

## Japanese Monkeys Living in the Okoppe Basin of the Shimokita Peninsula: The Second Report of the Winter Follow-Up Survey after the Aerial Spraying of Herbicide

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**ABSTRACT.** In regard to a late winter ecological survey of the Japanese monkeys living in the Okoppe Basin and to investigate the aftereffects of the herbicide which was sprayed aerially by the Aomori Regional Forestry Office, the following results were obtained: Troop Z, one of the three troops found in December, moved restrictively around the upper basin of the Okoppe River during this survey period, which area had been strongly influenced by the spraying. The movements of troop Z could be traced throughout this period and the distance of movement per day, the sleeping places, the population, and the social composition were confirmed. The nomadic range was 2.5 square km, equal to only 15.6% of that of December. The monkeys of troop Z fed mainly the bark and buds of trees. The poisonous residue remaining in the bark and buds is ingested by pregnant female monkeys through feeding and may exert some influence upon the fetus.

### INTRODUCTION

As one of the first research members of the winter follow-up survey after the aerial spraying of herbicide, I was engaged in an ecological survey of monkeys from December 10 to 30, 1970, which result has been previously reported (IZAWA, 1971). The survey was carried out from January to March, alternately by members of the Primate Research Institute of Kyoto University and by members of the 'Ashi-no-kai', a naturalist's group of Aomori. And from March 18 to April 5 it was further pursued by K. IMAI, A. TANAHASHI of the Japan Monkey Centre, and myself.

The results of the January–March survey and the final report based on due consideration and examination of these results will be published eventually. I report here on the results of the survey in which I was engaged.

The actual number of days spent in the survey is 15—i.e., from March 20 to April 3. The number of encounters with monkeys equals 21, direct observation time totaling 351 minutes. Such abundant observation time was the result of an intensive survey, focussing our attention only on troop Z (the troop around the Zaimoku River), which moved restrictively around the upper basin of the Okoppe River where the herbicide was sprayed aerially. For 5 days, at the beginning and the end of our survey, we also conducted an extensive survey.

### RESULT

#### 1. RECOGNITION OF TROOPS

We arrived at our study site on the night of March 19 and were told by the former

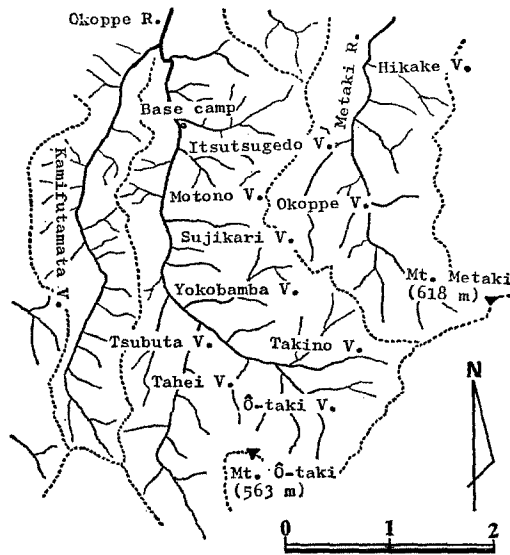


Fig. 1. Map of the upper basin of the Okoppe River.

survey members, who stayed on, that on the same day a troop (about 40 monkeys), after coming down the Sujikari Valley of the upper basin of the Okoppe River, went upstream along the Okoppe River towards the Tsubuta Valley, where they stayed until 3 p.m. (Fig. 1).

During our survey in December we had found that there were two troops moving around the Okoppe Basin, troops Z and M (IZAWA, 1971). Beginning on the following day, March 20, after separating into parties, we pursued the troop in the Tsubuta Valley and ranged extensively in order to locate the other troop at the same time in the study area.

On March 22, going out in three parties, one found that the troop pursued since the 19th went down the Tahei Valley and entered the Yokobamba Valley, crossing the Okoppe River. The population was over 40, a figure determined by counting footprints left in the snow. Another party confirmed, by footprints, that a troop of about 30 monkeys came down along the Hikake Dale of the Metaki Valley and climbed up the left slope of the Metaki Valley, moving towards the Shimofutamata Valley of the Okoppe River. Judging from the footprints, this troop seemed to have crossed the Metaki Valley on the morning of the 22nd (Fig. 2).

Neither troop M nor troop Z had moved in the upper basin of the Okoppe River last December. Troop M had frequented the area extending from the Metaki Valley to the Shimofutamata Valley. The population of troop M was 36. Troop Z had frequented the area extending from the Kamifutamata Valley to the Zaimoku Basin. Its population had been estimated by Y. SENDAI on January 6 as being up to 40.

The nomadic routes of troops M and Z last December, the populations of these troops, and the fact that we did not find any footprints or fresh remnants of nibbled food in our studies since March 20 in the Zaimoku Basin and the Ogawadai Basin, which troop Z had frequented last December, led us to conclude that the troop that

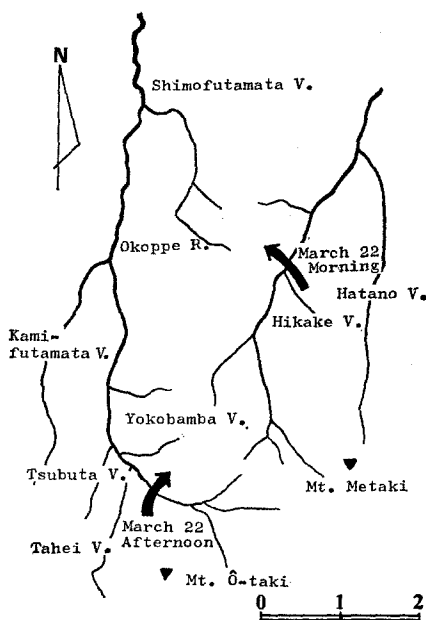


Fig. 2. Confirmation of the two troops.

was moving around the upper basin of the Okoppe River since the 19th was none other than troop Z. After that, we devoted ourselves to an intensive survey of troop Z because it moved around the sprayed area.

We did not have time enough to study troop I, which had its nomadic range east of those of troops M and Z.

## 2. FOODS AND NOMADISM OF TROOP Z

During period of 15 days from March 19 to April 2, we traced the movements of troop Z as well as its sleeping places for each night (Fig. 3).

The distance of movement per day (measured on the map) was 400 meters at the minimum and 1,400 at the maximum, the average being 817 meters. The nomadic range during this period was 2.5 square km, 1.0 square km of which the monkeys visited more than two times (Fig. 4). The nomadic range last December was 16.0 square km, the former figure being only 15.6% of the latter.

The upper basin of the Okoppe River is a complex land formation, each of the valleys being cut deeply, and here and there on the slopes and ridges are rocky places. Patches of full-grown *Thujopsis dolabrata* trees dot the slopes where the monkeys slept each night. Since we had many occasions of observing them and since we could follow their movements by tracing footprints left in the snow, we could check their foods, which were mainly the bark and buds of trees (Table 1). The hard winter-buds were just beginning to soften after the severe coldness of December to February.

The most-liked foods were the following: the bark of the twigs of *Schizophragma hydrangeoides*, the buds of *Fagus crenata* and *Quercus crispula*, the blades of *Carex conica* and *Tofieldia japonica*, and various kinds of lichen.

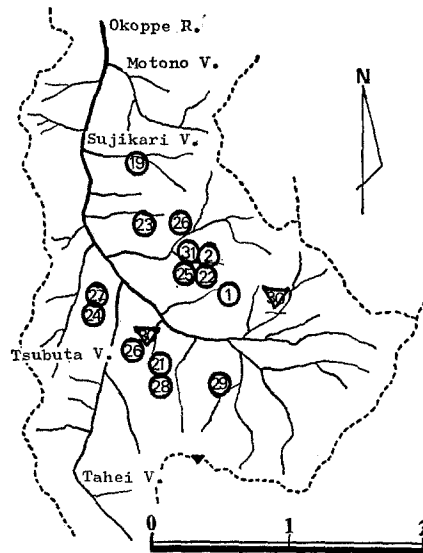


Fig. 3. Areas in which troop Z stayed. Figures inside the circles and triangles indicate troop Z's data of stay (Dates).

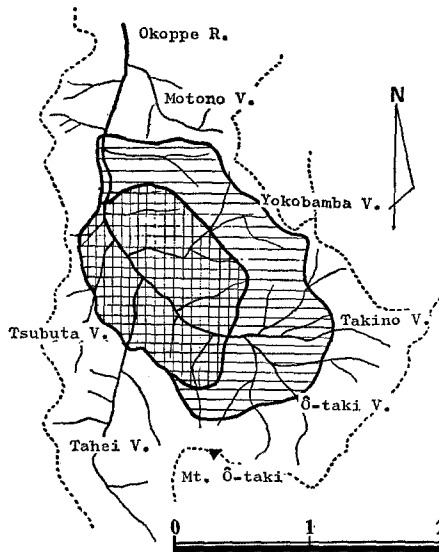


Fig. 4. Nomadic area of troop Z during the survey. Horizontal lines indicate the nomadic area; vertical lines indicate the area which troop Z visited 2 or more times.

1) *S. hydrangeoides* trees are found beside the dales in the upper basin of the Okoppe River. The monkeys came to feed on the bark of three tall trees three times and of two (other) tall trees twice. *Hydrangea petiolaris*, which is akin to *S. hydrangeoides*, is found abundantly in this area, but they did not show as much liking for this as they did for *S. hydrangeoides*.

**Table 1.** A list of the main foods of the monkeys during the survey.

Scientific name	Japanese vernacular name	Life form	Part eaten	Frequency of being eaten	Diam. of branch whose bark is eaten (cm)
<i>Ilex macropoda</i>	Aohada	Tree	Bark	+	0.5-1.5
<i>Acer pictum</i>	Itayakaede	Tree	Bark, Bud	++, ++	<1.5
<i>Schizophragma hydrangeoides</i>	Iwagarami	Wood vine	Bark, Bud	++++, +++	<0.7
<i>Ulmus laciniata</i>	Ohyo	Tree	Bark, Bud	+, +	0.3-1.0
<i>Pourthiaea villosa</i>	Kamatsuka	Shrub	Bark, Bud	+, +	0.3-1.5
<i>Kalopanax innovans</i>	Takanotsume	Tree	Bark, Bud	++, ++	0.5-1.0
<i>Hydrangea petiolaris</i>	Tsuruujisai	Wood vine	Bark	+	0.2-0.7
<i>Celastrus orbiculatus</i>	Tsuruumemodoki	Tree	Bark, Bud	++, +	<0.7
<i>Aesculus turbinata</i>	Tochinoki	Tree	Bark, Bud	+, +	0.5-1.5
<i>Fraxinus Sieboldiana</i>	Toneriko	Shrub	Bark	++	0.5-1.0
<i>Acer japonicum</i>	Hauchiwakaede	Tree	Bark, Bud	++, +	<1.2
<i>Ulmus Davidiana</i>	Harumire	Tree	Bark, Bud	++, ++	1.0-2.0
<i>Thujopsis dolabrata</i>	Hiba	Tree	Bark, Leaf	++, ++	
<i>Fagus crenata</i>	Bunanoki	Tree	Bark, Bud	++++, +++	0<
<i>Magnolia obovata</i>	Hounoki	Tree	Bark, Bud	++, ++	0.5-1.0
<i>Euonymus Sieboldiana</i>	Mayumi	Tree	Bark, Bud	++++, +	0.2-2.0
<i>Quercus crispula</i>	Mizunara	Tree	Bark, Bud	++, ++	0<
<i>Morus bombycis</i>	Yamaguwa	Tree	Bark, Bud	++++, +++	0-4.0
<i>Populus Sieboldi</i>	Yamanarashi	Tree	Bark, Bud	+, +	0.3-1.2
<i>Vitis Thunbergii</i>	Yamabudo	Wood vine	Bark, Bud	++, +	<0.3
<i>Acer palmatum</i>	Yamamomiji	Tree	Bark, Bud	+, +	<0.3
<i>Sasa Kurilensis</i>	Chishimazasa	Herb	Leaf	++	
<i>Carex conica</i>	Himekansuge	Hern	Leaf	++	
<i>Tofieldia japonica</i>	Iwashobu	Herb	Leaf	++	
A kind of lichen		Lichen		++	
Insect				++	

2) *Euonymus Sieboldiana* trees are found abundantly on steep slopes and also around this area. The monkeys mainly ate the bark of this species.

3) *Morus bombycis* trees are scattered along the Okoppe River. The monkeys fed on the bark and buds of one of these trees four times, on the 21st, 22nd, 26th, and 31st of March, respectively.

4) *F. crenata* is the most dominant tree in the mountainous area of the Shimokita Peninsula. This species is also found everywhere in this area; it is mixed with *Q. crispula* and *Acer japonicum* trees and the monkeys fed mainly on the buds of these tall trees.

5) On steep slopes and ridges there are many ledges where the snow had already thawed, and in the fissures and on the surface of bare rocks such grass as *C. conica* and *T. japonica* and several kinds of lichen grew. The monkeys frequented these ledges as favorable feeding and resting places.

That they could find suitable sleeping and resting places may also be the chief reason why the troop Z monkeys moved restrictively around the upper basin of the Okoppe River during the survey period.

1) The dense forests of tall evergreen *T. dolabrata* trees may be the most favorable places for the monkeys to ward off the severe coldness, and especially the heavy snowstorms, of the Shimokita Peninsula. They spent all their nights during the survey period in *T. dolabrata* forests, as mentioned already.

2) *T. dolabrata* trees grow mixed in *F. crenata* forests in the mountainous areas of the Shimokita Peninsula (IZAWA, 1971), and we find pure stands of *T. dolabrata* on almost

all the steep slopes in this area, where broad-leaved trees have been cut down by the Forestry Office to promote its growth.

3) As the land formation of this area is very complex, it may be very easy for the monkeys to find shelter in *T. dolabrata* forests on the lee side of steep slopes, thus obtaining protection from strong winds and snow.

4) On fine, windless days, the monkeys enjoy sunning themselves on ledges from which snow has melted.

5) There are any number of these edges which are suitable for resting and feeding, in this area.

In short, the upper basin of the Okoppe River has an abundance of such trees as *S. hydrangeoides*, *E. Sieboldiana*, *M. bombycis*, and *F. crenata*, etc., all of which are sources of the monkeys' favorite winter food, patches of *T. dolabrata* forests, in which the monkeys are free from any daily changes in the winter weather, and also contains suitable ledges for resting and feeding. These facts explain why the movements of troop Z centered around this area all through the survey period. In addition, stray dogs disturb the normal nomadism of monkey troops, but these never affected the movements of troop Z during the period.

### 3. SOCIAL COMPOSITION AND SPACING DURING MOVEMENT

We had two chances to observe a large group of the troop crossing a valley at one time, on 24 and 28 March. These two occasions, together with some other direct observations and the number of footprints left in the snow (Table 2), led us to estimate that the population of troop Z is 42 (Tables 3 & 4). As will be mentioned later, however, since we also now and then noticed a small temporary group detached from the main body, the number may be a little over 42. Through these observations we were able to assume that the population of troop Z is somewhere between 45 and 50, and that the added monkeys (3-8 head) may comprise adult or young adult males.

Last December we observed what seemed to be a whole population of troop M, forming itself into a single file, cross the Okoppe River. This time, however, the monkeys of troop Z crossed a valley twice, each time forming themselves into several columns and scattering to an extent of more than 100 meters. We measured the distances between footprints found in the snow-covered, thinly wooded dales; they were widely scattered, the distances between them ranging from 30 to 210 meters, the average being 125 meters (Table 5). Although we have said that they crossed the river

**Table 2.** Number of footprints.

Date	Size						Total	Notes
	Large	Large/ Medium	Medium	Medium/ Small	Small	Indistinct		
3/25	14	0	9	0	3	+X	26+X	Nearly all the troop members crossed a valley at one time.
3/26	14	0	15	0	5	+X	34+X	"
3/27	3	14	10	0	6	+X	33+X	"
3/28	8	0	3	0	4	12+X	27+X	"
3/31	4	0	8	1	3	+X	35-38	The troop separated into two parts and moved separately.
	5	0	8	1	2	3-6	+X	

**Table 3.** Social composition of troop Z.

Date	Adult								Total	Notes
	Male		Female		Sex un-					
	Over 6 yrs	4-5 yrs	Ad.	Old	known	3 yrs	2 yrs	1 yr		
3/20	5	1	1	0	1	1	2	0	11	A group moving separately from troop Z.
3/24	0	1	2	0	1	0	3	2	9	"
3/24	1	2	11	3	0	3	6	7	33	The troop passed through the vally en masse.
4/26	0	1	5	2	0		9	5	22	Feeding time. The troop was in open order.
4/28	5	2	15	1	0	4	6	7	40	The troop passed through the valley en masse.
Maximum	5	2	15	3		4	6	7	42	Social composition of troop Z.

**Table 4.** Comparison of social composition of troops Z and M.

Troop	Adult			3 yrs	2 yrs	1 yr	Total
	Male	Female	Sex unknown (4-5 yrs)				
M	5	13	5	4	4	5	36
Z	7	18	0	4	6	7	42

**Table 5.** Greatest distances between members of troop Z during a period of movement.

Date		Width (m)	Place	Movement direction of troop Z
3/20	Morning	50	Okoppe River	L→R*
3/21	Evening	70	"	R→L
3/22	Afternoon	150	"	L→R
3/24	Morning	30	"	R→L
3/24	Evening	160	Tsubuta Valley	L→R
3/25	Evening	90	Okoppe River	L→R
3/26	Morning	180	"	R→L
3/26	Evening	200	"	L→R→L
3/27	Morning	130	Tahei Valley	R→L
3/28	Afternoon	110	"	L→R
3/31	Afternoon	120	Okoppe River	L→R
3/31	Afternoon	210	Taki-no-sawa Valley	L→R

\*R: the right bank. L: the left bank.

at one time, it is quite natural that there should be a certain time-lag between the time the first and the last crossed, so that we ought to have measured the length of files; we had no opportunity of doing so, however.

While we observed the main body of troop Z crossing the rivers or dales in the manner mentioned above, we also noticed small temporary groups moving through other places from time to time. The longest period of time they moved in a group temporarily separated from troop Z was 45-50 hours; the greatest distance of this group from the main body was 1,200-1,400 meters (Table 6).

There were three cases of monkeys detaching themselves temporarily from troop and forming a small group; said group consisted of only a few males. Almost all the

**Table 6.** Small groups temporarily separated from troop Z.

Date	Patterns of separation of troop Z into small groups	Estimated duration of time of separation (hrs)	Maximum distance between two groups	Notes
3/19 Evening– 3/20 Afternoon	A: The greater part of the members of troop Z. B: 11 head. (A ♂, 5+Y ♂, 1+A ♀, 2+ 3yrs, 1+2yrs, 1+Sex unknown,2)	20–22	620–660 (m)	Stayed overnight separately.
3/24 Afternoon– 3/26 Morning	A: The greater part of the members of troop Z. B: 9 head. (A ♀, 2+Y ♂, 1+2yrs, 3+ 1yr, 2+Sex unknown, 1) C: 3 head. (A ♂, 2+A/Y, 1)	A and B: 2–3 A+B and C: 45–50	200–300 800–1,000	A and B: stayed together. A+B and C: stayed two nights separately.
3/26	A: The greater part of the members of troop Z. B: 13 head. (Y ♂, 1+A ♀, 1+2–3yrs., 7+1 yr., 4)	2–3	250–400	Stayed together.
3/30 Morning– 3/31 Afternoon	A: 16 head. (A, 4+A/Y, 8+Y/J, 1+J, 3) B: 19–22 head. (A, 5+A/Y, 8+Y/J, 1+J, 2+A/J, 3–6)	25–30	1,200–1,400	Stayed overnight separately.

\* A: Adult. Y: Young (4–5yrs). J: Juvenile (2–3yrs) or Infant (1 yr).

members of a group were adult males, and almost all were juveniles. There was another exceptional case. From March 30 to 31 the troop divided into two groups, the population of each being nearly equal. Examining the size of footprints of each group, we found that there were infants and full adult male monkeys in each group. We did not, however, have any chance of making direct observations to determine the group composition of either group.

#### 4. INFLUENCES OF THE AIR-SPRAYED HERBICIDE ON MONKEYS

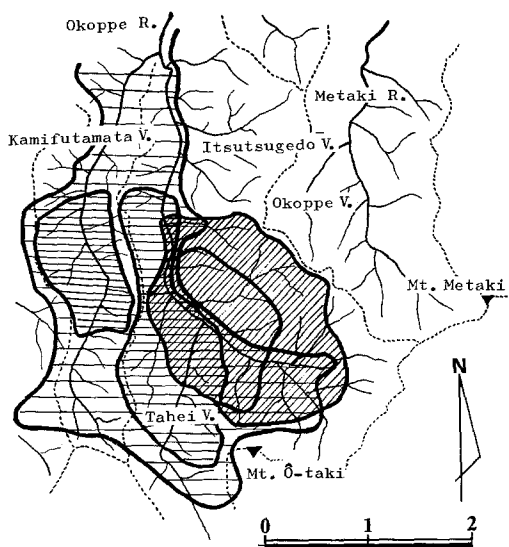
From the ecological survey conducted at this time we could not ascertain what, if any, direct poisonous effect the herbicide spraying of last June had on the monkeys, but the following items should be taken into account:

1) O. MORI's survey, which began in 1964 informs us that the upper basin of the Okoppe River had been most frequently used by monkeys (MORI, 1970). Our survey of last December revealed that this area has been deserted. This is quite natural because the red berries of several kinds of trees, which are the monkeys' main food throughout this season, had been damaged by the areawide herbicide spraying (IZAWA, 1971).

2) To the contrary, however, during the present survey period the monkeys frequented this area. This may be because the monkeys could feed on the bark and buds of trees as usual at this time of year and find favorable sleeping and resting places in this area.

3) The relationship between the herbicide-sprayed area and the nomadic range of the monkeys during this period is as follows: Of the nomadic range a little over than two fifth borders on the herbicide-sprayed afforestation site, having been under some influence of the spraying (MORI, 1970), and, of the area which they visited more than





**Fig. 5.** Nomadic area of troop Z and the area polluted by the aerial spraying of herbicide. Sparse horizontal lines indicate the area influenced by herbicide; dense horizontal lines indicate the area seriously influenced by herbicide; oblique lines indicate the nomadic area of troop Z.

two times, a little less than two fifths had been under a strong influence (MORI, 1970) (Fig. 5).

4) During this period the main food was the bark and buds of *Schizophragma hydrangeoides*, *Euonymus Sieboldiana*, *Morus bombycis*, and *Fagus crenata* trees.

5) The influence of the spraying was most clear on woodvines such as *S. hydrangeoides* and *Vitis Thunbergii*, which had shed their leaves immediately after the spraying and among which some had already sprouted their second growth. (MORI, Pers. Comm.)

6) *M. bombycis* had also shed its leaves, but at the end of August young leaves were seen growing on the tips of the twigs. In autumn many twigs that looked twisted and disfigured in mid-growth—those whose middle parts were awry but whose tip-ends and ramified parts were normal—could be seen. (MORI, Pers. Comm.)

7) Most *F. crenata* trees did not shed leaves nor have any of their twigs disfigured, but in the area where a great quantity of herbicide was sprayed some of the twigs had withered tips, on which no winter buds could be seen. (MORI, Pers. Comm.)

8) We collected and brought back those twigs the bark and buds of which the monkeys had gnawed. Among them there were two, *Fraxinus Sieboldiana* and *E. Sieboldiana*, the normal twigs of which were gnawed but not the disfigured ones.

9) Although a chemical analysis would tell how much 2,4,5,T and 2,4,D remains in the bark and buds of those twigs, we are quite convinced, through chemical gauging of the leaves that fell in autumn (KURIHARA, Pers. Comm.), that some poisonous residue still remain in them.

10) The quantity of poisonous residue that might be found in such grass as *Carex conica* and *Tofieldia japonica*, which grows on ledges, and lichen, which grow on the surface of rocks, on which the monkeys fed should also be taken into account.

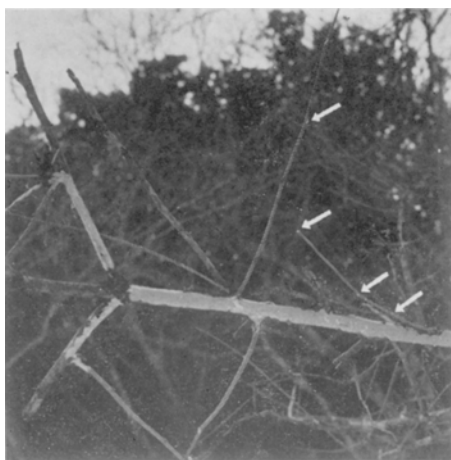


Fig. 6.



Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.

11) The poisonous substance taken into the bodies of pregnant female monkeys may exert some influence upon the fetus.<sup>1)</sup>

#### 6. STRAY DOGS AS PREDATORS

In December we had found a number of footprints of stray dogs in the survey area. In the Zaimoku Basin also we had encountered stray dogs twice, first a group of two dogs and later a lone dog. This time we saw many of their footprints in the Okoppe Basin, especially along the river and on the ridges in the middle and lower basins of the Okoppe River. We observed a lone dog, also, in this area.

Y. SENDAI, observed, once in January and again in February, a group of monkeys being chased by a pack of 4 or 5 dogs. Further, from January to March the research workers often discovered footprints of dogs along with those of monkeys; presumably, the former were tracking the latter. According to those research workers there were, in some cases, traces which showed the normal nomadism of the monkeys being disturbed by dogs.

During this period, however, no footprints of dogs were discovered within the 215 square kilometer area where troop Z moved. We cannot tell whether this was because the land formation of this area was too complex for stray dogs to roam in or because we were always in such close contact with the monkeys that the dogs were afraid to come near us. At any rate, during this period the nomadism of troop Z never seemed to be influenced by any stray dogs.

At three different places we collected stray dog's excrement which, upon analysis, was found to be mainly compound of fur and bone fragments of animals.<sup>2)</sup> By the dale we found a broken legbone of a Japanese serow apparently nibbled at by dogs. These facts convinced us that in this area stray dogs hunt some wild animals. The

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1) This survey has not yet clarified our apprehension for the subsistence of all, but especially the aged, monkeys mentioned in my first report (IZAWA, 1971). Also, as we could not exactly grasp the population and composition of troop Z in the first survey, we cannot clarify the degree of population decrease and of the changes in the composition of troop Z from the data acquired through this survey.

2) It is not yet clear which animals these fur and bone fragments originally came from, but according to Dr. M. IWAMOTO (Primate Research Institute of Kyoto Univ.), whom we asked to examine them, there was, in this excrement, nothing that could be considered as coming from any monkey.

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#### EXPLANATION OF FIGURES

**Fig. 6.** *Morus bombycis*, bark and buds of which are bitten off by the monkeys. Arrows indicate the buds left by the biting.

**Fig. 7.** A broken-off twig of *Schizophragma hydrangeoides*. The bark was bitten off. Arrow indicates moss on the twig which was also eaten by the monkeys.

**Fig. 8.** Adult male monkeys breaking off a twig of *Schizophragma hydrangeoides* for food.

**Fig. 9.** Adult female monkey moving in the snow.

**Fig. 10.** Adult male monkey moving in the snow.

population of stray dogs in the Zaimoku and the Okoppe Basin may be no less than 10.

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