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Practical Application of an Aerial Driving Census Method to the Japanese Serow and Associated Birds and Mammals in Rugged Mountain Forests

By

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Summary : An aerial big game censusing method developed in wide and open habitats has been applied in many countries. An improved aerial serow censusing technique by helicopter suitable for rugged topography was developed and applied in this study. By this direct visual counting method the total of the serow in 2 297 ha was 105 individuals in March 11, 1982, 134 in March 9, 1983 and 119 in March 15, 1984, respectively. Comparison was made with the block count on the ground in the same area : the aerial census indicated nearly double the block count. To test the precision of the aerial census method, identical censuses were carried out in five sections (1 314 ha) on two consecutive days under the same conditions. As a result of repeated counts a total of forty-eight head were detected and forty-three were found on the following day. These two counts were not significantly different from each other. This proves high reliability in this census method. Applicability and validity of this method using a helicopter was examined and the possibility of a reasonable census of the large associated birds and mammals other than serow was also suggested in this study.

Introduction

An aerial big game censusing method has been established and applied to many kinds of animals using light aircrafts over wide and open country[3)4)6)7)9)11)15)16)]. In Japan, OHTA *et al.* (1972) and HAGA *et al.* (1978) tried to count the sika deer, *Cervus nippon yesoensis* HEUDE from a helicopter in Hokkaido[10)14)]. MARUYAMA & IWANO (1980) counted the sika deer *Cervus nippon centralis* KISHIDA from the air by helicopter in Nikko, central part of Japan and compared the result with numbers of deer previously estimated by the block count method[5)] on the ground[12)]. They detected extremely inadequate numbers from the air and eventually thought the method to be unsuitable and difficult to apply for the habitat with mountainous topography and vegetation in Japan. Accordingly the block count method has often been adopted for the deer and the Japanese serow, *Capricornis crispus crispus* TEMMINCK in a nation-wide census.

Recently, the serow, endemic to Japan has been gradually increasing under strict protection. However, the increase of the serow gives rise to serious problems of damaging young forest plantations such as Hinoki *Chamaecyparis obtusa* SIEB. *et* ZUCC., Sugi, *Cryptomeria japonica* D. DON and Japanese larch, *Larix leptolepis* GORDON by browsing and horn rubbing. Management of the serow has become an urgent problem. Population density, the most basic factor to manage the serow, has been estimated mainly by the ground censusing methods such as the block count method and

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the pellet-group count method[2], although they are problematic in efficiency or accuracy. Until now, a major obstacle to the management of serow in forested habitat has been in the scarcity of the data of accurate population densities. Therefore, development of new and efficasious serow censusing techniques has been eagerly awaited. We improved an existing orthodox aerial censusing technique and established a new one which is suitable for the natural conditions of Japan[1]. This report describes the field application of this method under the typical Japanese mountainous topography ; compares the results of the aerial census with the block counts' ; and discusses the reliability of the aerial count.

The study area

The study area is located in steep mountainous National Forest, ranging from 700 to 1 512 m in altitude, in the Kamisawatari and Tange, Nakanojo, areas of north-western Gunma Prefecture (Fig. 1). Gunma Prefecture is in the temperate forest region of central Japan where the following tree species were originally predominant: oaks, *Quercus mongolica* FISCHER and *Q. serrata* THUNB., Siebold's beech, *Fagus crenata* BLUME, Yedo hornbean, *Carpinus tschonoskii* MAXIM., Japanese red pine, *Pinus densiflora* SIEB. *et* ZUCC. etc. Several decades ago, the deciduous forest was largely clear-cut, except for the ridges, for charcoal or pulpwood : old deciduous and coniferous stands were left as a protection belt along the ridges, to protect young planted trees from cold wind and heavy snow. After this, marketable coniferous trees such as Hinoki, Sugi, and Japanese larch were planted (Fig. 2). Approximately half of the 2 297 ha study area, consisting of eight sections is covered by young planted coniferous trees : this provides numerous openings and forage for the serow. Therefore, the area holds a high serow population. Planted trees, less than five-year-old, have often been killed by heavy and repeated serow browsing year after year. The whole study area was surveyed by air, where 48% of the slope was covered with deciduous forest, mostly mature 11-15 m tall trees.

The topography varies from relatively narrow V-shaped valleys with small streams and rills to an easy terrain in the lower parts where the planted young trees and clear-cut areas are seen. High and steep precipices, of more than 150 m are obvious in the area. They are used by the serow for escaping predators including the human. Altogether, the study area represents the typical year-round preferred habitat for the Japanese serow. A heliport was established in a south-east corner of the study area.

Methods

Several trials revealed that the parallel, linear strip transect method used by the large jet-helicopter, Bell 204-B was unsuitable for the Japanese serow. We developed a new flight technique and the direct visual counting method "Aerial Driving Census Method" with the Aerospacial 350-B type jet-helicopter, with a crew of six, fewer than the former. Four crew members, a pilot, a navigator (recorder) next to the pilot and two observers in the back seats, were sufficient to count the serow by direct visual observation. The pilot operated the helicopter under instructions from the navigator with a map on which all streams and the border lines of sections were marked with colour markers in advance for recognizing their location easily. The topographical map of 1 : 10 000 scale was

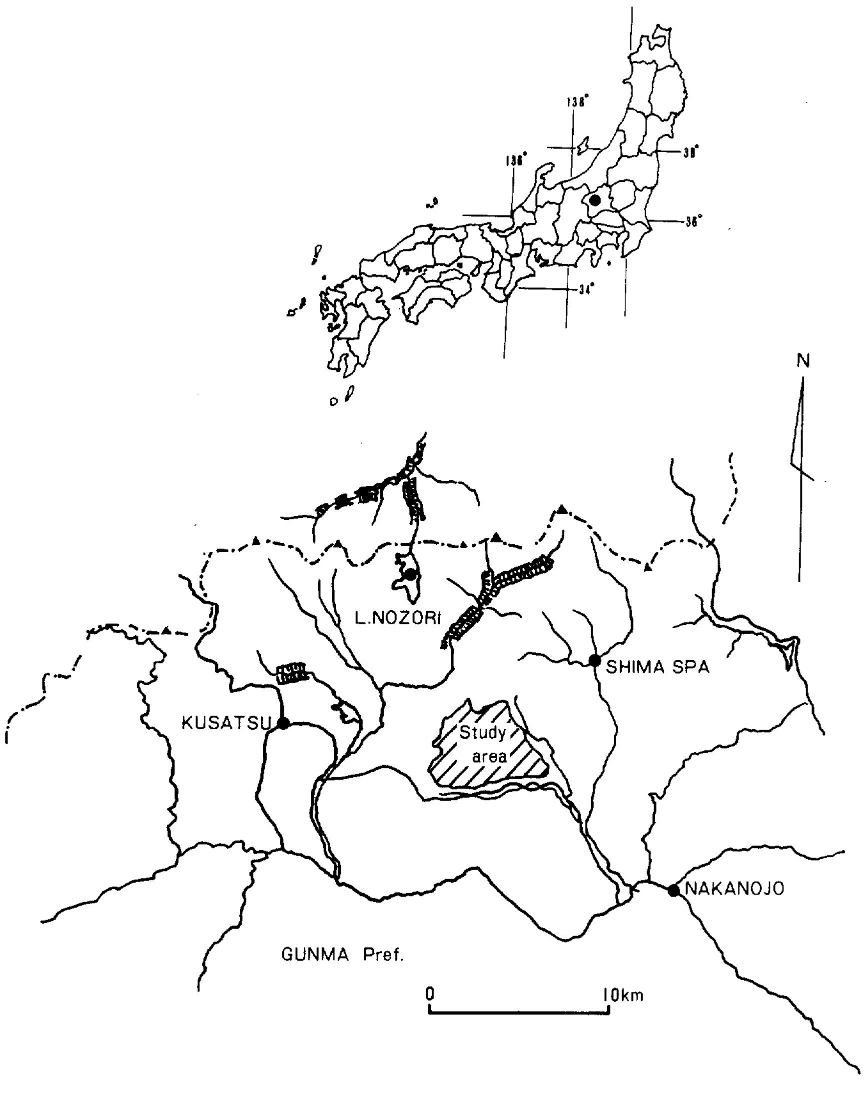

Fig. 1. Rough sketch of the study area in Gunma Prefecture, central part of Japan. A shaded area shows a detail location of the area.

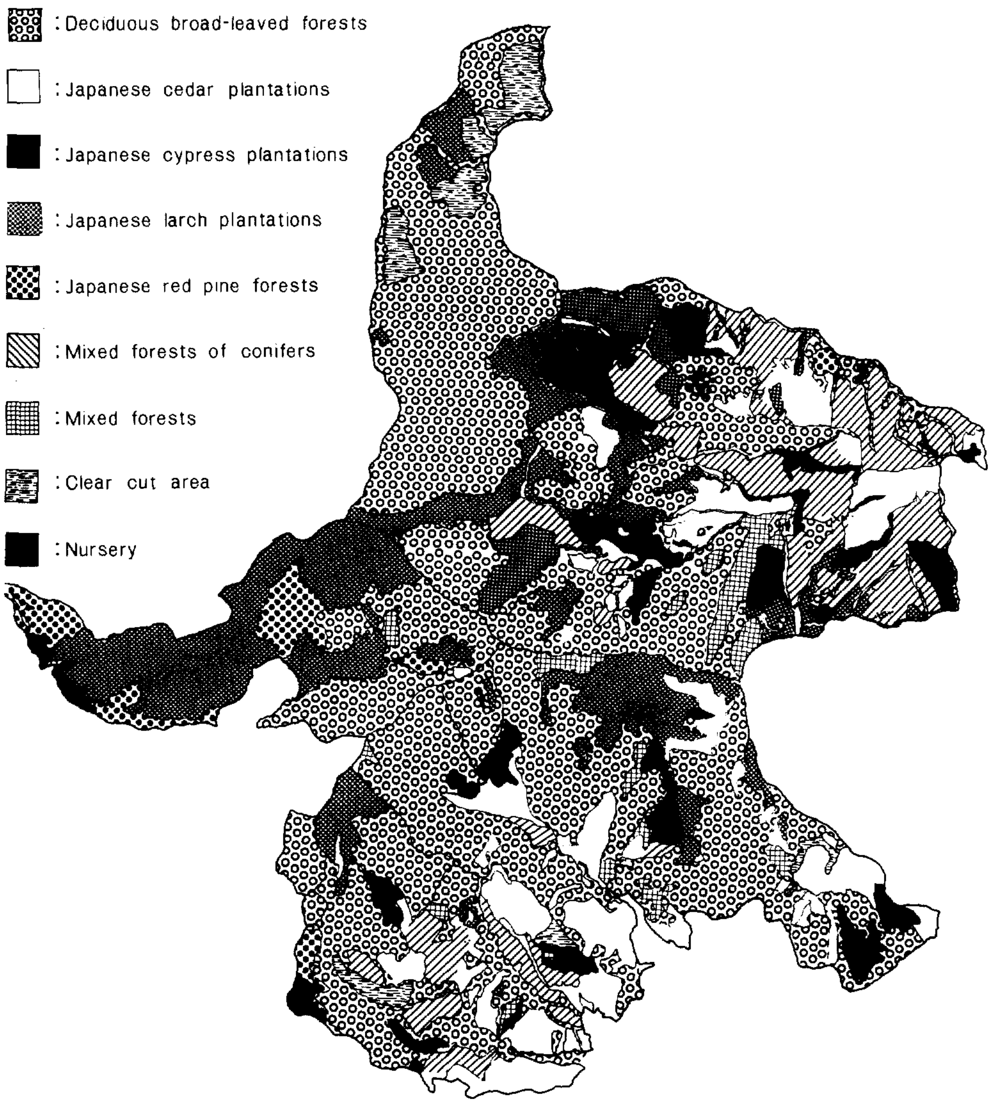

Fig. 2. Vegetation map of the censusing area, Nakanojo and Kusatsu, Gunma Prefecture. Different patterns in schema show each vegetation of the study area.

detailed enough to allow the navigator to spot his location easily and to put a mark on it when observers called out the number of serow. All of the crew were used to confirm the detected serow to eliminate double counting. A distribution map was compiled later from the data.

When the helicopter was slowly ascending a V-shaped mountain valley, the two observers in the rear seats could look around both slopes entirely and see all serow. Two observers, looking out of their windows, could scan both slopes and the stream bottom, while the helicopter flew as close as possible to 20–30 m above the ground at a speed of 20 to 30 km an hour. When the helicopter had reached the top of the valley, it flew back at a comparatively high level at normal speed (50–60 km/hr.) and then descended to fly low up the next valley stream. Visual counting was made mainly during up-flight with reaffirmation on the way down. To prevent double counting, each valley was surveyed only once.

In steep-shaped valleys, the helicopter flew along the stream as described above, while in widely spread flat or gentle slopes it flew straight and parallel to the ground surface. In wide, open valleys it could fly up one side of slope and back down the other (Fig. 3). In this case, the helicopter may fly at a higher velocity than the routine survey. Over rocky slopes or precipices, the observers on one side could search for cliff-dwellers while the helicopter hovered or slowly moved near the precipices vertically or horizontally. Efficiency of observation was further improved by the removal of the rear helicopter doors, so that the observers could easily scan a wide angle from the valley-bed to the top of the ridge.

In order to estimate reliability of the present census, two test censuses were carried out under the same conditions, using the same observers, flight course, hour, helicopter, pilot, navigator, etc. over two consecutive days, on a sample area of 1 314 hectares, comprising five sections, on November 30 and December 1, 1982. In addition, intense aerial driving censuses were carried out on closed-canopy, Hinoki and Sugi forests. Two types of dense conifer forests, thirty-seven-year-old Sugi (3.69 ha) and sixty-nine-year-old Hinoki forests (10.91 ha), were used for this purpose. Each block of forest had medium crown density. The helicopter flew above the trees as close as possible at a speed of 5–10 km an hour and in some cases it hovered over the forest. These forests were checked for serow by two persons on the ground immediately after the air driving.

The block count (ground count), prior to the air census, was carried out on December 9, 1981 over an area of 316 ha (section No. 44) to make a comparison with the air count. The procedure of the block count was the same as that in MARUYAMA's 1983 study[13].

While many species of larger birds and mammals could be identified from the air, their enumeration distracted from the accuracy of the serow count. Therefore, only two additional species were counted : the hare, *Lepus brachyurus* TEMMINCK and the copper pheasant, *Phasianus soemmerringii* TEMMINCK.

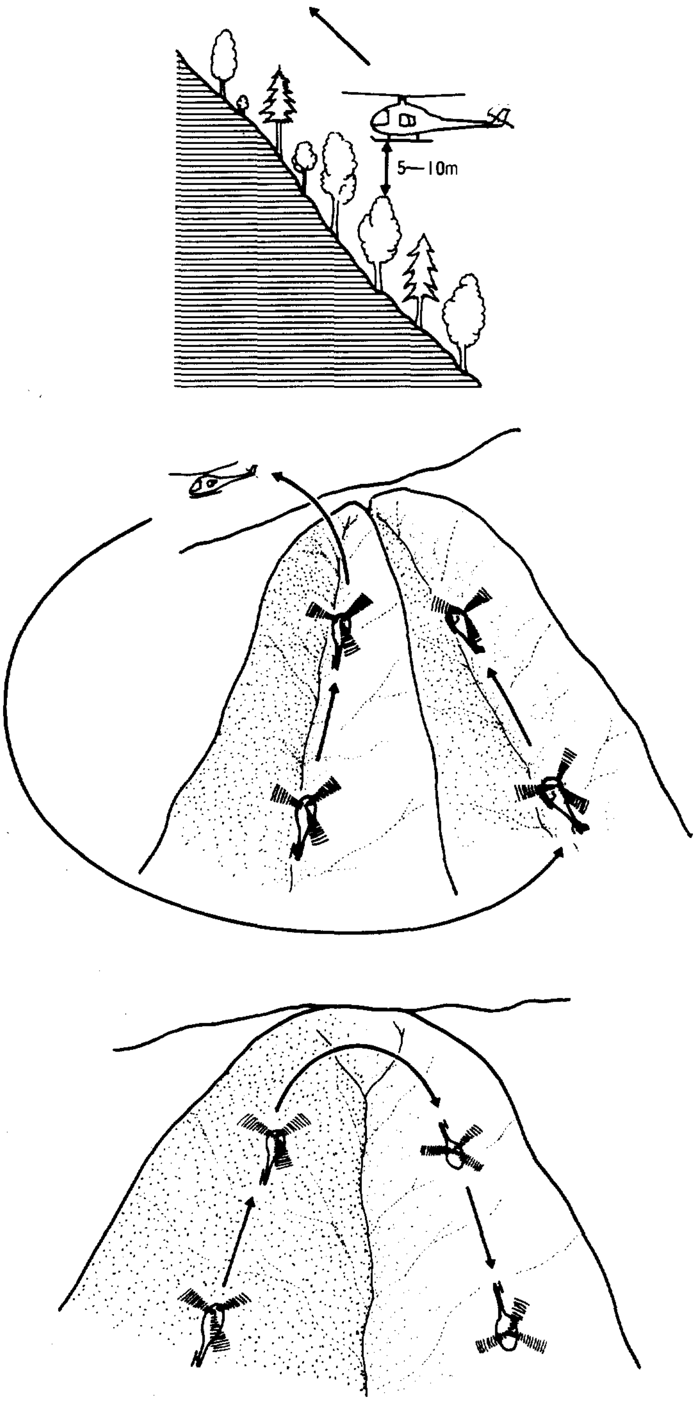

Fig. 3.　A helicopter flies over the tree (top), flight techniques in the typical V-shaped valley (middle) and in the comparatively flat valley (bottom).

Results

1. Field application of the method

Many wildlife species, including the serow, ran around trying to escape the low buzzing helicopter : they were driven away by the annoying noise and strong wind (Fig. 4). Things moving either on the ground or in the air were able to be spotted without difficulties. This made detecting possible and easy even under the chaotic conditions. Some serow on the slope were running down towards the valley-bed and the others skipply away parallel with contour lines at top speed. In some cases they were going uphill. Motionless serow could not be sighted from the air even on the clear-cut mountain slopes when the helicopter flew more than 50 m in the air at high velocity (more than 50 km/hr.).

Serow usually ran comparatively short distance when disturbed and remained there until the helicopter had passed on. The helicopter flew faster than the serow in general, therefore they were usually left near the original spots : they were seldom counted again on other slopes. This is probably because of their territoriality. They only could cross over the ridges when a helicopter was buzzing persistently. They hardly ever ran into dense coverts, such as a thick bush or a tall thicket of bamboo grass, etc. Snow seldom affected their detectability but in some conditions foot prints or U-shaped tracks in the deep snowfield revealed the presence of serow near the survey ground.

Fig. 4. A serow in the deep snow escaping the helicopter. It is very easy to spot moving things even under bushy or snowless condition.

Confirmation was required between observers to avoid a duplicated count when someone sighted a serow. Sometimes they were running under the helicopter and were sighted by the opposite crew : serow were found frequently by the pilot or navigator, seated in the front, prior to the observers. A high-powered helicopter was recommendable for taking the census in steep and rugged topographical regions : the helicopter had to soar high up in the air abruptly when it was faced with high walls or tall trees.

As much as 60 to 100 minutes were spent collecting data and buzzing in one flight on an average, providing a census coverage of about 250–300 ha per hour. It proved practical to fly and observe five hours per day even in early-winter.

2. Annual serow population

Whole study areas were surveyed once a year in March therefore, an annual serow population was checked. The total observed population of the serow in 2 297 ha was 105 individuals (4.6 head per square kilometer) in March 11, 1982, 134 (5.8 head per square kilometer) in March 9, 1983, and 119 (5.2 head per square kilometer) in March 15, 1984, respectively as shown in Table 1. Means and the 95% confidence margins of an aerial serow population survey in the study area are shown in Fig. 5. Forty-nine pairs, two groups of three, and only one group of four were observed throughout three years. Each pair probably consisted of an adult serow (probably a ewe) and her young or two adults (probably a ram and a ewe). Young were obviously smaller than adults and they crawled under the accompanying adults (probably ewes). The groups of three may have consisted of a couple and their lamb. The one group consisting of four serow is probably made up of two pairs. It is supposed that the two pairs of serow were encountered accidentally at the same point while escaping the helicopter. Serow never

Table 1. Number of serow detected in each section for three years.

	Study area	Nakanojo						Kusatsu		Total
	Section	38	39	40	43	44	45	12	15	
	Group size / Area (ha)	320	226	213	239	316	335	301	347	2 297
1982 Mar. 11	1	14	11	9	8	18	9	5	3	77
	2	7	4	1	0	0	1	0	1	28
	Total	28	19	11	8	18	11	5	5	105
1983 Mar. 9	1	23	6	11	9	8	26	9	4	96
	2	4	3	1	4	1	4	2	0	38
	Total	31	12	13	17	10	34	13	4	134
1984 Mar. 15	1	17	13	4	10	7	13	8	5	77
	2	0	5	2	1	2	4	2	0	32
	3	0	1	0	0	0	1	0	0	6
	4	0	0	0	0	1	0	0	0	4
	Total	17	26	8	12	15	24	12	5	119

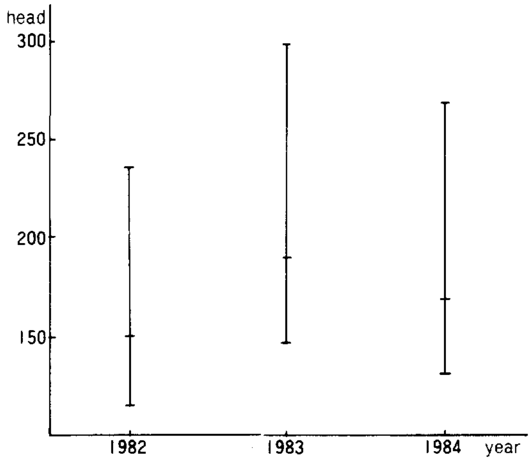

Fig. 5. Mean and the 95% confidence limit of each serow population in three consecutive years since 1982.

aggregate throughout the year, and they are thought to be solitary animals fundamentally.

Serow were not distributed in the survey area evenly. A high population density was observed on south-western slopes where snow was scarce throughout the winter season. Only a few serow were found in the Kusatsu area, whereas many were concentrated into the Nakanojo area (Fig. 6). A comparison of the serow distributed throughout the study area shows that few serow were detected in dense coniferous forests with poor forest bed vegetation, whereas a lot of serow were found in mixed and deciduous forests. A few serow were also counted on the young plantation area where no suitable cover was found. This means that the deciduous forest, even after defoliation, is useful cover for the serow and they prefer to stay in such shed forests even when there are ever-green conifer stands in the vicinity.

A comparatively stable number of serow were counted in some areas in spite of the lapse of time : fifty-one serow were detected in four sections (section Nos. 39, 40, 43 and 44) on January 13, 1983 and forty-nine individuals in the same sections on November 21, 1983 (Table 2).

3. Verification of reproducibility

To test the precision of the aerial census method described above, identical censuses were conducted on two consecutive days under the same conditions, over an area of 1 314 ha, comprising five sections (section Nos. 38, 39, 40, 43 and 44). Each crew member observed the same areas as on the previous day at the same time. As a result of repeated counts, a total of forty-eight individuals were detected in five sections on November 30, and forty-three head were found on December 1, 1982. The number of serow counted in each section are shown in Table 3. Numbers of serow counted on previous days did not tally with the latter one. Differences between them will be discussed later.

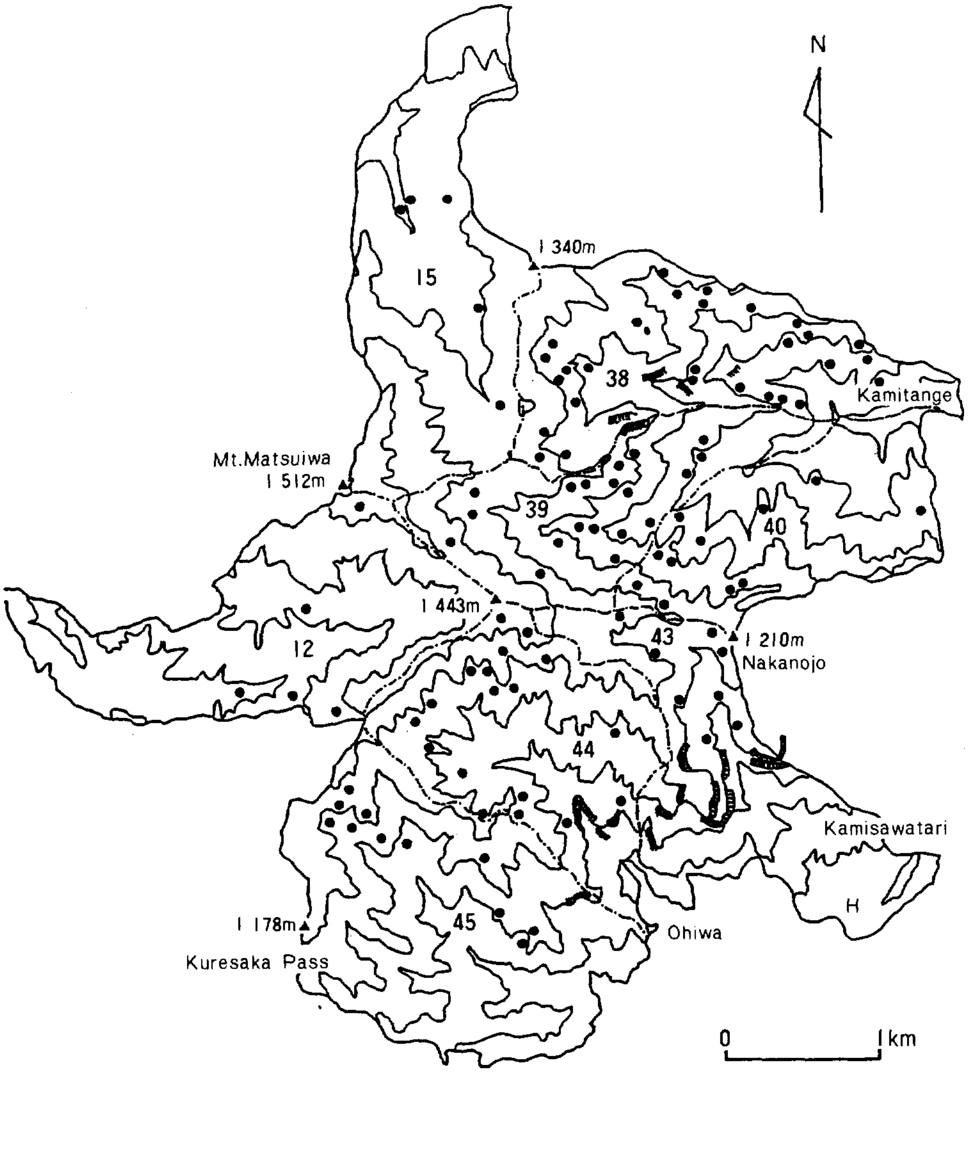

Fig. 6. Distribution map of the serow counted from the air in the study area in March 11, 1982 (numbers show No. of section. H : heliport).

Table 2. Comparison of the numbers of serow detected in the same section in different occasions.

Study area / Section / Group size		Nakanojo 39	40	43	44	Total
1983 Jan. 13	1	5	11	8	12	36
	2	1	2	—	3	12
	3	—	—	—	1	3
	Total	7	15	8	21	51
1983 Nov. 21	1	16	5	10	11	42
	2	1	1	—	—	4
	3	—	—	—	1	3
	Total	18	7	10	14	49

Table 3. Results of repeated count of the serow in the same area under the same conditions for two consecutive days

Study area / Section / Area (ha) / Group size		Nakanojo					Total
Section		38	39	40	43	44	
Area (ha)		320	226	213	239	316	1 314
1982 Nov. 30	1	13	8	9	4	8	42
	2	1	1	0	0	1	6
	Total	15	10	9	4	10	48
1982 Dec. 1	1	18	4	4	4	9	39
	2	2	1	0	0	0	4
	Total	20	6	4	4	9	43

4. Aerial driving count in closed-canopy forest

It was very difficult but not impossible to find serow in dense evergreen conifer forests with growth sufficient to obscure ground visibility when the helicopter flew over the forest at routine census speed (i.e. 20–30 km/hr.). However, it was possible to detect serow, or their tracks on the snow, in this type of forest when the helicopter flew at lower speed of 10 km per hour or hovered. Two types of dense conifer forests, thirty-seven year-old Japanese red cedar (3.69 ha) and sixty-nine year-old Hinoki cypress forests (10.91 ha), were checked by two people walking about in the forest to determine whether any serow were lurking there or not immediately after the persistent aerial seeking was over. But no serow was found by these ground observers in either forest. Most serow prefer the abundant food in the deciduous forest-bed to that in the conifer forest, which protects the serow but provides little food. In closed canopy forests, only a very low speed allowed counters to detect the serow among the trees.

5. Comparison with the block count

In order to test the accuracy of the much-used block count method, the aerial serow census of one 316 ha section was compared with a block count census made two months prior in the same section. The surveyed area was divided into two parts : one of them was checked in the morning by eight persons and the other was surveyed in the afternoon. Each person covered 10 ha at a time on an average. The block count gave a density of 2.37–2.96 serow per square kilometer on December 9, 1981. In contrast, the aerial census indicated 5.7 serow per square kilometer in the same area on March 11, 1982 : nearly double the block count.

6. Other animals detected from the air

It is very easy to find moving wildlife on the ground or in the air during a slow, low-level helicopter survey because animals are driven away by violent wind and deafening noise of the helicopter. Dried leaves and fresh snow on the ground are whirled up by the strong wind. The following twelve species of birds and mammals other than the serow were identified from the air in the course of this census : the Japanese monkey, *Macaca fuscata fuscata* BLYTH, the hare, the Japanese squirrel, *Sciurus lis* TEMMINCK, the Japanese black bear, *Selenarctos thibetanus japonicus* SCHLEGEL, the Japanese red fox, *Vulpes vulpes japonica* GRAY, the buzzard, *Buteo buteo japonicus* (TEMMINCK & SCHLEGEL), the golden eagle, *Aquila chrysaetos japonica* SEVERTZOV, the copper pheasant, the rufous turtle dove, *Streptopelia orientalis orientalis* (LATHAM), the Japanese green woodpecker, *Picus awokera awokera* TEMMINCK, the great spotted woodpecker, *Dendrocopos major hondoensis* (KURODA) and the jay, *Garrulus grandarius japonicus* TEMMINCK & SCHLEGEL (Table 4).

Table 4. A list of birds and mammals detected and identified from the air.

MAMMALIA	
Macaca fuscata fuscata	Japanese monkey
Lepus brachyurus	hare
Sciurus lis	Japanese squirrel
Selenactos thibetanus japonicus	Japanese black bear
Vulpes vulpes japonica	Japanese red fox
Capricornis crispus crispus	Japanese serow
AVES	
Buteo buteo japonicus	buzzard
Aquila chrysaetos japonica	golden eagle
Phasianus soemmerringii	copper pheasant
Streptopelia orientalis orientalis	rufous turtle dove
Picus awokera awokera	Japanese green woodpecker
Dendrocopos major hondoensis	great spotted woodpecker
Garrulus grandarius japonicus	jay

Table 5. The copper pheasant found from the air during the serow count (Jan. 14, 1983)

Sex	Section					Total
	38	39	40	43	44	
Cock	2	7	5	4	4	22
Hen	6	6	7	3	10	32
Total	8	13	12	7	14	54

Table 6. Number of hare found in each section. Most of hare (72%) were brown fur bearers. (Mar. 14, 1984)

Study area	Nakanojo						Kusatsu		Total
Section	38	39	40	43	44	45	12	15	
Colour / Area (ha)	320	226	213	239	316	335	301	347	2 297
Brown fur	17	2	10	9	9	10	12	0	69
White fur	1	2	1	0	0	0	1	0	5
Total	18	4	11	9	9	10	13	0	74

This method was also tested on the copper pheasants and hares inhabiting the study area. The counting of both species was carried out at the same time as the serow count. The sex of the copper pheasant can be determined visually by its size because of their sex dimorphism. A total of fifty-four copper pheasants comprising twenty-two females and thirty-two males were counted in five sections (1 314 ha) on January 14, 1983 (Table 5). The largest number of flocks of pheasant, consisting of both sexes, were found in the wide valley-beds where no running water was observed in late fall. The beds were covered with thin snow in mid-winter. Some solitary cocks flew out from the slopes in the deciduous forest.

The hares driven away by the helicopter were also counted in the course of an aerial serow survey. Seventy-four individuals were detected from the air on March 14, 1984 in eight sections (2 297 ha). There were two types of hare in fur colour found in the same area : 72% of the hare were brown and the rest were white (Table 6).

Discussion

Linear flight along a parallel course through mountain ranges, regardless of the rugged topography, was not suitable for surveying serow, because they were too small to be detected on the VTR screen. In addition, the picture angle had to be changed frequently, according to the rugged terrain. With the present method the helicopter was successfully used for counting serow which inhabited that rugged, mountainous area. The key to success in aerial surveying was in flying at low altitudes and low speeds up each valley.

OHTA *et al.* (1972) flew at a speed of 60 km/hr., 200–300 m above the ground. They detected only two deer and some foot prints of sika deer in the snow. As a result of this first trial they suggested the possibility of an aerial survey. HAGA *et al.* (1978) also flew by helicopter to count the sika deer but at a height of 50–100 m above the ground and at a speed of 50–100 km/hr. with circuitous flying as the needs of the case demanded. The result of this survey was that twenty-nine deer, comprising of seven groups, were detected from the air. However, neither group had eventually developed a census method in these trials. MARUYAMA & IWANO (1980) tried to compare the result of the aerial sika deer count with that of the block count method. In their flight, the helicopter flew at 70–120 km/hr. and 50–200 m above the ground, along a strip 500 meters in width over the area. The aerial surveys were carried out with the same flight technique used in wide and flat countries : they surveyed the study area with the helicopter, flying parallel to the ground at a constant altitude. The aerial count detected only 1.10–30.0% of the serow by the block count method, so the aerial census was thought to be unsuitable for Japan's mountainous topography. The cause of low detectability in an aerial count is thought to be high altitude flight and high velocity. As a result of our trials we concluded that the direct visual counting method, at a speed of 20–30 km per hour, the most effective way of taking a census of serow.

Comparatively stable numbers of serow were counted annually in the study area as shown in Fig. 5. This was probably caused by the scarcely of natural predators, such as stray dogs, and by the constant food supply from the young deciduous forest beds.

The results of the aerial counts carried out under the same conditions on two successive days, over an area of 1 314 ha comprising of five sections, proved their high reproducibility (Table 3). Forty-eight serow were counted on November 30, 1982 and forty-three on the succeeding day. The numbers of serow in these two counts were not significantly different ($P = 0.275$) from each other.

The number of serow in each section did not coincide with that of the previous day. This depends to some extent on daily movement among some sections, or repeated countings. Daily movement of serow within their habitat (territories in some cases) caused the disparities : boundary lines among adjacent sections were usually artificially drawn on the ridge or in the midst of the valley-bed, which probably divided their habitats into many sections as shown in Fig. 6. Artificial border lines between two sections have no significant barrier for terrestrial mammals. While some were missing under the rugged topography and chaotic vegetation : the serow prefers to inhabit steep mountain slopes where some caves were seen from the air.

As a result of repeated counts it became clear that the detectability of the serow suffered some deterioration. Helicopter censuses were made three times in each fiscal year, November, January (or February) and March. At the beginning of the aerial helicopter census same serow ran from place to place frantically, while others moved slightly at the end of the repeated counts. This makes finding difficult and we conclude that single buzzing is enough for censusing serow from the air.

Comparison of the air and the ground counts were made between December 9, 1981 and March 11, 1982. An aerial count detected nearly twice as many serow as the ground count. The difference between them is not thought to be a seasonal change because of their territoriality throughout the year. A comparatively stable population were counted on the same survey area (section Nos. 39, 40, 43 and 44) during consecutive air surveys : fifty-one serow were counted on January 13, 1983 and forty-nine on November 21, 1983 in the above four sections (Table 2). It is unlikely that the number of serow changed rapidly with the lapse of time since the ground count carried out at the beginning of December, 1981. We also counted the serow in the same area in every March for three years. As a result comparatively stable populations were observed from the air : 105, 134 and 119 individuals were detected on an area of 2 297 ha in 1982, 1983 and 1984, respectively (Fig. 5).

The real cause of the difference might depend on some oversights by ground observers under the dense bush or brush conditions. Differences between the ground and air censuses were probably the result of visibility bias inherent in the ground count. It is likely that the serow escaped previously without being noticed when observers were walking around in the dense and bushy survey area. Further, steep and rocky slopes make ground observation slow and inefficient. In fact, a wide vacant area around some foresters who were working in the forest were observed from the air. GILBERT and GRIEB (1957) compared the result of air and ground deer count by an aircraft in Colorado and revealed that aerial counts consistently tallied with the same percent of deer present on the ground[8].

Results of aerial censusing suggest that the technique is very useful and effective for counting wildlife living in mountainous areas. The helicopter count has several characteristics and merits. First of all, the air census is not influenced by any kind of topographical conditions. Secondly, in the case of the air survey no snow was required for counting the serow. This means the technique is available for all sorts of areas throughout Japan. Thirdly, it is possible to cover a wide range of the study area by air : about 1 250–1 500 ha/day was covered by the air, whereas a person can only survey less than 3 ha/hr. on average by the block count. The aerial survey minimizes the error caused by small area survey on the ground : if the ground count takes place in low density sections, number of serow must be estimated extremely low. Lastly, the aerial census is more reliable than the ground count. The aerial count indicates nearly double the block count in the same area.

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山岳林におけるヘリコプターによるカモシカ等のセンサス

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摘　要

新たに開発したヘリコプターセンサス法を用いて，群馬県の国有林 2 297 ha においてカモシカ等のセンサスを行った。1982～1984 年の各々 3 月に実施したセンサスで，105 個体，134 個体，119 個体のカモシカを数え，三者間に有意差はなかった。また，同調査地内の 1 314 ha で二日間にわたって行った再現性のテストでも，各々 48 個体，43 個体を数え，互いに有意差はなく，当調査法の再現性の高いことが判明した。区画法との比較を行った結果，316 ha の中で地上では 2.37～2.96 個体/km^2 を，空からは 5.7 個体/km^2 を数え，空からの調査は地上調査の約 2 倍となった。三か年間の調査でカモシカをはじめノウサギ，ツキノワグマ，イヌワシ，ヤマドリなど 13 種の鳥獣が識別できた。ノウサギとヤマドリはカモシカと並行してセンサスを行い，各々 74 個体，54 個体を数えた。この結果，当調査法はカモシカのみならず他の鳥獣への適用の可能性を示唆した。ヘリコプターセンサスの利点は，1）地形，植生，積雪などの地上条件に左右されない，2）動物に動きを与えるので発見が容易である，3）地上調査に比べて広範囲の調査が可能で，小面積調査に由来する誤差が小さい，4）再現性が高い，5）非積雪地帯でも適用可能で汎用性が高い，6）同時に複数の鳥獣のセンサスが可能，などである。

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