

# The behaviour of white rhinos at Ziwa Rhino Sanctuary, Uganda with particular reference to night-time activity

F.J. Patton\*, P.E. Campbell, A. Genade, R. Ayiko and G. Lutalo

Ziwa Rhino Sanctuary, Nakasongola, Uganda

\*Corresponding author: felixp@africaonline.co.ke

## Introduction

There used to be several hundred northern white rhinos (*Ceratotherium simum cottoni*) and eastern black rhinos (*Diceros bicornis michaeli*) in Uganda. The northern white rhino could only be found to the west of the Albert Nile while the eastern black rhino could only be found in the north and east of Uganda (east of the Albert Nile and north of the Victoria Nile). In the 1970s a small number of both white and black rhinos were translocated out of their range to Murchison Falls National Park.

The civil unrest of the 1970s and early 1980s saw heavy poaching resulting in the extermination of Uganda's rhino population, with the last rhino killed in 1983.

Following several years of political stability, a group of Ugandan citizens decided to reintroduce rhinos in Uganda and in 1997 formed an NGO called Rhino Fund Uganda. In 2001, two white rhinos were imported from Kenya and located at Entebbe Zoo, renamed the Uganda Wildlife Education Centre. By 2004, the NGO had raised enough funding for the establishment of a sanctuary specifically for rhinos and in 2005, Ziwa Rhino Sanctuary, Nakasongola received its first four rhinos from Solio Ranch, Kenya with two more from Disney Animal Kingdom, USA in 2006. Since then four calves have been born.

Groves et al., (2010) published research, which concluded that the northern white rhino was a separate species to the southern white rhino and Rookmaaker (2011) proposed that the northern white rhino should be referred to as the Nile rhinoceros (*C. cottoni*). All the white rhinos introduced to Uganda and born at Ziwa are of the species *Ceratotherium simum simum*, the southern white rhino as the Nile rhino (*C. cottoni*) is all but extinct worldwide.

The rhinos at Ziwa are held under heavy, around the clock, security by armed guards and monitoring rangers. Following the two translocations, the rhinos were held in quarantine in a boma within the reserve before being released. During this period, the rhinos became used to the sight and sound of humans. After release, the rhinos have been accepting of human presence from as little as ten metres.

Since June 2010, in order to better understand the behaviour and movements of the rhinos, the monitors have kept an hourly record of the location and key activities of each rhino. Ziwa is almost unique for a rhino sanctuary, as it has no predators such as lions or dangerous wildlife such as elephants and buffaloes, so the rangers are able to follow the rhinos, even throughout the hours of darkness. This paper presents an analysis of the first year of monitoring data, with particular reference to the night-time activities.

## The Study Area

*Ziwa Rhino Sanctuary covers 70 km<sup>2</sup> in the Nakasongola district of central Uganda*

Prior to becoming a wildlife sanctuary in 2004, the area was part of a cattle farming operation. As such, there is very little other wildlife in the area apart from a number of the smaller antelopes such as bushbuck (*Tragelaphus sylvaticus*) and oribi (*Ourebia ourebi*). Some 30% of the reserve is swamp but only the southern swamp area is always water bound. Other swamp areas dry out in times of low rainfall and become flooded in times of high rainfall.

Rainfall has averaged around 1,000 mm over the past 10 years; data for the study period is shown in Table 1.

Table 1. Rainfall, in mm, recorded by month at Ziwa Rhino Sanctuary during the study period (June 2010 through May 2011) compared to the six-year mean from 2004 through 2010

| Rainfall at Ziwa Rhino Sanctuary |                    |                |
|----------------------------------|--------------------|----------------|
| Month                            | June 2010–May 2011 | Mean 2004–2010 |
| June                             | 22.6               | 53.8           |
| July                             | 103.1              | 99.5           |
| August                           | 77.7               | 95.1           |
| September                        | 177.9              | 95.9           |
| October                          | 71.0               | 191.1          |
| November                         | 37.6               | 99.6           |
| December                         | 62.2               | 45.2           |
| January                          | 0.0                | 29.5           |
| February                         | 16.9               | 28.3           |
| March                            | 50.1               | 79.8           |
| April                            | 130.6              | 141.3          |
| May                              | 172.8              | 113.6          |

A basic vegetation study was carried out in July 2010 and the resulting general vegetation map is shown (Fig. 1).

The ‘non-swamp’ areas are mostly woodland with a dense grass understorey. Since most of the reserve has grass cover and there are very few grazing animals, there is a predisposition for the grass to grow overlong and fibrous. White rhinos prefer short and intermediate sized, sweet green grass (Schrader, 2006) and grass growth at Ziwa is essentially managed by controlled burning and/or by controlled cattle grazing to the benefit of the rhinos.

For security and monitoring purposes, the reserve is organised on the basis of 5 sectors: Karakwende (K), Mikerenge (M), Wangoriro (W), Rwanyanya (R) and Lugogo (L). Each sector is further organised into numbered blocks of three or four per sector.

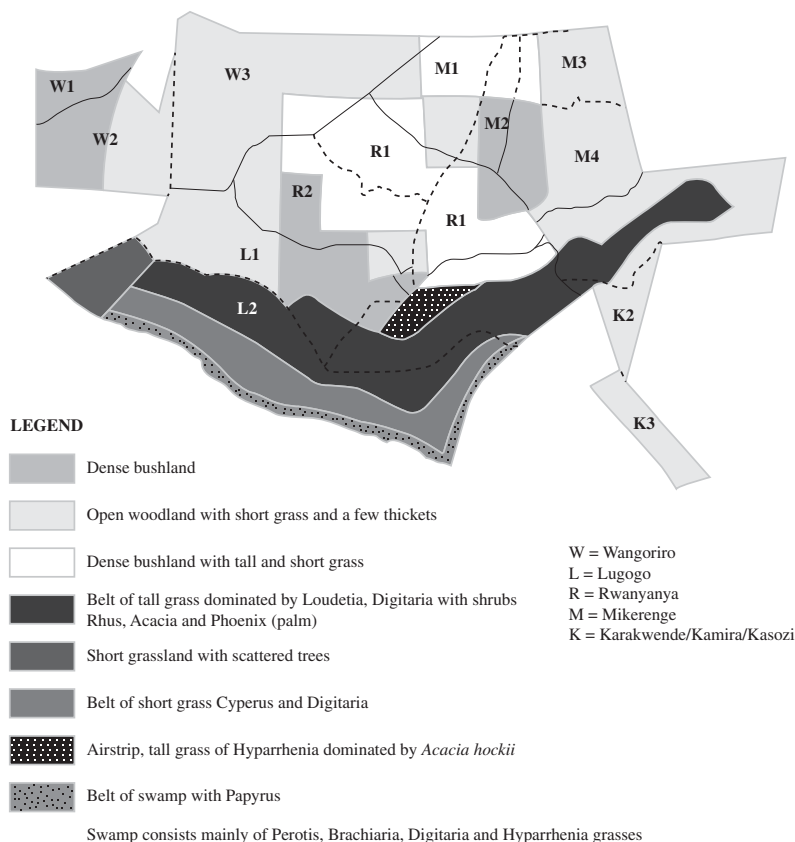


Figure 1. Basic vegetation map of Ziwa Rhino Sanctuary.

Table 2. The usage of the main sectors and blocks in Ziwa by month in percent

| Sector | Block | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May |
|--------|-------|------|------|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|
| K      | 1     |      | 0    |     | 0    | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| K      | 2     | 0    |      |     | 0    |     | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| K      | 3     |      |      | 0   | 0    | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| L      | 1     |      |      |     |      |     |     |     |     | 0   |     | 17  | 11  |
| L      | 2     | 11   | 15   | 10  |      |     |     | 16  | 58  | 95  | 92  | 81  | 59  |
| L      | 3     | 17   | 14   |     |      |     |     | 12  |     |     |     |     |     |
| M      | 1     | 0    | 0    | 0   | 0    | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| M      | 2     | 0    | 0    | 0   | 0    | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| M      | 3     | 0    |      | 0   | 0    | 0   | 0   |     | 0   | 0   | 0   | 0   | 0   |
| M      | 4     | 10   | 10   | 18  | 17   |     |     | 13  |     | 0   | 0   | 0   |     |
| R      | 1     |      | 10   |     |      |     |     |     |     | 0   | 0   | 0   |     |
| R      | 2     | 26   | 21   | 20  | 22   | 34  | 17  | 16  | 10  | 0   |     |     |     |
| R      | 3     | 12   | 11   | 27  | 33   | 14  |     | 22  |     |     |     |     |     |
| W      | 1     |      |      | 0   | 0    |     | 25  |     |     | 0   | 0   | 0   | 0   |
| W      | 2     |      |      |     |      | 13  | 25  |     | 8   | 0   |     | 0   | 11  |
| W      | 3     |      |      |     | 10   | 12  | 16  |     |     | 0   | 0   |     | 0   |
|        | Total | 76   | 81   | 75  | 82   | 73  | 83  | 79  | 76  | 95  | 92  | 98  | 81  |

Table 3. Summary of the main locations, by percentage use, of the Ziwa rhinos by month with monthly rainfall data

| Sector  | Block | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May |
|---------|-------|------|------|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|
| L       | 2+3   | 28   | 29   | 10  |      |     |     | 28  | 58  | 95  | 92  | 81  | 59  |
| R       | 2+3   | 38   | 32   | 47  | 55   | 48  | 17  | 38  | 10  |     |     |     |     |
| W       | 2+3   |      |      |     |      | 25  | 41  |     |     |     |     |     |     |
| W       | 1     |      |      |     |      |     | 25  |     |     |     |     |     |     |
| Rain mm | 23    | 103  | 78   | 178 | 71   | 38  | 62  | 0   | 17  | 50  | 131 | 173 |     |

## Method

Rangers monitoring each of the Ziwa rhinos—six adults and three calves—followed the animals on foot from a distance but keeping them in sight as much as possible. During the hours of darkness, rangers used torches to observe the rhinos whenever they heard any sound indicating activity and at 15-minute intervals they checked on the rhinos. During full moon periods the rhinos were easily observed without torches. A team of two rangers is allocated to each rhino or rhino group (mother and calf—and possibly with a sub-adult) and stays with it/them for the 12-hour shift wherever they go.

The rangers completed a daily sighting form for each hour of the day between June 2010 and May 2011. For each rhino, the rangers recorded the location (sector and block), the type of habitat (wet swamp, dry swamp or other), one of three main activities (feeding, resting or moving) plus any of four secondary activities: drinking, wallowing, mating or fighting.

The data was entered using Microsoft Excel 2007 on a Toshiba Satellite Pro laptop. Macros were written to automate the consolidation and analysis of the data. For location and habitat type, the analysis was based on the number of rhinos found for the hour of the day while for activities the analysis was based on the number of hours spent on each activity per day.

The daily data was not always complete, as there were occasions when a particular rhino was out of sight (especially in thick bush habitat) or had run off and had to be found again, especially after a disturbance at night. To account for this, the data for all rhinos was consolidated for the analysis. Individual rhino data were reviewed to determine any significant difference from the average.

## Results

Table 2 shows the percentage use by the rhinos of each main sector and block by month in bold plus the blocks where there was no record of a rhino using the area shown as 0. Table 3 show the mainly used sectors/blocks from Table 2 in relation to the rainfall for each month.

Of 192 data points (16 locations in each of 12 months), 42 (22%) were significantly used, 68 (35%) were partially used and 82 (43%) were never used by the rhinos.

Over the 12 months of the study, the preferred habitat type was dry swamp at 54%, other habitats at 40% with wet swamp at only 6%.

The Wangoriro sector is on higher ground, which was used by the rhinos when other sectors became waterlogged after the rains accumulated between July and October. All the rhinos preferred sector Rwanyanya blocks 2 and 3 where there was new grass growth after burning while the female rhino Kori also chose the Mikerenge sector, block 4 and the Wangoriro sector, block 2 and the female rhino Nandi also chose the Lugogo sector, block 3.

In the second six months of the study period, all rhinos were concentrated in the Lugogo sector, block 2 close to the swamp with permanent water with other areas becoming dry. Prior to this, the rhinos were more likely to be found in different parts of the reserve where standing water was available.

The mean number of rhinos carrying out one of the important activities for each hour of the day is shown in Table 4, while Table 5 shows the mean number of rhinos undertaking a main activity over a length of time.

Table 4. Mean number of rhinos carrying out one of the main activities for each hour of the day during the study period

| Hour of day | Moving      | Feeding    | Resting    | Drinking |
|-------------|-------------|------------|------------|----------|
| 2400–0100   | 6.9         | 123        | 42         | 1        |
| 0100–0200   | 7.5         | 108        | 57         | 2        |
| 0200–0300   | 7.6         | 95         | 70         | 2        |
| 0300–0400   | 6.3         | 82         | 84         | 1        |
| 0400–0500   | 7.0         | <b>54</b>  | <b>110</b> | 1        |
| 0500–0600   | 7.7         | <b>53</b>  | <b>110</b> | 1        |
| 0600–0700   | 6.0         | <b>75</b>  | <b>90</b>  | <b>1</b> |
| 0700–0800   | 6.6         | 114        | 60         | 1        |
| 0800–0900   | 6.6         | 127        | 45         | 3        |
| 0900–1000   | 6.7         | <b>142</b> | <b>28</b>  | 4        |
| 1000–1100   | 7.4         | 130        | 43         | <b>7</b> |
| 1100–1200   | 6.8         | 94         | 79         | 3        |
| 1200–1300   | <b>4.9</b>  | <b>80</b>  | <b>96</b>  | 4        |
| 1300–1400   | <b>4.3</b>  | <b>79</b>  | <b>97</b>  | 2        |
| 1400–1500   | 6.6         | 84         | <b>89</b>  | 4        |
| 1500–1600   | <b>10.2</b> | 103        | 67         | <b>8</b> |
| 1600–1700   | <b>10.1</b> | 130        | 41         | <b>7</b> |
| 1700–1800   | 8.6         | <b>136</b> | 36         | <b>7</b> |
| 1800–1900   | 7.1         | 134        | 38         | 3        |
| 1900–2000   | <b>4.8</b>  | 131        | 44         | 3        |
| 2000–2100   | 5.8         | 129        | 42         | 2        |
| 2100–2200   | 8.0         | 131        | 38         | 2        |
| 2200–2300   | <b>10.2</b> | 126        | 36         | 2        |
| 2300–2400   | <b>10.3</b> | 126        | 37         | 1        |
| Total       | 173.8       | 2586       | 1479       | 70       |
| Mean        | 7.2         | 108        | 62         | 3        |
| SD          | 1.7         | 27         | 26         | 2.2      |
| Range       | 5.5–8.9     | 81–135     | 36–88      | 0.7–5.1  |

NB: Significant results shown in bold

The data from Table 4 suggests a 'typical' day would be described as follows:

0800–1200 h—feeding

1200–1500 h—resting

1500–1700 h—moving (especially to water)

1700–0100 h—feeding

0100–0400 h—resting and feeding

0400–0800 h—resting

Table 5. Mean number of rhinos undertaking a main activity over a length of time, in hours, during the study period

| Hours spent | Feeding    | Moving     | Resting    |
|-------------|------------|------------|------------|
| 1           | 74         | <b>136</b> | 84         |
| 2           | <b>107</b> | <b>55</b>  | <b>137</b> |
| 3           | 71         | 4          | <b>167</b> |
| 4           | <b>82</b>  | 0          | <b>162</b> |
| 5           | <b>118</b> | 0          | <b>121</b> |
| 6           | <b>81</b>  | 1          | 43         |
| 7           | 72         | 0          | 16         |
| 8           | 74         | 0          | 3          |
| 9           | 52         | 0          | 2          |
| 10          | 43         | 0          | 1          |
| 11          | 25         | 0          | 0          |
| 12          | 12         | 0          | 0          |
| 13          | 9          | 0          | 0          |
| 14          | 4          | 0          | 0          |
| 15          | 1          | 0          | 0          |
| 16          | 2          | 0          | 0          |
| 17          | 3          | 0          | 0          |
| 18          | 2          | 0          | 0          |
| 19          | 3          | 0          | 0          |
| 20          | 2          | 0          | 0          |
| 21          | 1          | 0          | 0          |
| 22          | 0          | 0          | 0          |
| 23          | 0          | 0          | 0          |
| 24          | 0          | 0          | 0          |
| Total       | 838        | 196        | 736        |
| Mean        | 35         | 8          | 31         |
| SD          | 40         | 29         | 57         |
| Range       | 0–75       | 0–37       | 0–88       |

NB: Significant results shown in bold

Table 5 shows that the rhinos spent 60% of their time feeding, 34% resting, 4% moving and 2% drinking.

## Discussion

Quality data suitable for analysis on choice of location prior to the study were not available but it is possible

that these locations were favoured due to experience gained during the period the rhinos were investigating the reserve before settling in areas of preference.

Dry swamp grasses at Ziwa were found to contain a high proportion of *Hyparrhenia* sp., which, when young and short, is highly palatable to livestock. The rhinos' location could be closely associated with the burning of the swamp areas and resulting new growth. However, the rangers observed that once the grasses grew tall and/or the water level of the swamps increased after good rains, the rhinos chose to move to higher ground and especially to areas that had been well grazed by livestock.

The preference for short grasses was also found by Jordaan (2010), who reported that they comprised the most important food resource while Schrader et al. (2006) reported that white rhinos foraged mainly in high-quality short and woodland grasslands while late in the dry season they also used flushes of green grass in previously burnt *Themeda* spp. grasslands.

Resting and feeding constituted the vast majority (94%) of the white rhinos' activities, which was similar to results found by Jordaan (2010), although at only 86% of total activity. The 8% difference may be partly explained by the different methods of data collection; Jordaan used 15 minute snapshots and collected very detailed multiple activity data (to the second) while the Ziwa study utilized single activity data by the hour. Despite the two very different approaches, the studies revealed similar results.

The data in Tables 4 and 5 show that while rhinos may carry out any of the main activities at any time of the day, significant activity and inactivity were found to be as follows.

### Feeding

The rhinos would feed for anything from two to six hours at a time. The most likely times for feeding were between 0900 and 1000 h and between 1700 and 1800 h. The least likely times for feeding were between 0400 and 0700 h and between 1200 and 1400 h. Owen-Smith (1974) reported that the main feeding periods of white rhinos was during early morning and early evening and continued in spells through the night similar to Jordaan's results (2010), which were that the main feeding periods were between 0700 and 1000 h and between 1500 and 2100 h, which was generally the case at Ziwa.

## Moving

The rhinos would move for up to one hour at a time, with the most likely times between 1500 and 1700 h when the rhinos were likely to go to the water and between 2200 and 2400 h, when the rhinos would move from a feeding site to a resting site as feeding was more likely to occur in open areas and resting in more secure bush areas, albeit within the same sector/block. The least likely times for moving were between 2400 to 0200 h and between 1900 and 2000 h.

## Resting

The rhinos would rest for two to five hours. The most likely resting times occurred between 0400 and 0700 h and between 1200 and 1500 h. The least likely times for resting were between 0900 and 1000 h. Owen-Smith (1974) reported that the main resting periods for white rhinos were during the midday period and, on the hottest days for between five and eight hours while Jordaan (2010) reported the main resting periods were between 1000 and 1500 h and between 2100 and 0700 h. This is similar to the results from Ziwa.

## Drinking

It was found that rhinos drank for less than one hour at a time. The most likely times for drinking were between 1000 and 1100 h and between 1500 and 1800 h. The least likely time for drinking was between 0600 and 0700 h. Jordaan (2010) reported that the main drinking period was between 1500 and 1800 h with no observations of drinking between 2100 and 0600 h, which largely corresponds with the findings at Ziwa.

## What the rhinos did at night

For the purpose of this study, night hours were considered to be between 1900 and 0700 h. While it can be seen from Table 4 that there are few significant data, it can be considered that between 1900 and 2400 h the rhinos would be expected to be feeding but not expected to be feeding between 0400 and 0700 h. These times correlate closely with those for the rhinos' resting periods. In addition, drinking was unlikely to occur during night-time hours.

In summary, the rhinos spent seven hours (58%) feeding and five hours (42%) resting during the 12-hour period. Jordaan (2010) reported that during dry

months, rhinos only spent 2 night-time hours (17%) feeding and 10 hours (83%) resting while during wet months the rhinos spent 7 hours (58%) feeding and 5 hours (42%) resting, which is the same as the Ziwa rhinos. This similarity may be explained by a closer examination of the rainfall statistics. The annual rainfall stated for the Willem Pretorius Game Reserve (WPGR) was 578 mm with the six wet months representing 70% equal to 404 mm or 67 mm per month. The mean annual rainfall for Ziwa over six years was 1072 mm although the rainfall for the study period was very low at 701 mm. When compared to WPGR, the Ziwa habitat could be considered as consistently wet and generally more like the wet period in WPGR.

## Conclusions

The Ziwa white rhinos exhibited activity behaviour that, in general, corresponded closely with that recorded in other reserves. Night-time activity was observed at a greater frequency than other researchers had recorded and showed that, in the case of Ziwa, rhinos were more actively feeding during the night hours than had been previously suggested.

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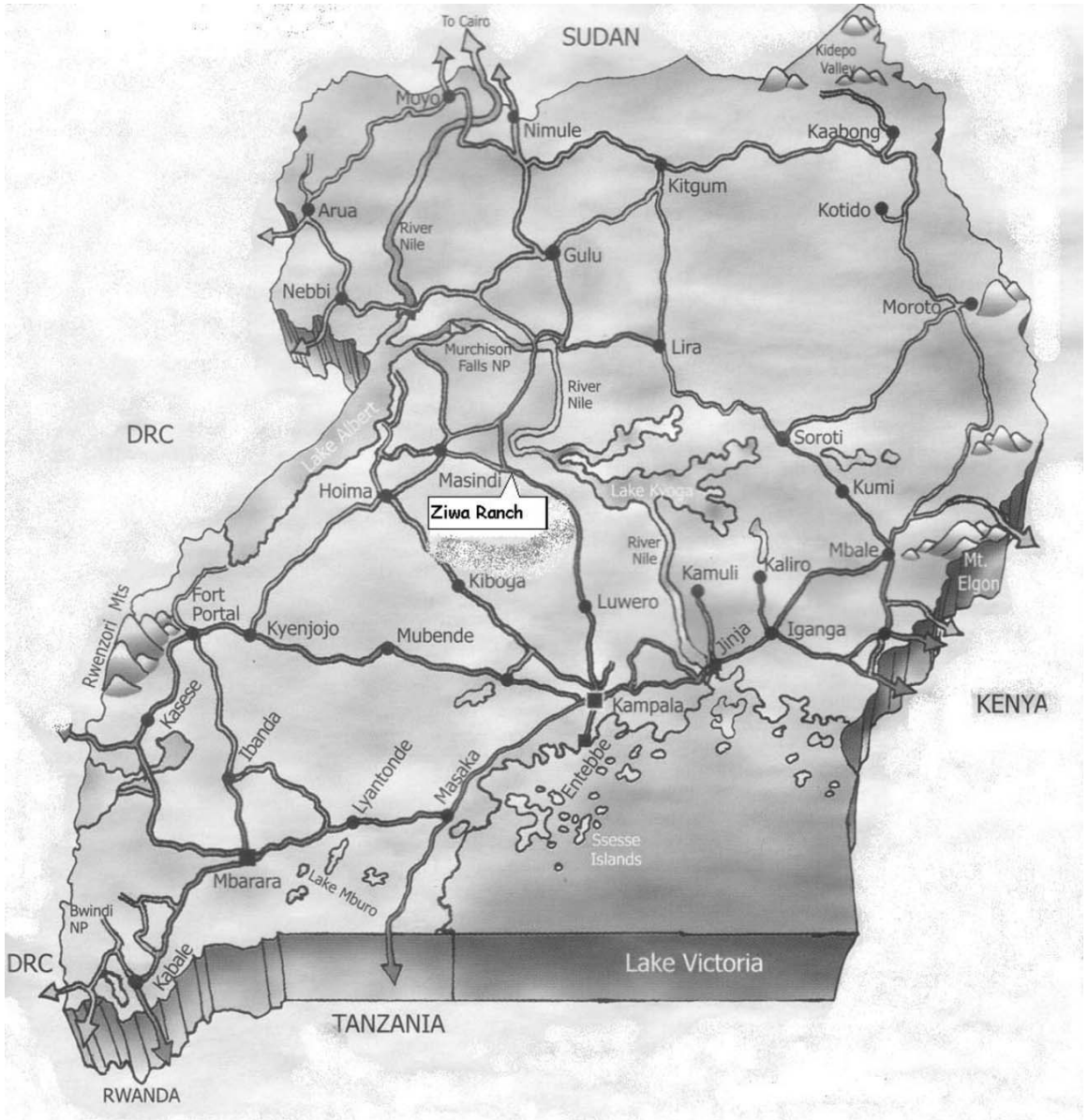


Figure 2. Location of Ziwa Rhino Sanctuary at Ziwa Ranch.