

Population density of Small Kashmir flying squirrel (*Hylopetes fimbriatus*) at Dhir Kot, District Bagh, Azad Jammu and Kashmir

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Abstract: The study was conducted to estimate the population of the small Kashmir flying squirrel in the district Bagh. The study area was divided into two sampling sites depending upon the vegetation and overall climatic variation. Surveys were conducted in the study area from October 2008 to June 2009. Line transect method was used to estimate the population of Kashmir flying squirrel. Each site was visited twice in a month. Transects were randomly selected in each study site and observations were recorded while walking through transects. Population density was estimated as 2.28 per hectare. Population density of at site A (1370-1690 m) was estimated to be 2.23 per hectare whereas the density at site B (1690-1980 m) was 2.33 per hectare. Maximum number of squirrels was recorded in June, 2009 (5.04 squirrels per ha) while the lowest number was recorded in February, 2008 (0.18 squirrels per ha). Density of the Kashmir flying squirrel increased in summer and declined drastically in winter months.

Key words: Population dynamics, hardwood trees, temperate forest Indo-Malayan region, red Murrelets.

INTRODUCTION

Small Kashmir flying squirrel (*Hylopetes fimbriatus*) is mainly confined to Himalayan moist temperate forest and almost sympatric with *Petaurista petaurista* (Corbet and Hill 1992; Hoffmann *et al.* 1993; Roberts 1997). The range of *H. fimbriatus* extends from Afghanistan to Kashmir and Punjab, India, along the edge of the Himalayas. This squirrel resides in fir *Abies pindrow*, spruce *Picea smithiana*, deodar *Cedrus deodara* forests and chestnut *Aesculus indica* - oak *Quercus* spp. forests in the mountains of the northwest Himalayas. Small Kashmir flying squirrel is also widespread in drier forest zones characterized by deodar and Holly oak (*Quercus balut*) in southern Chitral, forests of Dir and Swat Kohistan. It also occurs in Murree hills and Gilgit (Roberts 1997).

Flying squirrels have always attracted the mammalogists worldwide. Various aspects of their ecology, biology and population dynamics have been investigated by a number of scientists. Corbet and Hill (1992) studied the distribution of flying squirrels in Indo-Malayan region and found that the small Kashmir flying squirrel is distributed with red giant flying squirrel (*Petaurista petaurista*) in Himalayan moist temperate forest ranging from 1,350 to 3,050 m elevation. Densities of northern flying squirrel (*Glaucomys sabrinus*) was found higher in older forest stands than in younger forest stands of north eastern California. Moreover heavy logging and intensive site

preparation was found to have negative affect on flying squirrel population (Waters and Zabel, 1995). Nakagawa *et al.* (2007) found that abundance of terrestrial small mammals, were significantly negatively correlated with the percentage of fruiting trees with and/or two months lag. Wauters *et al.* (2002) reported that space used by one species did not affect on other species. In Estonia habitat of Siberian flying squirrel (*Pteromys volans*) has mainly decreased due to destruction of good nesting and hiding places (Tim and Kiristaja, 2002). Ransome and Sullivan (2004) reported that population of certain species of flying squirrels is not limited by the availability of nesting sites but food appeared to have a significant effect on the population. The densities of northern flying squirrels (*Glaucomys sabrinus*) and red squirrels (*Tamiasciurus hudsonicus*) had a strong relationship with the density of large spruce (*Picea* sp.) and hardwood trees and snags in conifer sites (Holloway and Malcolm, 2006). Carey *et al.* (1992) reported that flying squirrel densities are twice as greater in old forest stands as compared to younger forest stands.

No specific study on small Kashmir flying squirrel has so far been conducted in AJ&K, so information on its population and biology/ ecology is not available. Presently this species has been declared as vulnerable (VU) in Pakistan (Sheikh and Molur, 2005). Present study aimed to estimate the population of small Kashmir flying squirrel in Dhir kot, AJ&K.

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MATERIAL AND METHODS

Study Area

The study was conducted at selected forest blocks in Tehsil DhirKot (33° 51' N 73° 29' E) located at western side of district Bagh, AJ&K. Dhirkot is located 25 kilometres from Kohala and 132 kilometres from Islamabad, at an altitude of 1676 meters. Study was conducted in an area of 10km² of the forest along the north eastern side of village Sanghar Bathara. The forest is located in the transition zone; blue pine (*Pinus wallichiana*) on higher elevations and chir pine (*Pinus roxburghii*) on lower. Other tree species like kau (*Olea ferruginea*) and white oak (*Qurecus incana*) were also present in the forest. Beside these many small trees, herbs, shrubs and grasses were also abundant in that area.

Study Design

The study area was regularly visited for a period of nine months from October 2008 to June 2009. The data were collected for four nights a month. Study site was divided into two sampling units (A and B) representing almost two different habitats depending upon dominant plant species and overall climate. Each sampling unit was visited twice in a month.

Site A is a low lying area mostly covered with chir pine and kau (*Olea ferruginea*). Beside these plenty of fruit trees e.g. walnuts, apples, pears, and citrus fruits were available in this area. Oak tree is less common in this sampling unit. As forest of this sampling unit is comparatively newer one so less number of old trees are available for feeding, nesting and roosting of Kashmir flying squirrel. Elevation of this sampling unit ranges from 1370 meters to 1690 meters. Climate of this site is relatively milder as compared to site B. Water is abundantly available in this unit. Snowfall although occurs but it is less common in this unit.

Site B is an upslope area having elevation range from 1690 meters to 1980 meters. This unit is mainly covered with blue pine and oaks. Forest in this unit is much thicker and older as compared to site A. Winter is too harsh in this site as snowfall occurs frequently and temperature falls below freezing. All of the above mentioned species of fruit trees were also found in this unit.

Population Estimation

To estimate the populations of flying squirrel line transect method was used. Transects were randomly selected in each sampling unit. Transects were selected which were representatives of a sampling unit or at least a part of sampling unit. Data were collected while walking through the transect length. Both direct as well as

indirect method of population estimation was employed. Direct method entails searching actively for the animal along a predetermined strip of land using binoculars and searchlights. Activity sounds of flying squirrels were also noted with estimated distance. Length of strip and flushing distance was noted so that total area sampled could be extrapolated to get an estimate of total population in study area. Width of the transect was calculated by multiplying the average flushing distance with 2. Length and width of the transect was multiplied to the total area of the transect. Density of Kashmir small flying squirrel in a transect was calculated using the following formula;

$$\text{Density (per hectare)} = \frac{\text{Number of individuals flushed}}{\text{Area of transect (hectares)}}$$

In this way density of both sampling units were calculated. T-test was applied to compare the difference in densities of both the sites.

RESULTS AND DISCUSSION

Average population density (for both the sites) of small Kashmir flying squirrel was found to be 2.28 squirrels per hectare in the study area. Population density of small Kashmir flying squirrel at site A was 2.23 squirrels per hectare and at site B 2.33 squirrels per hectare (Table. 1). Value of T-test (0.36) showed that there was no significant difference between the densities of two units.

Table 1 Month wise densities per hectare at site A and B

Month	Density at Site A	Density at Site B
October	1.46	3.34
November	3.32	2.14
December	0.79	1.07
January	0.25	0.67
February	0.38	0.00
March	3.00	2.10
April	2.78	3.27
May	4.26	3.24
June	4.86	5.24
Mean (S.E)	2.23±0.55	2.33±0.54

The density of small Kashmir flying squirrel did not remain constant through the year rather it varied with the season. There was a sharp decline in population density at the start of winter; the minimum during the coldest months (December to February). Maximum

number of individuals were recorded in June, 2008 (5.04 squirrels per ha) while lowest number of squirrels was recorded in February (0.18 squirrels per ha). The sharp increase in the density of small Kashmir flying squirrel in the beginning of spring showed the increasing trend throughout summer (Table 2). It is presumed that increasing trend in the density may persist after the study period until the start of next winter.

Table 2. Month wise average density per hectare (for sites A and B)

Month	Density per hectare
October	2.39±0.69
November	2.23±0.12
December	0.99±0.33
January	0.45±0.31
February	0.18±0.18
March	2.25±1.29
April	3.02±0.37
May	3.75±0.59
June	5.04±0.29
Mean (S.E)	2.28±0.5

Small Kashmir flying squirrel prefers to live in old and mature forest as compared to newer one, because there are more roosting, nesting and feeding cover available in old and thick forest vegetation. Lower density of Kashmir flying squirrel (2.23 squirrels per ha) was recorded at site A which suffered from severe logging, resulting in the reduction of roosting, nesting and feeding resources at this site. Holloway and Malcolm (2006) also found that density of flying squirrels (*Glaucomys sabrinus* and *Tamiasciurus hudsonicus*) were higher in old forest stand than newer ones. Waters and Zabel (1995) reported that heavy logging is negatively affecting northern flying squirrel (*Glaucomys sabrinus*) density in north eastern California.

Present study reveals that small Kashmir flying squirrel resides at the elevation higher than 4450 feet (1356 m) in moist temperate forest, and its range of distribution extended beyond 6500 feet (1981 m). Corbet and Hill (1992) described that small Kashmir flying squirrel is distributed in Himalayan moist temperate forest between elevations of 1350m to 3050m.

From November, 2008 to February, 2009 density of small Kashmir flying squirrel was slightly higher at site A as compared to site B, for temperature dropping radically in site B. Furthermore site B is characterized by early freezing temperature, frequent rainfall and snowfall from December to January. Because of these harsh winter

conditions density of Kashmir flying squirrel decreases at site B. To overcome these ruthless conditions some individuals of small Kashmir flying squirrel may locally migrate towards low lying areas (site A) while rest of them hide themselves in wintering shelters. These shelters are mostly the grass stocks which local people erect for safe wintering diet of their cattle. During the period Kashmir flying squirrels used stored food in the form of acorns, walnuts, seeds of cone and many different fruiting plants and other starch rich food items.

On the other hand, in winter density of site A was a bit higher than site B. It was because, winter was relatively milder in site A as compared to site B. Temperature is more favorable and rainfall occurs less frequently. In winter food resources were plentiful in site A than that of site B. Snowfall although occurs but it was less intensive in site A. Kashmir flying squirrel prefers to spend its winter in site A because of these appropriate conditions.

A sharp decline in density of Kashmir flying squirrel was observed at the start of winter. As the winter begins the temperature starts decreasing rainfall become frequent and food resources diminished. So Kashmir flying squirrels hide themselves in wintering shelter and holes or nests to cope these challenging conditions. Lowest density (0.38 squirrels per hectare) has been recorded in February. This is because temperature was too low at food was limited during this coldest month. At the beginning of spring density of Kashmir flying squirrel starts increasing gradually and reaches at its peak at the end of summer.

In summer conditions become more favorable as temperature rises to normal and choice of food also increases. But in summer the density of Kashmir flying squirrel in site B was faintly higher than site A. This is because of less availability of roosting and nesting sites site A. Moreover, in summer plentiful food resources were also available for small Kashmir flying squirrel at site B.

Although feeding resources were almost similar in both sites but flying squirrel preferably used site B. In summer nests were required for flying squirrels to breed. So availability of more nesting and roosting sites in site B attracts flying squirrel to live in this old forest. Population density of small Kashmir flying squirrel declined in winter in similar fashion as that of site A where the population density declined more sharply. The reason of this sharp decline was that winter was more prolonged and harsh at site B. Like the site A, minimum density of site B was recorded in January and February. In January density of Kashmir flying squirrel was 0.67 per hectare while in February no squirrel was observed at site B.

As the spring turn up sudden rise in population density of Kashmir flying squirrel has been recorded in site B. This increase in population density of Kashmir flying squirrel is much similar to that of site A. In April when suitable conditions were available density of Kashmir flying squirrel increase rapidly. This may be due to the upward movement of those individuals which were migrated to low lying areas (site A). Now more food resources were available and more suitable condition exists so Kashmir flying squirrel prefers to live in this habitat type. Population density progressed in this site as the summer proceeds. Maximum density has been recorded in June (5.24 squirrels per hectare) at the end of study period. But population density of Kashmir flying squirrel increased in similar fashion till the next winter arrived.

Comparison of densities of Kashmir flying squirrel at two sites viz. A and B from October 2008 to June 2009. Densities at both sites decrease in winter and increased in summer in almost similar fashion. It is also clear that during winter decline in density of Kashmir flying squirrel was much sharper at site B.

Values of estimated population densities of Kashmir flying squirrel from October, 2008 to June, 2009 with their standard error has been given in Table. 2, that explains the trend of population density of Kashmir flying squirrel at the study sites from October, 2008 to June, 2009.

ACKNOWLEDGEMENTS

The authors are grateful for the field assistance provided by Sajid Abbasi and Hafiz Ameer Muhammad Khan, at Dhirkot, district Bagh, Azad Jammu and Kashmir. Also thankful to local communities for providing the facilities in field work during study period.

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