

Reproduction and Breeding Biology of Indian Pika; *Ochotona roylei* (Lagomorpha) from Tungnath Garhwal Himalaya India

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Abstract Background: The present study deals with the reproductive behavior and breeding biology of Indian Pika (*Ochotona Roylei* .) Inhabited in the snow-fed Tungnath areas of Garhwal Himalaya Uttarakhand, India, at the altitude of 2200 to 4500 meters at sea level. Materials and Methods: The observation is based on the data collected during March, 2007 to September 2010 from the high altitude of Tungnath Garhwal Himalaya, Uttarakhand India. Results and Discussions: The animal breeds once in the year during the May to June at the age of 7 -10 months. The gestation period is 28 to 30 days and having fecundity 1-5 offspring with recorded weaning time 20 to 22 days. Morphologically Juvenile Indian Pika have slightly haired, with eyes closed and well-developed teeth, the average mass of offspring was 10 to 12 g on 3rd days after birth and eyes open on 9 ± 2 days after birth. The weight of juvenile Indian Pika was recorded average 70 ± 23 g in 22 days. Indian Pika reaches minimum adult mass within 3 months of birth and sexually mature within 7 to 9 months and breed in next coming season. Mortality rates are greatest in the first three months after birth and average mortality rates recorded 40 to 60 % each year, and found that very few Indian Pika survived at the studied population for the three years of the study in their natural habitat.

Keywords Reproduction, Breeding biology, Garhwal Himalaya, *Ochotona roylei*

1. Introduction

All animals try to find the good quality food materials in the surrounding environment, to fulfill and to conduct their various life parameters like fecundity, parturition, growth, gestation, weaning including its life span [1,2,3,4,5]. Especially in snow fed alpine areas, where environmental conditions are highly changeable, the animal activity and breeding season in all animals to be existing at the same time

[6]. All animals face the same type of environmental condition and may be the similar time of parturition and for reproduction due to favorable climatic condition such as food availability or density of mates with predation risk [7, 8]. There is also considerable evidence shows that mammals use changes in photo period or some secondary compounds in newly emerging vegetation as predictors of breeding season activity [9, 10]. For territorial species, being born in early snow fed seasons may be critical to finding of food materials and securing a territory for survival. The Indian Pika (*Ochotona roylei*) is small, diurnal, tailless snow fed animal belonging to the order Lagomorpha (rabbits and relatives) and family Ochotonidae [11]. They are territorial and do not hibernate during the winter [12], but rather forage under the snow and on vegetation that was collected and stored in a hay pile at the end of the summer [13]. There are approximately 30 species throughout the world [11], most are restricted to Asia with only three *Ochotona* species that presently live outside of Asia [14, 15, 16, 17]. Geographically the Indian Pika reported from the Ganesh Himalayan area including northern highland belt of Nepal [18], the Himalayan area of China, Tibet and adjacent areas [19]. In Garhwal Himalayan area, Indian Pika also known as “Runda” [20]. The name “Runda” is derived from local Garhwali language (a regional Indian Language), which means tailless. They are restricted to snow fed areas where aromatic and medicinal herbs are abundant [18, 20]. Within order Lagomorpha, Indian Pika occupy distinguished position by their mode of life and behavior quite different from those hares and rabbits. In the last few years back some valuable works related to Pika were done in many other countries by various [16, 21, 22, 23, 24]. Some information is also available related to body temperature regulation in high altitude areas [21], foraging behavior [25], seasonal changes in activity pattern and adaptive value in relation to plant haying behavior [26]. The study about the growth of the different species of Pika in the wild and captive environmental stages were conducted by Millar and Tapper [27, 28, 29]. A few studies have described the growth of the

Pika and reproductive behavior under predation risk [30]. Very little information is available specially from India on Pika (*Ochotona roylei*) about geographical distribution, external morphology, general behaviors related to movement, sexual activity, alarming calls foraging and food hoarding behavior [13, 20, 31], and symbiotic relation with some other animals [18] from Nepal at Ganesh Himalaya. In Garhwal Himalaya studies on the animal activity pattern is very little. The sociological field studies of the wild mammals are after obstacles by certain technical difficulties, among which their rapid locomotive ability roaming a wide range, nocturnal habit and shyness of human interference are most serious. The visual observation related to this wild animal is very interesting behavior in respect to their sedentary nature in a very short range habitat for the study purpose where a good mass of medicinal and aromatic plants are available [32]. This study on reproduction and breeding is essential to know about rapid growth to ensure Pika reach an adult weight prior to the onset of winter. So an effort has been made in the present study to find out the breeding biology of Indian Pika (*Ochotona roylei*; Lagomorpha). Also in the absence of detailed studies and monitoring, it appears too conjectural to assume that it is decreasing or increasing.

2. Study Areas

Indian Garhwal Himalaya is recognized as a rich biodiversity center due to its different climatic conditions and provides a variety of ecosystems with floral as well as faunal diversity. It consists of an altitudinal variety that ranges from 2290 m to 6387 m at sea level situated between latitudes 30.23 N to longitude 79.22 E (Map location and photograph of the study area is given in figure 1 & 2). The adverse climatic condition of this area reveals about maximum 20°C at daytime in the month of June, 2008 to minimum -4°C air temperature recorded -4°C at midnight in the month of March 2007. High wind velocity, heavy frost, blizzards and low air pressure throughout the year is very common except a few months of the summer. Precipitation is found to be in the form of snow, hail and sometimes heavy rain. The two most remarkable climatic characteristics of the Garhwal Himalayas are hypoxia and cold. The study area is also enriched with myriad types of floral as well as of faunal diversity. Tungnath alpine region consist about 171 species of different grasses, sedges, monocots, forbs, and shrubs and most of them are medicinal [33]. Some important flora consist of *Rhododendron spp.* (Buranish), *Querques spp.* (Baanj), *Cedrus deodara* (Devdar), *Pinus spp.* (Kail) and *Abies pindraw* (Raga). The major wild animals found in this area are *Panthera uncial* (Snow Leopard), *Selenarctos thibentanus* (Himalayan Black Bear), *Moschus moschiferus* (Musk deer), *Martes flavigula* (Himalayan Yellow throated Martin), *Capra ibex* (Himalayan Ibex), *Hermitragus jemlahicus* (Himalayan Thar), *Lophophorus impejanus* (Himalayan Monal Pheasant) and *Pucrasia macrolopha* (Koklass Pheasant).

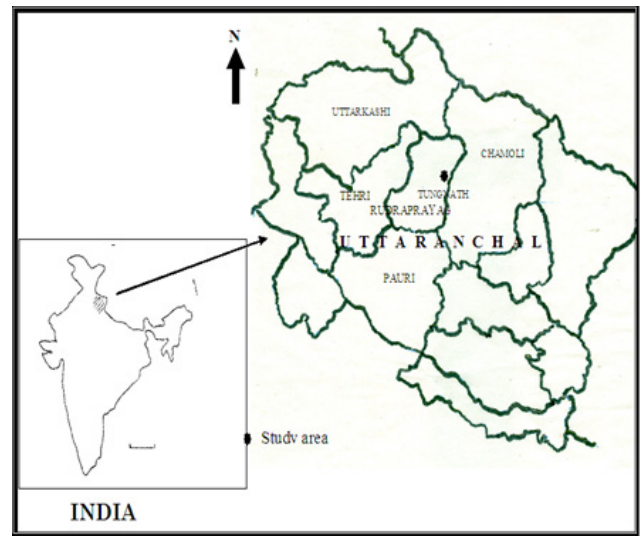


Figure 1. Study area in Map of India (Not for Scaling)



Figure 2. Study area at Garhwal Himalaya, India

3. Methods

In the present study on the reproduction and breeding biology of Indian Pika was examined in snow fed alpine areas of Tungnath (Garhwal) Himalaya, India. The study animal was located with the help of a binocular telescope by observing and searching its peculiar calls. The identification of animal was mainly made by certain physical peculiarities i.e. small in size, absence of tail with short, broad, rounded ears, short legs, and body (fur) color from dark gray to black brown. For the animal movement during breeding season, some individuals marked artificially by dyeing the fur with picric acid. The dyed furs turn to bright orange after 36 to 48 hours. Data on body mass and a sign of maturity was recorded by capturing individuals with the help of the rat catch cage net from their burrow in the study areas at Tungnath Himalaya in the day time by using a small piece of apple and other fruits and flowers available in the study areas [31], photograph of the study animal captured during the study period is shown in figure Number 3 to 5.



Figure 3. Indian Pika in its habitat in Uttarakhand, India



Figure 4. Indian Pika captured for physical observation



Figure 5. Indian Pika release after physical observation

The identification of the sexes is made by examining sex organs and secondary sexual characters i.e. mammary glands, which are present outside its body [34]. The status of reproductive activity for females was assessed by the appearance of their mammary glands, namely if these were visible, already swollen, or if the hair around the mammary glands showing that they were lactating in previous years. For males, the testicles were examined by simply touch by feeling, and they show visible and swollen. The activities of different females and males related to their territory preparation, struggling, and collection of grass material in the territory were observed from an ample distance using binoculars. The gestation period is observed on picric acid marked animals (three female in each study area) by making

regular (daily) visit and observe at the selected study areas (Chopta, Tungnath and Chandrasila) of Tungnath Himalaya. Information on fecundity and mortality were calculated by counting juveniles per female ($N \text{ juveniles} / \text{Female}$) during the breeding seasons (April to September 2007; 2008 and 2009) in three areas (Chopta, Tungnath and Chandrasila) of Tungnath Himalaya (table-1).

Table 1. Fecundity recorded during study period (2007-2010)

S.No.	Areas	Fecundity	Survive
1	Tungnath Areas	1	1
2	Tungnath Areas	3	2
3	Tungnath Areas	4	0
4	Tungnath Areas	5	2
5	Tungnath Areas	2	2
6	Tungnath Areas	3	1
7	Tungnath Areas	2	0
8	Chopta Areas	3	2
9	Chopta Areas	2	2
10	Chopta Areas	1	1
11	Chopta Areas	5	3
12	Chopta Areas	2	2
13	Chopta Areas	3	2
14	Chopta Areas	4	2
15	Chopta Areas	2	0
16	Chopta Areas	4	1
17	Chandrashila Areas	5	1
18	Chandrashila Areas	5	1
19	Chandrashila Areas	1	0
20	Chandrashila Areas	3	2
Total		60	27
Average		3	2.571429
Survival %			45 %

Individuals found dead were also included in the analysis of fecundity. The weaning time was calculated by watching juvenile activity in the morning and evening, when the individuals stop feeding of mother's and intake solid food, the female go away for an extended period up to 2 hours for food searching. The external morphology including size and color, were observed by capturing juveniles from study areas and daily activities including food searching territory making patten were observed by watching juveniles from an adequate distance with the help of binocular without disturbing the animals [31]. The sexual maturities of juvenile were observed in capturing the animal by examining sex organs

that are outside its body at regular intervals in the study areas.

4. Results

The reproduction and breeding biology of Indian Pika (*Ochotona roylei*) was conducted at the high altitude site of Tungnath (Garhwal) Himalaya where the animal inhabited. The atmospheric temperature ranged from -40 to 200 C. During breeding season the temperature was ranged from 15-200C. The average weights of the adult male Pika were 146 ± 18.2 g (range, 127.8 to 164.2 g) while the adult females were 158 ± 14.6 g (range, 143.4 to 172.6 g). In the last week of April 2007, during the field observation and morphological study of Pika, females showed first signs of breeding / reproductive activity in the form of visible mammary glands. Lactating females could be detected in May and June 2007 also. In males, the first visible testicles were observed in May 2007. The mating system of Pika is observed as facultative monogamous based on the paired configuration, its persistence in time, and the interplay of aggression and social tolerance behaviors. Females mate in their home range in 500m radius, only with their territorial partner, there is not any evidence was observed for mating

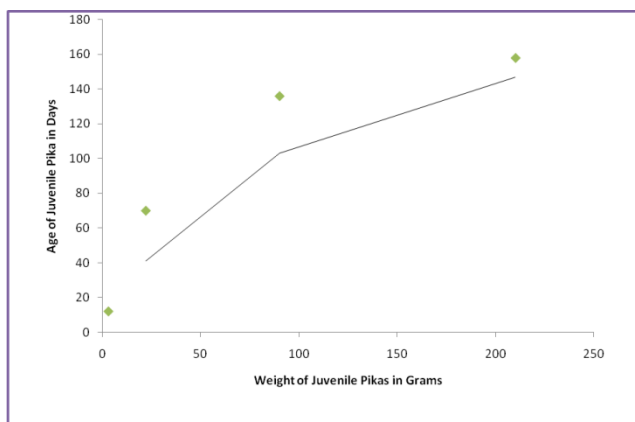
with others territorial partner. The mating/reproductive activities is observed in the last week of May to second week of June as struggling animals with its territorial partners based on the snow melt in their home range. Breeding seasons at higher elevations were found to let behind lower elevations (Chandrasila at an elevation of 4000 m at sea level) by four to six weeks. The first Parturition occurs as early in March at some low-elevation sites (Chopta at an elevation of 2400 m as sea level). Overall parturition occurs in May with a peak in June throughout the study area. In present study one nest hole having two juveniles observed before snow-melt from the Tungnath area at an elevation of 2800 m as sea level in February, 2008 shows that Pika start breeding before the snow melt because Pika do not hibernate and have access to food stored in their haypiles.

The average gestation period recorded 28 to 30 days based on average timing calculated between struggling animals with partners (mating) and juveniles present in the nest holes, and juveniles stop feeding of mother's milk (weaning time) and start feeding it with solid food (medicinal and aromatic plants including some grasses) was observed 20 to 22 days. The fecundity of the study animal (Pika) was observed minimum 1, maximum 5, and average 3 young per adult females (Table 2).

Table 2. shows the Reproductive feature of adult and Juveniles Indian Pika

Features		Minimum	Maximum	Average
Study area (Tungnath Himalaya)	Altitude (m at sea level)	2290	6387	4338.5
	Latitude	-	-	30.23N
	Longitude	-	-	79.22E
	Temperature (°C)	-04	20	--
Adult Weight	Male weight (g)	127.8	163.2	146
	Female weight (g)	143.4	172.6	158
Breeding Features	Breeding season	May	June	--
	Gestation Period(days)	28	30	29
	Fecundity	1	5	3
	Weaning Time (days)	20	22	21
Juvenile their weight	Eyes open on (Days)	7	11	9
	Feeding of solid food (days)	20	22	21
	Third day (g)	10	12	11
	After 22 days (g)	47	93	70
	After 3 months (g)	117	155	136
	After 7 months (g)	143.4	172.6	158

Morphologically early borne Juvenile Pika have slightly haired, with eyes closed and well developed teeth, the average mass of offspring was 10 to 12 g on 3rd days after birth and eyes open on 9 ± 2 days after birth. The weight of juvenile Pika was recorded average 70 ± 23 g in 22 days. After 20 to 22 days mothers are going away from the nest for extended periods for searching of food materials, and return in every 1.5 to 3 hours for nursing an average of 8 ± 2 minutes. Pika may reach minimum adult mass within 3 months of birth and recorded 136 ± 19 g. The Pika mature sexually within 7 to 9 months and breed in next coming season. The growth curve of juvenile Pika was given in the graph (Graph 1). When the Pika from Tugnath area become adults they have some aggressive and territoriality behave as agonists behave, scant marking, alarm calling, etc. In present observed mortality rates are greatest in the first three months after birth and average rate of mortality in Pika populations is 40 to 60 % each year, and found that very few Pika survived during the study period (2007-2010) from their natural habitat.



Graph 1. Growth curve of juvenile Indian Pika

5. Discussion

To continue the race of life in ecosystems, animals use two types of strategy, faster growth rates, and deviation in the timing of parturition according to environmental conditions to take benefit of the most excellent conditions for growth. In the present study Pika appeared to use both of these strategies in response to the highly changeable environment. In the Indian Himalayan alpine environment, Pika has to reach adult weights, establish territories, and begin collecting vegetation for their hay pile (food hoarding) before the onset of winter. Similar activity pattern was noted from different region by different authors [28, 29, 35] in others Lagomorpha. In present observation breeding is observed in the last week of May to second week of June based on the snow melt in their home range. Breeding seasons at higher elevations were found to let behind lower elevations (Chandrashila at an elevation of 4000 m at sea level) by about four to six weeks. Females showed first signs of breeding / reproductive activity in the form of visible

mammary glands could be detected in May and June 2007. In males, the first visible testicles were observed in May 2007. Similar time period and other reproductive activity were reported from different mountainous alpine zones [27, 35, 36, 37, 38, 39]. The mating system of Pika in the present observation is as facultative monogamous based on the paired configuration. The same pattern also been reported by Smith and Weston [35] from an American alpine zone. Females mate in their home range, only with their territorial partner, there is not any evidence was observed in the present study for mating sign with others, but in other Lagomorpha (American Pika) female may exhibit mate choice when more than one potential mate is available [35]. The observed populations showed a formal behave in sexual activity and reproductive output and were restricted to the summer months. Sexual activity was easier to detect for males than for females, since females showed only signs of pregnancy and lactation, but no signs of fertility. In present study sexual activity started in May and ended in June. Similar observation with slight modification as per environmental condition was taken by IUCN [12] in other Lagomorpha. Variation in the average parturition date among years, in the present study at Tugnath Himalaya, was partially correlated with net snow accumulation, with later parturition occurring after winters with large snow accumulation. Similar opinion has been observed in others Lagomorpha, where variation in initiation of first litters was positively correlated with snowmelt [38, 39]. Indian Pika may delay breeding following winters with high snow accumulation in order to coincide parturition with vegetative growth. The average gestation period was recorded 28 to 30 days and juveniles stop feeding mother's milk after 20 to 22 days. After 20 to 22 days juveniles start occasion feeding of milk in the extended period. A similar observation was recorded by different authors [16, 39, 40, 41] from different alpine zones in different species of Lagomorpha. In present study fecundity was recorded 3 litters per breeding season from the Tugnath alpine zone. A similar observation was recorded by IUCN [12] in different species of Ochotona from other alpine zones. While some authors indicated that Pika may have two litters per year based on females being pregnant and lactating at the same time [42, 43, 44], however, this does not provide evidence that two litters are successfully weaned. Similarly, Rausch, [42] collected adult females and found them to be pregnant late May to early June. Other studies have reported that the litter number of Pika ranges from 1-4 Pika, averaging 2.2-3 [16, 42, 45]. The timing of breeding in Pika from the study at Tugnath Himalaya site allows juveniles to be born where the vegetative growth is good. Which helps juveniles to provide good quality of food with high vegetation growth (biomass) including medicinal and aromatic plants during summer (July) [13, 31]. This may be helpful high energy demands of females during nursing as well as, higher quality vegetation medicinal and aromatic plants. The same opinion has been given by Smith and Weston [35] for some other Pika from different alpine zone. The delay in the timing of parturition in other mammals due to winters with deep or

persistent snow-cover has been reported and supporting our present finding by Adams and Dale [46]. The fast growth rate allows Pika to achieve near adult body size within the same season for successful survival, after therefore timing of parturition does not seem to significantly influence the survival. Smith and Weston, [35] have the same opinion in other Lagomorpha form American mountain area. Morphologically early borne Juvenile of Tungnath Himalaya Pika has small haired pink to light gray body color with eyes closed and teeth were becoming visible, the average mass of offspring was 8 to 12 g (N=05) on 3rd days after birth and eyes open on 9 ± 2 days after birth. The similar finding was recorded by Smith and Weston [35] in other *Ochotona* species. The weight of juvenile Pika was recorded average 70 ± 23 g (N=05) on 22 days and 136 ± 9 g (N=05) after 3 months of birth from Tungnath area showing some faster growth due to availability of good food. In the present study from Tungnath alpine zone Pika mature sexually within 7 to 9 months and breed in next coming season. The first adult behavior from Tungnath Pika is recorded with aggression and territoriality, such as agnostic behavior, scent marking and alarm calling at the age 7 to 9 months and breed in next coming season. The same behave has also been given by Smith and Weston, [35] from their study areas. The mortality rates are greatest in the first three months after birth and average mortality rates in Tungnath Pika populations is 40 to 60 % each year, and found that very few Pika survived in the study area for the last 2-3 years (2007 to 2010). This may be due to ecological changes taking place in and around the study Tungnath Himalaya areas i.e. sudden changes in temperature and snow malting may be due to eco-geological or geographical changes taking place. The high mortality rate was given in other Pika from different alpine zone by Smith [44] and Peacock [47] but the cause was not clear.

6. Conclusion

The present study deals with the reproductive behavior of Indian Pika (*Ochotona Roylei*) inhabited in the snow fed Tungnath areas of Garhwal Himalaya Uttarakhand, India, at the altitude of 2200 to 4500 meters at sea level. The animal breeds once in the year during the May to June at the age of 7-10 months, gestation period is 28 to 30 days and having fecundity 1-5 offspring with recorded weaning time 20 to 22 days. Morphologically Juvenile Pika have slightly haired, with eyes closed and well developed teeth, the average mass of offspring was 10 to 12 g on 3rd days after birth and eyes open on 9 ± 2 days after birth. The weight of juvenile Pika was recorded average 70 ± 23 g in 22 days. Indian Pika reaches minimum adult mass within 3 months of birth and sexually mature within 7 to 9 months and breed in next coming season. Mortality rates have recorded 40 to 60 % each year, and found that very few Pika survived in the studied area during the three years among the population in their natural habitat.

7. Recommendations

1. It has been observed at different locations that tourists are not careful and aware about the dumping of remains of food items. These dumps not only attract the mouse-hare but it also attracts few others herbivorous wild animals, which generally lead to drastic changes in their behavior. Tourist must be motivated against environmental pollution and towards conservation.

2. Studies are required to be conducted area-wise and altitude-wise status distribution in all over the Indian Himalayan range, which will be helpful in concluding its exact status whether the animal is endangered, vulnerable or rare.

3. Eco-development and awareness activities through training programs and workshops can provide better strategies in remote areas.

4. Grazing by horses, mules and other domestic animals is another major problem and it should be controlled in some of the habitats where the population of Indian Pika still exists.

5. It is recommended that the hoardings must be placed regarding to environmental conservation, which will be helpful in creating awareness among local people and tourist about the conservation issues of Himalayan biological diversity.

6. The rodent under study (*Indian Pika*) is found to feed upon medicinal plants in their native habitat. Proper taxonomy and biological study of these medicinal plants should be conducted to know the pharmacological effects on these rodents.

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