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Social Pattern of the Japanese Pika, *Ochotona hyperborea yesoensis*, Preliminary Report[1)2)]

By

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(*With 4 Text-figures*)

The sociological field studies of wild mammals are often obstacled by certain technical difficulties, among which, their rapid locomotive ability roaming a wide range, nocturnal habit and shyness for human interference are most serious. On this aspect, the pika is a favourable material for their strong sedentary nature, concentration in a narrow range and bimodal diurnal activities, all facilitating direct visual observations, though compensated by the necessity of tedious work at rocky mountains remote from laboratories.

In the course of ecological, ethological and sociological studies of *Ochotona*, elemental behaviour and daily activities in two species, *O. roylei* (Ogilby) and *O. hyperborea yesoensis* Kishida, were described by the present author (1968, 1969), but so far no detailed report has been published on social behaviour of *Ochotona*, including two species cited above. However, the presence of a quite interesting and specialized social organization has been suggested by many naturalists based upon; 1) their limited habitat preference, 2) settlements with plural individuals and 3) vocal communication among cohabitants. The social organization suggested by these fragmentary observations is of a particular interest when the nature of the genus as a glacial relic is considered together.

Following the previous report on elemental behaviour patterns and daily activities of the Japanese pika, *O. h. yesoensis*, the present paper deals with a preliminary description of their social pattern, confirmed through continuous observations made at Station Oketo (alt. 500 ~650 m) using individual recognition. The observations are still being continued but here the descriptions are given based upon the result obtained from 21st July 1968 to 16th Sept. '69.

Before going further, several new terms shown schematically in Fig. 1 introduced by the author since the last two papers are here mentioned to avoid confusion.

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1) Contribution No. 872 from the Zoological Institute, Faculty of Science, Hokkaido University, Sapporo, Japan.

2) Studies on the genus *Ochotona* Link (Mammalia, Lagomorpha, Ochotonidae), III. *Jour. Fac. Sci. Hokkaido Univ. Ser. VI, Zool. 17, 1970.*

Nest range: Used exclusively for fixed range where most of daily activities are performed by one or more individuals for a prolonged period.

Set[1]: The place where they spent the majority of their daily life, including both subterranean and epigene activities, calls, food intake, sunbathing, inspection, rest and so forth. Consequently the daily activities consist of a temporal mosaic of both intra-set activities and inter-set movements. Although the places for defecation or food hoarding found among blocks of big rocks indicated the presence of the set, there only the frequent use of the places confirmed by continuous observations proves the existence of sets definitely.

Nest hole: Involving all entrances used by them, irrespective of natural crevices or holes dug by themselves. Therefore, the holes are not necessarily connected with "nest chamber".

Nest burrow: All subterranean labyrinthine systems used by them, including mere subterranean pathways, too. Therefore, the nest burrow does not mean the nest in the ordinary usage, which is expressed by set, in the present study.

Occupant: The possessor of a nest range, irrespective of the number of individuals.

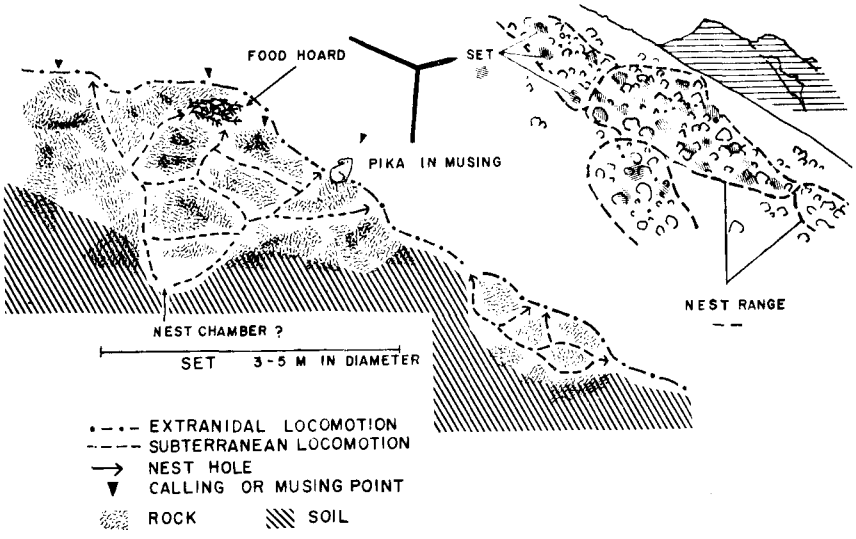

Fig. 1. The structure of nest ranges shown schematically. Nest chambers invisible from the outside are not yet studied.

Methods

In addition to basic procedures given in the previous paper, some essential techniques used in the present study, such as individual and sex recognitions and trapping are briefly described here.

1) The "resting place" used in the previous two papers (Kawamichi, 1968, 1969). The term set replaced here by "set", defined in the text, is, therefore, not used in the sense, synonymous to nest burrow adopted in fox and badger (Neal, 1948).

Individual recognition: Each individual is distinguished by certain features recognized with binocular telescope (×9) and peculiar calls. The most reliable recognition marks are deformity or scars found at ear margins. The scars on hair coat and body colour help the recognition but these are less stable, often changing at moulting. On the other hand, calls are quite reliable for recognition, being peculiar in each individual in tone, duration and rhythm, all of which are stable throughout the year, except for a gradual change from juvenile to adult stages. Thus, for the daily trails the identification by calls is much more useful than that by physical features. Particular individuals could be identified by calls produced at the places so remote that visual identification was nearly impossible.

Of course, the application of artificial markings by cutting ear margins is the most reliable method to identify the individuals without spending much time for observation. But the merit of this method is compensated by the low survival of trapped individuals and the difficulty to catch a particular individual. In the present study, therefore, identifications were mainly made by calls and certain physical peculiarities, with some individuals marked artificially.

Sex recognition: The most reliable identification of sexes is naturally made by examining exogenitalia (cf. Duke, 1951). But in the coruse of the present study it was confirmed that calls are quite distinctive among sexes, especially in breeding season, as given in the section Occupants.

Trapping method: Any trapping method for small mammals, by the following workers such as Dalquest (1939), Miller (1939), Martin (1943), Roest (1953) and Haga (1960), seems to be effective, though none of them is ideal for live-trapping. It must be mentioned that the mortality within the trap is considerable. Usual cage traps for rats with pieces of apple as bait are set at frequently used nest holes or defecation places, or on their pathways on grassy ground, although the rate of catch is not high. The duration of trap setting depends upon the intensity of their daily activities at a given season. Considering auroro-crepuscular activities and various inhibiting factors (cf. Kawamichi, 1969), 1 ~2 hours in each morning or evening trip period are adequate and effective, especially to keep them alive.

Nest range

The pikas have a strong sedentary nature, each individual staying within a fixed area for its daily life. As details of a particular nest range were already described (Kawamichi, 1969), here are various shapes and types of nest ranges briefly touched on.

Although the daily life is mostly spent within their own nest ranges, they occasionally go out of their nest ranges or invade those of neighbours, the frequency of which differs according to seasons and sexes. Therefore, the widely accepted term, *home range*, is deliberately avoided in the course of this study until the relation between nest range and home range will be discussed in future.

The Japanese pika shows a conspicuous habitat preference for slide rock areas either exposed or partly covered. Extents of certain nest ranges are shown in Fig. 2, confirmed by more than 121 morning and 88 evening trip periods during 21st July, '68 ~16th Sept. '69.

Their daily activities are concentrated in sets, which are many within one nest range (Kawamichi, 1969). Therefore, the most frequently used part of the nest range includes all sets and quite fixed pathways connecting them. They occasionally use, however, some usually ignored pathways or extend their activities to the areas surrounding sets, especially at autumn hoarding trips. Therefore, the extent of nest "range" includes both frequently and only occasionally used areas. Consequently the *observed extent* partly depends on the duration of observations, the longer the observations, the wider the "observed" extent. But they are not so bold as taking long trips far from their own sets that several nest ranges shown in Fig. 2, especially *A*, are regarded fairly reliable approximations of the real extents. The maximum extension of these boundaries would seldom exceed 5 ~10 m.

Occasionally they, especially males, invade the neighbouring nest ranges, but return to their own nest ranges mostly within 2 ~3 hours, so that there is no difficulty to determine the ownership of a given area.

The four nest ranges illustrated (*A*, *B*, *C* and *D*) showed no marked fluctuation of the extent during the observation periods, except for a minor area.[1] During the snowy season, 12th Dec. '68 ~end of April, '69, each nest range, at least *A* and *B*, tended to enlarge 5 ~7 m wider than the previous apparently due to active intake of fresh food during winter in spite of ample hoards.

The sedentary nature of the Japanese pika, staying within a fixed range all the year round, is clearly confirmed from the data given in Figs. 2 and 3. Figure 4 shows that many pikas (37 individuals reconfirmed during 30th Oct. ~8th Nov. '68) stayed on a slide rock slope at one section of St. Oketo[2], where most part of the slide rock area is covered by a mosaic of 23 nest ranges for a long period. The figure also shows one-limit of the boundary of the habitat occupied by the definite population studied. As any more individual does not stay at the area, slide rock areas shown as unoccupied in the figure might actually be partitioned by occupants living in nest ranges nearby as shown by closely studied nest ranges *A* ~*F*. The slide rock area extends upwards to the upper forest involving numerous nest ranges. Probably the habitat is continuous to the top of Mt. Ukoubetsu, 1,021 m.

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1) Two sets (a) and (b) (Fig. 2) were indubitably possessed by two individuals, Bp and Bq, used especially by Bq until May, '69. Thereafter, the two sets were transferred to the possession of *A*, the visits of Aq_2 to (a) were observed for at least once and to (b) for twice after substitution of Aq_2 for Aq_1 (cf. Case 3). This suggests the transfer of the area from *B* to *A*, considering the strictly sedentary nature characteristic to females (Aq_1 and Bq).

2) Located within Oketo Forest Affairs: Division No. 110, 18 km southwest of the town, 5 km north of Mt. Higashi-Mikuniyama.

Boundaries of nest ranges (Figs. 2 and 4) usually coincide with one of the following three situations: 1) Wide bamboo bush zone without slide rocks, 2) Narrow discontinuity of slide rocks, or a band of poor slide rocks, usually 10~20 m, though such situation is also seen within one nest range, and 3) Situation with no remarkable topographical change on wide slide rock zone confirmed from the outside. Interestingly an abandoned trail, which pikas must traverse exposing their bodies for 5 m (a snow tunnel was traversed on the trail during snowy season in 1969),

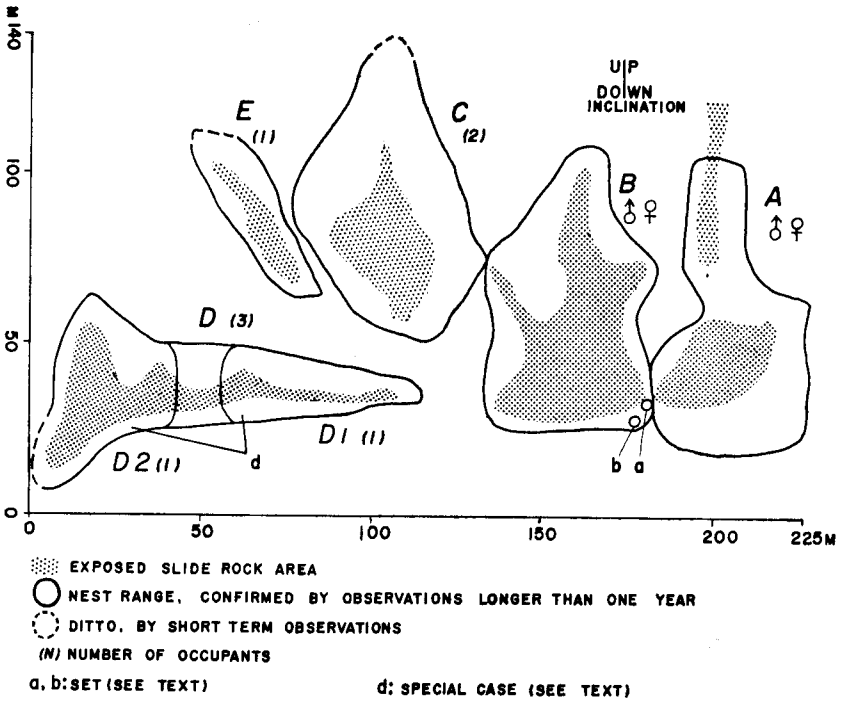

Fig. 2. Extents of several nest ranges. The areas not dotted in each nest range have no exposed slide rocks, but are provided with subterranean interstitial systems used by pikas. Nest range *A* is illustrated in detail in Kawamichi (1969, Fig. 4).

does not serve as the boundary, nevertheless such narrow discontinuity in other places often coincides with the boundary of nest range.

The establishment of nest boundaries by three ways mentioned is explained as follows: First, some boundaries seem to depend basically upon microtopography, distribution of slide rocks, especially in the discontinuity as in *A*, *B*, *C* and *F* where streaks of slide rock run from upper to lower zone, corresponding to the boundaries.

Secondly, there must be occurred the minimum extent of each nest range enough to sustain the daily life of occupant or occupants. This must be far

smaller than the usual extent like as in *A*, *B*, and *C*. For example, *D1* the smallest one among 23 nest ranges is far smaller than the others, probably formed by some social relations, rather than environmental limitation. Such minimum extent should be correlated with the fulfilment of necessary for the minimum requirement, as in the case of territory in birds (Howard, 1964). Although no detailed accounts on this interesting problem are referred here, observations with over-populated areas may give a cue to solve this problem.

Thirdly, the influence of inter-range social relation upon extent and shape of nest ranges is assumed. For example, one big slide rock area is clearly shared by several nest ranges without "neutral zone" (cf, *I*,*J*, and *K*), indicating mutually excluding relation among occupants.

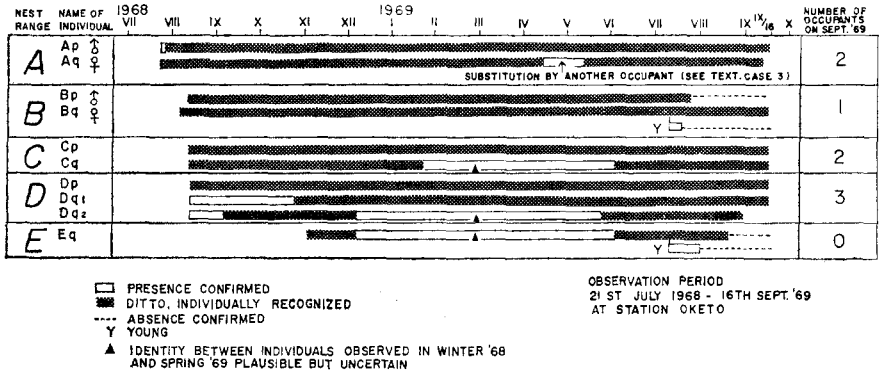

Fig. 3. Prolonged residence of pikas in definite nest ranges. Compare with Fig. 2.

Such "conscious" segregation is inferred from the following facts: Invasions in adjoining nest ranges are not so often, even in the probable presence of subterranean interconnected burrows. One vacant nest range *J*, the occupants of which were lost during winter in 1968～'69, was, thereafter, freely used by the occupants of the neighbouring nest ranges *I* and *K*, resulting in the division of the former range from the two sides by neighbouring occupants or pairs.

Not only inter-range but also intra-range social relations must affect the shape of nest ranges. Nest range *D* serves as an example (cf. Figs. 2 and 3). Dp cruises the whole range and the other two individuals, Dlq and D2q have each their own nest ranges within the wider range of Dp[1] The former is identified with a male and the latter two females from their call types. In this case, such irregular shape must be formed mainly by social relation, though the formation of an elongated elliptical shape is possible in such occurence of two females (also cited

1) In such case, the term nest range should deserve for each, recognizing three overlapped nest ranges in that area.

in the next section). It is still uknown how the extent and shape of each nest range is affected by the number of occupants, either occupied by one individual or more.

Consequently the contour of nest ranges possessed by solitary or plural occupants is determined primarily by the topographical distribution of slide rock area which restricts their habitation, and secondarily by the reconciliation between essential daily life and social relations, both of inter- and intra- nest ranges.

Occupants

In the Japanese pika, each of all individuals keeps a definite nest range for a long period and they spent mostly within such ranges. By the definition of the term occupants, therefore, all individuals deserve occupants, irrespective of solitary or plural excluding some temporary stay, etc.

Figure 2 shows three types of nest ranges, each characterized by the number of occupants during all seasons except for the post-breeding family phase, that is, single, pair and trio. Whereas solitary (Eq and Sq) and trio (Dp, D1q and D2q) occupants are rather exceptional, pair-occupant or communal use of one nest range by two individuals, is regarded predominant and principal type in the species as shown in Fig. 4.

In such case, two individuals are almost decidedly male and female forming a pair for a long period, mostly over one year as shown in Fig. 3. Evidence to support this opinion is cited here:

Case 1: Two pairs (Ap, Aq_1 & Bp, Bq) of two neighbouring nest ranges, (*A* and *B*, cf. Figs. 2 and 4) live-trapped on 12th Dec. '68 were respectively adult male and female, judging from exogenitalia. These four individuals stayed at respective ranges for at least nine months as shown in Fig. 3.

Case 2: During the first half of a year, presumably March to July, the member of all pairs are distinguished into two types by peculiar calls. One is always strong and successive, expressed "Kítz-Kítz-Kítz...." usually more than ten syllabled, the other incredibly silent except producing a mostly characteristic monosyllabic call, heard as "Pí:" "Pyú.", "Pyú:tz" or "Kyú:" and "Kyú:tz" all common in the inclusion of a long "vowel".

These two call types evidently correspond to the respective sexes of five individuals (2♂♂ and 3♀♀) including four individuals mentioned in Case 1, the former type is male and the latter female. This correspondence of sexes and call types will be applied to other pair occupants.[1)]

Case 3: One female Aq_1[2)] at *A* was dismissed in spring '69 between 13th April

1) Using this result, all individuals shown at Fig. 3 are symbolized to two signs, p and q, by their call types. Individual name Cp means, for example, the individual, living at nest range *C*, of "Kítz-Kítz-Kítz...." call type which is probably male. Also Cq has "Pyú:tz" call type at *C*, probably female.

2) Aq_1 is frequently cited as an individual A in Kawamichi (1969).

~10th May, replaced by another individual Aq_2, producing calls of "Pyú:" or "Pyú:tz" as in the former occupant Aq_1. The other partner Ap, male, still stayed here, so the new occupant with such call type should be a female.

Case 4: From July to August, '69, young appeared at many nest ranges possessed by pairs (*B*,*F*,*I*,*R* and *U*). The movements of young were exclusively confined within the nest ranges of adult pair for at least 2~3 weeks, where certainly young had to be born.

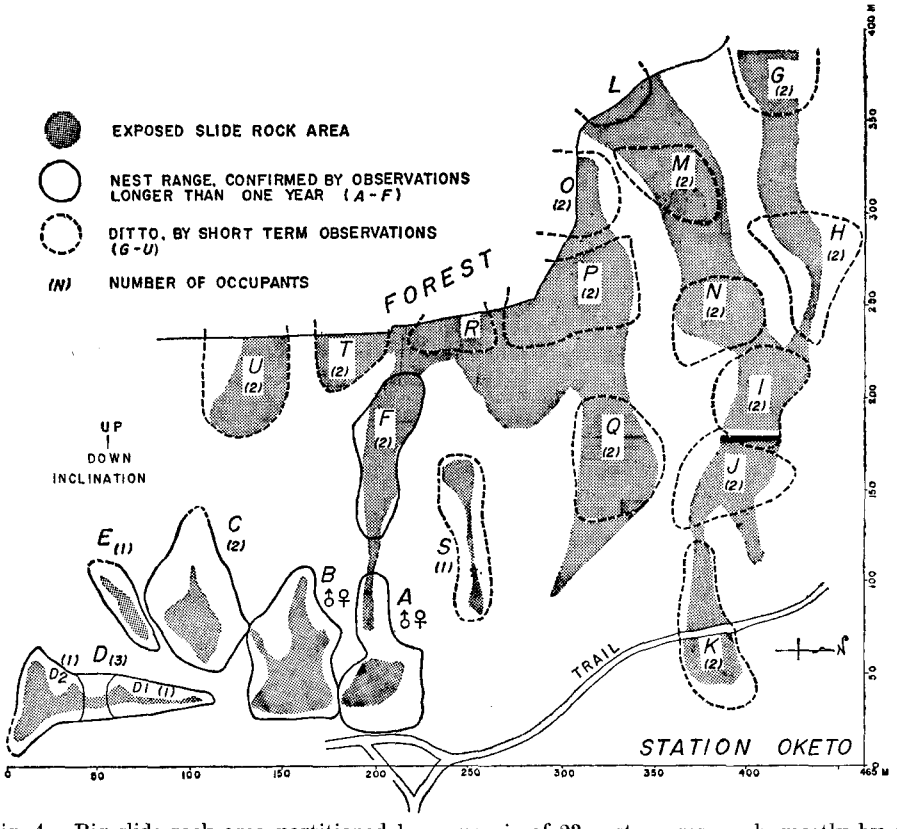

Fig. 4. Big slide rock area partitioned by a mosaic of 23 nest ranges, each mostly by a pair.

Case 5: At a solitary nest range *E*, one occupant Eq with the call type "Pí:", "Pyú:" or "Pyú:tz" was frequently visited by two adult individuals (Dp and Ep) of the two neighbouring nest ranges (*D* and *E*), both with successive calls of "Kítz", especially during May to June, '69. Since 9th July, '69, calls of a new young were heard within *E*, occasionally responding to the adult individual Eq,

suggesting the individual with "Pyú:" type being the female (mother) and the two visitors the males.

The other types of occupant, solitary (Eq and Sq) and trio (Dp, D1q and D2q), are sociologically of a great interest. Solitary occupants (Eq and Sq) are individuals born in 1968, judging from their juvenile calls distinct from those of adults, suggesting these two being the females pushed out of the nest ranges of their mothers. Three situations are assumed as to the appearance of solitary occupant: 1) Small range permissible for only one individual due to either isolated slide rock area simply by topographical condition, or occupation by co-occupants around the solitary nest range: For instance, *E* is interpreted as the latter case. 2) Unfavourable habitat condition by poor slide rocks, usually not occupied by pikas, as in the case of *S*, and 3) Loss of a partner in a pair nest range, which happens mostly during winter. For exmaple, two pair nest ranges (*T* and *O*) lost each one partner during Nov. '68 ~ June '69, but each partner (although two partners remained were not decisively individually recognized) stayed still within the same nest range of the same extent. After the breeding season in 1969, two individuals of the opposite call types, the sex probable opposite to occupants were adopted in both nest ranges.

Daily behaviour of trio-occupants (Dp, D1q and D2q) at *D* is noteworthy: One individual cruises the whole range and the other two are segregated for each other as mentioned above, under observations covering 18 morning and 18 evening trip periods during 22nd Oct. '68 ~ 16th Sept. '69. The former Dp is identified to the male and the other two (D1q and D2q) the females by call types. This suggests a strong repulsive tendency between females, but the admission by a male for the presence of plural females.

In spite of the occasional presence of such solitary and trio conditions, their basic social pattern is clearly the continuous pair formation throughout the year, considering their sedentary nature of a pair at fixed nest ranges, most of which must persist over one year.

Concluding remarks

In connection with the preliminary accounts on the social pattern of the Japanese pika presented above, here are given some comments on pair formation, census method, and social structure.

By the definite habitat preference for slide rock areas and the tendency to segregate into nest ranges, the pika population in a given slide rock area is composed of, in principle, a number of pairs seemingly with little change of members throughout the year. In September, both in 1968 and '69, a few new borns occupied vacant nest ranges within the station, and formed pairs with solitary occupants in some nest ranges. Moreover, some of these new borns even drove away the previous occupants in certain nest ranges. These facts also favour the conclusion on the occupation of the habitat by a relatively sedentary

population consisting of a number of pairs. Such clear segregation in pairs forming a lasting spatial mosaic, reported in many birds in breeding season, seems to be relatively rare in mammals. Although the possession of the social relation comparable to the so-called territoriality by pikas is undeniable, the closer analysis and comparison are required to clarify the nature of their nest range system.

Secondly a method of population census based upon direct observations is proposed. It was already mentioned that the peculiar habitat preference and habits of pikas make precise direct observations possible in contrast to many mammals, the activities of which can usually only indirectly be studied. Furthermore, the population structure in each habitat, consisting of a number of pairs, each of which occupies a relatively definite and stable nest range, is ideal for the population census based upon direct observations, which is practically impossible in many other mammals.

The best season is June to make such census, because both sexes produce calls easily distinguished for each other. In this month calls of males are very characteristic as mentioned above, but they make invasions to other nest ranges more frequently than in other season. On the other hand, the females produced calls less characteristic and less clear, but they are much more sedentary than males, confined to the nest ranges. Therefore, the combination of these two characters, male calls and female sedentarism may give the best census result in the following way.

At first a favourable observation point must be chosen, where the perspective for the whole slide rock area is possible. There the points, where male (p) calls, especially successive calls "Kítz", are produced, are plotted on the map with dots during morning or evening trips of a few days. From the distribution of these dots, a mosaic of nest ranges, the diameters of which are approximately 40 ~ 70 m in most cases, is obtained, and the number of nest ranges is regarded as the approximate estimation for the number of paris, or the doubled number of inhabitants in the area concerned. This first approximation is improved by confirming the activities of females(q), especially the weak call "Pyú:tz" sound from each nest range through the observation in one morning or evening trip period. Figure 4 represents an example of the population census made by this method. The right half of the area includes 10 pairs or 20 individuals within 200 × 400 m. sq., estimative for 8 days' observations.

Thirdly a few notes are given as to their social structure. It was mentioned that permanent pair formation is the social pattern basic to the Japanese pika. Moreover, it is interesting that this pair structure is linked with an extreme sedentarism, resulting in the appearance of a population consisting of a number of paris, each of which occupies a definite nest range. Although with occasional mutual invasions into neighbouring ranges, the whole population forms in general a mosaic of mutually exclusive nest ranges. Thus the social pattern of the Japanese pika resembles that of the song sparrow, *Melospiza melodia*, shown by the works by Nice.

As to the Japanese pika, the following two characters favour the permanent pair formation: 1) Deep snow cover remaining in mating season, about May to June, make the encounter between partner easy, and 2) Abundant hoards and communally used snow tunnel system maintain the winter survival at relatively high level.

Pair formation in young individuals seems to occur, in all probability, one or two months after birth, soon aquiring the independency from the mother mostly in August, judging from the re-arrangement of some pairs including new born individuals. This is also indicated by the higher growth rate in pikas even than in some other rodents in frigid region, *Clethrionomys rutilus dawsoni* and *Dicrostonyx rubricatus rubricatus* (Haga, 1958). Such rapid growth is regarded as an adaptation for severe climate, especially for wintering, which is one of the most serious problems for the survival in alpine and arctic mammals. It is still unknown whether the new born can participate in hoarding or not. At any rate the rapid growth is prerequisite to such activities.

In the present paper, the interindividual behaviour is mentioned only briefly. Judging from their social structure, the behaviour found in interindividual relations, including both intra- and inter- "nest range" ones, must be far richer than in other solitary mammals. Besides fighting or chasing widely seen in other mammals, the characteristic calls of pikas similar to those of birds rather than other mammals, at least some of them, must play an important role in their social adjustment.

The author is indebted to Prof. M. Yamada and Dr. Sh. F. Sakagami for their valuable advice and to Mr. S. Yamane for assistance for mapping. Sincere thanks are also due to the staffs of Oketo Forest Affairs for their great kindness.

Summary

Social pattern of the Japanese pika, *Ochotona hyperborea yesoensis* Kishida was studied at Station Oketo from July, 1968 to Sept. '69. By a strong sedentary nature, "nest range", a fixed area within which most of the daily life is spent, is clearly determined, although occasional invasion into other nest ranges happened. Thus, most part of a given slide rock area is covered by a mosaic of many nest ranges.

Boundaries of nest ranges usually coincide with one of the following three situations: 1) Wide bamboo bush zone without slide rocks, 2) Narrow discontinuity of slide rocks or band of poor slide rocks, and 3) Situations without any remarkable topographical shifts. Establishment of these three boundaries is explained by: 1) The result of dependence basically upon microtopography, distribution of slide rocks, especially in the patched zone, 2) The necessity of the minimum extent of the range enough to sustain the daily life and 3) The influence of inter- and intra- "nest range" social relations.

Nest ranges are classified into three types, solitary, pair and trio ranges by the number of occupants, of which the pair is the predominant and principal type. In such case, the pair range is occupied by two individuals, almost decidedly male and female forming a pair for a long period, mostly over one year.

Solitary and trio ranges are rather rare. For the appearance of solitary condition, three situations are conceivable: 1) Small range permissible to sutain only one individual, 2) Unfavourable habitat condition due to poor slide rocks and 3) Loss of the other partner in a pair. Daily behaviour in a trio range was noteworthy; one probable male cruises the whole range and the other two, probable females, are segregated each other within the range.

A method of population census was proposed by direct observations, using their calls and sedentary pair formation.

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