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<NOTE>

## **Population density of chimpanzees in Tanzania**

*Midori Yoshikawa<sup>1</sup>, Hideshi Ogawa<sup>2</sup>,  
Tetsuya Sakamaki<sup>3</sup> and Gen'ichi Idani<sup>4</sup>*

*1. Great Ape Research Institute (GARI), Hayashibara*

*2. School of International Liberal Studies, Chukyo University*

*3. Faculty of International Studies, Meiji-Gakuin University*

*4. Wildlife Research Center, Kyoto University*

### **INTRODUCTION**

Chimpanzees (*Pan troglodytes*) are distributed around the eastern shore of Lake Tanganyika in western Tanzania. Based on an extensive survey conducted in the 1960s, Kano<sup>1</sup> showed that chimpanzees were distributed

in (a) Gombe, (b) Lilanshimba, (c) Ugalla, (d) Masito, (e) Mukuyu, (f) Mahale, (g) Karobwa, and (h) Wansisi (Fig. 1). In 1996, Ogawa *et al.*<sup>2</sup> identified another chimpanzee habitat, (i) Lwazi (Fig. 1). However, chimpanzee population density and distribution in Tanzania have not been revised since Kano's report<sup>1</sup>. In this paper, we showed the location in which we found beds and other traces of chimpanzees, and estimated chimpanzee population densities in (d) Masito, (e) Mukuyu, and (i) Lwazi. Besides, with the use of some additional unpublished data, we revised estimated chimpanzee population densities in (b) Lilanshimba<sup>3</sup>, (c) Ugalla<sup>4</sup>, (g) Karobwa<sup>5</sup>, and (h) Wansisi<sup>6</sup> using the DISTANCE 5.0 computer program<sup>7</sup>.

## METHODS

In Tanzania, most chimpanzee habitats are savanna woodlands (miombo woodlands) dominated by deciduous trees of *Brachystegia* and *Julbernardia*, with a small proportion of evergreen riverine forests, grasslands, and bamboo thickets.

We visited all the areas indicated in Fig. 1 (a–i) and other areas where chimpanzees might have been distributed, using 1/50000 topographical maps, vegetation maps, satellite data, and information provided by locals. In addition to the areas reported in previous studies<sup>2,3,4,5,6</sup> and Table 1, Ogawa and Kanamori visited the Ufipa Escarpment (8°15'S, 32°00'E to 8°30'S, 32°15'E) from Aug. 9–13 and Aug. 31–Sept. 8, 2001. Ogawa visited (a) Gombe from Sep. 3–6, 2003 and Mishamo from Aug. 4–9, 2006. Sakamaki made an extensive survey in (f) Mahale from Jan. 23–30, 2006. Idani and Sakamaki stayed at the area between (g) Karobwa and (h) Wansisi from Jan. 23 to 30, 2006. Ogawa stayed at Mishamo (5°36'S, 30°28'E) from Aug. 4 to 9, 2006.

We conducted line transect bed censuses at (d) Masito: Lemera (5°15'S, 30°20'E) and Kasakati sites (5°20'S, 29°55'E), (e) Mukuyu: Lungonya site (5°40'S, 29°55'E), and (i) Lwazi: Msalamba, Mwinbi, Luanji, and Senge sites (8°10–25'S, 31°00–15'E)<sup>2</sup>. With the use of some additional unpublished data, we revised estimated chimpanzee population densities at (b) Lilanshimba<sup>3</sup>, (c) Ugalla<sup>4</sup>: Bhukarai, Bukombe, Issa, Issa Basin,

Mfubasi, Mfuwazi, Mtongesi, Nguye, Nkondwe, and Shangwasites; (g) Karobwa<sup>5</sup>: Ntakata and Kapalagulu<sup>5</sup> sites; and (h) Wansisi<sup>6</sup>.

We measured the distance of some census lines using a tape measure; for other reconnaissance path, we used a portable GPS (Garmin 60CSx) and/or a pedometer. We walked not only on traditional paths used by locals, but also on paths used by wild animals, as well as off paths, and traveled through various types of vegetation. We measured the perpendicular distance from the census line to a chimpanzee bed using a distance meter (Nikon Laser 800S), counting the steps of local guides, or by eye after being trained to estimate distance in this way.

Densities of chimpanzee beds were estimated using the DISTANCE 5.0 computer program<sup>7</sup>. We used the Akaike Information Criteria (AIC) selection rule to choose a model from among three key detection functions (uniform, half-normal, hazard-rate) and three adjust detection functions (cosine, simple-polynomial, and Hermite-polynomial). We used those bed densities to estimate densities of bed-building chimpanzees,

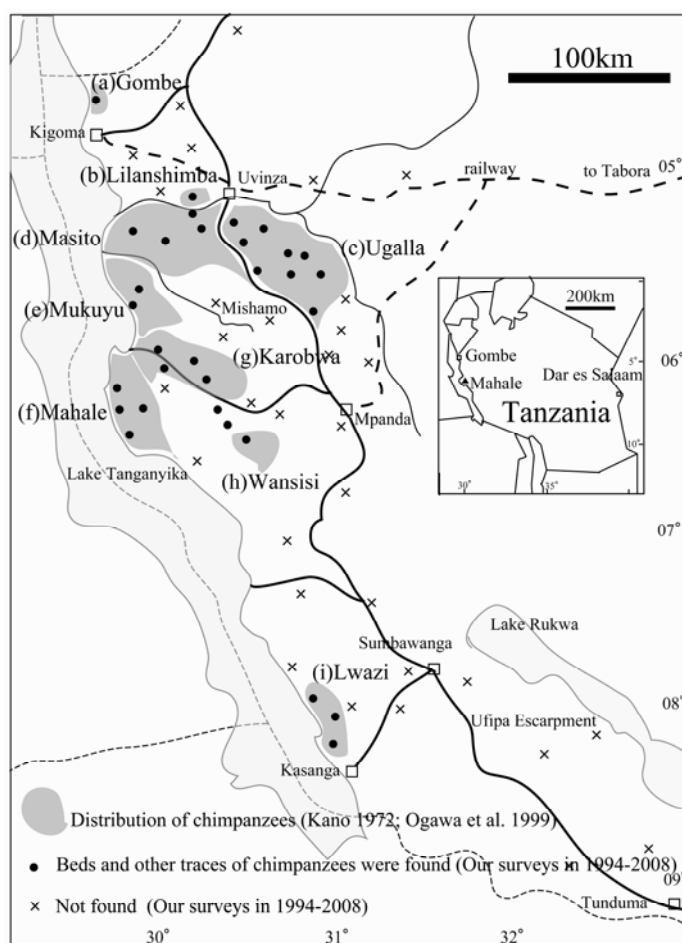


Fig. 1. Distribution of chimpanzees in Tanzania.

**Table 1.** Population density of chimpanzees outside of national parks in Tanzania.

| Area            | Density <sup>(1)</sup><br>(individuals/km <sup>2</sup> ) | 95%<br>Confidence<br>interval | Number<br>of beds | Census<br>distance<br>(km) | Study year                                                                                                               | Density <sup>(2)</sup><br>in 1960s<br>(individuals/km <sup>2</sup> ) | Habitat area <sup>(3)</sup><br>(km <sup>2</sup> ) |
|-----------------|----------------------------------------------------------|-------------------------------|-------------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------|
| (b) Lilanshimba | 0.02                                                     | (0.01–0.05)                   | 60                | 85.3                       | 2006 <sup>3</sup>                                                                                                        | 0.29                                                                 | 140                                               |
| (c) Ugalla      | 0.10                                                     | (0.07–0.18)                   | 496               | 332.2                      | 1995–2007 <sup>4</sup> and this study<br>This study: Aug 10–31, 2008<br>Dec 23, 2007–Feb 29, 2008<br>Jun 27–Aug 29, 2008 | 0.08                                                                 | 2800                                              |
| (d) Masito      | 0.12                                                     | (0.04–0.49)                   | 54                | 51.3                       | This study: Aug 2–4, 2003<br>Aug 1–7, 2005                                                                               | 0.17                                                                 | 2200                                              |
| (e) Mukuyu      | 0.05                                                     | (0.02–0.18)                   | 55                | 49.1                       | This study: Aug 9–15, 2005                                                                                               | 0.27                                                                 | 1100                                              |
| (g) Karobwa     | 0.03                                                     | (0.02–0.08)                   | 123               | 183.7                      | 2003 <sup>5</sup>                                                                                                        | 0.38                                                                 | 900                                               |
| (h) Wansisi     | 0.02                                                     | (0.01–0.08)                   | 29                | 19.2                       | 2001 <sup>6</sup>                                                                                                        | 0.12                                                                 | 500                                               |
| (i) Lwazi       | 0.01                                                     | (0.00–0.03)                   | 40                | 140.8                      | This study: Jul 20–24, 2003<br>Aug 17–29, 2005                                                                           | -                                                                    | 1250                                              |
| Total           |                                                          |                               | 857               | 861.6                      |                                                                                                                          |                                                                      | 8890                                              |

Population densities of bed building chimpanzees were estimated. Densities in the national parks, (a) Gombe and (f) Mahale, are not shown in this report.

(1) Density was estimated by DISTANCE 5.0<sup>7</sup>.

(2) Density in 1960s<sup>1</sup>.

(3) The habitat areas of (b), (c), (d), (e), (g), and (h) were referred to Kano<sup>1</sup>. The area of (i) was referred to Ogawa<sup>2</sup>.

assuming that chimpanzees build  $1.15 \pm 0.047^8$  bed per day. We used 260 days<sup>4</sup> as the mean lifespan of a chimpanzee bed, because previous research has shown that bed trees in (c) Ugalla last for more than 260 days, and the study areas had climate, vegetation, and bed trees similar to Ugalla, with the exception of Gombe (a) and Mahale (f). We also conducted a marked bed count census at the Nguye site in Ugalla in 2008.

## RESULTS

Fig. 1 shows the distribution of chimpanzees in western Tanzania. We confirmed that chimpanzees continue to inhabit all the areas they had inhabited in the 1960s. In addition to these areas, we found chimpanzee beds between (h) Wansisi and (g) Karobwa (6°17'S, 30°22'E). In contrast, we found no evidence of chimpanzees in flat areas, such as the Mishamo Basin. As reported by Kano<sup>1</sup>, chimpanzees mainly seem to inhabit mountainous areas.

Table 1 summarizes chimpanzee population density outside national parks in Tanzania. In all areas, densities were lower in the 1990s–2000s than in the 1960s<sup>1</sup>, with the exception of (c) Ugalla (Wilcoxon signed rank test,  $n = 6$ ,  $z = -1.99$ ,  $p < 0.05$ ).

Our marked bed count census at the Nguye site in Ugalla revealed that 36 beds were made during 180 days along five 5-km transect lines, indicating a density of 0.09 individuals/km<sup>2</sup> (95% Confidence interval

0.05–0.24). This estimation is not contradictory to the assumption that chimpanzee beds can last as long as 260 days in this area, because the results of the standing crop bed count census in Ugalla also revealed a density of 0.10 individuals/km<sup>2</sup>, when we used 260 days as the mean lifespan of a chimpanzee bed (Table 1).

## DISCUSSION

Kano<sup>1</sup> hypothesized that the chimpanzee population in (h) Wansisi was isolated from chimpanzees in (g) Karobwa. However, we observed chimpanzee beds between these two areas. The hilly geographical features and type of vegetation suggest that the chimpanzee habitat of the Wansisi area may be narrowly connected with that of the Karobwa area. If so, the areas shown in (c–h) may form one continuous huge chimpanzee habitat. No researchers have observed bed-building activity in (i) Lwazi, but DNA sequences from fecal samples have indicated that the inhabitants are chimpanzees (*Pan troglodytes*) and may either be or be close to *Pan troglodytes schweinfurthii* (Tashiro, unpublished data). To date, our surveys have confirmed as many as four local chimpanzee populations in Tanzania, in: (1) Gombe, (2) Lilanshimba, (3) Ugalla-Masito-Mukuyu-Mahale-Karobwa-Wansisi, and (4) Lwazi (these populations do not include the introduced population on Rubondo Island in Lake Victoria). Our surveys indicate that no local populations have been exterminated during the past 50

years.

However, it is likely that each chimpanzee habitat area has shrunk. Calculation of the possible and actual chimpanzee habitat areas will require additional surveys and analyses using satellite and GIS data. The number of chimpanzees has clearly been reduced because population densities in each area were lower than in the 1960s<sup>1</sup>. Although direct comparison is difficult due to the differing methods of estimation, Table 1 indicates that the population density has been reduced since the 1960s. Density has been markedly reduced in (b) Lilanshimba, (e) Mukuyu, (g) Karobwa, and (h) Wansisi, probably due to the large human population in these areas, whereas density was unchanged in (c) Ugalla. In (b) Lilanshimba, (e) Mukuyu, (g) Karobwa, (h) Wansisi, and (i) Lwazi, increasing numbers of immigrant farmers have cultivated fields, except in steep mountainous areas. Trees have been cut down for use as lumber and firewood. Burundian refugees at the Mishamo settlement set many snares in (e) Mukuyu and (g) Karobwa, and Congolese refugees set snares in (b) Lilanshimba; this poaching resulted in deaths of chimpanzees in these areas<sup>3,5,6</sup>. Proper conservational planning is vital to protect chimpanzees and their habitats in Tanzania.

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