An Ecological Study on the Wild Mountain Gorilla (*Gorilla gorilla beringei*)

- Report of the JMC 2nd Gorilla Expedition 1959 -

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INTRODUCTION

The mountain gorilla was found by Captain Oscar von Beringe in 1901, and in 1903 it was named *Gorilla gorilla beringei* by Matschie, but the actual ecological study of this animal began actively in the twenties. C. Akeley and M. H. Bradley (1921), C. Akeley and J. M. Dersheid (1927) and B. Burbridge (1926-27) went to Mt. Mikeno and Mt. Karisimbi on the side of Congo Birunga Volcanoes in order to investigate gorillas. C. Akeley's purpose was to collect materials, and he returned with a successful collection of specimens of the mountain gorilla, while the others were only exploring journeys, as it were, mainly to find gorillas.

The first systematic scientific expeditions were the Harvard African Expedition (1926-27) of J. H. Coolidge and the Joint Expedition of Yale University and Carnegie Institute (1929-30) led by H. C. Bingham. The former inquired into the distribution and classification of the mountain gorilla and the latter is highly valued as the first scientific approach to the ecology of mountain gorillas.

The study of H. C. Bingham is called a "psychobiological study" developed from the stand-point of the psychological study of primates at the Yerkes Laboratory, and it also presented a fine report of observations of ecological and sociological aspects of gorillas. Bingham succeeded in grasping the outline of the mountain gorilla's wild life, but still more regular study

was anticipated.

Later studies of the mountain gorilla were carried on at the hands of game rangers such as J. Blower (1956) and O. Milton (1957), and then the second scientific challenge was begun by Dr. L. S. Leakey, Miss R. Osborn (1956) and Miss J. H. Donisthorpe (1957). Especially the excellent study of J. H. Donisthorpe left an epochal footprint in the history of gorilla study. Her intention was to make a sociological study of the mountain gorilla, but she was restrained mainly to an ecological study because of inconvenient conditions of observation.

The Primates Research Group has been engaged in ecological and sociological studies of the Japanese monkey for the past ten years and is preparing to start a study of Anthropoids. Beginning with a preliminary survey of the Thai gibbon by S. Kawamura, we aim to follow with an investigation of the mountain gorilla.

In February 1958, the Japan Monkey Centre sent Prof. K. Imanishi and J. Itani as the First Gorilla Expedition to Central Africa to carry out a preliminary survey of the gorilla. They arrived at the conclusion that the Gorilla Sanctuary on the Uganda side of the Birunga Volcanoes is suitable for a study-field.

The JMC Second Gorilla Expedition was sent to the Gorilla Sanctuary on April 1959. Before this, the big plan of the African Primate Expedition undertaken by Prof. J. T. Emlen and Mr. and Mrs. Schaller had already been set in motion at the beginning of that year and Dr. N. Bolwig of Witwatersland University in Johanesburg had made a preliminary survey at the Gorilla Sanctuary and in Kayonza Forest. With these expeditions, the study of the mountain gorilla has become rapidly gained impetus. Among them the research by G. B. Schaller was extended over in 1960 and is proving a great success.

In the meantime, JMC has sent J. Itani to Congo and Uganda as the Third Gorilla Expedition. We intend to further the progress of our research by provisionizing the gorillas as we have the Japanese monkeys, and J. Itani is to test the possibility of this method.

As stated above, the interest in the gorilla, especially in mountain gorillas, has been aroused on a world-wide scale during the last two or three years, and probably with in a few more years the living conditions of this important and very strange animal will be revealed.

THE SECOND GORILLA EXPEDITION

The aim of the First Gorilla Expedition was to make clear the living state and distribution of the wild mountain gorilla by extensively surveying them, and the Second Gorilla Expedition was similarly of a preliminary nature. Under the circumstances surveys lasting for long periods are not allowed, we can only continue short periodical surveys for a half year at a time.

One of our purposes was to make an extensive ecological survey of the chimpanzees and mountain gorillas living in Kayonza Forest, and at the west coast of Kivu Lake in Congo, after the intensive ecological and sociological survey of the mountain gorillas on the Uganda side of the Birunga Volcanoes.

Another important aim was to test the possibility of provisionizing the gorillas and to find a suitable place for carrying it out. The great success in our study of the Japanese monkey (*Macaca fuscata*) was mostly due to this method, the provisionization of the wild Japanese monkey. Our experience in surveying of wild Japanese monkeys has taught us that it is almost impossible to perform a sociological study by trailing monkeys in the mountains, and it seems also impossible to do this in the thick jungle of Africa. We therefore decided to apply to the gorilla the provisionization method used for the study of the Japanese monkey.

The Second Gorilla Expedition consisted of two investigators, Masao Kawai and Hiroki Mizuhara.

We aimed to make an intensive sociological study, similar to that which has been steadily pursued during our study of the Japanese monkey. This attitude is, moreover, necessarily required from a reconsideration of the history of gorilla inquiry. But, like J. Donisthorpe, we can hardly describe the habitat at the Gorilla Sanctuary as the most convenient field for observation and for adequate sociological study. Thus, due to the fact that the sociological study of the gorilla is stimulated to a large extent by ecological factors, we have made a particular effort to study the ecology of the animal as the basis of our investigations.

We tried a sociological approach through the thick forest; this was found to be possible but unsatisfactory. Our task in this investigation was not to solve the problems but to find their point. From this point of view we can say that our survey fulfilled its purpose and the newly found problems will be fully studied in the following survey.

1. Equipment. we kept the equipment as light as possible.

The chief items were:

A complete set of field camping equipment

Binocular (8×37°)	2
35mm camera	2 (Canon VI. F 1.8, Nikon V. F 2.0)
6×6 camera	1 (Mamiya 6, F 3.5)
Telephoto lens	2 (Canon 100mm, Nikon 135mm)
35mm wide lens	1 (Canon 35mm)
16mm cinecamera	1 (Bell and Howell 75mm)
Portable tape recorder	2 (Shoulder type, Minicorder)
Jeep Jll	1 (Delivery wagon 70 H. P.)

We carried little food with us, for we decided to gather it wherever we were.

2. To Kisoro. On April 4th, 1959, we left Kobe by the Nagasaki Maru and arrived at Mombasa in Kenya on May 5th. Then passing through Nairobi in Kenya, Tororo, Jinja, Kampala, Masaka, Mbarara, and Kabale by jeep, we reached Kisoro, Kigezi district, Uganda on May 20th.

Kisoro is 1900 m above sea level, an important point on the route from Uganda to Congo. Mr. M. W. Baumgartel is managing the Travellers' Rest there and we decided to use it as our base-camp.

Miss J. Donisthorpe (1957) and Prof. K. Imanishi (1959) have reported that Mr. M. W. Baumgartel is an earnest amateur student of gorillas. He provided three well-trained gorilla trackers and gave us much help in our survey during the three months that we spent there.

The places of the survey and schedule are as below.

Uganda side of Birunga Volcanoes (Gorilla Sanctuary (Fig. 1)

May 20 ~ July 10

August 3 ~ August 14

Kayonza forest and other place

July 12 ~ July 21

Mt. Kahuji and Kabona in Congo

July 26 ~ August 2

Fig. 1 (**a**) Our field of research of the Mountain Gorilla near Lake Kivu.

SURVEY OF THE BUFUNVIRA RANGE

1. *General description of the habitat*

A drive of about 11 km from Kisoro, passing through Nyarusiza village, brought us to the foot of the Birunga Volcanoes. These volcanoes extend into Congo, Ruanda-Urundi and Uganda, and the mountain gorillas living there, namely at Parc Albert in Congo, on the Ruanda side, and in the Gorilla Sanctuary on the Uganda side are carefully protected.

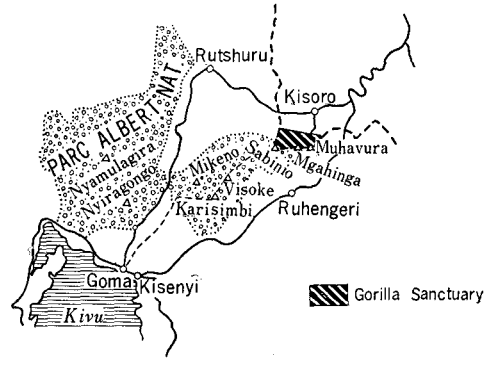


Fig. 1 (**b**) Birunga Volcanoes; habitat of the Mountain Gorilla.

The volcanoes on the Uganda side are included in the so-called Bufunvira range or Mufunbira range, and there are three extinct volcanoes, Mt. Muhavura (4127m), Mt. Mgahinga (3470m) and Mt. Sabinio (3647m), towering among them (see map). At the foot of Mt. Muhavura is a stone hut, Schandle's Camp (2270m) named after Mr. Schandle who completed the water course. It can be reached by car from Kisoro.

Mt. Muhavura is a conical mountain, and very beautiful. Grand per-

pendicular ravines carve the mountain sides deeply; water flows here in the rainy seasons but they are dry as a bone in the dry seasons. On the other hand, Mt. Mgahinga has no valleys, but its skirt is very wide. Both have been cultivated as high as 2400m - 2600m, which means intrusion into the gorilla habitat.

Since J. H. Donisthorpe (1957) has already reported about the vegetation of Muhavura and Mgahinga and the condition was hardly changed in 1959, the year of our expedition, we will omit a description of the vegetation. The mountains are high and the vertical distribution of vegetation is remarkable, as shown in Figure 2.

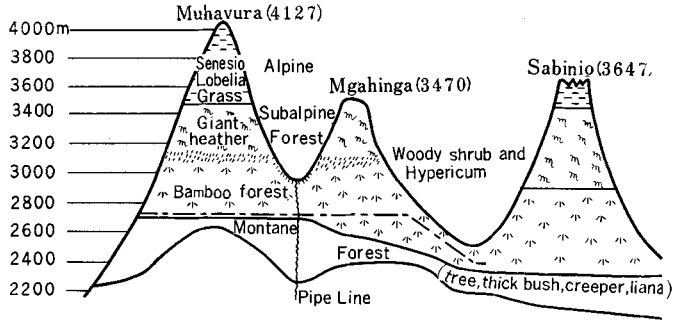


Fig. 2 Altitudinal distribution of plants in Gorilla Sanctuary.

The rainy season lasts from September to May, so that we were subjected to rains until the end of May. As J. H. Donisthorpe also reported the details of the weather conditions of the district, we will add here only that of the temperature. The minimum temperature was 4°C and the maximum was 18°C at Saddle Hut (in the bamboo hut on the saddle, at 3000m). It is said that it sometimes freezes on the summit of Muhavura.

2. *Method of the survey*

At the col between Mt. Muhavura and Mt. Mgahinga is a partly open place surrounded by bamboo forest from which we can enjoy a wonderful view of Nyarusiza village on fine days. J. H. Donisthorpe set up a little bamboo hut for her camp and when we got there, three bamboo huts had been built by M. W. Baumgartel; he called there "Saddle Hut".

Leaving our jeep at Schandle's camp, and employing porters to carry our outfit, we made this saddle hut our camp.

A reservoir behind the hut (to the south) and a pipe line passing near by made it easy for us to get water even in the dry season.

We worked with three gorilla trackers of Nyaruanda; the chief tracker, Ruben Ruwanzagire, though more than fifty years old, was an expert tracker who helped R. Osborn and J. H. Donisthorpe and knew every detail about the gorillas at Bufunvira. The second one was Peter Ntirubabarira, 27, and the third, Bagirubgira was about 30, both with extensive experience as trackers. Ruben seldom went with us but the other two followed our survey. Peter and Bagirubgira camped at Saddle Hut by turns with a porter at night — one went down in the evening and climbed back the next morning.

As is common in field studies of wild animals, the study of gorillas begins with a survey of their track. After finding the gorilla track we must follow and trail it faithfully through the thickest jungle and up and down

cliffs, conquering all difficulties. If we took a short cut and waited at a spot where the gorillas were likely to pass, in almost cases we missed the gorilla track, and the survey was a failure.

It is neither easy to differentiate the gorilla track exactly from that of other animals, nor to decide when the track was made, but fortunately the trackers of Nyaruanda were expert in judging these points rapidly. It must be almost impossible to make a gorilla survey of Bufunvira without these trackers.

When we followed the track, we sometimes encountered gorillas which menaced us by barking and then left. When the gorillas were seen to bark, the trackers insisted on putting any end to be survey and withdrawing.

They refused to listen to our request to trail the gorillas farther, saying that soon after barking, the gorillas would go over Muhavura to the Congo side and there would be no use following them. As the trackers knew only a few English words and about ten of Swahili, it was very hard to persuade them to continue the trail with this limited communication. In spite of this, we tried to persuade them and finally at last succeeded in making them follow the gorillas again.

Under the condition of the thick bamboo forest and lower forest, we almost always encountered the gorillas at a distance of 10 or 20 meters. This often resulted in frightening them, which we wished to avoid as much as possible but observing them from a distance was very difficult because of the configuration of the habitat.

If we encountered gorillas, we followed the track the next day and were able to find their nest. After-examining the nest, we trailed the track continuously until we met the gorillas again. In this way we completed a 24 hour trail and became acquainted with their behavior by actually having experienced part of the nomadic life of the gorilla and covering the ground where they had walked.

We stayed at Saddle Hut for seven days and every day we succeeded in following the gorilla track. After these continuous surveys we came back to Travellers' Rest at Kisoro to take two days' rest. The whole schedule of our expedition was as stated above.

3. *Nomadism and food*

a) *Nomadism*

It is not yet known when gorillas awake. When gorillas made nests about 50 meters behind Saddle Hut, we heard them begin drumming at 4:30 a. m. This suggests that they awake between 4:30 and 5:00 a. m., but the time they left the nests and got to work was later, about 7:00 a. m.

Although there is a report that gorillas assemble before they start out this, seems not to be general, for only one example observed from the tracks around the nests supports this opinion. The rate of nomadism is very slow. In many cases they rest twice a day, in the forenoon and in the afternoon;

the former is only a short rest, but the latter is accompanied by bed-making to enable the animals to repose well.* We saw the leader gorilla taking a nap once on June 26, 11:56 a. m., in a sideways posture and somewhat breast down.

The distance of one day's nomadism is about 1 kilometer in a straight course and varies inversely with the quantity of food. Four troops were found in this area; the largest of them, consisting of 18 animals, moved 2 or 3 kilometers. Since a large troop needs more food it covers a wider range, as the gorillas never scatter during their nomadism.

Later the same troop went from the Uganda side to Ruanda, passing over Mgahinga with considerable speed. We were not able to survey on the Ruanda side, but presumably the animals migrated several kilometers a day at that time.

The main nomadic range extended between the north side of Mt.Muhavura and Mt. Mgahinga, and about 15 kilometers above and below the *forest reserve line*. The gorilla habitats on the Uganda side of these mountains are limited to the nomadic ranges of four troops, as shown in Figure 3,

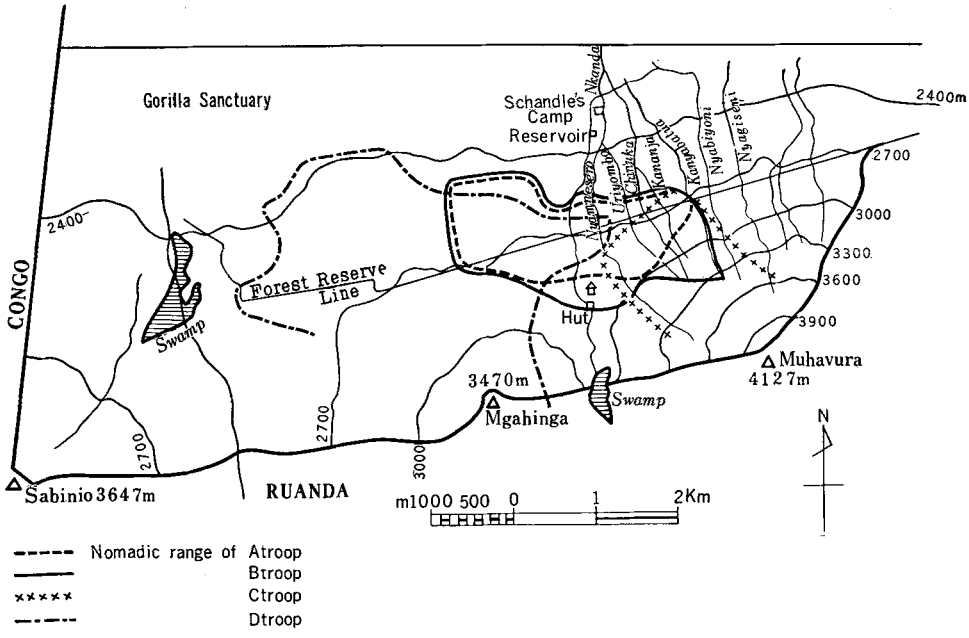


Fig. 3 Nomadic range of 4 troops of gorillas in Gorilla Sanctuary.

located within the area defined above. Of course there are exceptions. They sometimes go to the summits of Mt. Muhavura and Mt. Mgahinga. In fact, J. Itani found the marks of their feeding at 50 meters below the summit of Muhavura and we also found an old nest near by. Not only has J. H.

*)…H. C. Bingham (1932) named it "day nest".

Donisthorpe reported the existence of a nest at the top of Mt. Mgahinga, but we actually saw gorillas cross about 50 meters below this spot. The swamp at the saddle is a gathering place for buffalo, but gorillas often traverse there during their nomadism.

The lower limit of nomadism extends to the border line between the cultivated fields and the lower forest, but the animals never invade the cultivated areas. We found four troops with 39 gorillas in this region. Figure 3 shows the nomadic range of these found troops, A, B, C, and D.

B-troop. The B-troop, which was the main object of our study, consisted of 7 gorillas. We met them for the first time on May 26 and by August 12,* we had observed them directly for seventeen days, and located them without seeing them on six days. On one occasion we were able to set up a record of observation of one hour and forty minutes.

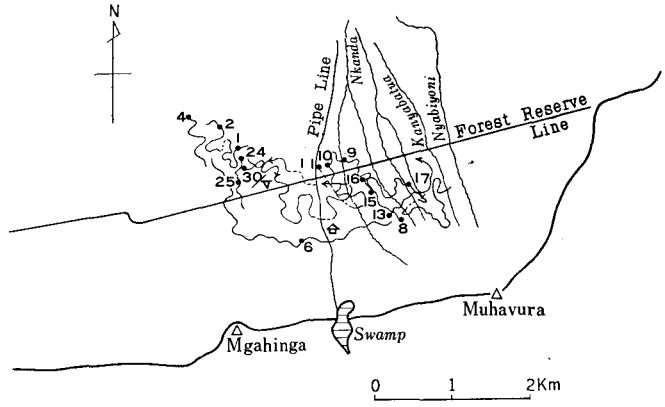


Fig. 4 Tracks of B-troop from May 30 to June 25; sites and dates of the nests.

Figure 4 shows the track of nomadic travel of the B-troop from May 30 to June 25. (Fig. 4)

One of the staple foods of gorillas is the bamboo shoot (described below). This appears in June and July and in August the shoots have grown to tough to eat. Bamboo shoot is abundant in the north-west part of Muhavura and below the forest reserve boundary line of Mgahinga. There is also a bamboo forest lower than 3200 meters on Mgahinga, but it is too thick to grow much bamboo shoot, so that the gorillas seldom go there.

During the bamboo shoot season, the gorillas rely on it for ninety percent of their food and consequently they go to the north-eastern part of Muhavura and back again to the lower, northern part of Mgahinga.

A-troop. Our first meeting with the A-troop of 5 gorillas was on May 30. Since then we observed them directly on four days and located fresh tracks and nests only, on three. The type of nomadism was the same as that of the B-troop.

The troop that J. Itani and K. Imanishi found in 1959 seemed to be

*) ···On some days we observed them once and on others several times.

this A-troop and it was probably the A-and B-troops that J. H. Donisthorpe often encountered. Moreover, the sketch map of Donisthorpe, to "Illustrate sightings of the gorillas, their nests and tracks of the different days" from February to September mostly agree with the nomadic range of the A- and B-troops. To the best of the knowledge of M. W. Baumgartel and the trackers, both A- and B-troops seem to live chiefly on the Uganda side.*

C-troop. We encountered the C-troop of 9 gorillas on May 22, this troop was observed directly on four days and located twice. It seemed to migrate from the Ruanda side, for the gorillas returned there when we encountered them on May 24. Since the growth of bamboo shoot was too sparse for them, they ate chiefly wild celery and *Cynoglossum amplifolium.*

D-troop. This was the largest troop that we met, consisting of 18 gorillas. When we were camping on the plain of Mt. Sabinio during our search of a part of the Mgahinga side, we encountered the D-troop first on July 7. On three days we observed it directly and three other days we only located it.

The animals of the D-troop were on their nomadic travels just below the forest reserve boundary line, in the north-west part of Mgahinga, where low bamboo with creeper were dominant and made the thickest sort of jungle. In the Sabinio part of this area live many elephants and green-coloured venomous snakes called "impoma" by the Nyaruanda men. The natives call the place "tebeko" and shun it.

The A-and B-troops were never seen to go into "tebeko" and no evidence of gorillas having previously entered there, for example old nests, could be found. The nomadic travels of the D-troop were twice as long as those of the others (A, B, C-troops, even reaching the borders of the cultivated land.

When August came, this troop moved gradually eastward and invaded the north-western part of Muhavura, crossing the pipe-line; they soon, however, went back to the Mgahinga side and were seen to migrate to the Ruanda side, going over the east top of Mgahinga on August 10.

Though it is not certain when the D-troop appeared from the Ruanda side, they probably moved to "tebeko" at the beginning of June, judging from old nests, having crossed near the top of Mgahinga. They seemed to be searching for bamboo shoot on the Uganda side, and with the end of its season they went back again to the Ruanda side.

The sense organs of the gorilla seem not to be especially sharp in comparison with those of other animals. The fact that we were able to approach to within 10 or 20 meters from the gorillas in the thick forest that their auditory function, as well as their optic and olfactory functions,

*)…According to a letter from J. Itani on the Third Gorilla Expedition (Aug., 1960), gorillas were not seen on the Uganda side. Perhaps they had to migrate to the Ruanda side to seek a better feeding place, because of the lack of rain.

are developed to about the same extent as those of man.

J. H. Donisthorpe says that the gorilla's way of life is mainly terrestrial, with about 10 percent arboreal life. We observed gorillas climbing bamboo only once and never saw them climb a tree. We believe that these observations, together with the facts that only 4.3 % of the nests were tree nests and that we scarcely found any gaps in their tracks while chasing them, proves the view of Donisthorpe.

This investigation at Bufunvira occupied almost 45 days, from May 22 to August 12. (July was spent in a preliminary survey of the gorillas in Kayonza forest and on the west coast of Lake Kivu). During this period, we were able to observe gorillas directly on 28 days and locate their position on 42 days (on three of these the location was done by native trackers only). During J. H. Donisthorpe's survey of 122 days, fresh tracks were found on 99 days and gorillas were located 41 times, while J. M. Dersheid (1927) saw them 33 times in seven months. Compared with these records, our encounters with gorillas occurred at a rather high rate.

b) *Food*

The food of the mountain gorilla has been investigated by H. C. Bingham and J. H. Donisthorpe, the latter especially, made a minute list of foods of the mountain gorillas in the Bufunvira range. Table 1 is the food list of the Birunga gorilla which we made. Identification of species was done by Dr. E. M. Lind, Department of Botany, Makerere College, Kampala, at our request.

Twenty-four plant species and one fungus were recognized as food; of these, we found 18 species by ourselves and added to the list* 7 other species identified by the three trackers. Our list in general agrees with that of J. H. Donisthorpe. Fifteen species marked "D" in Table 1 proved to be the same as those in Donisthorpe's list; the description of these is omitted. Two of the remaining 10 species, listed by her as *Droquetia inera* and *Stephnia abyssinica*, are believed to correspond to *Umhurura* and *Umhunba* in Table 1, and it is doubtful whether gorillas eat nettle or bracken that she listed up.

Thus, with respect to the food of the gorillas at Bufunvira, our investigation arrived at almost the same conclusion as that of J. H. Donisthorpe. In particulary four species were agreed upon as their staple food and we confirmed the fact that the gorillas began in August to eat *Basella alba*, described as a staple food by J. H. Donisthorpe, since they prefer bamboo shoot to this and other plant foods during its season, from May to August.

The favorite foods of the gorilla bamboo shoot and wild celery. When the bamboo shoot season ends, they eat celery. The relation between the times of obtaining there food plants is indicated in Donisthorpe's graph and our observations agree with hers. Bamboo shoot appears in the area where

*)…J. Itani (1956) found about 180 plant species used as food by the wild Japanese monkey at Takasakiyama; by comparison, the gorillas have relatively few edible species.

Table 1 Foods of Mountain Gorillas at Bufunvira range (1959.5—1959.8).

Name			Native's name	Description	How part eaten	Taste
No.	Fam.	Ge. & Sp.				
	Staple Foods					
1	Umbelliferae	Peucedanum spp. (Giant Celery)		(D)	(D) stem, leaf	slightly bitter
2	Gramineae	Arundinaria alpina (Bamboo)	Umuto	(D)	(D) bamboo shoot	〃
3	Compositae	Veronia spp.	Iriherehere	(D) V. lasiopus and V. syringiforia	(D) stem, leaf a little	leaf very bitter, stem dry
4	Labiatae	Plectranthus or Colenus sp.	Umtindikwa		(D) 〃	〃
		(Prychnostachys goetzenii)	Sindikwa	name Donisthorpe's description		
5	Boraginaceae	Cynoglossum amplifolium	Igifashi	(D)	(D) root only	dry
Supplementary Foods						
6	Umbelliferae	Peucedanum runssoricum Engl.	Kisengasengo	(D)	(D) stem, root	leaf a little, root dry
		(Anthriscus sylvestris)		name Donisthorpe's description		
7	Campanulaceae	Loberia. (Giant loberia)		(D)	(D) stem, leaf a little	leaf very bitter, stem dry
8		Kniphofia (Red hot poker)	Umrenbehra	(D)	(D)	stem dry
9	Piperaceae	Piper capense Linn. F.	Ichunge	(D)	(D) stem	slightly bitter
10	Polygonaceae	Rumex usambarensis Dammer	Umhunba		stem	sour
11	Compositae	Senecio (Giant groundsel)		(D)	(D) leaf base, stem	leaf and its base bitter
12	Euphorobiceae	Acalypha bipartia Muell. Arg.	Umnyanung		leaf, stem	grassy flavor
13	Labiatae?	?	Munbiliza		leaf, stem	
14	Cucurbitaceae	Momordica foetida Schum. et Thom.	Umhanba		leaf, stem	grassy flavor
15	Papilionaceae	?	Umranrashi		leaf, stem	grassy flavor
16	Rosaceae	Rubus pinnatus Willd (Bramble)	Mkehre		leaf. fruit	sour
17	Hypericaceae	Hypericum lanceolatum Lam.	Umshunguru	(D)	bark of stem	
18	Basellaceae	Basella alba		(D)	(D) leaf, stem a little	
19	Compositae	Sonehus oleraceus L.	Ulubunange		leaf, stem	bitter
20		? (Thistle)	Ikirongorela		leaf, stem	grassy flavor
21		?	Umhurura	(D) ?	leaf, stem	
22		?	Igitamatama		root	
23		?	Umhanda	(D) ?	leaf, stem	
24		?	Umnanira		nut	
25		?	Ugundirizi	(D)	(D) a little eaten	

bamboo and lower forest (montane forest) are mixed below the forest reserve boundary line (2700m) at the end of May, then in June in the upper part of the bamboo forest. The prime of the bamboo shoot season is June and July; during this period the gorillas depend on it for 90% of their food the 8% remainder consists of *Cynoglossum amplifolium* and a little red hot poker as seasoning.

Gorillas generally eat the bamboo shoot by breaking it off from the root and peeling it skilfully. The peelings are heaped in a circle of about one meter in diameter. This habit is very convenient to differentiate the traces of the gorillas from those of the golden monkeys which also live abundantly in this mountain and like bamboo shoot. But these animals scatter the peels about him they eat. Gorillas use their forepaws very skilfully to judge from the peels which remain. The paucity of cases in which the animals have carried bamboo shoot to the sunny plain or to their nests to eat, it there indicates that they seldom resort to this behavior. They are so fond of bamboo shoot that in August they eat the part which has become rather too hard, and even the lower part which is becoming hard stem.

The root of C. *amplifolium* is probably one of the most favorite foods of the gorillas. It is mainly found in the lower forest, but is not plentiful to satisfy their hunger, since they eat only its root and abandon the stem and leaves. The root has no taste for us, but it is well known that there is no accounting for tastes. The gorillas dig a hole — 10 cm in diameter and 5-10 cm in depth—, and then pull the root. The hole which is left is perfectly circular, and we suppose that they use their hands as well as do men. Both the bamboo shoot debris and these holes provided valuable clues in chasing the gorillas.

When the bamboo shoot season came to an end, the gorillas began to eat giant celery, then *Veronia spp.* and a similar plant, *Plectranthus spp.* During this time collected quantity of *C. amplifolium*, did not decrease, which means that it is the only plant that the gorillas eat constantly throughout the year.

We tasted 17 species of the gorilla's food; of these, 8 species were bitter. From the fact that four of five staple food species, i. e., all except *C. amplifolium*, are bitter, we assume that gorillas are strong enough to endure bitter taste, or that they rather like bitterness.

In spite of careful observation, we could not find evidence that gorillas take animal food. H. C. Bingham also pointed out that the gorillas on the west part of the Birunga Volcanoes never ate honey, birds, worms, etc. From these facts we may say that the gorillas in this region are completely vegetarian.

We were surprised not only that the kinds of foods were so few but also that the quantity of food eaten was so little, as can be inferred from the amount of dung. Amount of bamboo shoots which they eat a day are

not so much. Since the nomadic distance of the animals is comparatively short and the product of bamboo shoot is limited, they take only about 20 or 30 bamboo shoots a day.

Example 1. On June 19th, we went down through the bamboo forest between Valley Nyabiyoni and Valley Kanyabatua on the northern side of Muhavura, counting the number of bamboo shoots under 1.5 meters high which were to be found in the strips of ground 3 meters in width on both sides of us. On our way down, we found old gorilla dung and many bamboo shoots higher than 3 meters; from this we understood that the animals had not appeared there for rather a long time. The bamboo shoot had not been ravaged, and the lower we went the more bamboo shoot we found.

On walking downward for 30 minutes from the upper end of the bamboo forest, we counted 50 bamboo shoots within the defined; during the succeeding 8 minutes walk to the forest reserve boundary line 34 bamboo shoots were numbered.

We presume that the average width of a procession of 6 gorillas is about 10 meters, and that they advance 600 meters during the morning. If we advance with a speed of 40m/minute, we can cover 1520 meters in 38 minutes. On the strip of ground, 1520 meters in length and 6 meters in width, we found 84 bamboo shoots lower than 1.5 meters high. From this, we can calculate that 140 bamboo shoots will be produced on a strip of the same length and 10 meters width.

If the gorillas advance 600 meters, about 55 bamboo shoots can be found in that distance.

$$600/1540 \times 140 \fallingdotseq 55$$

As the group consisted of 6 gorillas, the share of one is about nine bamboo shoots; that is, a gorilla can take only nine bamboo shoots during the 600 meters traversed during one morning.

This is merely an example, but it is certain that the quantity of food taken by gorillas is less than we expected, even at the lower part of the forest reserve boundary line at Mgahinga where bamboo shoot was most abundant.

The land under cultivation advanced to a rather high part of Muhavura and Mgahinga, and gorillas often came down close to the border. Beans, corn, potatoes, etc. are cultivated at Ishamba. One might well suppose that it would be a fine feeding place for the gorillas, but they never ravage the crops.

On the basis of these data, it must be considered that the gorillas at Bufunvira are contented with coarse foods of a few kinds.

4. *Resting places and nests*

a) *Resting places*

Gorillas rest during their travelling and feeding. It is so characteristic of them to make resting beds that H. C. Bingham and J. H. Donisthorpe devoted more than a few pages to describing this in their reports. H. C. Bingham called this resting bed the "day nest".

As J. H. Donisthorpe pointed out, the resting place is decided in accordance with various conditions and resting beds are not always made.

About 30 percent of rest stops are accompanied by such bed making.

In some cases the resting beds are made of creeper, vine and thick grass, and are simpler than the night beds. (Fig. 5)

Seventy percent of the gorillas' rest is taken lying directly on the ground without making a bed. There seemed to be no particular conditions for selecting a resting place, but many of the animals are fond of lying on grass or in a not-too-sunny place where the sun-light filters through the trees. Although they are often seen to rest gathered around the leader, they make individual nests at night as if they consciously avoid contact with the other animals. The assemble at resting time probably presents an opportunity for close social contact, in which are included factors of social behavior such as affinity, grooming, etc. The young males frequently sat apart from the others. This disposition was especially strong in a young male of the D-troop that joined and left the troop freely. The report that the gorillas never leave dung at their resting place was supported by our observations.

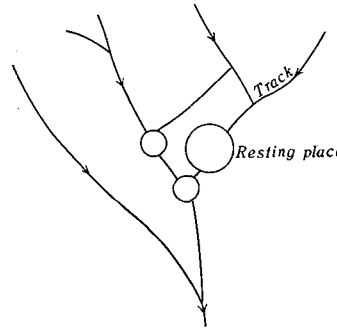
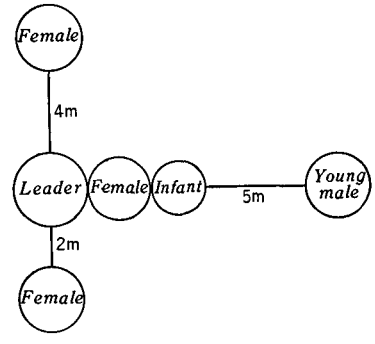


Fig. 5 (**a**) Arrangement of resting places of B-troop and their tracks at the sunny grass-covered ground in the mixed forest of bamboo and trees (22nd June).



(**b**) Arrangement of resting places B-troop on the sunny grass covered ground in the bamboo forest. (15th June)

b) *Nests*

It is well known that gorillas make a bed "nest" for sleeping. We found and investigated 365 nests in the Bufunvira range. The places for nest making are shown on Table 2; many of these were above the ground. Though the result of J. H. Donisthorpe's investigation showed that the ratio of nests on the ground to those above ground is approximately 1:1, our observations indicate that the gorillas made more nests above ground because of the food they ate. (Table 2)

We never saw gorillas climbing trees, and found few nests in the trees (only 4.3% of the total). It is said that infant gorillas often make nests in the trees, but we could not confirm this, although sometimes a mother

Table 2 Nests of the gorilla at Bufunvira range.

Researcher / Site of nest	Kawai & Mizuhara	J. Donisthorpe
Total number of nests	365	225
Number on the ground	155	121
Number off the ground	210	104
On tree	16	
On bamboo	188	
On the vines and creeper	6	

gorilla and her infant have a nest in a tree together. Nests in trees are generally small so that some take them for infants' nests.

Among the gorillas belonging to the same group, nests were made on the ground or off the ground quite at random. There seems to be no rule to which individual gorilla will make its nest on the ground or off the ground, except that, generally speaking—as H. C. Bingham and J. H. Donisthorpe pointed out—the leader male makes his nest on the ground.*

Table 3, however, presenting the results of investigation of 50 cases shows that this is not a fixed rule. There were ten cases (20%) in which only one gorilla nested on the ground, with the rest nesting off the ground. The nest on the ground to belong to the leader. In 18% of the cases, all the nests were off the ground (9 cases); if can therefore be concluded that although the leader males on the ground much of the time, they make their nests off the ground an extent of at least 18%.

Table 3 Sites of nests.

All nests on the ground	3 cases
All nests on the bamboo	9 cases
Only one nested on the ground, the rest off the ground	10 cases

The dung that the gorillas leave behind them in the nest is crushed in nearly every case. However, we often found nests without dung and in a few cases all of the troop left dung in their nests.** We investigated 36 troop nesting sites and a total of 212 nests, of which 29 were without dung. In only one case (A-troop of 5 gorillas) did all the members of the leave, dung in their nests. J. Blower said that in the dry season the gorillas get up early and do not leave dung in the nest, but this seems doubtful, because we found nests without dung in the rainy season at the end of May. Since we could not find satisfactory reasons to define the conditions or the types of individuals which left dung in the nest, it seems better to reduce the explanation simply to the quantity of the food the animals take, as the trackers say.

The materials for bed building are bamboo, tree branches, woody shrubs and grass. Among the woody shrubs, *Veronia spp.* or *Plectranthus spp.* were used most often. The nests were built of either fine or coarse materials, depending upon the conditions at the nesting place and not on differences among individuals. Even when the nesting place obviously lacks suitable materials for bed building, the animals never search for and bring materials for nesting from other places. This fact may show the limit of their tool-making ability.

Our carefull investigation showed that, all the troops and every individual

*) ···J. H. Donisthorpe: It has been suggested that the leader of the group invariably sleeps on the ground. This could be so, for no group of nests was seen without at least one on the ground.

**) ···When the nests were high up in the bamboo, we could not climb to investigate the dung, so it is hard to treat the matter statistically.

seemed to make their nests in the same way; for example, they always make bamboo nests by bending the bundle of bamboos from one side, never making the bamboo trunks support the nest from both side. The height of a bamboo nest is generally from 2 to 4 meters (Table 4), but gorillas often make nests on a slope, so that the vertical distance from the ground becomes greater.

Table 4 The nearest distances between nest and nest, heights of position of nest.

Name of troop	Meters / Nest	m ~1	~2	~3	~4	~5	~6	~7	~8	~9	~10	~15	~20	~30	~50
A	distance between nests	1	1	3	4	4	2	2	1		1			1	
	height of nest	2	1	2											
B	d. between n.	3	15	13	19	8	16	7	2		9	3	3	2	2
	h. of. n.	2	8	15	14	3	3		1						
C	d. between n.	3	5	10		2		1					1	1	
	h. of. n.	2	2	4	2	2			1						
D	d. between n.	7	37	22	19	3	5	1	2		5	3	4	1	3
	h. of n.	10	16	4	1	2			1						

The inside of a ground nest is, hollowed on one side with a high roof just above this part. If the hollow is for the animals' hips, the gorilla must lie on its back in many cases. (Fig. 6, Fig. 7)

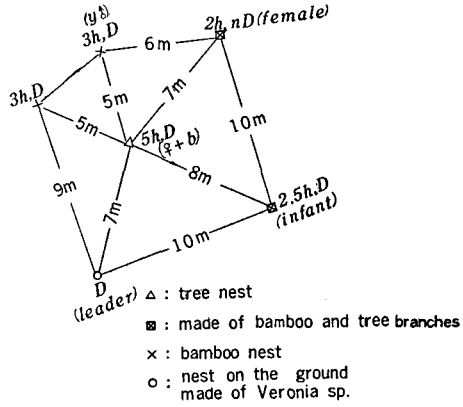


Fig. 6 A case of nesting of B-troop in the mountain forest at Mgahinga.
2h: 2 m height
D: dung
nD: no dung

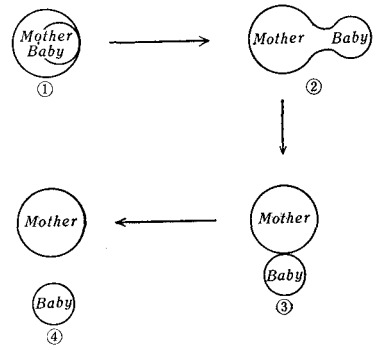


Fig. 7 The process of separation of the baby's nest from that of its mother.
1) Baby's nest is included in mother's.
2) Gourd-shaped nest connects mother's nest with baby's.
3) Two nests in contact with each other.
4) Two nests separate.

The nests are arranged at random. The approximate distances between

each two contiguous nests as shown in Table 4, are commonly from 2 meters to 6 meters, although a few nests are set within a meter. The four troops all showed the same tendency.

Some observers have denied the existence of fouled baby nests, while others have insisted that even baby gorillas have their own nests. Our observations were somewhat different.

As H. C. Bingham has reported, baby gorillas sleep with their mothers in the same nests and frequently leave dung. As they grow, they have their own nest, apart from that of the mother. The process by which the nests become separate, is indicated in Fig. 7, is like nuclear fission in an amoeba. First, the mother's nest swells into a gourd-like shape.*

In the larger part sleeps the mother gorilla and the smaller part is for the baby. Soon the nest separates into two parts, but the baby's nest remains close to the mother's. Then at last separation is completed and the baby's nest becomes independent. We still do not know in what stage of the baby's development this acquisition of an independent nest occurs, or to what extent the mother helps the baby to build its nest. This interresting problem remains to be solved by future research. Fifty percent of the baby gorillas left dung in the nest at each step in the separating process.

H. C. Bingham, has stated that gorillas do not select a special nesting place**, but make their nests wherever they happen to be, and we have found this to be quite true.

The gorillas' nomadism is in search of food, and with the sunset they build nests where they are without selecting particularly a comfortable or convenient place to repel enemies. Old nests are generally not used, but in one exceptional case we observed a gorilla which built a new nest on an old one.

For what purpose do gorillas make their nest ? We know it is for confortable sleeping, and for this purpose, the bamboo bed is the best, but beds which are roughly made of twigs are too small and not as comfortable as lying on the grass without a nest. The nest is, moreover, neither a shelter against rain or frost, nor a cradle for the babies.

Among the surviving anthropoids, only the gibbon has no nesting habit, and only the gibbon is purely arboreal and omnivorous. The others are less terrestrial in the following order ; gorilla, chimpanzee and orang-outang,

*) ···Shwab observed nests of this shape.

**) ···H. C. Bingham : p. 35 "As a working hypotheses—, there are gorilla movements between such forests and that nest building is adapted somewhat to the daily circumstances that are encountered—The location of nest sites each night appeared to be a matter of expediency rather than selective foresight—"
"They appeared to go about in a vagrant manner making little or no preparation for the night or the morrow until the time for sleeping or roving was at hand. They seemed to accept the circumstances as they occurred, and adapted themselves to essential changes of the environment without following a fixed order of living—"

and all of them build nest and are herbivorous. It should be noted that the terrestrial and herbivorous habits and nest building carefull be seen to arise in parallel during evolution of the present anthropoids. Although it is said that the most ancient primitive human life began with a hunting nomadism on a steppe or savannah, consideration of the life of the great apes (except the gibbon, which has a specialized way of living) suggests that there have been more primitive life stages intervening before the hunting and nomadic life began. Should we not, from this point of view, consider the nest building of the gorilla in relation to the evolution of primate life ?

5. *Social composition of the troop*

The composition of the gorilla troop has not yet been satisfactorily elucidated. Even the studies by H. C. Bingham and J. H. Donisthorpe have not been adequate in this respect. It is very hard to look into gorilla society, and observation through the thick forest of bamboo and lower forest of the Bufunvira range was particularly difficult. However, we were able to infer the membership of the troop and its social components by investigating the nests. From a different point of view, such investigation of the nests was useful to confirm the results of observations. The construction of the membership of the troop on the basis of our survey is given in Table 5.

According to this table, a gorilla troop consists of one adult male as leader, young males and females and infants; that is, a troop of gorillas seems to be one polygamous* family.

Table 5 Social composition of 4 families on Birunga range.

Name of family	Total number of animals	Number of nests	a ♂	(a-y) ♂	y ♂	(a-y) ♀	j	i	b	?
A	5	4	1			*2		1		1
B	7	6	1		1	3		1		1
C	9	8	1			2		1	3	2
D	18	15	1	1		4	4	3	2	3

* It is possible that one of these is a young male.

a : adult, y : young, j : juvenile, i : infant, b : baby, (a-y) : adult or young.

The adult males of the four troops were silver-backed, but that of A-troop was rather small in stature. Of the young males, one of D-troop was silver-backed and all the others were black-backed.

The gorilla troop is said to divide and combine. In spite of careful observation, we could not find enough data to prove this, but the following observations support this viewpoint.

We observed a young male of the D-troop leave its family and become solitary in the middle of August. This silver-backed young male would return to the troop and build his nest at night nearby.

*) ···Blower, J. (1956) states that a troop of gorillas is a family.

When the D-troop was in the lower forest area at Mgahinga, one group of seven, and an other of eight, month-old nests were found. As there was no evidence of the presence of other troops, it can be assumed that the members of the D-troop spent the night in two separate groups. In August, moreover, the number of nests of the D-troop amounted to 11, 12 or sometimes 13, which indicates the separation and solitary behavior of two or three members of the family.

When there were 12 nests, 9 of them were built together and the other 3 lay scattered about, while in the case of 15 nests, 10 were in a cluster, with another group of 5 nests at a distance. It is difficult to visualize the construction of a troop of gorilla on the basis of such observations alone, but we suppose that 8–9 members of the troop constitute the central part and the remaining 6–7 animals come and go as the peripheral part of the troop.

As the D-troop was a favorable sample for a study of troop construction because of its large population, we chose this troop as the main object of our study in August. On the 10th of August, however, the D-troop crossed near the top of Mt. Mgahinga and moved to the Ruanda side, so that we had to give up the trail.

In the case of the B-troop, a black-backed male built its nest on one occasion about 150 meters away from the others, and its nest for another night could not be found at all. It sometimes made its way alone for a day, and this may be one step in the direction of a solitary life.

What attracted our attention most about the A-troop was that two spoors were generally left. This meant that the A-troop separated into two parties as they proceeded. As proof of this, we found two sets of nests built in separate places, with a distance of more than 100 meters between the two groups of nests. It is very interesting that even such a small troop has its sub-group.

The above examples are not cases of combination and division between troops, but rather suggest changes in the membership and social relations within one troop.

Our observation made it evident that some young males part from the troop and join it again, but finally become solitary and independent. There are individuals that sometimes leave the troop and build their nests a little apart from the others. These must be juvenile males. These questions will be discussed later, in connection with the growth of a new troop.

6. *Territory and intergroup relations*

J. H. Donisthorpe has pointed out that each troop of gorillas does not have its own special territory on which it opposes other troops, as is true of monkeys in general. This was, anticipated by the JMC First Gorilla Expedition, and it constitutes very important basic information for our survey. We were also able to prove this by superimposing the nomadic ranges of the

four troops of gorillas at Bufunvira range.

Both A and B-troops stayed on the Uganda side, and their nomadic range was almost the same. The D-troop was in the north-western part of Mgahinga in July, as though it intended to avoid the territory where the A and B-troops were. However, in August, the D-troop extended its nomadic range to the north-western part of Muhavura so that it overlapped that of the A and B-troops.

Even when their nomadic ranges overlap, the troops avoid one another and no familiar relations between them can be observed. This phenomenon is quite incompatible with the opinion which stresses the possibility that the troops may combine. For example, when the A-troop was on the Mgahinga side, the B-troop usually went to Muhavura, and it move to the central part of Muhavura when the D-troop appeared in that area.

Once we observed the C-troop to come from the Ruanda side and approach with in 100 meters of the B-troop. Both made drumming or gave cries of "hou, hou," as if to warn each other with those sounds. The old tracker, Ruben, predicted that they would begin fighting the next day, but actually the C-troop went back to the Ruanda side three days later. In this manner, they sometimes restrain each other if one troop meets another.

Ruben told us that in 1957 he had witnessed fighting between the chief gorillas of two troops, in which one was killed*. This gorilla was strangled to death.** Since this male was black-backed and rather young to be the leader of a troop, we guess that he may be one of the young males of a troop, or a solitary one. This incident does not provide evidence of fighting among troops, but it at least gives us a key to help solve questions concerned with intertroop relationships.

Gorillas do not defend themselves by force from other gorillas, which are opposed to them and invade their particular territory. That is to say, they avoid collisions of force with force, i. e., they practice a sort of habitat segregation by means of maintaining common nomadic ranges and consciously trying to avoid the other gorillas. This method is more effective for co-existence than confronting one another in a struggle for territory, and it requires a rather highly developed level of mind in the Primates.

7. *Social behavior*

Although the primary aim of our survey was to observe the social behaviors or social relations among the gorillas, this was almost impossible because of the thick foliage of the lower forest and the bamboo forest. Whatever of their social behavior we were able to see was almost in rela-

*) ···That gorilla was sent to Mackerere College, Kampala, by M. W. Baumgartel and kept as a specimen of the skeleton. Judging from its skeleton and teeth, it appears to have been a comparatively young animal.

**) ···According to the letter of M. W. Baumgartel, in May, 1960 Ruben fought with a young female gorilla which tried to strangle him. These facts suggest that strangling is one of the gorilla's fighting tactics.

tion to the observer, and to our great regret we were able to make only fragmental observations of the social relations, social order and organization of the gorillas.

When gorillas find observers, they always give a warning cry. Hearing this, the females and infants run away at once, but the leader remains to hinder our approach. He stares at us, hiding himself behind the bushes or trunks of trees, and often makes violent, threatening ejaculatory sounds. Those are very similar to the warning cries, but are louder, more violent and tense. Threatening sounds were voiced 21 times in 16 minutes at the maximum. On threatening occasions they often resort to drumming. Although there is an opinion that they strike the chest with their fists, actually they do this with the palm having the fingers bent inward a little. The rate of beating is rather fast and the animals make continuous beatings several times. There are kinds of this sound; a dull sound ("bata, bata") made by beating the thick muscles, and a comparatively clear sound ("poko, poko"). M. W. Baumgartel and the trackers claim that the latter sound is made by beating the cheek — the sound itself indeed resembles that made by beating the cheek — our observations, however, indicate that it comes from beating the upper part of the chest, near the clavicle. This kind of drumming is evidently made as a threat.

Sometimes the gorillas break fresh bamboo 5 cm in diameter with one hand. From the nature of the break it is apparent that a strong force is applied instantaneously. Sometimes we found 10 or so bamboos thus broken on the gorilla track, but we have not determined the reason underlying this behavior.

The leader, after his threatening, vanishes into the jungle after his troop. In the place where the leader was we always find dung, and gorillas in general leave dung when they are escaping from being followed. Sometimes much dung is left, and sometimes it is soft and yellow with a very bad smell of indigestion. The same phenomena are seen in the case of the Japanese monkey, on occasions when they are extremely agitated.

To protect the troop by such threatening behavior is usually the role of the leader male or a young male, but occasionally a female or child takes this role.

Example 2. On 16 of June, while we were following the B-troop, the leader often tried to hinder us with threatening sounds and drumming. But we continued pursuit after he vanished into the bush.

On the fourth such occasion we stood face to face with him, with a distance of 11 meters between us. The leader yelled with anger, drummed on his chest and broke bamboo. Suddenly a child appeared from behind him and began drumming at us. The period of drumming was long and it was unskilfully done. A few minutes later female appeared, making a sound ("kyan, kyan") like a dog. She carried a baby on her back. At the same time, the leader commenced a violent mock charge. He dashed forward at a gallop in a jumping fashion, stopped 2 or 3 meters in front of us and shook the bamboo

like a storm, and then went back. This sort of mock charge has made three times.

We experienced such a violent general attack including a female and child only once, and we never again heard the ("kyan, kyan") sound of the female or the unskilful drumming of a child.

The mock charge represents fierce threatening, and it is said that the gorilla chases and bites the leg of anyone who runs away frightened by this. It is therefore necessary to stand still and store, and not to move. It is very interesting that the gorilla makes only a mock charge, and not a direct attack. Animals usually attack directly, when they are driven into such circumstances, trying to escape from danger by dint of force. This must be the most effective means available to them, but they also have to anticipate considerable danger to themselves. Compared with this method, it is far wiser and safer for the gorillas to expel their enemies by threatening, and avoid danger to themselves. Then, if the man is going to run away, the gorilla watches for a chance to bite him.

The day following this general attack, we found the attitude of the B-troop to have changed completely. When the leader sounded a small alarm, the whole troop escaped rapidly. We were much surprised at the skill displayed in this alteration of their attitude. The B-troop was indeed well versed in survival tactics.

The following characteristic behavior on the part of the young males was observed. When observers approach they run in the direction on opposite to that taken by the rest of the troop in an attempt to attract attention to himself. This is a kind of strategy, of which the following is a typical example.

Example 3. On the 13th of June, we drove the B-troop into Kananja Valley. This spot was about 3400 meters above sea level, and a plant belonging to the Compositae was abundant instead of the bamboo forest. The gorillas crossed the valley and began to traverse the side of the cliff on the opposite slope. Following three females, a large leader male appeared with silvery white hair on his side and back. He made threatening sounds and vanished into the bush after drumming.

A young male appeared next, but he took on entirely different course from that of the leader and females. Then he went about 50 meters and began to utter threatening sounds accompanied by drumming. He continued to prevent our advance for 10 minutes, until the other members of the troop had crossed the valley and reached safety. Although his threatening cry of "gwat" become feeble and finally died away, he continued to resist stoutly.

The three smaller troops (A, B, C-troops) used to run away when they met us, but a large troop like the D-troop showed different reaction. In this case it was not the leader but the young males that hindered and threatened us. The leader paid little attention to us and left deliberately with the females and infants. The young males followed us, as did those of the other

troops, but they are self-possessed enough to threaten us with their stretching legs toward us or by striking the ground with their fists, and sometimes they even feign anger to tease us. When we are standing still, some of them come to look at us by turn. Those that belong to the large troop have less fear of men, and this psychologically superior state of mind makes them behave composedly.

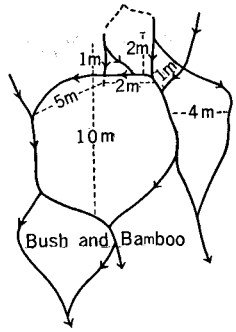
Example 4. On July 7, the three observers were following the D-troop. Two young males of the troop noticed our approach and quietly went behind us. Passing through the bamboo thicket, we suddenly faced five gorillas. At least three of them were adult females. They cried loudly and dashed into the bamboo thicket just in front of them. We continued to advance and came to a narrow open place, where we could see a silver-backed male walking along calmly. The young males behind us drummed repeatedly. Then the bamboo in front of us was shaken and two gorillas came toward us and a young one peered at us from his hiding place. The distance between us was about 12 meters, and the animals hurridly hid themselves at the sight of us. While this was going on, the main group of the troop moved far away from us.

Example 5. On July 8, we were in the zone of shorter bamboo growth, in the north-west and Sabinio part of Mgahinga, following the D-troop. The bamboo forest was low there but very thick, with vines clinging to it. The trackers call the place "tebeko" and very reluctant to enter it. Elephants and buffuloes invade this "tebeko" area from Sabinio.

A young male gorilla gave a warning cry at the sight of us, but the leader male made no such sound. We were prevented from advancing by two young males and two juveniles. They stood facing us, keeping a distance of 15 or 20 meters. The gorillas frequently uttered threatening sounds and drummed, hiding themselves behind the bush so that we could not see them clearly. Soon we heard them strike the ground with their fists and some of them put out a leg or their head and looked to us. This continued for about half an hour and finally forced us to retreat.

This behavior provides a very interesting example of the social role of children and young gorillas. Among Japanese monkeys, reconnaissance, standing guard, obstruction of enemies, etc., are important roles of the young males, and the young gorillas seem also to have these social roles. But the young male Japanese monkeys never go behind the enemies or perform strategic behavior. From this point of view, the gorilla's social behavior are more developed than the Japanese monkeys, and their social activity is carried on at a higher level.

The study of gorilla nests did not provide us with data which could be used to investigate the social relations among these animals, but a thorough study of their tracks gave certain insights into these problems of social organization. Figure 8 shows representative examples of the tracks of a gorilla troop. The tracks shown in (a) and (b) are typical of the procession of a gorilla troop. The animals are likely to come together both during procession and while they feed. In generally, in B-troop the distance between the two individuals at the two ends of the group is not more than 20 meters. They do not form parallel tracks when they move, but come together and separate,



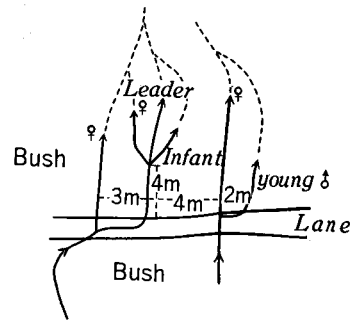
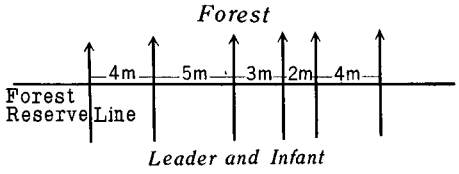
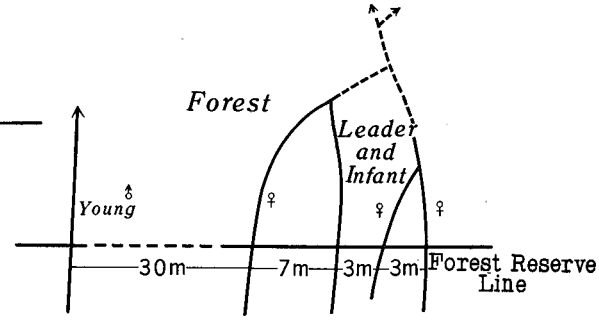


Fig. 8 Varieties of tracks of gorillas at Bufunvira Range.

a) Mesh-like tracks of B-troop in the mixed forest of trees and bamboo.

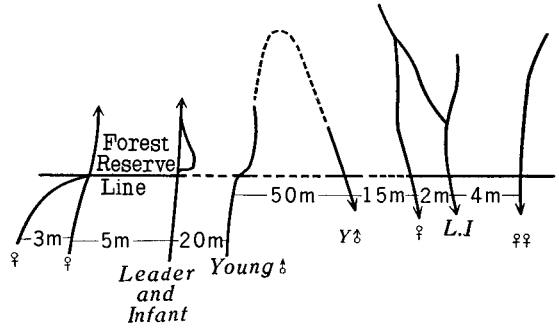
b) Tracks of B-troop crossing a lane in the bush.





c) Tracks of B-troop crossing the forest reserve line.

d) Tracks of B-troop crossing the forest reserve boundary line.



e) Tracks of B-troop crossing a lane near Nyamnesero Valley.

so that the composite again a little way off, track resembles a mesh. This way of advance is characteristic, and not found in other animals. It is said that gorillas often advance in single file (H. C. Bingham and J. H. Donisthorpe) but such cases were very rare in our experience. On the contrary, all members of the B-troop traversed the forest reserve boundary line in parallel, as (c) shows.

The way of advance is comparatively fixed in the B-troop. In short, the young male often advance at a short distance from the main group, ((a) (e)) while the leader, females and infants move together. One infant was always with the leader male on such occasions, and judging from their resting place, the leader, one female and one infant seemed in many cases to rest in a group.

According to M. W. Baumgartel, when this leader gorilla died of disease

in 1960,* one infant remained with the dead leader**. We infer from these facts that these three gorillas, a leader, a female and an infant were usually united by a strong relationship and behaved together.

This fact also means that there is one particular female which is on intimate terms with the leader. The infant left by the dead leader suggests the role of the leader as father, and presents a very interesting problem about the gorilla.

In many cases the A-troop left two tracks; one of the leader and a female and another of a young female and infant i. e., the troop divides into two parties when it advances. We found that there was a female in close relation with the leader in this troop also.

Mother gorillas were often seen to advance with their babies on their back or waist, but to our regret we could not observe other mother-baby relations. From the D-troop we sometimes heared heavy crushed sounds voiced ("ot, ot") and the sound of movement around. The trackers said that this is male's voice to calling the female, and indicates the beginning of copulation, but we were not able to observe what actually met on.

It was rather strange that all the babies of the four troops of Bufunvira gorilla seemed to be of the same age. That is to say, the question arises as to whether the breeding season may not be restricted in this region. This point will be discussed below.

8. *Communication*

As one main object of this survey, we tried to record the vocalization of the gorillas in as great detail as possible in order to find out their communication system of them. At the beginning of this work, we expected that a highly developed, emotional and complex short distance communication system of them. At the beginning of this work, we expected that a highly developed, emotional and complex short distance communication system must be a part of their social life, considering the size of their groups and their degree of sensibility.

Contrary to our expectation, we were able to collect only 8 different types of vocalization in the Bufunvira range, and in addition we felt that their vocalization was limited in quantity.

However, there is still a possibility that further intensive study will disclose many different nuances of the gorillas' vocalization possessing sense, or social meaning, and it can be naturally expected that there is some developed vocalization, among animals close to each other, which we could not hear from a distance.

Sounds of 'alarm' and 'threat' were most frequently heard. These two are quite similar, but the latter is roared much more loudly than the

*) ···From his letter of June 17, 1960

**) ···The infant was caught by Ruben, the tracker, and later sent to Regent Park.

Table 6 Varieties of vocalization of gorillas

Vocalization	Vocal state	Meaning	Crying animal
Hou, Hut	continuous sound	calling ?	all members ?
Grrrrr	single sound	?	?
Hwat, wat	〃	alarm	(a-y) 숀, (a-y) 우
Gwat	〃	threat	(a-y) 숀
Gieh	〃	cry in attack	(a-y) 숀
Ki :	continuous sound	scream	infant
Ot, ot	single sound	sexual display ?	(a-y) 숀
Kien	〃	threat	(a-y) 우

a : adult, y : young, j : juvenile, i : infant, b : baby, (a-y) : adult or young

former, and with greater emphasis. It is a gloomy rather desperate, single cry. 'Alarm' is heard rather often. Sometimes we could record these two with a high frequency (e. g. 21 times in 13 minutes, or 12 times in 8 minutes) alternately or as a mixture. Usually, 'threat' is followed by 'alarm', which is repeated sometimes 2-5 times. 'Alarm' is given not only by the leader, but also by females, young males, or juveniles in the troop, and occasionally 'alarm' is given by several of them at a time.

It is a remarkable fact that the relaying of warning vocalism takes place in the troops, in the same way as is seen in troops of Japanese monkeys ; that is, the first alarmer is relieved by an other ; the 'alarm' baton ; so to speak ; is handed on to the next alarmer. The typical order of succession follows the ranking in the leadership system : females—young males—leader male.

'Alarm' and 'threat' are often succeeded by drumming. 'Threat'—drumming, drumming—'threat', drumming—'alarm' is the usual order of sequence.

'Hou, hut' is a soft, penetrating call. It is believed to be used in calling the other members of the troop, but we were not able to determine this point with certainty. It is heard as component of a mixture which includes 'alarm' or drumming ; it is sometimes followed by a throaty 'grrrr' and ends with one beat of drumming or the breaking sounds of snapping bamboo stems.

'Ot, ot' is a thick, suppressed single tone which conveys a vague feeling of eroticism. We heard this sound once in the lower forest at Mgahinga. Although trackers describe as a tone connected with sexual display, we were not able to secure any evidence in this connection. 'Gieh' is a threatening voice with mixed feelings of terror and threat, which was heard when a leader male attacked us (see Example 6).

The famous habit of chest-drumming has been nearly monopolized by gorillas.* Undoubtedly this characteristic behavior usually expresses a threat

*) ···Although J. H. Donisthorpe stated in her report that she was never fortunate enough to hear chest drumming, we very often heard it from a distance of 10 meters, and sometimes from further away we heard the sound which broke the silence of the forest.

against an enemy. But sometimes, as described above, it is combined with various kinds of vocalization, and this simple behavior can also express various different meanings in the social life of these animals, because of its clear sound which is quite suitable for long-distance communication.

As we stated above, drumming gives two different sounds 'poko poko' and 'bata bata', but it is very difficult to recognized two different meanings from them. Another means of communication is to beat the ground; this sound was directed at us, undoubtedly as a threat, by the four young males which we faced in the forest at Mgahinga.

So far as we can judge from our data, the gorillas' vocal communication seems rather poor in variety* and content, on the other hand, we can anticipate that they have other ways of communicating at close range in their social life, such as gestures of various sorts, facial expressions, etc.** The mode of their nomadic movements can be considered to constitute a significant basis for this opinion.

The animals move on their way, not in parallel with each other, but so that a reticulated spoor is left after passage of their troop.*** What makes them prefer this zigzag course? When they pass through the thick jungle while feeding, the heavy growth thick plants may screen them from their comrades. Thus, if they resorted to their auditory sense only, they could follow the leader by using vocalization without having to depend on their eyes to recognize him. On the other hand, their reticulated spoor suggests that they also use their eyes as well as their auditory organs in communication.

9. *Relation with other animals*

a) Humans

In the Birunga region, the gorillas usually avoid human beings. When they feel some danger, they threat on the invader with a mock charge and jump forward 2-3 meters toward him. If the invader shows an evasive attitude, the mock charge immediately changes into a true charge, and the invader will certainly be injured by the sharp canines or Hercullean arms of the animals.

So the golden rule when ones meets them is "No retreat; keep your eyes on the eyes of the animal, and stand resolutely against him". This attitude is effective in most cases. In our experience, the leader male and the young

*) ···Dr. Rham, at IRSAC, distinguished only about 10 different types of vocalization made by 4 captive gorillas.

**) ···Three infants of the lowland gorilla in the Nagoya Zoo show many types of drumming. They beat on their own chests, arms, belliers, hips, knees and the soles of this feet, and strike their palms together. They also beat the trunk of trees, walls, or the ground with their knuckles and beat on their comrades' backs with their hands.

They have, moreover, very expressive eyes, probably more so than other species of apes.

***) ···Japanese monkeys take same way when they move around the thick forest.

males were the aggressors in making such a mock charge.*

Only once (and we hope such an accident never happens again), we were the object of a true charge in the forest of Mgahinga. Our 'golden rule' seemed to lose its authority at that moment.

Example 6. On June 17th, five of us (two trackers, one porter, Mizuhara and Kawai), were following the gorillas' spoor, which crossed a pipe line as two streaks running to right and left toward the thick bamboo forest of Mgahinga. Just as we turned right at a corner, we heard a terrible shout and saw a silver-backed male, the leader of A-troop, 6 meters ahead dashing toward us with a ferocious expression showing a blaze of passion. A tracker, who was at the head of our procession, was just bending his head low to pass through a bush tunnel at that moment. The leader male first crashed into him and run over him, crushing him under his heavy weight. We, two (Kawai and Mizuhara) were thrust down 2—3 meters behind the tracker. The other tracker stood still and sung his panga against the animal. The Gorilla dashed at and beat him on the arm, and there ceased to attack and retraced his path. Fortunately, all of us escaped severe injury.

This leader male must have been frightened at suddenly meeting us, and his fear and anger drove him to make a true attack on us at the risk of his life. Furthermore, it may well be that the personal character of the leader of A-troop was another of this attack. This particular gorilla is known as the most hot-tempered leader in the Bufunvira range, as we experienced for ourselves when we carelessly routed him out of his nap. We can suppose that his violent aggressiveness is correlated with his youth (he was thought to be the youngest among the four leaders in this region), and the size of the troop to which he belongs (his troop is the smallest in Bufunvira range). We received an impression of a steady and quiet manner from the D-troop, and we did not expect any violent true charges from them.

b) Other animals

J. H. Donisthorpe reported with respect to the mammals and snakes living in the Bufunvira range (see Table 7). We also mention about those which were found by our survey are also listed in Table 7. Among these animals, the first four species in the list (No. 1—No. 4) and one species of snake can be described as the antagonistic neighbours of the gorillas.

The habitat of the elephant and buffalo is shown in Fig. 9. Sometimes the gorillas move into the range of these animals. But generally speaking, these three species of large vegetarians have segregated habitats of their own. The elephants chiefly live in the bamboo forest which grows on easy slopes, and the buffaloes roam around near swampy ground.

According to the Nyaruanda people, elephants move out of the way of gorillas at the sight of them; we did not have an opportunity to confirm this. On the other hand, we did not hear of any trouble happening among

*) ···H. C. Coolidge and H. C. Bingham were the objects of a true (or mock) charge by an adult male gorilla, which they shot.

Table 7 Chief Animals at Bufunvira range.

No.	Donisthorpe	Kawai & Mizuhara	Native name	Range of Habitat
1	Elephant	〃	Enjojo	Bamboo forest, Lower tree forest meadow
2	Buffalo	〃		Bamboo forest, Swampy place
3	Leopard	〃	Chui	All range
4	Golden Monkey	〃	Manhei	Bamboo forest
5	Pig	Bush pig	Grube	Bamboo forest, Lower tree forest
6	Hyena			
7	Red forest duiker	〃	Humberi	Under 3400m (Under giant forest)
8	Yellow forest duiker	〃	Mhongo	Under 3200m
9	Tree hyrax	〃		Under 3400m ?
10	Rat	〃	Inbeba	Under 3400m ?
11	Adder (snake)			
12		Forest hog	Isenge	Lower tree forest, Bamboo forest, Swamp
13		Porcupine	Ikinyogote	Lower tree forest
14		Snake (Viper ?)	Impoma	Lower forest especially north west of Mgahinga

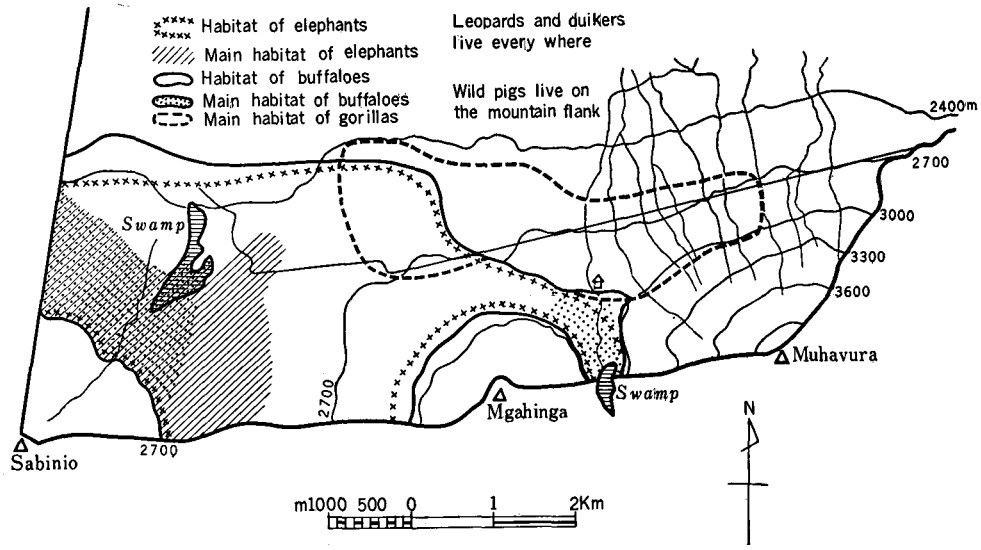


Fig. 9 Habitat of chief mammals in Gorilla Sanctuary.

these three species of giants of the bamboo forest. Leopards are often described as the predators of baby gorillas, but we think this may be rather rare, or occur by accident if at all. Leopards live in caves, above the middle part of the mountain, and move around almost all over the slope for their hunting. Throughout the survey, we found many dead duikers and a porcupine killed by leopards, but we never saw the leopards themselves, since they do not move about during the daytime. There were, however, two grave mounds of Nyaruanda who were killed by a leopards near the saddle camp.

The golden monkey (*Cercopithecus mitis Kandti*) lives in the bamboo forest and in the lower forest. These animals constitute the only species which is inimical (except humans) to the gorillas, since they compete with the gorillas for the poorly produced bamboo shoots in this region.

Of snakes, we saw one species twice, once in the lower forest, northwest of Mgahinga, and the other time near the forest reserve boundary line of Muhavura. The native people dislike to approach "tebeko" for fear of treading on this snake, which is 60 cm long, and deadly poisonous. However, we have never heard of a gorilla killed by this snake.

In Gorilla Sanctuary, insects were not seen abundantly, and beetles are especially scarce. We found only about 10 beetles belonging to 4 species. Even if the gorillas like beetles, therefore, these insects do not occur in sufficient numbers to add significantly to their diet.

SURVEY AT MT. SABINIO

Sabinio (3647 m) rises over three countries, Uganda, Congo, and Ruanda, with five steep peaks. To reach this area, we took the path running across the foot of Mgahinga from Schandle's camp.

In the northern part of Mgahinga, 8.5 km from Schandle's camp, there is a swamp which spreads over the central part of a meadow. Four huts stand there; one is built of duralumin and belong to the members of the Alpine club of Uganda, while the other three are of bamboo. Since the swamp dried up in the dry season, we had to carry water for cooking. We stayed there for 7 days, from the 2nd to the 9th of July.

The Mgahinga range foothills of the extend to Sabinio with an easy slope, and a thick growth of bamboo forest spreads from the 3200m line on Mgahinga to the slope of Sabinio. Sabinio, except for the meadow at its base, is covered with thick bamboo forest which spreads into the Ruanda range as far as the eye can reach. Since the bamboo on Sabinio grows lower than that the Muhavura range, and is entwined with vines and the creeper, we had to push our way, cutting the bamboo stem by stem with our panga. Otherwise we walked along the paths of the elephants or buffaloes which run in all directions.

Since the vegetation type of Sabinio is considered to have reached the climax of bamboo at the present time, the productivity of bamboo shoots has been sharply checked. We could find, for example, only 5 bamboo shoots after 3 hours' walk in the thickly growing bamboo forest. Moreover, no other plants which would serve as food for the gorillas are able to grow there in the climax state of the bamboo. The gorillas, therefore, have to compete for food with the golden monkeys, buffaloes and even with the elephants, so long as they stay here.

However, a limited amount of bamboo shoots, celery, *Veronia sp.* and other foods of gorillas grows in the bamboo forest adjacent to the area under

cultivation, and in the lower forest which spreads to the north-west of Mgahinga. It was there that we found the D-troop (18 individuals). But this region still forms part of the range of elephants and buffaloes, and is therefore not an especially good place for gorillas in relation to their social contact of these animals. We did not find and evidence that the bamboo forest on the slope of Sabinio constitutes a gorilla habitat. Ruben, however, found the spoors of gorillas on the lower slope in June '59, and G. Schaller saw one group of nests built a year ago, near the borderline of Ruanda.

We presume that Sabinio cannot be a good habitat for gorillas, except as it lies on the path of their migration to some other places. Sabinio thus appears to be rather the habitat of elephants and buffaloes, which line here in great members, than of gorillas. So the extent of the gorilla habitat in the Birunga volcano area, we suppose, is interrupted by the over-grown bamboo forest which extends east and west between Sabinio and Visoke.

Provisionization of gorillas. In 1956, M. W. Baumgartel tried to provisionize the gorillas, providing them with corn, potatoes, and other vegetables at Muhavura. But the gorillas heartlessly ignored his efforts, while the buffaloes and wild pigs gave them a hearty reception. He made a second attempt with rock salt, three tons of which were placed in the swampy place (12 minutes' walk southwest from the saddle hut) near the col between Muhavura and Mgahinga. Nevertheless, these stiff-necked monsters were again deaf to his call, and passed near the salty-swamp only once. As a result, hundreds of buffaloes and elephants were provisionized quite successfully, instead of the gorillas.

Nowadays, the cultivated area is extending high up into the lower forest of Muhavura, and the gorillas come down to the border-line between the cultivated fields and the lower forest, but they have never yet invaded the plantations of potatoes and beans. It appears that gorillas in their natural state are too conservative, and have too unbalanced a diet to learn new foods.

It may be given as a conclusion that plans for provisionization in this region have very little or no chance to succeed in the future.

SURVEY AT KAYONZA FOREST

Kayonza Forest, also known as "Impenetrable Forest", is located in the northern part of Uganda, 25km from Kisoro. This vast virgin forest, covering a space 25km by 13km, is the last (with Bufunvira) habitat in Uganda and the ~~northern~~ eastern boundary in Africa for the mountain gorilla.

We spent 7 days surveying this area with a Twa hunter as tracker. Since Kayonza Forest has been appointed by the government as a forest reserve, the African people are not permitted to enter this area, but our Twa hunter knew every inch of this forest.

We made camp on the summit of Ntendule (2160m) as the base for our survey, and walked about the forest in its neighborhood. In the forest,

ranges of steep valleys and rising hills run in every direction, and this region forms a typical example of a dense montane forest.

Tall grasses and tree ferns grow densely among the labyrinth of ravines between the steep hills, and gloomy moss forest are seen along the brooks.

Although the gorillas chiefly move along the ravines, and it was rather easy to follow their spoor where they had crushed the tall grass, sometimes we had to track them across the ravines from ridge to ridge, however, the survey of Kayonza demands a task which considerable stamina on the part of the investigator. In this forest, the gorillas prefer the petiole of the tree fern as their staple food, eating the pith after removing the husk.

Four troops were found living near Ntendule; the social composition of these troop is as follows. (Table 8)

Table 8 Social composition and other records of gorilla families in Kayonza Forest.

Name of family \ Number, Age, Sex	Total number of animals	Number of nests	a ♂	y ♂	a ♀	i	i-b	b	?
P	17	13	1	1	4	2	1	3	5
Q	13	10	1	1	4	1		3	3
R	5 nests about a month old								
S	fresh tracks seen								

Only two of these troops of P and Q provided us with an opportunity to observe them directly; we were barely able to accumulate fragmentary evidences of the presence of troops R and S. The nomadic ranges of P and Q-troops are overlapping to the extent that we once found fresh spoor of the Q-troop running close to nests which the P-troop had built the night before. We found also nests and spoor of the R-troop, and a fresh spoor of the S-troop, with in the nomadic range of P and Q-troop. These facts provide further evidence for denying the existence of territoriality among plural troops of the gorilla.

Direct examination of the P and Q-troops indicates that these troops are similar to those seen in the Bufunvira range. As mentioned above, we can find many fundamental factors in connection with the gorillas' mode of life which are common to Kayonza and Kisoro.

But at the same time, we also found some interesting points of difference at Kayonza. We found 6 babies in the 4 Bufunvira troops, and determined that they were all about the same size, from the size of the dropping or by direct observation. The similar size of the babies suggests that their birthdays were rather close to each other. But in Kayonza, the droppings of the babies were found to be of various sizes. On one occasion we were puzzled to decide from its droppings whether the animal in question was a baby or an infant. The size of its droppings suggested that it must be an

infant, but the fact that its nest was connected with its mother's nest (as in the case of babies in Bufunvira) suggested that it was a baby. After all, we may conclude that the breeding season is not the same for all the gorillas in Kayonza.

In Bufunvira, every morning without exception the gorillas leave their sleeping place after dropping excreta in their nests, but in Kayonza, droppings were seen outside the edges of the nests in many cases. The droppings of the babies were always in the nest; those of the infants were sometimes in, and sometimes outside of the nests. As a rule the quantity of droppings excreted at a time in Kayonza was twice as great as the amount excreted by the Bufunvira gorillas. One night was spent by the Q troop without nest-building. The evidences of their bivouac were found at the feet of tree ferns, where they could gather branches and grass to build their nests. The Q-troop usually build perfect nests on the ground, or above the trees.

During this examination, we found a rule of uniformity in the manner of nest-building in Kayonza; that is, all the members of the troop build their nests on the same level, even with the ground. In Bufunvira, every individual of the troop chooses a place for its nest freely, on the trees, on the bamboo, or on the ground.

Example 7. On the 14th of July, we found 13 nests of the P-troop on a slope running down to the bottom of a valley. Tree ferns and forest-trees grew here, but all the nests were built on the bare ground, and most of them were at the foot of a large tree.

In connection with vocalization we learned little, aside from a kind of curious voiced sound, "out, out" which was not heard in the Bufunvira range, but its meaning was not clear.

Because of the extreme difference in the vegetation between Kayonza and Bufunvira, it was practically impossible to make a comparative study of the gorillas' feeding habits the two different habitats. However, some of the topics which have been outlined above suggest a considerable difference in the life patterns between the two habitats, and provide interesting problems in a socio-ecological sense.

Kayonza forest, in spite of its bad topographical conditions, is rather more convenient for observation than the Gorilla Sanctuary. The gorillas usually move along the ravines, and they often expose themselves before our binoculars long enough to observe them when they are in the grass bush. The absence of elephants or buffaloes makes survey safer, but the danger of meeting poisonous snakes still has to be reckoned with. We found our Twa guide to have a keen sense in tracking gorillas and to be quite obedient to us.

There are no huts in this forest, and conditions for camping are worse than they are in Muhavura, but still Kayonza can be a good field so long as one prepares enough equipment for camping.

SURVEY AT KABONA IN EASTERN CONGO

After a one day survey at Mt. Kahuji, we went to Kabona in the Kivu district for our preliminary survey of gorillas in Congo. Kabona is 35 km from Walung along the Ihemba road, and 90 km from Bukavu. We had previously heard of Mr. Alex Notté, a Belgian who once tried the provisionization of gorillas there. We carried out a 3-day survey in Kabona Forest with him and his two Bashi trackers. The montane forest of Kabona lies at an altitude of 2100m, covering hills of moderate slope and continuing up to the bamboo forest at about 2300 m. A purely bamboo forest extend upward from about over 2500 m.

In the bamboo shoot season (September and October), gorillas migrate to the upper bamboo forest; there were no bamboo shoots to be seen when we visited Kabona Forest at the end of July.

Sometimes gorillas come to within 50 m in front of Notté's cottage. We found 6 gorilla nests after a walk of only 30 minutes from his cottage, and on our first expedition, we found a solitary male's nest near the 6 nests.

Although we were not able to sight the gorillas themselves in this forest, we did a nest-study, and found 6 different troops consisting of 1, 2, 3, 5, 6, and 7 animals, respectively, in the forest of about 12 square kilometers. As in Bufunvira and Kayonza, no indications of territoriality among the troops could be recognized. The evidence of a solitary male and troops of small size (2-3 individuals) suggested the formation of new troops.

Tree ferns are common along ravines like those of Kayonza Forest, but we were surprised to find that, unlike the Kayonza gorillas, the gorillas in Kabona never use it for food. This case presents a major problem concerning the choice of the main food in different habitats.

The success which Mr. Alex Notté has achieved in his attempt to provisionize the gorillas in this area renewed our confidence in the prospects for this method. After acquiring this tract of forest several years ago to use for plantation and forestry, Mr. Notté tried the provisionization of gorillas for the entertainment of sight-seeing visitors.

As the result of tests in which he prepared honey, sweet potatoes, carrots, corn and stems of the banana plant, he found the banana stem to be the most economical and most acceptable to the gorillas. He succeeded in feeding them on ten successive days at a fixed station, and at all the stations which he had determined, the prepared banana-stems were completely eaten up. In spite of this remarkable success, he felt that the nomadic life of the gorillas would constitute a difficult obstacle, and gave up provisionization mainly for economic reasons. Nevertheless, his discovery that it is possible to feed these animals remains an important forward step in the process of gorillas provisionization.

SOME UNSOLVED PROBLEMS

1. *Troop and intertroop relationships*

The results of surveys in the Bufunvira range and Kayonza Forest indicate that the gorilla troop is a polygamous family. If any troop among the six which were found in Bufunvira and Kayonza, we were able to find one silver-backed adult male as the leader of the troop, and one black-backed (young) male, 2-5 females, some children and babies (only the D-troop has two silver-backed males, but one of them sometimes leaves the troop). Some questions, however, remain to be answered. J. Donisthorpe observed two silver-backed males (one of them the leader) among a group which consisted of 5 individuals. Although this seems to contradict the theory of the polygamous gorillas family, it can be explained by considering "young silverbacks" and "combination-development of two or more troops."

Frechcoph reported that the back hair of a mountain gorilla in the Berlin Zoo turned to silver gray when he was eleven years old. According to Urbain (1939), puberty of gorillas is 12 or 13 years old.

For this reason, we believe it not inconsistent to refer to a gorilla troop as a family, even though its population may consist of more than 20 members and include two or more silver-backed males. Moreover, if it is true that two or three troops may combine to form one large troop, the presence of several silver-backed males in this combined troop is to be expected as a matter of course.*

From this point of view, the exceptionally large troops, of 38 gorillas seen by H. C. Bingham, and of 27, seen by G. B. Schaller, are probably best thought of as large families, or as combinations of two or more families.

With respect to the way in which the family develops and is maintained as its population increases, and the manner in which combinations and divisions take place between families, the following considerations are advanced.

Within the family, the members most likely to give rise to problems are the young adult males which have just reached maturity. In the D-troop of Muhavura, we observed a young silver-backed male repeatedly leaving the troop and rejoining it; we also found a solitary silver-backed male at Kabona. Considering that other reports also mention a number of examples of solitaries, it may be concluded that it is a matter of general occurrence for an adolescent male to become solitary.

We believe that the cause of his leaving the troop should be sought in the relations between the son and his father and mother. It is obvious that troubles of a sexual kind are likely to arise between a male which has reached maturity and his father, the leader of the troop; probably one of the factors causing the adolescent male to become solitary, therefore, is pressure from the leader.

*) ···G. B. Schaller told me that he found two or more silver-backed males in each of the three troops which he observed. He also supports the idea that several troops may combine.

The relation with the mother, on the other hand, is governed by an incest prohibition. In wild troops of the Japanese monkey, sexual intercourse is not seen between mothers and sons. In other words, there is a mother-son incest prohibition.* It is thus easily possible to imagine that a similar state of affairs exists in the gorilla family.

In considering the factors which cause adolescent males to leave the family and become solitary, it is therefore believed necessary to look for sexual antagonism not only between son and father, but also between son and mother.

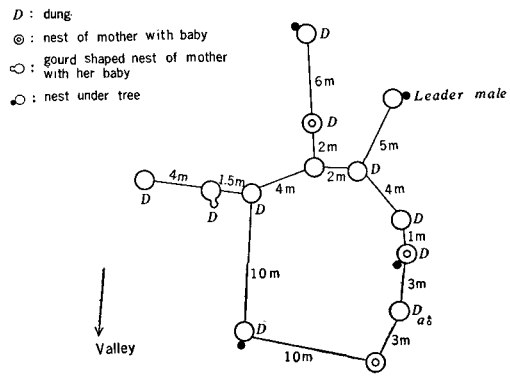


Fig. 10 Arrangement of nests of P-family on a grassy slope in Kayonza Forest. All the gorillas have left their dung outside of their nests.

Contrary the case of the Japanese monkey, a solitary male gorilla has a chance to go back to his troop, and probably has a chance to make a new troop unit taking out a young female from the original troop. Furthermore, the division of the troop may occur if the estranged young male leaves his troop with two or more young females.

As mentioned above, in both A and B-troops, we saw a strong continuous relation between the leader and a specified female. These pairs of male and female must be father and mother, forming the nucleus of the troop. The young males were always in the peripheral part of the troop, and their nests were sometimes found apart from the other nests of their respective troops. In D-troop, sometimes several (1, 2, 3 or 4) individuals showed a tendency to separate from the mother troop. We think of them as a young male, young female and juveniles, although we were not able to confirm this.

Gorilla troops have been said to combine in some cases. We also think this may occur, although we know little about the mechanism of troop combination. We suppose it happens between two troops in blood relationship with each other, between two branches or a branch and the original troop, and that gorilla troops which do not have a common kinship relation are antagonistic to each other and may not combine i. e., they are segregated by their lack of kinship relation in stead of by territoriality.

*) ···During ten years of sociological studies on wild troops of Japanese monkeys, we have never observed a case of copulation between mother and son. Since the sociological studies of S. Kawamura on the Nara deer suggest that there is a mother-son incest prohibition also in the deer society, it may be appropriate to think of this as generally characteristic of the societies of higher mammals. Furthermore, we believe that among gorillas, the incest prohibition is confined to the mother-son relation, and does not affect the father-daughter and brother-sister relations.

According to J. Donisthorpe, a troop can be divided into several components in free combination. This idea, however, seems to be based on the nest distribution, and it is a question whether or not it can be generalized. We hope that direct observation of many cases will lead to fruitful results in connection with the problem of combination-division of troops such a study in now being made by G. B. Schaller at the Mt. Mikeno-Karisimbi range in Congo.

2. *Differences among gorillas' habits*

In view of the results of our ten years' study on problems connected with "culture" or "monkey culture" of the Japanese monkey, we have expected the gorillas to offer a rich example of highly developed behavioral patterns by which we would be able to study the culture. The following are some phenomena of interest concerned with differences in their habits.

Nesting. We kept track of 98 gorillas in 14 troops, and examined 464 nests in our field trips throughout this survey. We examined the building methods and shapes of their nests in detail to determine whether or not any difference could be found to correlate with location and family. We were not able to find significant differences among them in these respects.

Table 9 Nesting sites in 3 regions.

Region / Nesting Site	Bufunvira	Kayonza	Kabona
On the ground	155	35	19
Off the ground	210	13	32

Table 9 shows the place-preferences of these animals in nest building. Although some apparent differences can be seen in it, among the three different regions, we cannot regard these as true differences if we take into consideration the different conditions of the habitats and seasonal factors. At Kayonza, the gorillas drop their excreta beyond the nest-edge, contrary to a definite opinion which has been based on observation in other fields. But even at Kayonza, babies' droppings are seen in the nests. It must then be inferred that they learn this behavior as part of their growing process. This difference in the mode of excretion is worthy of notice in connection with the study of gorilla culture.

The nest building behavior seems to be fixed as a feature of the nomadic life of these animals. But the bivouac without nest building was possible at Kayonza. Although this occurred only once, it is remarkable that the lack of a certain behavior was ever seen in their daily activity. In the problem of place-preference for their nest building, we can expect an interesting correlation to the mechanism of social organization.* That is, the uniformity

*) ···We have previously found a difference in the social organization between two troops of the Japanese monkey. One troop, at Takasakiyama, is better organized than an other troop in Syodosima. The former has a rather narrow tolerance in its social order, and shows an evident unity of social behavior in contrast with the latter.

of a certain type of behavior in one group sometimes indicates a well-organized social structure of the troop. It may therefore be supposed that the Kayonza gorillas have a stricter unity of social organization than the Bufunvira gorilla troops. These problems must eventually be resolved by a sufficiently large number of case observations.

Food habits. In the matter of food, there are also some questions concerning the differences between the habits of gorillas living in different localities. With respect to the choice of food, the different trends of preference for tree fern between the Kabona gorillas and the Kayonza animals provide a good example of habit segregation of gorillas. Furthermore, field crops are raided by the gorillas at Kabona, and only the Kabona gorillas take without hesitation foods which were given by humans. We find here also the same problem of habit. This matter of taking and learning to like new food may be thought of as a difference in the positiveness of their behavioral patterns. But this positive behavior in taking to the newly offered foods, on the other hand, may be caused by richness in the varieties of the food in Kabona Forest.

In the same way, the poor and unbalanced food at Muhavura may provide the reason why the character of the gorillas there is conservative and timid. While there remain many unsolved problems in connection with the social behavior or social organization of the gorillas, which differs with every habitat and in every family, nevertheless, we have secured some suggestive data on which to base consideration of these problems. At the present, we stand at the starting point in our study of troop differences and habit differences among mountain gorillas, facing a hopeful prospect for successive survey in the future.

Acknowledgements. We want particularly to convey our hearty thanks for general planning and guidance to Prof. K. Imanishi, Dr. J. Itani and Prof. D. Miyadi, of Kyoto University and the Japan Monkey Centre. For funds and general support, we gratefully thank K. Sibusawa, President of The Japanese Society of Ethnology and JMC, and M. Tutikawa, Vice President of the Nagoya Rail Road Co. Ltd. and managing director of JMC.

Our thanks for technical help and advice are due to M. W. Baumgartel, keeper of the travellers rest at Kisoro, Uganda; B. Kinloch, Game Dept., Kampala; A. Notté, Kivu district, Congo; Dr. E. Lind, Maokerere College, Kampala; we are grateful for much information from Prof. J. T. Emlen and G. B. Schaller, Wisconsin Univ., U. S. A.; Dr. U. Rahm, I. R. S. A. C., Luwiro, Congo; J. Mills, Uganda Game Dept., Mbarara, Uganda. I also extend my hearty thanks to Prof. J. Dan who helped to make this report.

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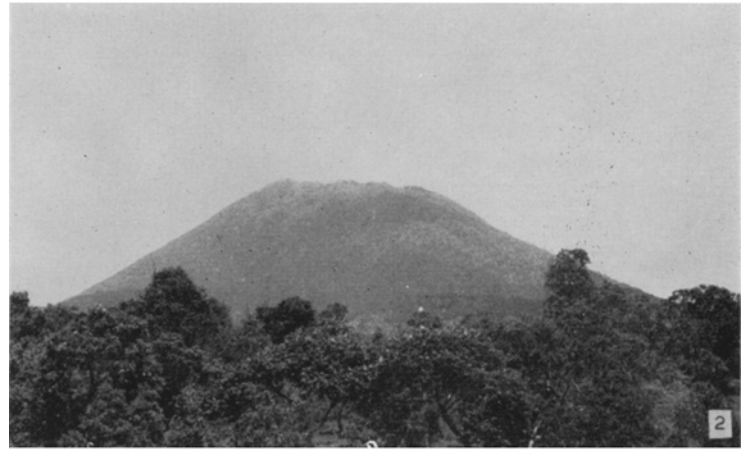
1. Mt. Muhavura and Mt. Mgahinga.

2. Mt. Mgahinga and shamba forest.



3. Tree fern forest. Gorillas live on leaf stems of this plant in Kayonza Forest.

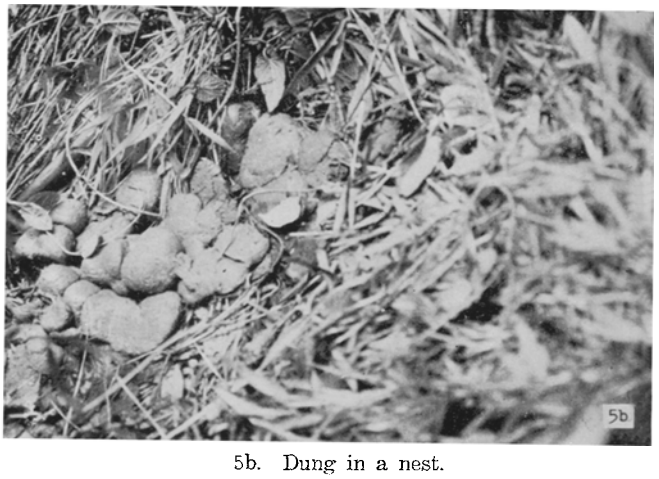
4a. A staple food, *Veronia* sp.

4b. A staple food, wild celery.

c. A staple food, *Cynoglossum amplifolium*, and hole dug to secure it.

4d. Fungus eaten and scattered by gorilla.

5a. Bamboo nest.



5b. Dung in a nest.

5c Tree nest.

5d. Gorillas spent night without making nests in Kayonza Forest.

6. Gorilla's track.

7 a, b, c. Silver-backed leader of B-troop of gorilla.

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*) with English Summary