survey also aimed to assist in establishing the exact boundaries of the Ramsar Site and to recommend possible buffer zones for the site. The following questions were addressed during the survey:

1. Ramsar Site Boundaries:
   - What is the situation within and outside protected areas?
   - What is the situation with regards to buffer zones?
   - Are there natural buffer zones?
   - Are there areas that need particular attention?

2. Wetland habitats and their extent:
   - What are the different wetland types/habitats?
   - How are they distributed?
   - What vegetation types and fauna are supported by them?

3. Land use paterns and trends:
   - How does the current land use compare with existing land use maps (based on 1994 remote sensing data)?

4. Status of protected areas:
   - How does the status of vegetation, disturbances and threats to habitats compare between protected areas (Game Reserves and Forest Reserves) and non-protected areas within the Ramsar Site?

1.5 Study Area

The Ramsar Site is located in the north west of Tanzania (3-6°S, 30-32°E) and covers approximately 3.25 million ha, stretching out over the administrative regions of Kigoma, Shinyanga and Tabora (Figure 1). The site includes the lower river basin of the Malagarasi River, Tanzania's second largest river basin which in turn forms 30% of the catchment of Lake Tanganyika. Other rivers within the Ramsar Site include the Muyovozi River, Kigosi River, Gombe River and Ugalla River. The site also includes three lakes (Nyamagoma, Sagara and Lumbe). The major part of the Ramsar Site is within protected areas, including the Muyovozi, Kigosi and Ugalla River Game Reserves (totalling 2.45 million ha), and the Mpanda Line, Uganda and Swangala Forest Reserves (totalling 650,000 ha), while the remaining 150,000 ha is comprised of unprotected public land and agricultural areas primarily under the control of villages or district authorities. The area receives approximately 800-1000 mm of rain, which primarily falls in two periods, i.e. November-December (short rains) and March-May (long rains).

The survey crew of 5H-MPK with the aircraft

2. Methods

2.1 Survey Methods

The aerial survey was carried out with two Cessna 182 aircrafts of the Wildlife Division. A low-level Systematic Reconnaissance Flight (SRF) was conducted, following the methodology described by Norton-Griffiths (1978) and further updated by Woodworth and Farm (1996). The survey was conducted during the period 17-28 November 2001, which is at the end of the dry season, when water levels in the area are at their minimum and animals are expected to be concentrated. The target altitude of the aircrafts was 350 ft (actual range approx. 200-1000 ft), flying at an average speed of 200 km hr^{-1} (or 120-130 knots/hr). A total of 76 transects from East to West (or West to East) were flown across the Ramsar Site, with a spacing of 5 km between each consecutive transect (see map of planned transects in appendix). The total length of all transects together was approximately 8000 km. Both aircrafts covered approximately 6-7 hrs. of flying per day (incl. an average of approximately 1.5-2 hrs. per day to/from base to transects). The exact positioning of the aircrafts on the transects was determined by GPS readings by the pilot, according to previously established latitudes and longitudes.

2.2 Data Collection

Observations were made by two rear seat observers and one front seat observer in each aircraft. Observations were limited to a strip of land visible between two markers attached to the wings on each side of the aircraft at a known distance and height from each of the individual observers' position. Strip calibration involved flying several passes perpendicularly over an airstrip at known altitude and recording the number of ground markers seen by the two rear seat observers. During the actual transects, the pilot called the precise start and end of a transect (based on GPS readings). Observations made during each transect were divided into sub-units of 30 seconds (each representing approximately 1.67 km of transect).

At the start of each transect, the front seat observer started his stopwatch, recorded the exact time of day. At the beginning of each subsequent 30-second sub-unit, the front-seat observer (FSO) called off the sub-unit number to the rear-seat observers (RSO's) and recorded the exact altitude of the aircraft. During each sub-unit, the FSO recorded information on fire (% cover of recently burned (black), % cover of visible surface water, and type of vegetation (see details below) on pre-printed data sheets. The RSO's recorded all observations on wildlife and all signs of human activity (see code list in appendix) in a small tape recorder, which were worked out later in the day onto data sheets for further analysis.

In addition, a total of 375 digital photographs were taken from the air, which helped in identifying and recording vegetation types and calibrating estimations of the extent of burnt areas.

Calibration of the strip width

2.3 Geographic Information Systems (GIS) and Maps

All data collected during the aerial survey were entered into computerised databases at the Tanzanian Wildlife Conservation Monitoring (TWCM). The data were analysed using software developed specifically for SRF surveys. Data were entered and combined with Geographic Information Systems used at TWCM to present estimated densities and ndistribution of all wildlife and human activities geographically on maps.

The availability of 69 topographical maps (1:50,000) produced in 1978 (by Surveys and Mapping Division), and a set of 10 excellent vegetation maps (1:250,000) produced in 1996 based on interpretation of August/September 1994 Landsat imagery (by Hunting Technical Services & Surveys & Mapping Division, supported by field studies 1994/1996) were extremely helpful in the planning, analysis and geographic presentation of the results of the aerial survey.

2.4 Analysis

The combined total area of the observation strips of the two aircrafts for all the sampled transects covered only about 6-7 % of the total study area. Total counts of wildlife made during the survey were then used to extrapolate for the whole Ramsar Site by multiplying by a factor of 14.8 to yield total population estimates. The same was done for the observations of human activities. Incomplete transects were not included in the final data analysis to avoid bias. The 95% confidence level (CL) was estimated according to Norton-Griffiths (1978). Data are presented as estimated densities per 5 by 5 km squares on the map (as digitised in the GIS database of TWCM).

Limitations of the methodology used in this survey include the limited reliability of extrapolation of data which were not evenly distributed, observer bias, inaccuracy in assessing vegetation or species identification from an aircraft at reasonably high speed and altitude, sleepiness/drowsiness from airsickness or its medicines, time of day of flying, and possibly many others. The majority of these issues are dealt with in great detail in the handbook on this methodology by Norton-Griffiths (1978), to which reference is made here.

The timing of the survey was a bit late for assessing the actual impacts from fires, as the first showers of the short rains had already fallen. Timing of the aerial survey also affects wildlife numbers and gtheir distribution, with highest concentrations expected during the peak dry season, while sigfnificant rains are expected to disperse the animals over much larger areas. The survey also does not accommodate for seasonal wildlife migrations, which means that actual numbers of certain species using the Ramsar Site might actually be higher (or lower) than the present aerial survey suggests.

Despite these limitations, SRF is believed to be one of the best available methodologies available to carry out a rapid assessment and wildlife census of the type required in this survey.

3. Results

3.1 Wetland Types and their Extent

The Malagarasi-Muyovozi Ramsar Site includes the following wetland types: permanent and seasonal rivers, freshwater lakes, permanent swamps, seasonally flooded swamps and floodplains, and some small areas of riverine swamp forest and peatland (Figure 2).

Rivers
Major rivers in the Ramsar Site include the Muyovozi River, Nikonga River, Kigosi River, Ugalla River and Gombe River, all of which join the large Malagarasi River, which discharges into Lake Tanganyika. The Malagarasi River Basin is the 2nd largest river basin in Tanzania, which forms 30% of the total catchment of Lake Tanganyika. The Malagarasi and Muyovozi rivers both rise in the highlands of Burundi and together with the Ugalla, Gombe and Walla rivers the basin drains a considerable portion of north-western Tanzania. Parts of the riverbed of the Ugalla River are more sandy (with sandy ridges and banks) than the other rivers in the area. In addition to these permanent rivers, there are a significant number of seasonal rivers (e.g. Ngalingali, Lubebuzi, Ibanda) or drainage channels ('dambos') running through the miombo woodland and other key vegetation types throughout the study area. These seasonal rivers and streams are dry during the dry season (several months of the year) but fill up during periods of significant rainfall. Most of them are seasonal tributaries that at some point join in one of the permanent rivers.

Lakes
Two significant lakes occur within the boundaries of the Ramsar Site: Lake Nyamagoma (also known as Lake Katali) (53 km^2) and Lake Sagara (328 km^2), both of which are located in the central part of the Ramsar Site. Topographical maps of this part of Tanzania also indicate the presence of Lake Masimba and Lake Lumbe, but these are in fact permanent swamp areas with little or no areas of open water. Several other much smaller 'lakes' (such as Nyalumoli, Samase, Kianza, Safumbe, Chagu, Ibanda, Mava, Tanga, Buhoro etc.), indicated only on 1:50,000 topographical maps of the area, are also permanent swamps or constitute seasonal lakes which fall dry during a major part of the year. Some additional areas of open water occur in the floodplains of the major rivers. The total extent of open water in the Ramsar Site is estimated to be in the order of 25,000 – 38,000 hectares (calculated from aerial survey transects and 1994 vegetation maps), which is much less than the 250,000 hectares mentioned in earlier documents (Anonymous, 1996; SIMMORS, 1999).

Permanent swamps
At areas where there is sufficient standing water all-year around, permanent swamps have formed consisting of emergent wetland plant communities (see below). These areas are primarily situated along the Muyovozi, Kigosi and Gombe rivers, and around Lake Nyamagoma. Smaller but significant tracts of permanent swamp vegetation can be found at Lumbe swamp (SE of Lake Sagara near the railway line) and along the Ugalla and

The Muyovozi floodplain

Malagarasi rivers. The total extent of permanent swamps in the study area is estimated to range between 133,500 ha (extrapolated from survey transects) and 162,500 hectare (estimated from 1996 vegetation maps). The previous estimate of 320,000 ha of permanent swamp area for the northern portion of the Muyovozi/Nikonga/Kigosi area alone, as reported in previous documents (Anonymous, 1994; SIMMORS, 1999) appears to be a considerable overestimate. The size of these permanent swamps may, however, increase or decrease over the years in response to significant changes in water levels.

Riverine swamp forest

A narrow fragmented strip of riverine swamp forest (gallery forest) occurs along parts of the Ugalla River in the south, Kigosi River in the north-east, and Malagarasi River in the north-west. The extent of this type of wetland forest could not be estimated but is very limited. One document (Anonymous, 1994) makes mention of an area of groundwater forest between Lake Sagara and the Muyovozi swamps, where the water table is reportedly close to the surface, but this could not be confirmed in the present survey.

Seasonal swamps/floodplains

By far the most extensive type of wetland found in the Ramsar Site are the vast areas of grassland, bushland and wooded grassland, which are seasonally inundated during the rainy season. Such seasonally inundated floodplain areas (also known as dambo's) are particularly prominent along the Muyovozi (incl. the so-called Batusi flats) and Kigosi rivers, and to a lesser extent along the Gombe, Ugalla and Malagarasi rivers. Seasonally inundated floodplains in the Ramsar Site cover an estimated total of 1 - 1.3 million hectares (extrapolation from the survey transect results). The extent of flooding on the floodplain fluctuates widely on a yearly basis depending on the amount of rainfall, with floods varying in level by as much as 6 m over a series of dry or wet years in southern parts of the Muyovozi floodplain (SIMMORS, 1999).

Peatland

Project documents and information sheets about the Malagarasi-Muyovozi Ramsar Site make mention of the occurrence of unforested peatlands (SIMMORS, 1999). Though this could not be confirmed by the present aerial survey, nor does the vegetation map make any reference to this as a separate vegetation type, it is likely that this refers to specific areas of permanent swamp and seasonally flooded grasslands, which have accumulated peat in their soils.

MALAGARASI-MUYOWOSI RAMSAR SITE (SIMMORS)

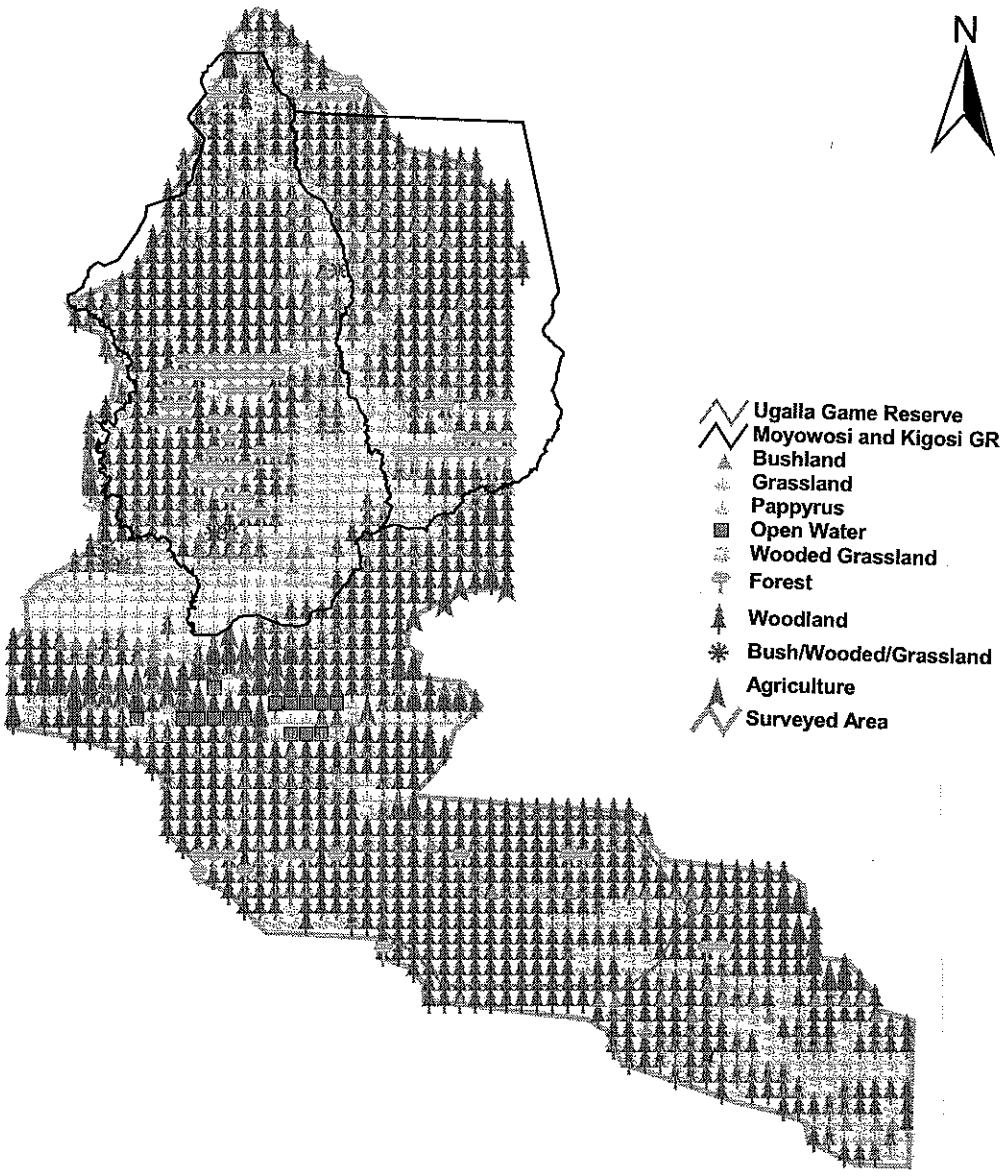

Figure 3. Map of the Ramsar Site, showing the geographic distribution of the various vegetation types as recorded during the aerial survey.

3.2 Vegetation

Introduction

The present aerial survey recorded the following six broad categories of vegetation types: F - forest (with a canopy cover of more than 75%), W - woodland (with canopy cover of 21-75%), WG - wooded grassland (grassland with sparse trees, < 21% canopy cover), BL - bushland (low brushy vegetation, often mixed with grass), G - grassland grassland with few or no trees, < 2% canopy cover) and P – permanent swamps (dominated by Papyrus, reeds and other tall emergent swamp vegetation). In addition, areas of cultivation (C) and open water (O) were also recorded. The above vegetation categories are based largely on a similar classification used for a general description of the main types of East African vegetation by Lind and Morrison (1974), and which has also been followed in the production of the 1:250,000 vegetation maps of the Malagarasi-Muyovozi-Kigosi-Ugalla area mentioned earlier. It should be pointed out here that, although these categories are satisfactory for general descriptive purposes and for the rapid assessment that was made during this aerial survey, they do not represent natural classes or types (Lind and Morrison, 1974). There are no sharp boundaries between them, and they should generally be viewed as overlapping parts of a vegetational continuum, which, within quite a small area, may range from grassland, through bushed or wooded grassland to woodland.

The extent of the different vegetation types were calculated by extrapolation of the survey results (% of total sub-units) for the entire area of the Ramsar Site (calculated by GIS to cover approximately 4.1 million hectares), the results of which are presented in Table 1.

Table 1. Extent of the various vegetation types in the Ramsar Site as calculated from the aerial survey results.

Code	Description	No. of Sub-Units with this type	% of Total No. of Sub-Units	Estimated Extent (ha)
W	Woodland (miombo)	2733	61.0	2,545,042
F	Forest (or dense miombo)	179	4.0	166,888
P	Permanent swamp	143	3.2	133,510
G	Grassland	410	9.2	383,842
WG	Wooded Grassland	754	16.9	705,102
BL	Bushland	123	2.8	116,800
C	Cultivation	105	2.3	95,960
O	Open Water	25	0.6	25,033
-	Total:	4462	100	4,172,200

Miombo woodland

Before embarking on a detailed description of each of the vegetation types, it should be emphasised that the vegetation in the Malagarasi-Muyovozi Ramsar Site is determined by a complex set of factors, including among others: soil type and topography, edaphic factors (such as rainfall and the extent, frequency and duration of flooding), the frequency and timing of natural and man-made fires, grazing by herbivorous wildlife and livestock, the occurrence and abundance of termites, agricultural encroachment and subsequent fallowing (regeneration), and the impact of elephants (opening up vegetation).

The following descriptions of each vegetation type are based on the observations made during the aerial survey (quantitative data on frequency, extent and status) and available literature (qualitative descriptions). Detailed vegetation maps (1:250,000) of the study area were produced in 1996, based on Landsat imagery data from Aug.-Sept. 1994, which helped in the analysis and interpretation of these data. A detailed paper on the flora of the Moyowosi game controlled area by Mutch (1977) is the only detailed record of vegetation in parts of the Ramsar Site to date. Further qualitative details on the vegetation types were derived from Lind and Morrison (1974), Denny (1985) and Campbell (1996). Although the aerial survey data need to be verified by ground surveys, it is believed they give a reasonably accurate picture of the main vegetation types that can be found in the Malagarasi-Muyovozi Ramsar Site.

Forest

Some patches of relict forest occur on mountainous hill slopes in western part of the Ramsar Site. Mutch (1977) also noted the occurrence of evergreen, multicanopied forest communities, represented in small, scattered and possibly relict patches of forest as islands in the 'lava' grasslands near the conjunction of the Malagarasi River and the Kibondo-Kigoma road. Mutch (1977) also reported a localized patch of ground-water forest near Marungu. Most of the vegetation recorded as forest during the aerial survey, however, actually comprises dense to very dense miombo woodland (see next section).

Miombo woodland

More than 60% of the Ramsar Site is covered in woodlands which can be characterised as miombo. 'Miombo' is a colloquial term used to describe those central, southern and eastern African woodlands dominated by the genera *Brachystegia*, *Julbernardia* and/or *Isoberlinia*, estimated to cover an estimated total area of 2.7 million km^2 in the region. In ecological terms, miombo comprises the woodland-dominated end of the spectrum of savanna formations. Miombo woodland is a typical example of a moist-dystrophic savanna (Campbell, 1996). Mature, relatively undisturbed stands typically comprise a 10-20 m high, single story, partly closed canopy of mostly pinnate-leafed tree species and an often sparse but continuous herbaceous layer of undergrowth dominated by grasses and shrubs (Campbell, 1996). A range of products from the miombo woodlands supports rural livelihoods, ranging from medicines and food to building timber and fuel. Miombo woodland also supplies products for towns and cities of the region, the most important of which is fuel (often in the form of charcoal). Some high-value tropical hardwood species are also extracted from miombo, including mninga (*Pterocarpus angolensis*).

Wooded grassland with *Borassus* palms

The extent of miombo in the Malagarasi-Muyovozi Ramsar Site was estimated from the aerial survey results to cover approximately 2.5 million hectares. The canopy cover of the miombo woodlands in the Ramsar Site varies (with particularly dense woodland occurring in the northern parts of Kigosi GR and the western parts of Moyowosi GR), and indeed much of the miombo woodland in Africa has been, and continues to be, modified by people (Campbell, 1996). In general terms, however, these woodlands appear to be still in a good condition. The vegetation classified during the survey as forest (nearly 170,000 ha) is actually also comprised largely of miombo woodland but with a dense tree canopy cover (as noted above). Mutch (1974) who provided a detailed floristic description of twenty-six, 15 m plots in the miombo woodlands in the Muyovosi Game Reserve, distinguished 4 dominant tree species in the area (comprising 78% of all trees in his plots): *Julbernardia globiflora* (most common species), *Brachystegia spiciformis* (on red soils), *Brachystegia wangermeeana* (on higher hills and gravelly ridges) and *Isoberlinia tomentosa* (in lower areas with black soil). Mutch (1974) recorded at least another 12 species of trees, 18 species of grasses, and at least 10 species of common herbs in the miombo woodlands of the Muyovozi area.

The miombo woodland throughout the Ramsar Site is utilized for wood extraction (see chapter 3.3). Miombo in unprotected areas within and outside the Ramsar Site is often converted for agriculture. Soils of miombo woodlands are typically nutrient-poor, and consequently farmers usually have to apply a long fallow period after a few consecutive harvests, during which part of the miombo vegetation regenerates, giving the impression of a shifting cultivation-type of agriculture. Such fallow land in various stages of miombo regeneration could clearly be distinguished during the present survey.

Wooded grassland

Wooded grasslands, here defined as open woodlands where the trees and/or bushes are scattered and the canopy cover is less than 20%, make up approximately 17 % of the Ramsar Site, covering an estimated total area of about 700,000 hectares. This type of vegetation is most often encountered in the transition zone between the miombo woodlands and the open floodplain grasslands along the major rivers in the area. Here, the vegetation forms an intermediate stage of succession between grassland and woodland, kept in a dynamic balance by the interplay of infrequent inundation from floods (in rainy season), occasional fires spilling over from the adjacent floodplain grasslands (in dry season), and grazing pressure from herbivorous wildlife. Elephants and other large herbivores also play a role by uprooting woody vegetation, while termites aid in the dispersal of seeds and construct high mounds which alter the microtopography creating environments ideal for certain shrubs. Wooded grasslands are also encountered in catenic hydromorphic areas (seasonally waterlogged depressions) within the miombo that are characterised by black cotton soil (often termed ‘mbugas’). Most of these are found in quite extensive valley systems scattered within the woodlands.

The wooded grassland are most often dominated by several species of *Combretum* trees (esp. in mbugas), along with *Acacia*, *Kigelia* and *Borassus*. Mutch (1977) documented at least 10 tree species, 12 species of grasses and 11 species of flowering herbs for wooded

Bushland vegetation

grasslands in the Muyovozi Game Reserve. Extensive open stands of the African Fan Palm *Borassus aethiopum* with scattered *Phoenix reclinata* atop termite hills and scattered *Acacia polyacantha* occur along parts of the edges of the floodplains of Igombe and Ugalla rivers as well as in the southerly areas of the Muyovozi river floodplain. Such areas, which may also be classified as wooded grassland, usually appear to experience more extensive flooding (Lind and Morrison, 1974; Mutch, 1977). Careful patterns of burning and shifting grazing on the floodplains exert an important influence on the vegetation, being major factors in maintaining the largely tree-less state of the vast grasslands of the floodplains (see below) in what would otherwise be an edaphically controlled *Borassus – Phoenix* wooded grassland (Mutch, 1977).

Bushland

Bushland in this survey was defined as low brushy vegetation, often mixed with grasses, and as such includes thickets and scrub. The 1994 vegetation maps even distinguish intermediate categories such as bushed grasslands and wooded bushlands, but this level of detail was applied during the aerial survey. Mutch (1977) described bushland as areas with more than 50 percent of shrubs, bushes, giant grasses or small trees growing densely together. Bushland covers an estimated 117,000 hectares or nearly 3% of the Ramsar Site. It is mainly found in the Kigozi Game Reserve along the Nikonga River valley (esp. towards its confluence with the Muyovozi River), while smaller areas occur to the NE and NW of Lake Nyamagoma, to the NW of Lake Sagara, and in parts of the Muyovozi Game Reserve. Bushland vegetation may consist of scrubby *Acacia*, *Combretum*, *Commiphora*, *Albizia harveyi*, *Pericopsis angolensis* and several other species, including *Tamarindus indica* and locally *Euphorbia candelabrum* atop termitaria and thickets of bamboo (*Oxylenantherum abyssintea)*. Mutch (1977) reported at least 5 species of grasses and 5 species of flowering herbs associated with this vegetation type in the Muyovozi area.

Grassland

Grasslands, defined in this survey as areas dominated by grassy vegetation with very few of no trees (canopy cover < 2%), cover approximately 384,000 hectares or 9.2% of the Malagarasi-Muyovozi Ramsar Site. Since truly natural grasslands in East Africa are rare, most of the grasslands in this region are either derived (secondary) grasslands that were formed from woodland as a result of burning and grazing, or edaphic grasslands maintained by permanent or seasonal flooding (Lind and Morrison, 1974). In the Malagarasi-Muyovozi area, both burning, grazing and flooding appear important factors in maintaining the grassland vegetation, areas which would otherwise be either edaphically controlled *Borassus – Phoenix* wooded grasslands or miombo woodlands (Mutch, 1977), as discussed earlier in this chapter.

The species composition and vegetation dynamics of floodplain grasslands are rather complicated. Grazing, fire and effective rainfall are interrelated in such subtle and complex ways that often it is impossible to predict the consequences of variations in their relative strength on the grassland vegetation (Lind and Morrison, 1974). Seasonally

The edge of the Muyovozi floodplain with extensive grasslands

flooded grasslands in African floodplains are among the most productive grassland ecosystems in the world which support high densities of grazing wildlife and livestock and typically provide the most productive fisheries in river systems (Denny 1991).

Grasslands in the Ramsar Site primarily occur in the floodplain of the Muyovozi, but also in the downstream parts of the floodplains of the Kigosi and Malagarasi rivers, sizeable areas to the north and west of Lake Nyamagoma, and in the eastern part of the Ugalla River Game Reserve. Grassland vegetation also dominates the so-called 'dambos' which are hygrophilous, largely treeless grasslands that occupy seasonally waterlogged valley depressions in the miombo woodlands.

In upstream areas, the grasses *Hyparrhenia*, *Themeda*, *Pennisetum racemosa* and *Setaria* are found in the outer edges of the floodplains (Mutch, 1977). Areas subject to greater flooding support *Hyparrhenia rufa* and especially *Echinochloa pyramidalis*. The distinction between grassland and permanent swamp is not always easy to make. Seral stages of the grassland follow the recession of the floods, giving the characteristic concentric zonation of *Hyparrhenia – Echinochloa – Vossia* as one approaches the central sump of permanent marshes (Mutch, 1977). Other grass species encountered in the Muyovozi area include the grasses *Echinochloa haploclada*, *Leersia hexandra*, and *Hemarthria natans*. Flowering herbs are relatively uncommon, except on slightly raised sites, and include *Aeschynomene* sp., *Spermacoce dibrachiata* and *Senecio* sp. (Mutch 1977).

In well-drained places where the evaporative demands are particularly high, saline-alkaline soils may develop, which are normally covered in tall grasses, sedges and *Typha* sp., with the shrubs *Pluchea discoridis* and *Sesbania sesban* and some scattered low *Acacia* or *Combretum* trees. In the Ramsar Site, such alkaline grasslands can for instance be found at Bweru.

Permanent swamps

Permanent herbaceous swamps are found where the soil is permanently waterlogged or flooded (even at the end of the dry season). These swamps consist of a variety of competing plant communities in zones regulated by the depth of water (Denny 1985, 1991). In the Malagarasi-Muyovozi Ramsar Site, such permanent swamps can be found in the river valleys of the Muyovozi, Kigozi, and Gombe rivers, and especially around Lake Nyamagoma, at an area called Lumbe swamp (SE of Lake Sagara near the railway line) and to a lesser extent in the Ugalla River valley and in the downstream parts of the Malagarasi River valley.

The extent of permanent (herbaceous) swamps in the Malagarasi-Muyovozi Ramsar Site was calculated in two ways. Extrapolation of the aerial survey transect results for the entire area yielded an estimated total cover of 133,500 hectares or 3.2% of the Ramsar Site. Calculations from the digitized 1:250,000 detailed vegetation maps of 1996 yielded a total 162,500 hectare of vegetation classified as permanent swamp on the maps, which amounts to approximately 3.9% of the Ramsar Site. The previous estimate of 320,000 ha

Permanent (papyrus) swamp around some open water

of permanent swamp in the upper portion of the Ramsar Site (Muyovozi/Nikonga/Gombe rivers) alone as reported in previous documents (Anonymous, 1994; SIMMORS, 1999) appears to be a considerable overestimate. As mentioned earlier, the size of these permanent swamps may, however, increase or decrease over the years in response to significant changes in water levels.

The vegetation supported by these permanent swamps is dominated by emergent sedges (Cyperaceae, most notably *Cyperus papyrus*), grasses (such as *Vossia cuspidata*, *Leersia hexandra*, 'African wild rice' *Oryza barthii*, *Andropogon africanus*, *Hemarthria natans* and) and cattails (also called bulrush, *Typha* sp.), with locally abundant leguminous shrubs such as *Sesbania sesban* (e.g. at Lake Nyamagoma), *Mimosa pigra* and *Aeschynomene* sp. (Mutch, 1977). The contribution of papyrus (Cyperus papyrus) to the herbaceous vegetation of these permanent swamps and marshes in the Ramsar Site was estimated to be in the order of 10-20% in the northern parts of the floodplains of Muyovozi, and Kigozi rivers, up to 50% in the southern parts of the Muyovozi and Gombe floodplains, and 50-100% in the areas around Lake Nyamagoma and at Lumbe swamp. This would lead to a very rough estimate of the extent of papyrus swamps in the Ramsar Site of around 48,000 – 90,000 hectares, far less than the earlier figure of an estimated 200,000 hectares of papyrus swamps quoted in the project and Ramsar documents (Anonymous, 1994; SIMMORS, 1999).

Open water vegetation

The lakes and other areas of open water in the river valleys (estimated to cover approximately 25,000 – 38,000 hectares or 0.6-0.9% of the Ramsar Site) display a diversity of waterplants, including water lilies *Nymphaea* (esp. Muyovozi, Malagarassi, Lake Sagara), and various submerged aquatic plants, including *Ceratophyllum*, *Chara* and *Utricularia* (esp. Malagarasi swamp) (Lind and Morrison, 1974) and floating water lettuce *Pistia* (only observed in a certain sheltered section of the Ugalla River).

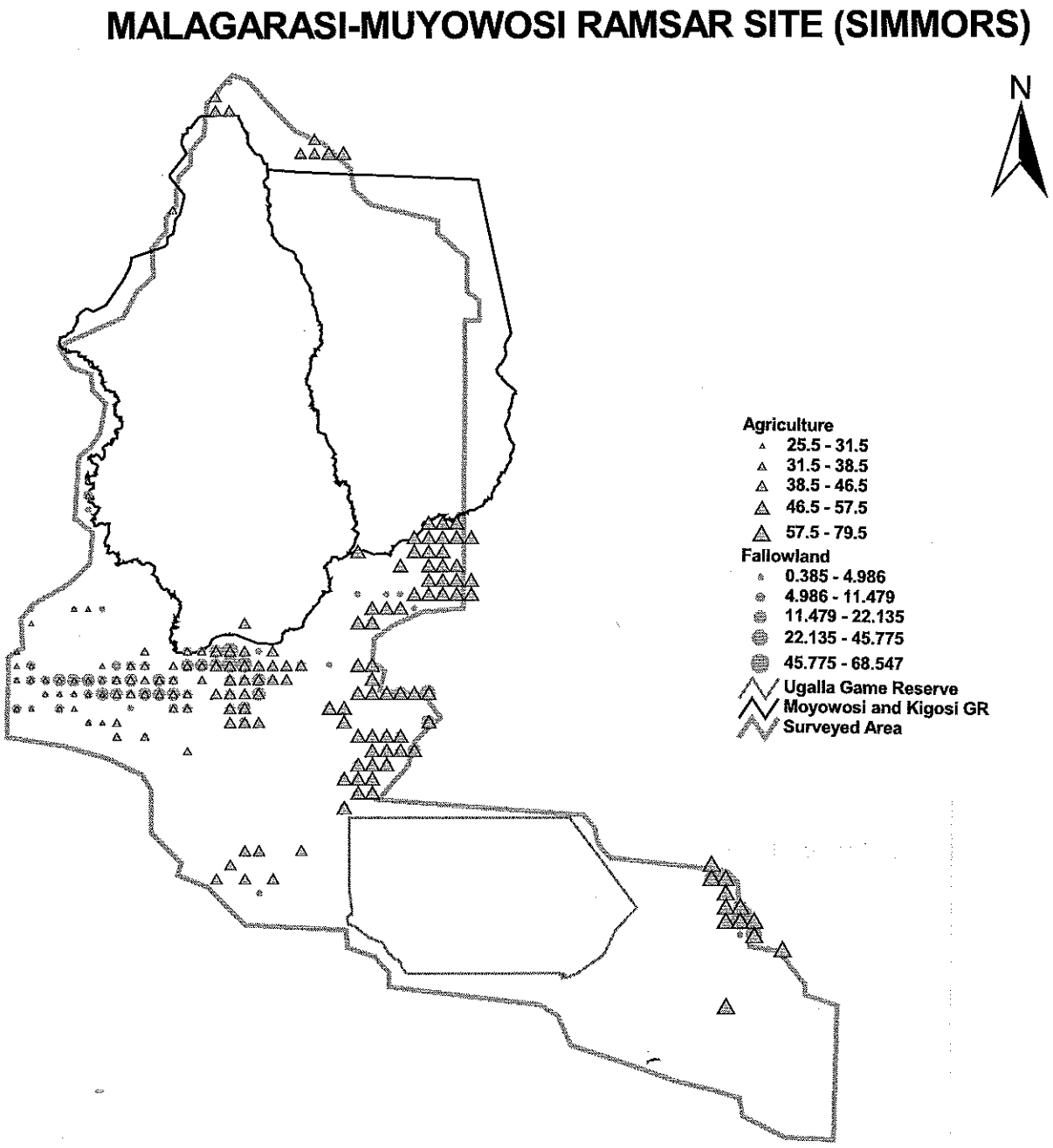

Figure 4. Map showing the distribution of agricultural cultivation & fallow land in the Ramsar Site, as observed during the survey.

3.3 Land-use/Human Activities

The wetlands and woodlands of the Malagarasi-Muyovozi Ramsar Site offer a vast array of natural resources and services to the people that live in and around the site. Contrary to game reserves proper, where conservation of wildlife is the primary aim, the wise utilization of resources is a central theme of concern in Ramsar Sites, and as such should also be seen as central to the discussion in this chapter. Yet, where illegal and destructive forms of exploitation occur, or resources are being over-exploited, the ecological integrity and support functions of the wetland ecosystems in the Ramsar Site are in danger, thereby threatening the livelihoods of those people who depend on it.

During the aerial survey any observations types of human activities that were visible from the air were systematically recorded, an overview of which is presented in Table 2 and Figures 4-9. The following sections will deal with each of the main types of land-use and other human activities separately.

Agriculture

The observations made during the aerial survey suggest that there are currently about 54,000 fields of cultivation and about 30,000 fields of abandoned/fallow land in the Ramsar Site, covering a combined total area of approximately 96,000 hectares (or 2.3% of the Ramsar Site's total area). The bulk of these active and abandoned agricultural fields is concentrated in the central zone of the Ramsar Site (around the lakes and along the railway line, as well as in the Gombe Game Controlled Area), while the remainder is located along the fringes of the Ramsar Site in the north and south-east (Figure 4). There appears to be relatively more fallow land in the western part of the central zone (to the west of and in between the two lakes) than in the eastern parts, which could indicate that the latter are either located on more fertile land or have been established more recently. Practically no cultivation was observed within the boundaries of the Muyovozi, Kigosi and Ugalla River Game Reserves, where this activity is prohibited.

By far the majority of all cultivation is in former miombo woodland areas. Nearly half a million hectares of miombo are cleared annually in seven countries of the miombo region, despite the growing appreciation of the values and functions of this important ecosystem (Campbell, 1996). Agricultural practices in miombo face the problem that soils in miombo are always typically nutrient-poor and acidic, raising questions about the sustainability of cultivation in these areas (Frost, 1996). Soils in miombo woodlands are also low in organic matter as a result of the widespread occurrence and abundance of termites (some depending on cellulose-decomposing fungi, which they cultivate in their mounds) and the frequent incidence of fire. There is no doubt that termites have a significant and widespread effect on soil properties where they occur (Frost, 1996). Termites are known to be serious pests in both agriculture and forestry in East Africa, occasionally causing serious damage to cotton, sugar and tea plantations locally throughout the region (Lind and Morrison, 1974).

Table 2. Overview of human activities in the Ramsar Site observed during the aerial survey (counted and estimated)

Human Activity	Estimates	Std Error	Count
Agriculture:			
Cultivation (No. of fields)	54,316	11,813	3,659
Fallow land – abandoned (No. of fields)	30,594	9,398	2,061
Livestock:			
Cattle	74,415	27,314	5,013
Sheep and Goats	9,248	3,859	623
Logging:			
Saw pits	6,071	917	409
Old saw pits (abandoned)	163	92	11
Tree felling (No. of trees)	24,196	7,104	1,630
Charcoal kilns	74	37	5
Hunting/Poaching:			
Hunter's camps	134	49	9
Poacher's camps	475	80	32
Human settlements:			
Villages	549	165	37
Huts – occupied (inside boma)	341	233	23
Huts – unoccupied (inside boma)	6,294	1,552	424
Huts with mabati roof	980	499	66
Huts with thatched roof	16,685	2,873	1,124
Masai boma – abandoned	59	28	4
Masai boma – occupied	59	34	4
Masai boma – unoccupied	15	14	1
Accessibility:			
Access roads & vehicle tracks	5,106	648	344
Footpaths or poachers' trails	4,186	647	282
Fishing & Mining:			
Fishing camps	356	123	24
Canoes	1,752	576	118
Mining camps	45	24	3
Mining holes	356	289	24

The low nutrient status of miombo woodland soils is reflected in the widespread traditional practice of various forms of shifting agriculture. The woody biomass is generally burnt when clearing miombo woodland for cultivation, which is usually done intentionally to fertilise the soil. Such ash-fertilization agriculture should be viewed as a well-adapted strategy through which people with limited resources overcome the constraints of their environment by capitalising on the nutrients stored in the vegetation (Frost, 1996). Even though some of the nutrients (notably nitrogen and sulphur) are volatilised in the process and thus partly lost, the burning does temporarily raise the nutrient status of the soil. The system does, however, rely on a long fallow period to replenish the nutrients in the soil and vegetation. Under increasing human population pressures, fallow periods are becoming shorter while people are exploiting the vegetation more intensily, indicating that this form of agriculture is becoming increasingly difficult to sustain. When it is gradually replaced by long-term or permanent cultivation as the pressures of expanding human populations reduce the availability of unoccupied land, gradual and long-lasting decline in soil fertility may result (Frost 1996). Crops grown in this area include tobacco, maize, ground nuts, cassava and kidney beans (see Jones and Hill (1994) for further details).

Pastoralism

The results of the aerial survey counts indicate that there were an estimated 74,000 cattle (boran and ankole/zebu) and approximately 9,200 sheep and goats present in the Ramsar Site at the time of the survey. This is substantially more than the earlier rough estimate of 15-20,000 cattle estimated in the project and Ramsar documents, but the latter estimate was confined to the central part of the study area only, and mentioned that more cattle was probably present in the southern part of the Ramsar Site. Single counts in a single season may, however, not give an appropriate picture of the actual numbers of grazing cattle in wetland areas. Repeated counts in different seasons in the Usangu wetlands under the SMUWC project, for example, have proven to give much more accurate and moderate figures on numbers of cattle than the earlier wildly exaggerated figures documented for the site. Historically, the area south and east to the Malagarasi River was part of the great cattle kingdom of the Waha, who even traded large herds of cattle with the Watussi in neighbouring Burundi. An outbreak of rinderpest (in the late 1890s) and subsequent invasions by vast numbers of Tsetse flies made it impossible to carry on maintaining large numbers of cattle in this region (Kjekhus, 1977). African floodplains have supported nomadic tribesmen and their cattle for thousands of years (Denny, 1991).

Most cattle, sheep and goats were observed in the central portion of the Ramsar Site, particularly along the southern parts of the Muyovozi, Gombe and Malagarasi floodplains (Figure 5). Lower densities of cattle were also observed in the flooded grasslands around Lumbe swamp and along the north-eastern border of the southernmost portion of the Ramsar Site (Walla River and Ugunda Forest Reserves). A lot of the cattle herding (esp. of boran) in the site is done by Tutsi herdsmen originating from neighbouring Burundi, who were settled in the southern floodplains of the Muyovozi Game Reserve as refugees in the early 1970s. Groups of nomadic pastoralists (Wasukuma) are reportedly also moving into the area during the dry season (SIMMORS, 1999). At present, little is known

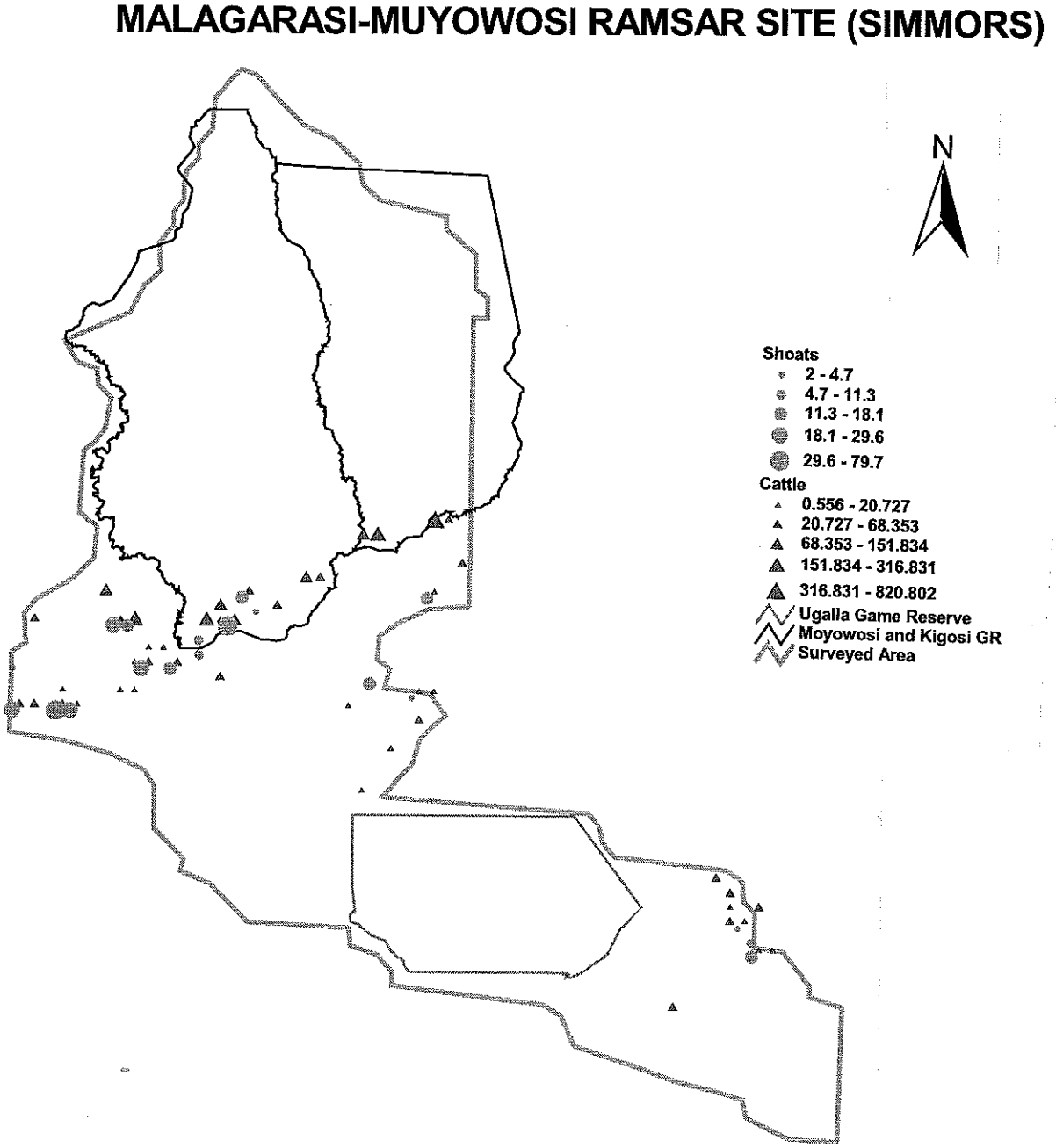

Figure 5. Map showing the distribution of cattle, sheep and goats in the Ramsar Site during December 2001.

about seasonal movements of the pastoralists and their cattle within or in & out of the Ramsar Site.

The pastoralists are involved in the burning of significant parts of the Muyovozi and Malagarasi floodplains to maintain suitable grazing conditions for their livestock, but fires within the Ramsar Site are also associated with hunting, poaching, honey gathering and fishing camps. The issue of fires is dealt with in the next section.

Burning of the floodplain & swamps

A rough picture of the approximate extent and distribution of burnt areas in the Ramsar Site as observed during the present survey (December 2001) is shown in Figure 6. It was often not possible to distinguish burnt areas over large parts of the floodplains with certainty, as a lot of fresh grass had sprung up in many areas following recent rains. Our results can therefore not be considered to be very accurate and complete, and probably present an under-representation of the actual extent of the fires. Nevertheless, the figure shows clearly how the occurrence of fire is widespread in almost all the floodplains, grasslands and wooded grasslands throughout the Ramsar Site.

Fire is a natural occurrence in most grassland ecosystems in Africa and has been one of the primary tools humans have used to manage grasslands (Ferguson, 1999; Herlocker, 1999; UNDP et al., 2000). Fire prevents bushes from encroaching, removes dry vegetation, and recycles nutrients. Without fire, the tree density in many of Africa's grasslands would increase, eventually converting them into woodlands or forests. Natural fires, typically caused by lightening, are thought to occur about every 1-3 years in humid areas and every 1-20 years in dry areas (UNDP et al., 2000). Humans have set fires in the savannas for at least 1.5-2 million years and continue to use fire as a low-cost and effective means to manage grasslands. Especially in Africa, people use fire to maintain good forage conditions for grazing herds of livestock. Not all fires, however, are started by pastoralists. Hunters and poachers also set grasslands and bushlands ablaze to stalk game species. Although fire can benefit grasslands, it can be harmful too – particularly when fires become much more frequent than is natural (UNDP et al., 2000). A detailed experimental study on the impact of fire on shrub survival was made in the Mkomazi Game Reserve (Ferguson, 1999). This study demonstrated clearly how frequent fires encourage the dominance of palatable grass species, benefiting both cattle and wild large mammal grazer numbers.

Woody plants, in order to survive periodic burning by grass fires, must be fire-tolerant. Thus, grassfires encourage the growth of species that are adapted to burning. Miombo woodland vegetation in Tanzania is especially well adapted to grass fires (Herlocker, 1999). Termite mounds allow certain plant species to escape the generally low flames of the grass fires (Lind and Morrison, 1974). Most of the permanent swamp vegetation (notably papyrus) is, however, much more sensitive to fire. The impacts of fires on the spread and status of papyrus and other permanent swamp vegetation in the Ramsar Site is currently unknown, and needs further study. Hilltop dry forests and relict forest patches, which could be potentially valuable habitat for species not found elsewhere, also

Grassland burning on the Muyovozi floodplain

represent less fire-tolerant communities which may be affected by frequent uncontrollable late burning.

Timing and frequency of burning strongly affect the impact of grass fires on rangeland vegetation. Most burning is at the end of the dry season when conditions appear most suited to it. However, fires occurring early in the dry season, when the grass is only partially dry, are not as hot and destructive as those that happen during the late dry season, and they are also more easy to keep under control to avoid damage to adjacent fire-sensitive types of vegetation (e.g. papyrus). A continued high frequency of burning may eventually harm the soil and grass cover (Herlocker, 1999). Several game reserves and national parks with savanna-type grasslands throughout Africa as well as in Australia have adopted fire management policies (including Serengeti), encouraging a regime of early burning (Andersen, 1996; Ferguson, 1999; Herlocker, 1999). Extensive burning early during the dry season, when fires tend to be low in intensity and patchy, is often applied as a management tool to reduce the frequency and extent of high intensity fires late in the dry season (Andersen, 1996). The choice of any fire management strategy should be determined by the tactical goals and strategic management objectives that one aims to achieve.

It is widely recognized that long-term fire-exclusion has a marked effect on the structure of savanna vegetation and associated faunal communities, although this may be partly obscured in areas which would experience frequent natural fires even in the absence of humans (Andersen, 1996). Some areas in the Okavango Delta (Botswana), where fires were completely prohibited, turned from savanna into forest and woodland within a matter of 10-15 years (G. Howard, pers. comm.). The ecological effects of different fire regimes (esp. in the long-term) on wildlife and other biota of the grasslands are poorly understood (Anderson, 1996) and require further study. Little is known about the impacts of the fires on seasonal migrations of wildlife and the breeding success of grassland bird species.

Utilization of woodland resources

Tree felling in the miombo woodlands is done for the extraction of valuable timber species such as mninga (*Pterocarpus angolensis*), fuel wood and charcoal production. Figure 7 shows the distribution of saw pits and tree felling in the Ramsar Site, as observed during the aerial survey. It is clear from this figure, that logging in the woodlands is widespread throughout the entire Ramsar Site. Areas least affected include the greater part of Muyovozi Game Reserve and the southern parts of Kigosi Game Reserve, possibly due to limited accessibility and longer distances to centres of demand or export routes. It is clear however, that within all three Game Reserves, where such activities are prohibited, illegal tree felling and saw pits are happening at a substantial scale and intensity, though not as intense and widespread as in the Forest Reserves (where logging is regulated by licenses issued by the District Forest Officers) and non-protected areas. An explanation for this situation could perhaps be found in the partial overlap between Game Reserves and Forest Reserves, resulting in confusion over administrative and legislative control, as was already pointed out earlier by Jones and Hill

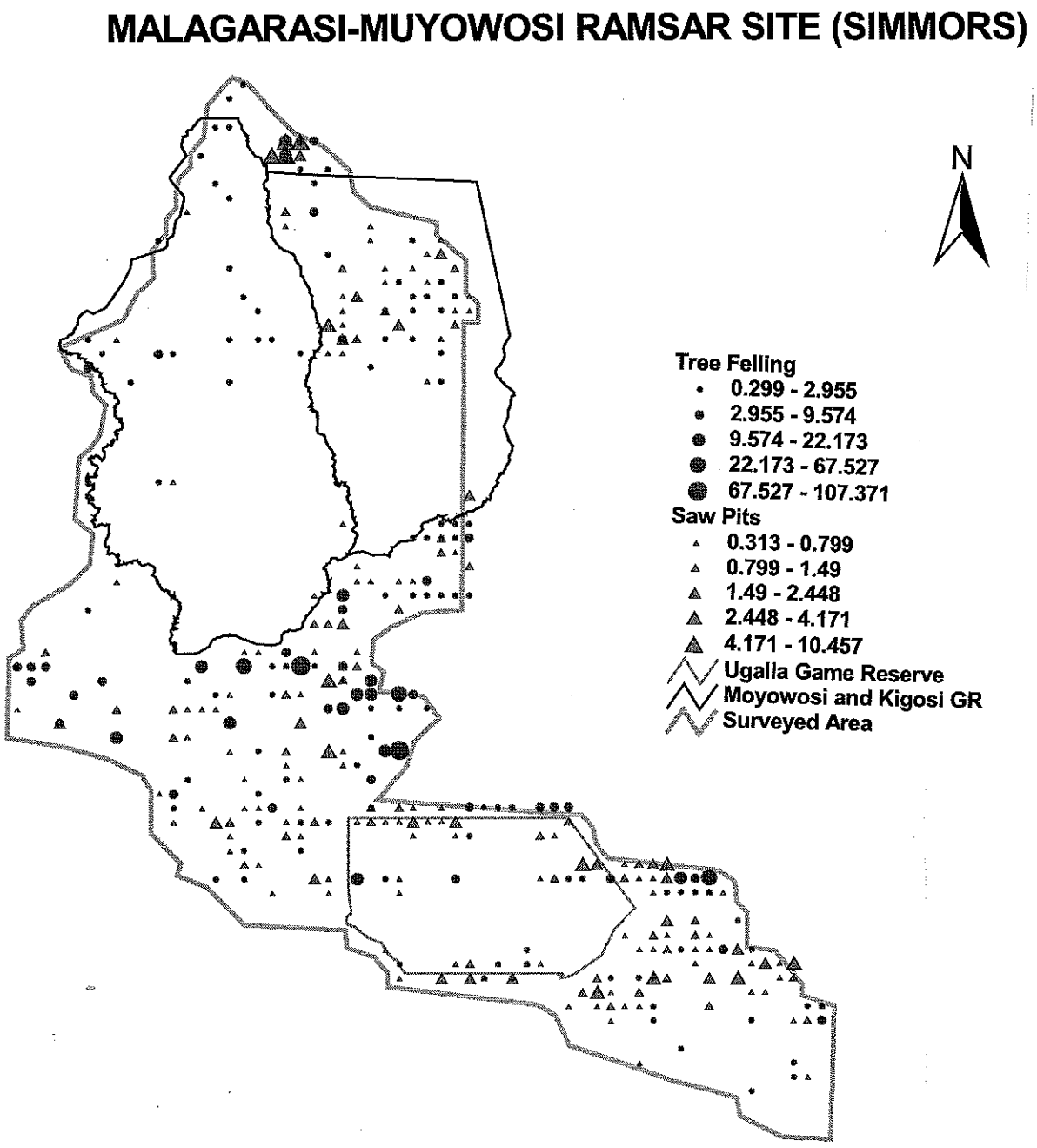

Figure 7. Map showing the distribution of saw pits and tree felling in the Ramsar Site, as observed during the aerial survey.

(1994). The results of the aerial survey do not allow any interpretation of trends in these logging activities, but data from other parts of the country indicate that logging and degradation of miombo woodlands is increasing rapidly, which calls for monitoring in the Ramsar Site. The effects of the illegal logging on the ecological character of the miombo woodland and its wildlife in the Game Reserves is unknown and needs further research. Further studies are also needed into regeneration potential and sustainable harvesting regimes for mninga.

Honey gathering occurs throughout the miombo woodlands in the Ramsar Site, and is permitted in the Game Reserves by licensed individuals, although it has been found very difficult to control. The Tabora region is famous for its trade in honey and bee-wax. The aerial survey did not yield much useful data on the distribution and numbers of bee-hives, which are difficult to spot from the air, especially in the more dense miombo. Further details on the honey gathering and issues pertaining to its management can be found in Jones and Hill (1994).

Hunting & poaching

Extrapolation of the aerial survey results indicate the presence of approximately 134 hunting camps and 475 poaching camps in the Ramsar Site (Table 2). Poacher's camps were widely distributed within the three Game Reserves, especially in the Kigosi Game Reserve and to a lesser extent in the Muyovozi Game Reserve. Hunting is done by licensed professional hunting companies for trophy hunting, which brings in a lot of revenue available to wildlife conservation. In 1992-93 for example, gross-earnings from tourism related to game hunting in Tanzania were 13.9 million US$, a three-fold increase over 1988 (UNDP et al., 2000). Poaching in this area, which is reportedly heaviest during the rainy season when hunting companies are not active, is mainly done for the bush-meat trade, to supply the nearby refugee camps and partly for the local market. The aerial survey results cannot tell us much about the impacts of poaching and hunting on the wildlife populations, but the widespread occurrence and density of poaching within Game Reserves, which is strictly illegal, is alarming. This concern was raised earlier in the report by Jones and Hill (1994), which provides more details on the poaching and also gives recommendations for the management and control of poaching in the area. Hunters and poachers also set grasslands and bushlands ablaze to stalk game species, thereby contributing to the widespread fires on the wooded grasslands and floodplain grasslands, as reported above.

Human settlements

A total of 37 villages were counted in the transects during the aerial survey, extrapolation of which would yield a total estimate of over 500 villages for the whole Ramsar Site. There are approximately 24,300 huts and houses within the Ramsar Site, 4% of which have mabati roofs and 27% of which are located inside bomas. A estimated total of 133 bomas occur in the area, 54% of which were abandoned or unoccupied. The distribution of villages, bomas and various types of huts is shown in Figure 9, which shows a major concentration of human settlements in the central zone and far south-eastern part of the

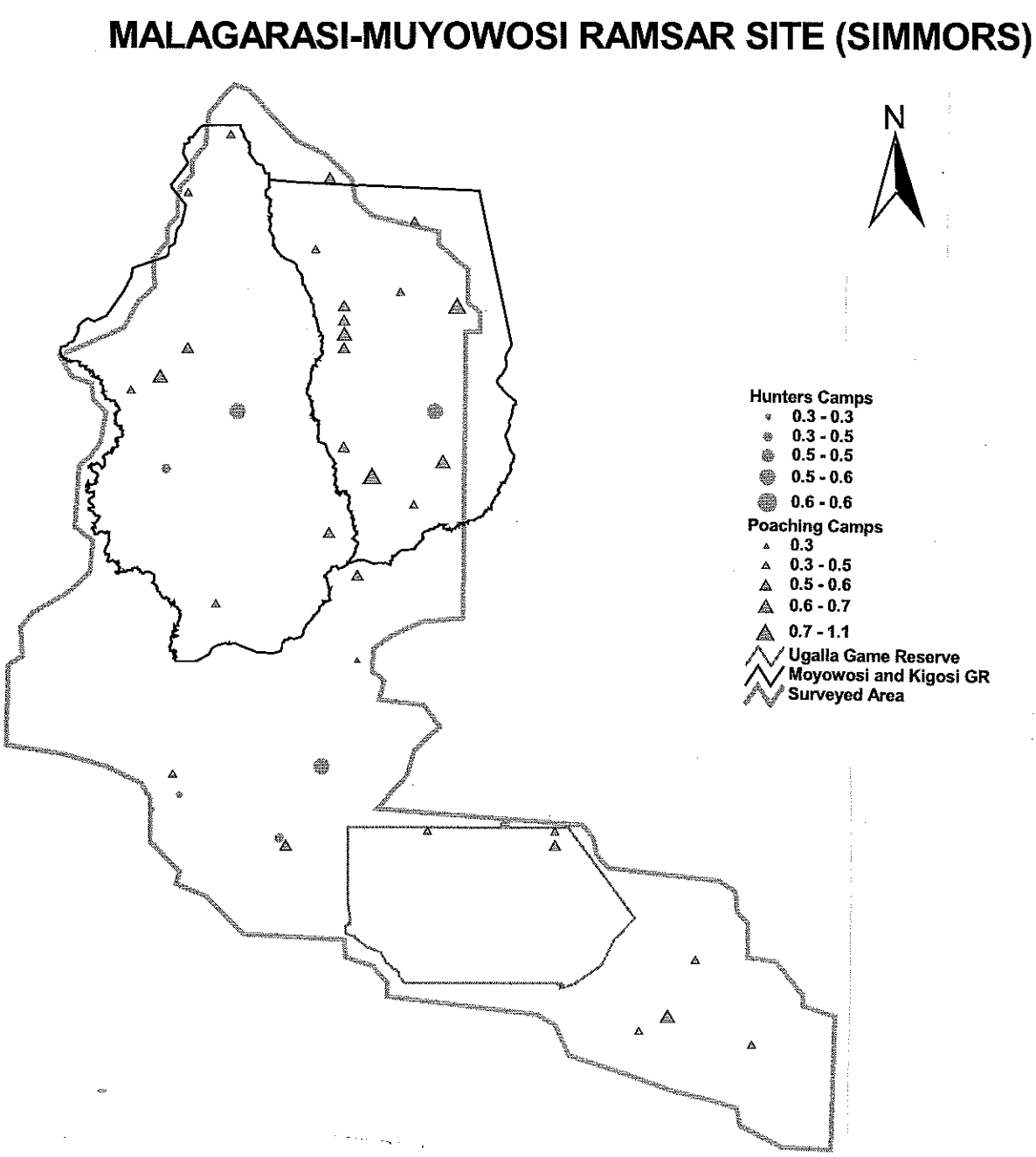

Figure 8. Map showing the distribution of hunting camps and poaching camps in the Ramsar Site, as observed during the aerial survey.

MALAGARASI-MUYOWOSI RAMSAR SITE (SIMMORS)

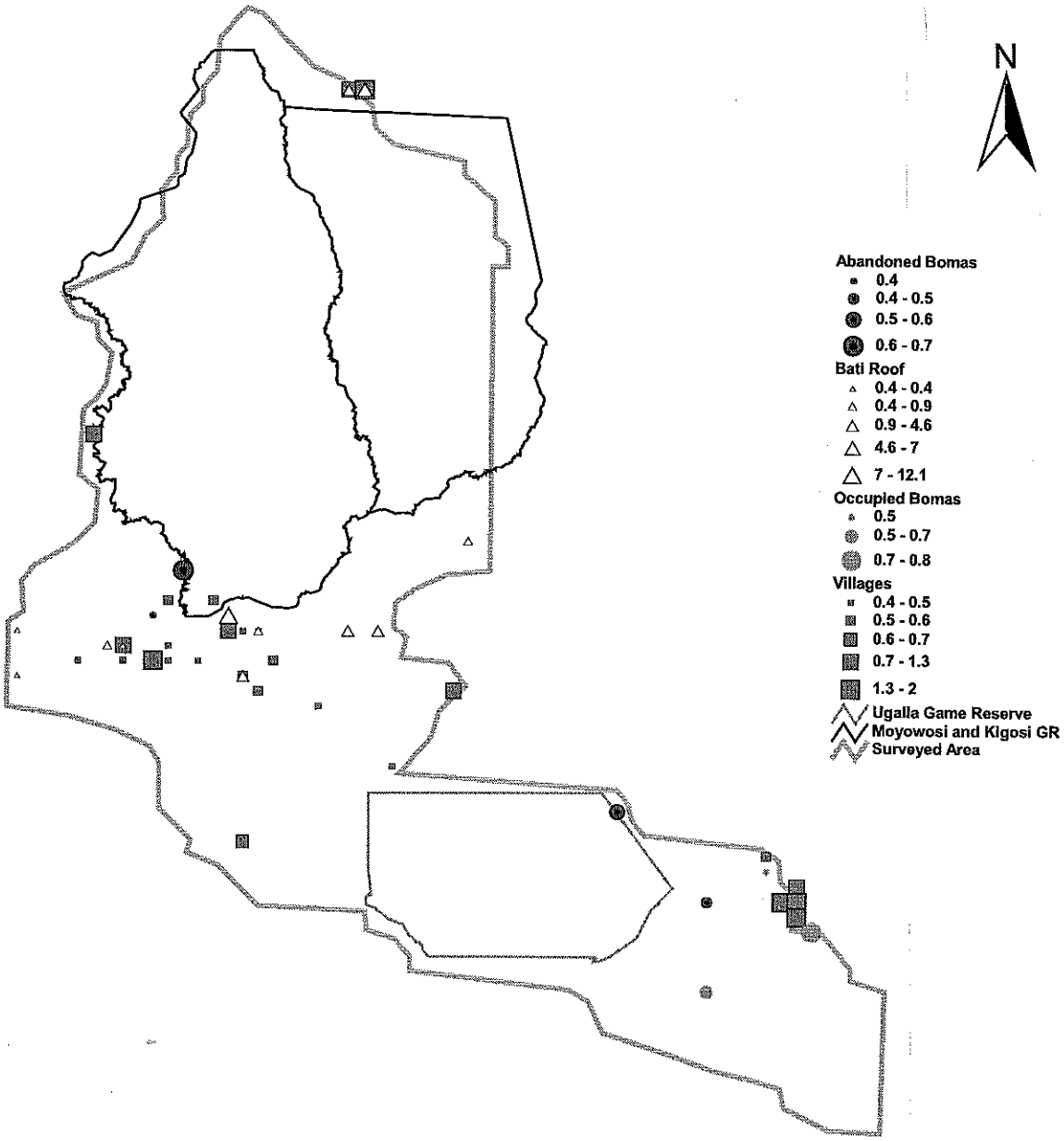

Figure 9. Map showing the distribution of villages, bomas, huts and other types of human settlements in the Ramsar Site.

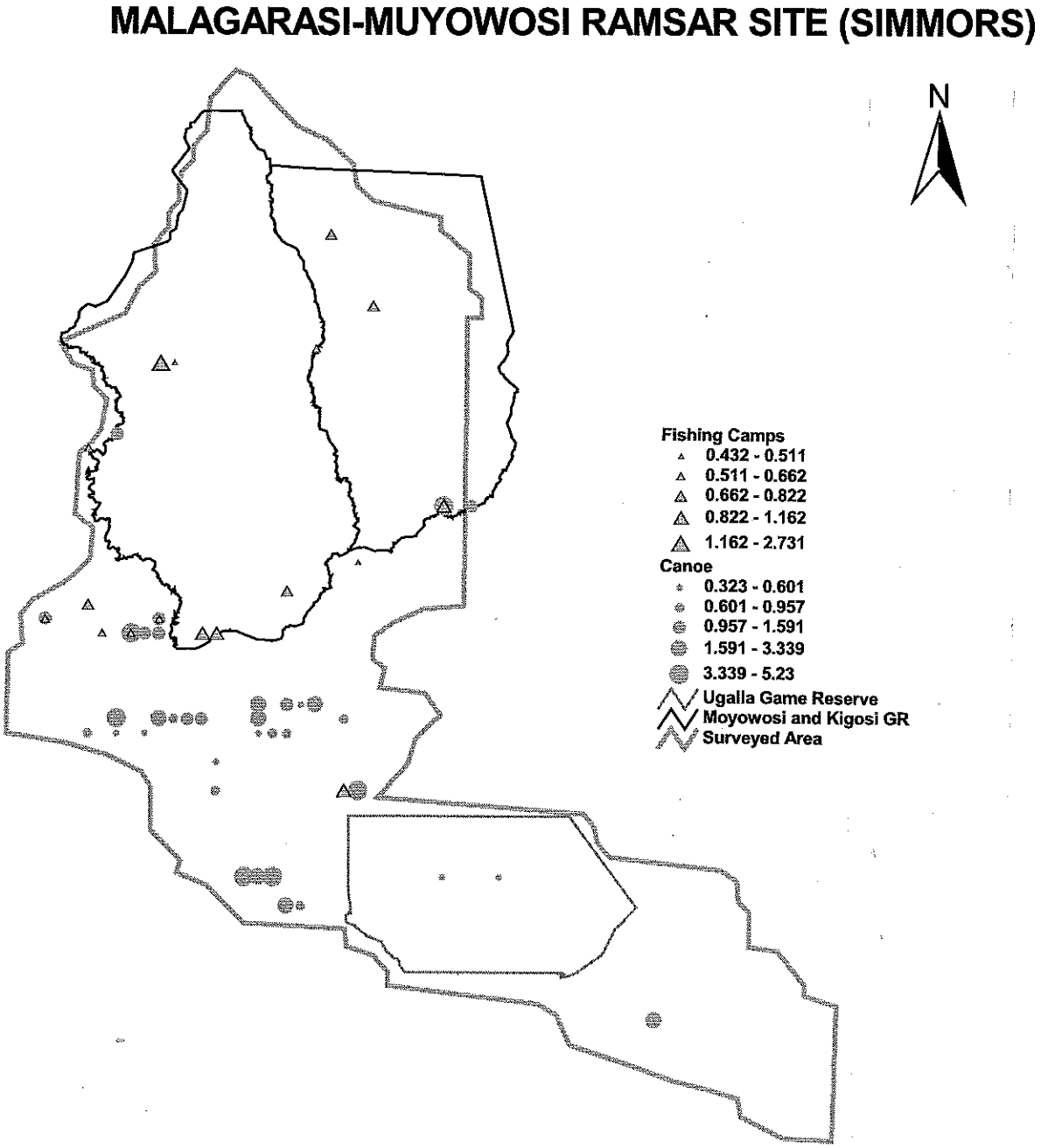

Figure 10. Map showing the distribution of fishing camps and canoes in the Ramsar Site, as observed during the aerial survey.

Ramsar Site, and an additional smaller concentration of settlements in the far north. The distribution pattern of human settlements matches fairly well with that of cultivation, cattle and to a lesser extent the areas with highest densities of tree felling.

Accessibility

Throughout the Ramsar Site (including the Game Reserves) there were many vehicle tracks and footpaths. While the vehicle tracks inside the Game Reserves mostly relate to licensed hunting safaris and patrol activities by the Game Park authorities, the footpaths in these protected areas most likely originate from illegal logging, poaching, and honey collectors. Some of the vehicle tracks in the forest reserves could relate to trucks transporting logs out of the woodlands. The highest densities of footpaths were observed in the Kigosi (913) and Muyovozi (813) Game Reserves and around the lakes Nyamagoma and Sagara (1,800).

Fishing and Mining

A total of 118 canoes were spotted during the aerial survey, primarily in the two lakes (Nyamagoma and Sagara) and a few along the Malagarasi, Ugalla and Gombe rivers. Extrapolation of these results over the entire survey area (as was done with all other data) would result in an estimated total of 1,752 ± 576 canoes, but given the extremely uneven distribution of open water bodies in the survey area, this extrapolation is probably meaningless. The survey also counted a total of 24 fishing camps, extrapolation of which would yield an estimated total of 356 of such camps in the entire Ramsar Site. Most fishing camps were found around Lake Nyamagoma, with some additional camps spotted along Gombe, Nikonga and Ugalla rivers, and another one at Lake Sagara. Fishing (like honey collecting) is a traditional activity. Fishing inside the game reserves is regulated by a licenses, but enforcement and control of license rulings is poor (Jones and Hill, 1994). At Lake Sagara there is an office of the Fisheries Division to administer the fishing activities in the lake.

The Ugalla River and its floodplain

4. Discussion

The aerial survey provided a successful rapid assessment of the status, distribution and extent of the wetland types and vegetation, the distribution and densities of wildlife (reported elsewhere), and the distribution and intensity of human activities (notably agricultural cultivation, livestock grazing, burning, logging, hunter's and poacher's camps, and settlements) in the Malagarasi-Muyovozi Ramsar Site. The aerial survey results cannot provide information regarding temporal trends in threats and activities over time, except for some general trends in wildlife numbers in the three Game Reserves derived from comparison with data from earlier aerial wildlife censuses in those areas. There is an obvious need for follow-up ground surveys to complement and verify the key findings of the aerial survey, provide more qualititative details on the composition of the different vegetation types, and to study in more detail some of the key issues that were identified.

4.1 Status of the vegetation

The following vegetation types occur in the Ramsar Site, in order of their approximate dominance: miombo woodland and forest (65%), wooded grasslands (17%), floodplain grasslands (9%), permanent swamps (3.2%), bushland (2.8%), while 2.3% was constituted cultivated areas and 0.6% open water. The extent of permanent swamps (roughly estimated to cover between 130,000 – 160,000 ha) is much less than previously reported (320,000 ha). Similarly, the earlier estimate of at least 200,000 hectares of papyrus swamps (Anonymous, 1996; SIMMORS, 1999) appears to have been a gross over-estimation if compared to the present estimate (based on aerial survey results and detailed 1994 vegetation maps) of about 48,000-90,000 hectares. Little is known about the year-to-year dynamics of the papyrus vegetation in relation to fluctuating water levels and rainfall patterns, and about the impacts of fire on the papyrus swamps.

The overall status of the miombo woodland vegetation in the Ramsar Site appears reasonably good from the air, although the distribution of saw pits and observations of tree felling was found to be widespread and intense. Floodplain grasslands and dambo's in the miombo are burned on a large scale for various reasons, which may have significant impacts on the vegetation in these areas, but so have wildfires, flooding and grazing. Most of the vegetation in the Ramsar Site is either a fire-climax vegetation or controlled by edaphic factors related to the flooding regime of the rivers.

The overall status of the vegetation in the three Game Reserves (where there is virtually no encroachment for cultivation and less tree felling) is better than in the Forest Reserves (where there is significantly more tree felling, encroachment, and other human activities), while the impacts of human activities on the vegetation were most significant outside these protected areas.

Cross-checking survey results with vegetation maps of the area

4.2 Internal and external threats to the Ramsar Site

The main issues and threats that were identified within the Ramsar Site, include:

- logging and tree-felling in miombo woodlands (for timber, fuel-wood and charcoal)
- burning of the floodplain and swamps (by pastoralists, hunters & poachers, honey collectors and natural fires)
- agricultural encroachment of the miombo woodlands (outside Game Reserves)
- widespread poaching (within and outside Game Reserves)

All these issues require follow-up study and monitoring in order to identify trends and decide on the most appropriate and effective management response.

External threats from the areas surrounding the Ramsar Site include agricultural encroachment and use of pesticides, deforestation and soil erosion, mining (Kahama, and Geita, effluents of which could end up in the Nikonga River), and increased pressures on the overall natural resources of the area arising from increasing settlement due to rising population densities and the settlement of large numbers of Burundi refugees.

4.3 Recommendations for management/wise use

In discussions regarding the identification of buffer zones to the Ramsar Site, it should be noted that most pressure on the natural resources in the area comes from the direction of areas with the highest densities of human settlements. These are concentrated in the north-east (east of Kigosi) and south-west (Burundi refugee camps) of the Ramsar Site, and particularly to the east of the central zone along the railway (unprotected areas). The western side of the Ramsar Site is poorly accessible and reasonably protected by a natural buffer zone in the form of steep mountain ridges, cliffs and forested hills. The various forest reserves that are part of and surrounding the Ramsar Site have provided a reasonably good buffer to the core wetland areas and Game Reserves in the Ramsar Site. Given the high density and wide distribution of illegal tree felling and poaching throughout these areas, however, it appears that there is a growing pressure on the natural resources which could threaten the ecological integrity and wildlife population levels in the Ramsar Site within the years to come. It is highly recommended that these trends be carefully monitored and the impacts of applied management strategies evaluated.

The overlap between forest reserves and game reserves in the Ramsar Site causes potential confusion over administrative and legal mandates and control, and is an issue that needs to be sorted out and solved urgently. This confusion over mandate and control may partly explain the widespread incidence of illegal tree-felling and saw pits in the Game Reserves, as well as the numerous footpaths into the Game Reserves, where logging is strictly forbidden and access (for hunting only) regulated by licenses.

Some areas of considerable conservation interest which are not included within the boundaries of the Ramsar Site are permanent swamp areas south of the Gombe River and

The western boundary of the Muyovozi Game Reserve

east of Lumbe swamp, habitats that are potentially and reportedly of considerable importance for shoebills. Also not included is the delta of the Malagarasi River into Lake Tanganyika, inclusion of which would have made more sense from an ecological point of view. Perhaps some of these boundary issues can be looked into, and their inclusion in the Ramsar Site be considered.

The exact boundary of the Ramsar site is not really very clear in some areas (e.g. in the central-eastern zone, where part of the permanent swamp areas associated with the Gombe river and Lake Masimba appear not to be part of the Ramsar site). These issues need to be clarified.

Appropriate management strategies need to be formulated and implemented regarding the regulation of livestock and burning in the Ramsar Site. There is a negative perception of often grossly exaggerated impacts of pastoralism on wildlife conservation and natural habitats in Tanzania. Yet, pastoralism and burning of floodplain grasslands in many parts of Africa has been going on for thousands or even millions of years, forming an important ecological factor determining the vegetation and wildlife populations in these areas. There is obviously a great deal more to say about the interaction between pastoralism and wildlife conservation, and there is also need for more research into these issues, particularly with regards to the impacts of different fire managament regimes on vegetation and wildlife, and the interaction between livestock and wildlife with respect to pests and diseases.

Issues such as establishing certain no-burn zones in the Ramsar Site, restricting burning to certain seasons (e.g. an early burning policy), or restricting livestock grazing to certain zones in the Ramsar Site, should be considered carefully, and based on the results of scientific studies.

4.4 Needs for further studies/research

The interpretation of the aerial survey results has brought to light a number of key issues which need further research, which are listed here below. There is, however, a need for a more strategic approach in identifying research priorities that can assist the management of this area, perhaps in the form of a research master plan. The research master plan for the Rufiji floodplain and delta, that is currently being developed by IUCN could serve as a model.

- There is a need for ground truthing and follow-up field surveys to come up with more detailed description of the composition of vegetation types of high conservation interest, such as the permanent swamps

- The regeneration potential of miombo woodland (in relation to agricultural cultivation and subsequent fallowing) and particularly with regards to regeneration, plantation techniques and sustainable harvesting levels of mninga (Pterocarpus angolensis)

At the Urambo airstrip

should be studies in more detail in this area (in collaboration with the miombo research station of TAFORI in Tabora)

- There is a need to conduct a detailed hydrological study of the entire wetland system of the Ramsar Site, including monitoring of water levels in relation to year-to-year fluctuations in rainfall and flooding events, etc.

- There is need for further studies on the impact of different fire management regimes on vegetation and wildlife, especially on permanent swamp vegetation, wildlife migrations and nesting bird species of conservation interest. This could lead to the identification of the best fire management practices. Such studies should also consider a way to monitor the distribution, extent and intensity of fires in the Ramsar Site from year to year.

- Continued monitoring of wildlife populations is essential to detect trends and demonstrate the impacts of poaching, management interventions and climatic factors.

Acknowledgements

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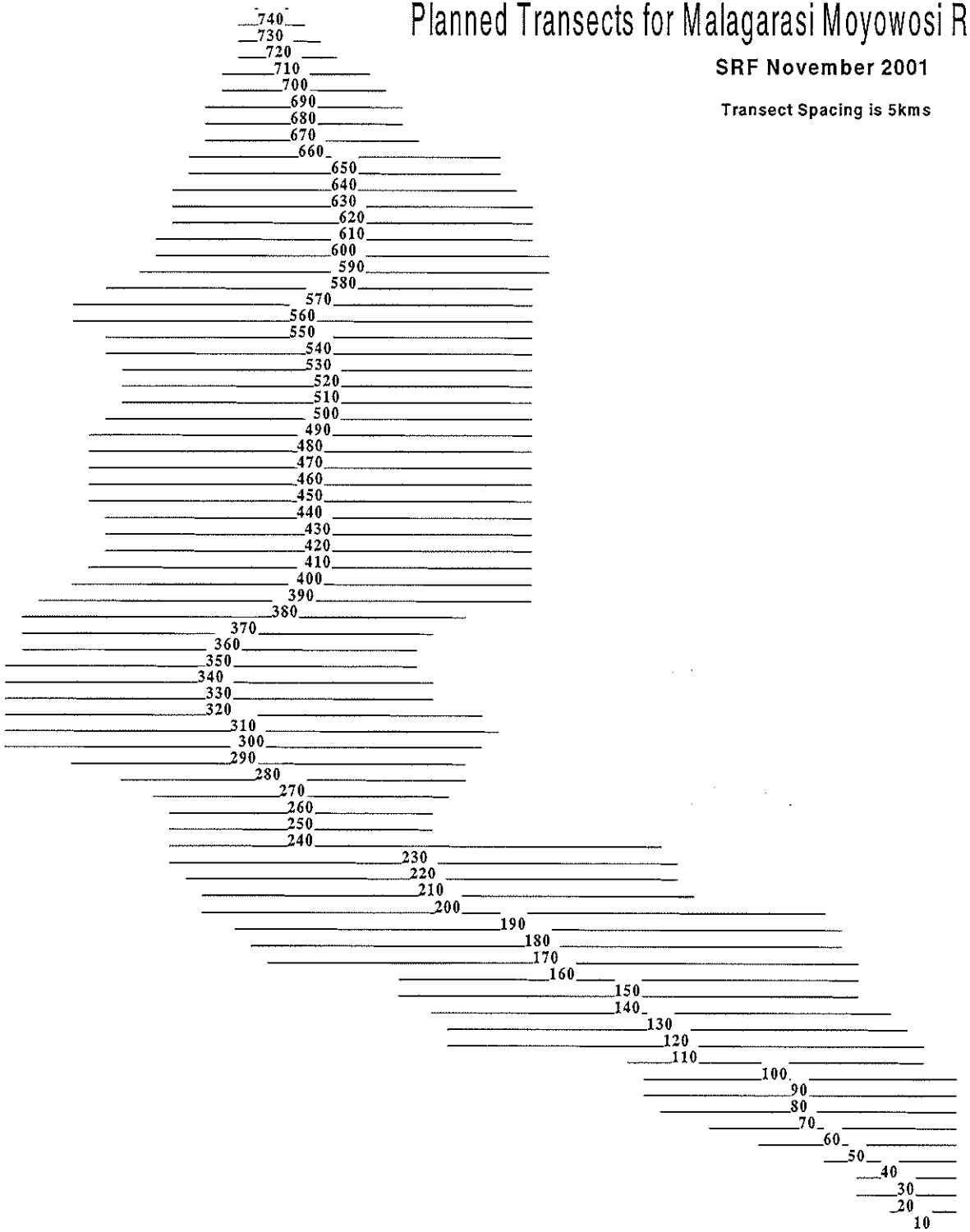
Appendices

Map of planned transects for the aerial survey
Overview of flight survey parameters
Copy of an FSO observation sheet (example)
Copy of an RSO observation sheet (example)
Vegetation Reference Sheet (with photographs)
Maps showing the distribution for each of the vegetation types (separately)

Planned Transects for Malagarasi Moyowosi Ramsar Site

SRF November 2001

Transect Spacing is 5kms



Survey Parameters

Aircraft ID	5H-MPK
Flying Height	
Average	*369.48*
Std Deviation	*66.16*
Maximum	*1100*
Minimum	*200*
Total Transects	*48*
Total Sub-units	*2800*
Transect Distance (km)	*5360*
Sample Area	*1846.9*
Mean Strip Width	
Left Observer (LSO)	*176*
Right Observer (RSO)	*168*
Combined	*344*

Aircraft ID	5H-MPK
Flying Height	
Average	*352.18*
Std Deviation	*31.21*
Maximum	*1000*
Minimum	*36*
Total Transects	*26*
Total Sub-units	*1662*
Transect Distance (km)	*2986*
Sample Area	*963.7*
Mean Strip Width	
Left Observer (LSO)	*165*
Right Observer (RSO)	*157*
Combined	*323*

Tanzania Wildlife Conservation Monitoring

FSO DATA SHEET

Survey: MO 4 Transect: 250 Direction: E Date: 21/11/01

Pilot: WAM FSO: PEB RSO-L: JEK RSO-R: MBO

Time Start: 9 : 35 Time Stop: 10 : 00 Total Transect Time: 24 : 47

Planned transect start: Actual transect start:

Planned transect end: Actual transect end:

Sub-	Radar	Water	Burnt	Veget.	
1	600	1	0	W	rocky
2	500	1	0	WG	
3	500	0	0	W	open -
4	470	1	0	W	
5	480	1	0	W.	rocky
6	490	0	0	W	rocky
7	480	1	0	W	
8	490	0	0	W	dense
9	500	0	0	W	dense
10	500	0	0	W	
11	490	1	0	W	rocky
12	480	0	0	W	
13	500	0	0	W	+WG
14	490	0	0	W	(rocky plateau)
15	700	0	0	W+P	
16	450	0	0	W	rocky
17	380	0	0	W	rocky
18	700	0	(1)	G+P	flood plain
19	700	0	0	W	rocky
20	490	0	0	W + WG	
21	350	1	0	W	open rocky
22	350	0	0	W	open
23	490	0	0	W	
24	500	0	0	WG + W	
25	600	0	0	W + WG	
26	650	0	0	W	
27	700	0	0	G (+ WG)	
28	800	0	0	W	
29	750	0	0	WG	(+G)
30	600	1	0	W	open +WG

Buffalo

elephants

Sub-	Radar	Water	Burnt	Veget.	
31	550	0	0	W	
32	300	0	0	W	ro
33	400	0	0	W	
34	470	0	0	WG +	W
35	480	1	1	G +	W
36	480	0	0	WG +	W
37	480	0	0	WG +	G
38	480	0	1-2	G	
39	410	0	(2-3)	G	
40	350	1	1	P+G	
41	340	2	0	P	
42	350	1	0 (1)	P + W	+C
43	310	0	0	W +	C
44	330	0	0	W +	C
45	390	0	1	WG	
46	440	0	1	W + C	
47	410	0	0	W	+C
48	390	0	1	W + C	
49	380	0	1	W + C	
50				(C)	
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					

Boundary Location

Expected		
Observed		

Remember to mark the subunit where boundary occurs

FSO Supplemental Observations

Observation	GPS location

Tanzania Wildlife Conservation Monitoring RSO DATA SHEET

Survey: M011

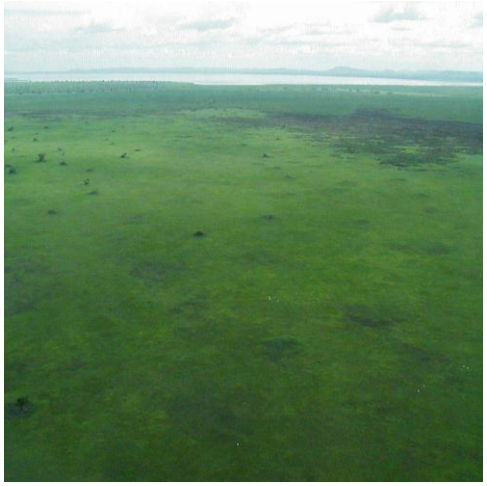
Date 21/11/01 Transect 260 (W) Observer MBo ~~Left~~ / Right

Tape Cassette Number 02

SubUnit	CODE	NUMBER	SubUnit	CODE	NUMBER	SubUnit	CODE	NUMBER
01	RL	1	08	Cu	2	28		
	FF	5		FF	10	29		
	FP	1		TH	4	30		
	TH	1		FP	1	31		
02	TH	5	09	FF	7	32	KG	5
	Cu	7	10	FP	1	33	RD	1
	FF	10	11	SP	1	34	RD	1
03	Cu	4	12			35		
	FF	7	13			36	CU	1
	FP	1	14	FP	1		TH	1
04	TH	3	15	FP	1	37		
	Cu	2	16			38		
	FF	5	17	FP	1	39		
	FP	1	18	RD	1	40	FP	1
	TH	1	19			41		
	TH	5	20			42		
	Cu	5	21			43		
05	Cu	1	22			44	FP	1
	FP	1	23			45		
06	Cu	2	24			46		
07	Cu	5	25			47	FP	1
	FF	8	26			48		
	TF	4	27			49		

Vegetation Reference Sheet

W – Woodland
(21-75% canopy cover,
can see ground)



G – Grassland
(grassland with few or no trees,
<2% canopy cover)

B – Bushland
(low brushy vegetation, often
mixed with grass)

P – Papyrus/Reeds/Swamps
(permanent swamp areas)

WG – Wooded Grassland
(grassland with sparse trees,
<21% canopy cover)

C – Cultivation
(agriculture & human habitation)

MALAGARASI-MUYOWOSI RAMSAR SITE (SIMMORS)

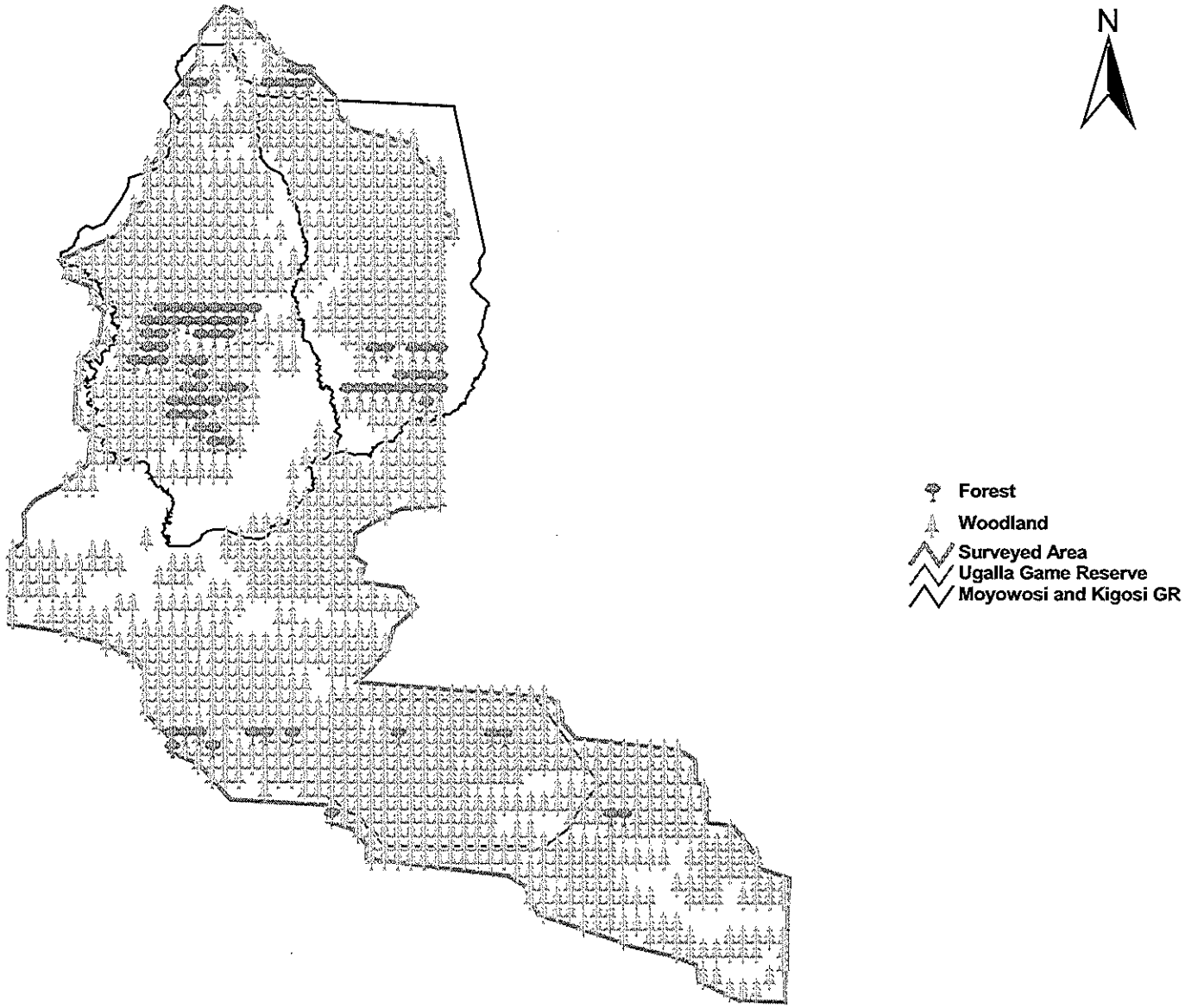


Figure x: Woodland and Forest, November 2001

MALAGARASI-MUYOWOSI RAMSAR SITE (SIMMORS)

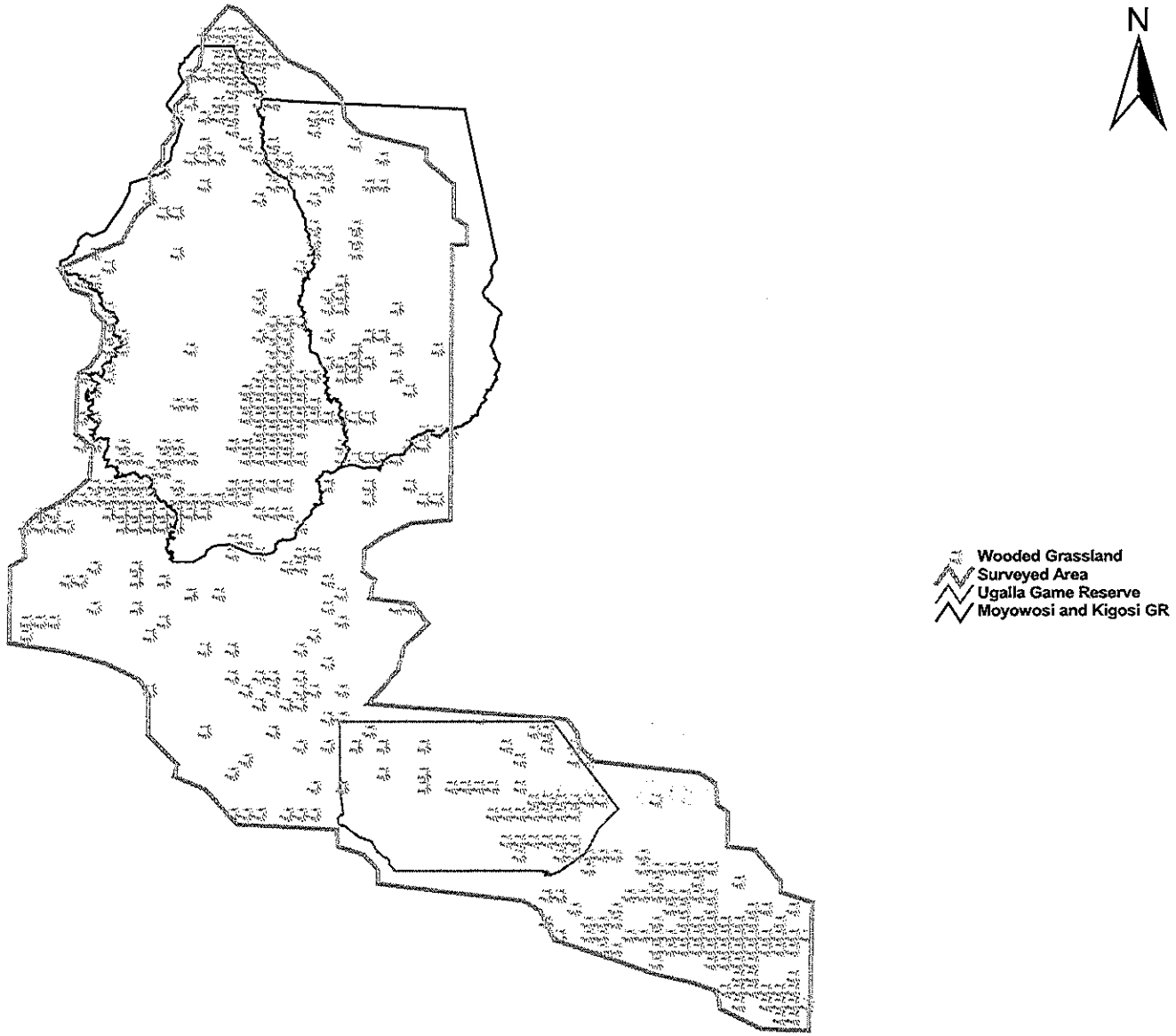


Figure viii: Wooded Grassland, November 2001

MALAGARASI-MUYOWOSI RAMSAR SITE (SIMMORS)

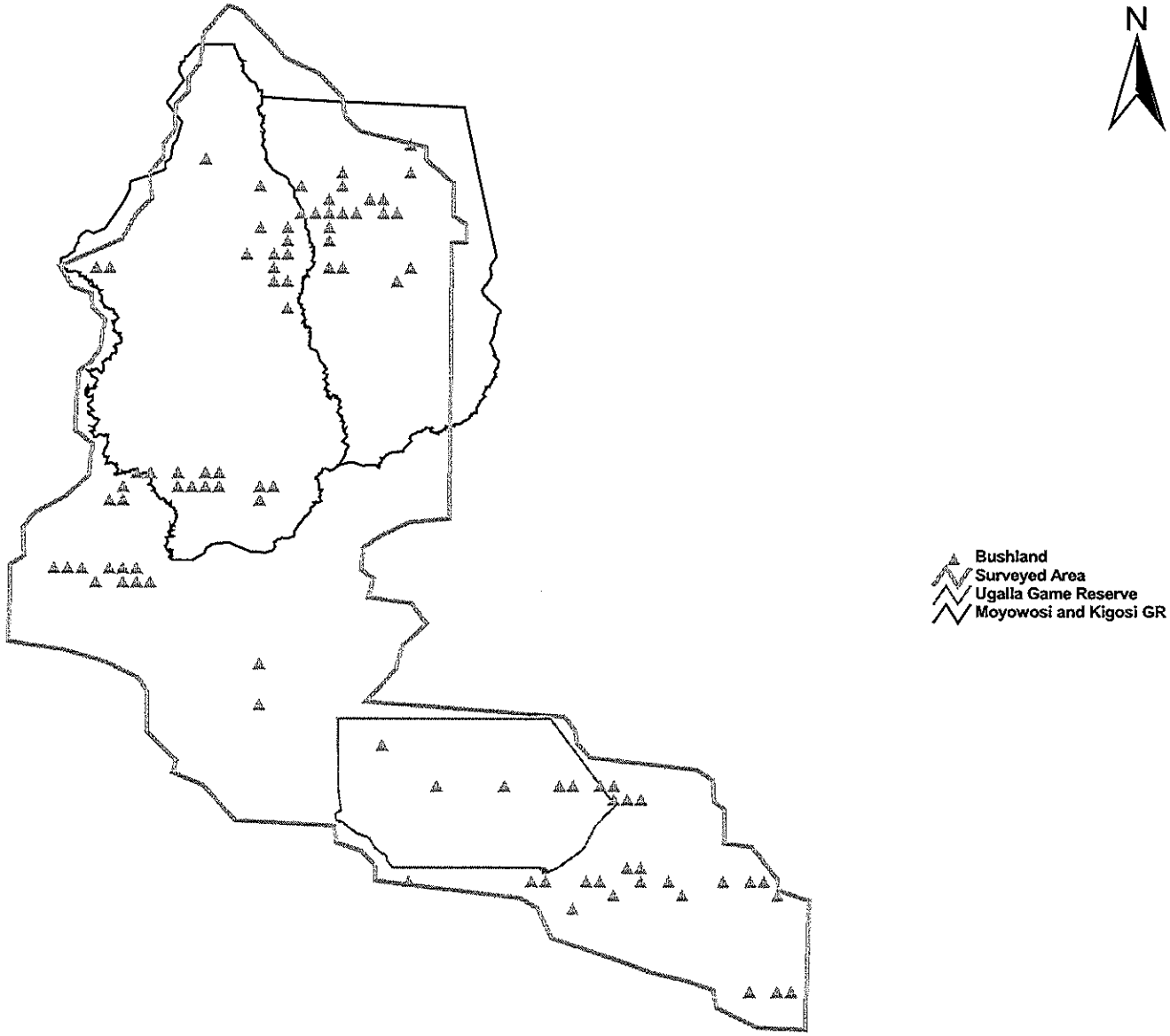


Figure iii : Bushland, November 2001

MALAGARASI-MUYOWOSI RAMSAR SITE (SIMMORS)

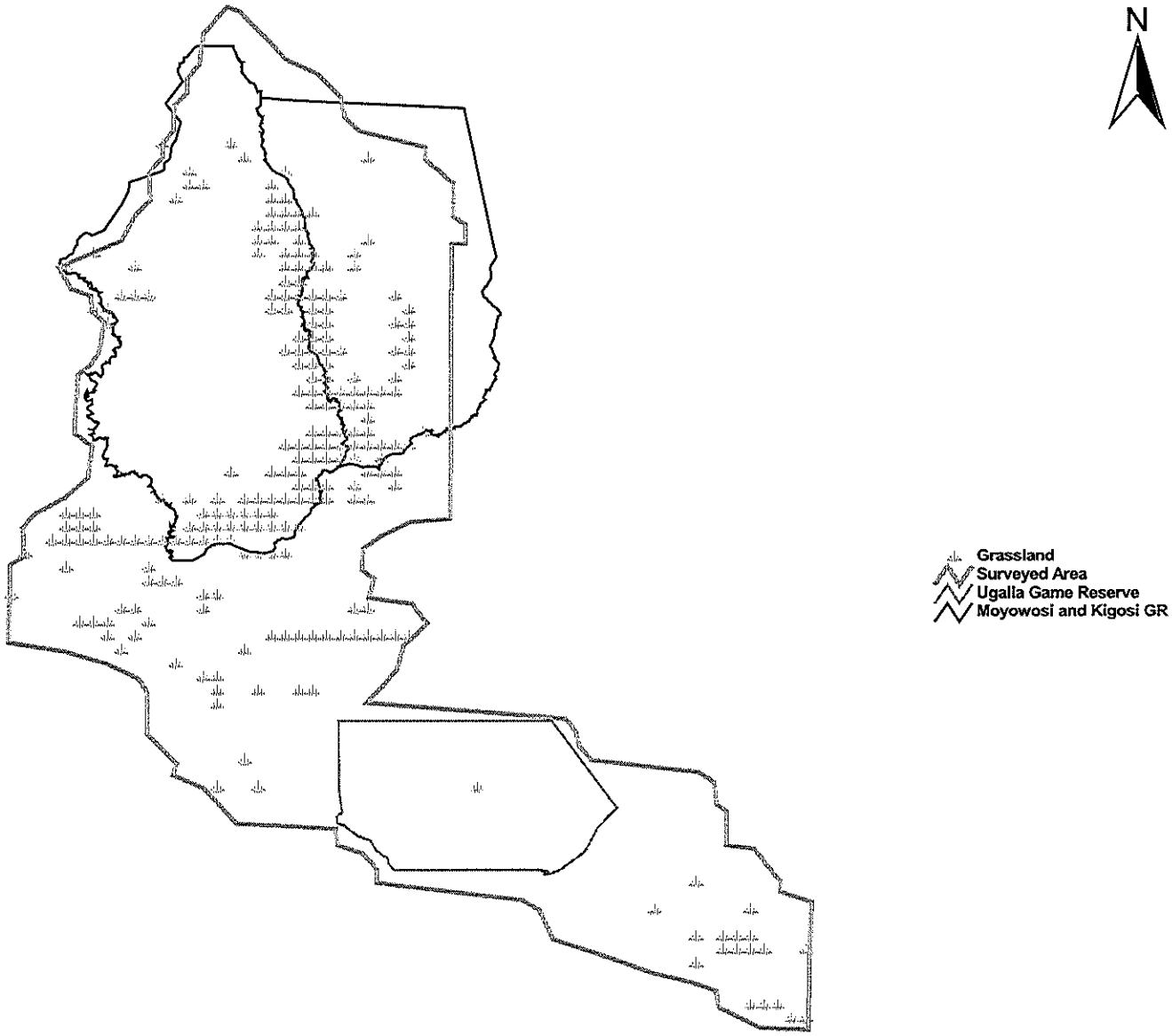


Figure v: Grassland, November 2001

MALAGARASI-MUYOWOSI RAMSAR SITE (SIMMORS)

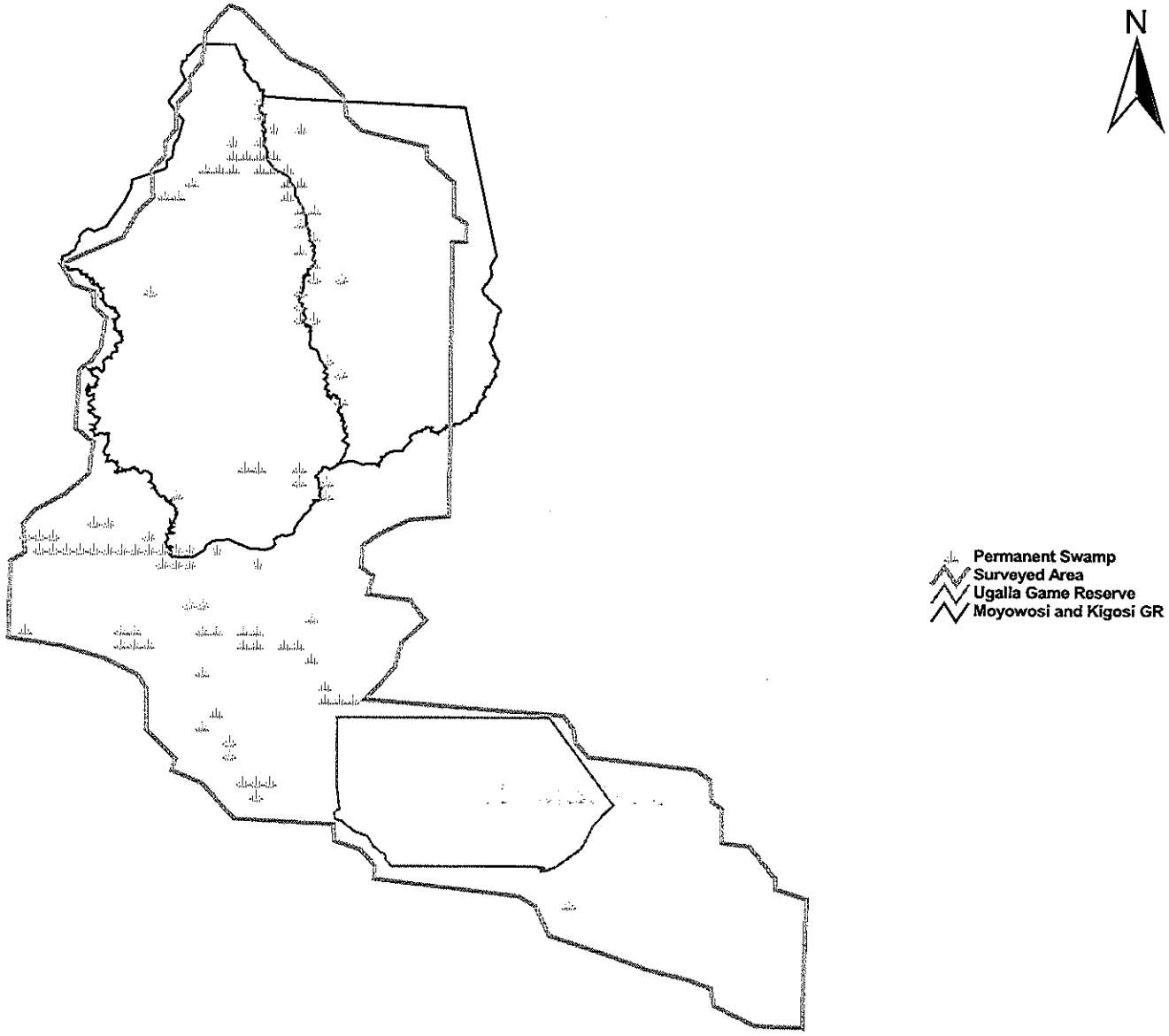


Figure vii: Permanent Swamps, November 2001

MALAGARASI-MUYOWOSI RAMSAR SITE (SIMMORS)

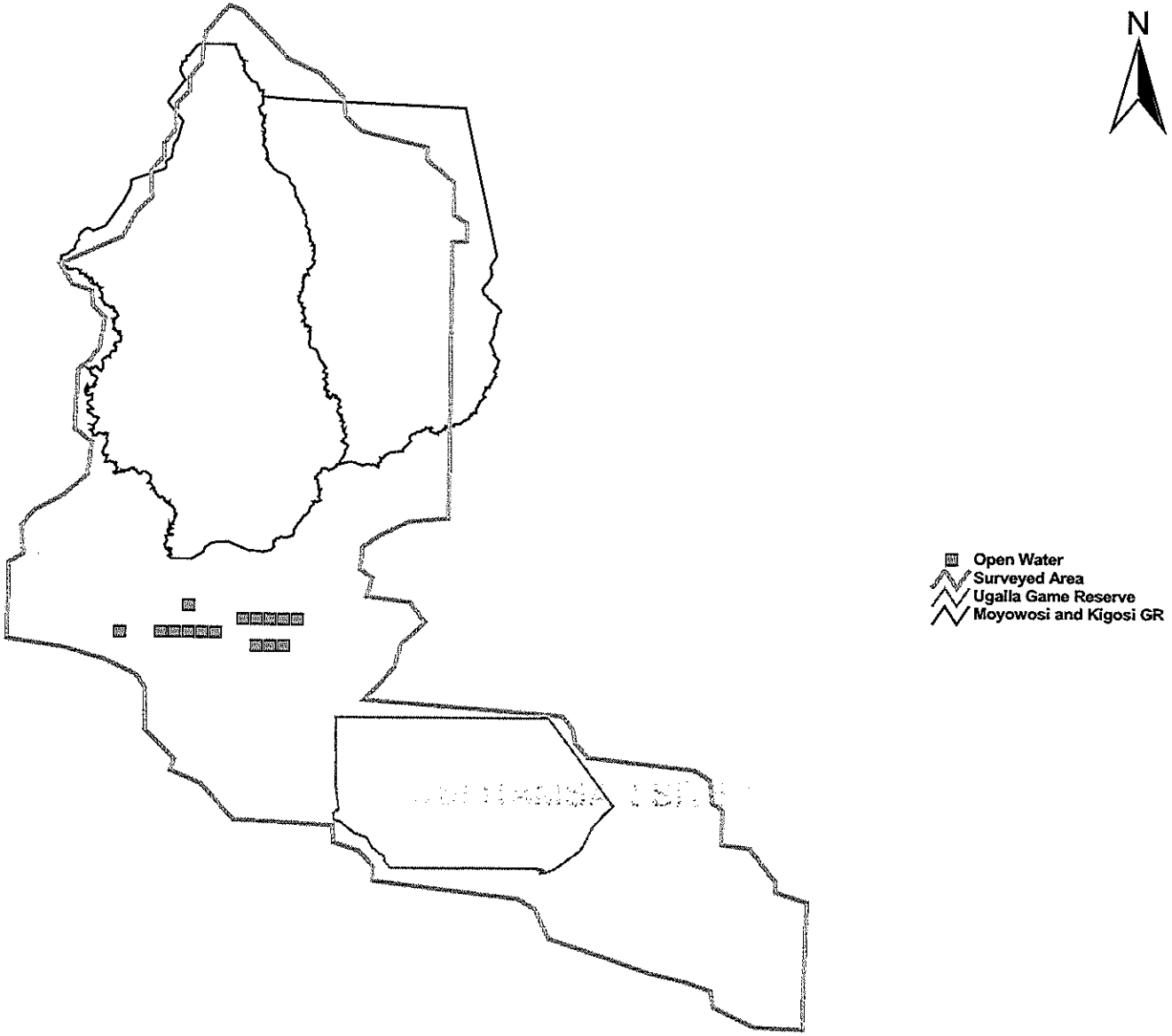


Figure vi: Open Water, November 2001