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Full Length Research Paper

The probable genetic introgression between Walia ibex (*Capra walie*) and domestic goats (*Capra hircus*) at Simien mountains national park (SMNP) in Ethiopia

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An exploratory survey was conducted at Simien mountains national park (SMNP) and bordering districts to assess the genetic introgressions between walia ibex (*C. walie*) and domestic goats (*Capra hircus*) in Ethiopia by studying breeding strategies, production and grazing systems. About 96.9% of the farmers practiced extensive goat production system. The common goat grazing places include outside and within SMNP with an index value of 0.60 and 0.36 respectively. Does selected with selection preferences of size, twining and mothering ability with an index of 0.28, 0.15 and 0.14 but, size, libido and growth was preferred for bucks with an index value of 0.35, 0.13 and 0.11 respectively. Relationships among indices with highest value traits were correlated. The correlation of size with pedigree was significant in both females and males ($p < 0.01$). This indicated farmers' interest to interbreeding their goats with the Walia to get strong and huge hybrid. The traits between *C. hircus* and *C. walie* ($r = 0.38$, $p > 0.05$) as well as *C. walie* and the suspected hybrid goat ($r = 0.21$, $P > 0.05$) were negatively correlated. However, traits between the suspected hybrid and *C. hircus* were positively correlated ($r = 0.34$, $p < 0.05$). Therefore, there is trepidation of introgressive hybridization between *C. hircus* and *C. walie.* However, there were no persuasive evidences that shown interbreeding between the two species.

Key words: Breeding strategy, *C. hircus*, genetic introgression, production system, SMNP, *C. walie.*

INTRODUCTION

Natural habitat is rapidly being converted into landscapes dominated by humans and domestic animals world wide (Kidd et al., 2009). Wildlife populations are also likely to live in direct contact with domesticated species. The wild can be negatively affected by domestic organisms through predation, resource competition and disease introduction (Manchester and Bullock, 2000; Kidd et al., 2009). Furthermore, introduction of domestic animals to wild population can also result in genetic introgression between domestic and wild animals (McGinnity et al., 2003; Hutchings and Fraser, 2008).

Hybridization among species has traditionally been viewed as an unusual event but occurs more commonly than originally believed (Mallet, 2005; Arnold and Meyer, 2006) and it may occur between wild and domestic species (Lecis et al., 2006). Interbreeding between domesticated and wild counterparts has been observed in terrestrial carnivores, ungulates, fowl, anurans and many fish species (Williams et al., 2002; Kidd et al., 2009). When domesticated species have wild conspecifics, one of the most detrimental impacts is the infusion of domestic genes to the wild relatives (McGinnity et al., 2003; Kidd et al., 2009). Interbreeding may also introduce genes favoured under artificial selection but maladaptive in the wild natural environment. This disrupts locally adapted gene complexes and can

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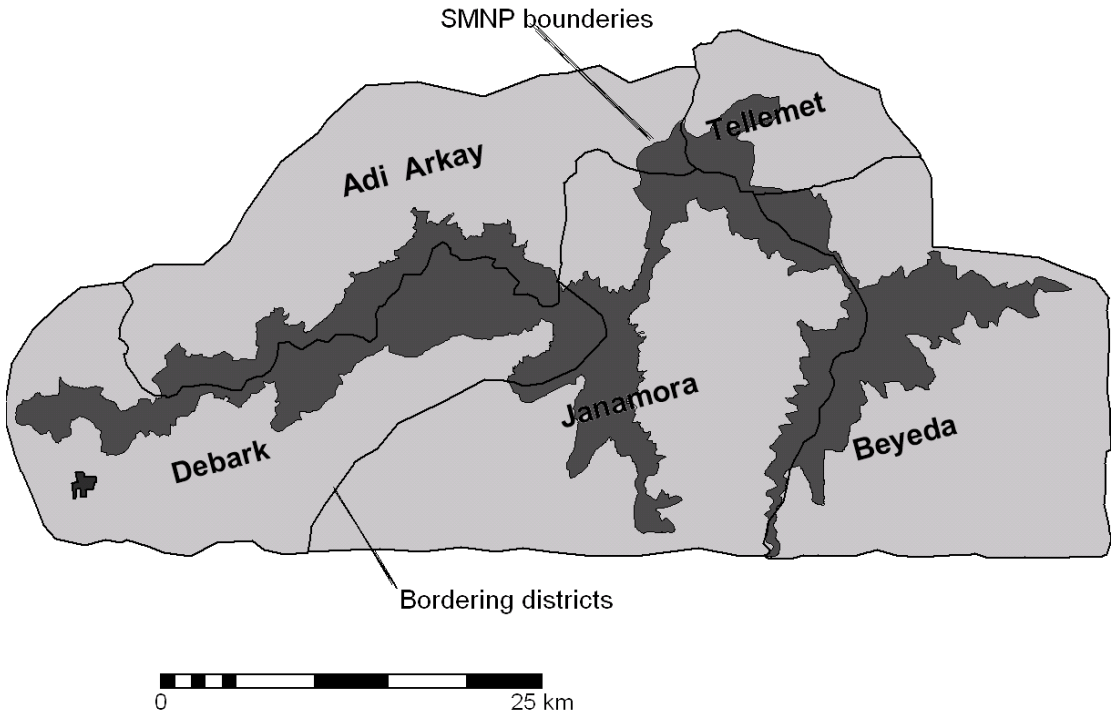

Figure 1. Location of the study areas, SMNP and related bordering districts.

reduce the fitness of wild populations and alter their evolutionary integrity (McGinnity et al., 2003; Hutchings and Fraser, 2008; Kidd et al., 2009) since domesticated animals are subjected to intense directional selection for production traits, line breeding and relaxed natural selections which result in low genetic variation and fixation of deleterious genes (Belliveau et al., 1999; Lynch and O'Hely, 2001). The consequences of genetic introgression between domestic and wild populations include reduced survival and fitness of the F_1 and F_2 generations, accelerated growth rate, decreased predator avoidance behaviours and increased agonistic behaviours (McGinnity et al., 2003; Wessel et al., 2006; Hutchings and Fraser, 2008).

The wild endemic species of walia ibex *(C. walie)* has been maintained in a wildlife reserve area in Ethiopia Simien mountains national park, (SMNP). The park is located within and around the vicinity of human settlements, which tend to cross their domestic goats with *C. walie* males as they believe the crossbreds are thriftier (PaDPA, 2006). Risk of hybridization between the domestic and wild goat populations in SMNP area has been also expressed earlier (Shackleton, 1997). Due to closer genetic similarity between Walia ibex (*Capra ibex walie*) and domestic goat (*Capra hircus*), there is a strong concern of an interbreeding that could modify the genetic behaviour of *(C. walie).* Therefore, the objective of this study is to asses the probable genetic introgression between (*C. walie*) and central highland domestic goats at SMNP, Ethiopia.

MATERIALS AND METHODS

Study sites

The study was conducted at a wildlife conservation area Simien mountains national park (SMNP) and surrounding districts. The park harbours two of the world's most threatened mammals: the Walia ibex (*Capra ibex walie*) and the Ethiopian wolf (*Canis simensis*). SMNP is located in the northern parts of Ethiopia, North Gondar zone of the Amhara national regional state (ANRS). The geographic location extends from 13°9'57'' to 13°19'58'' north latitude and from 37°54'48'' to 38°24'43'' east longitude. The park is situated within three districts of north Gondar administrative zone, namely Debark, Janamora and Adarkay (Figure 1). It is 120 Kms north-east of Gondar, which is about 741 kms away from Addis Ababa. The park has altitudes ranging from 1900 to 4543 m.a.s.l. It covers an area of 179 km^2 of the Simien mountains watershed (Gebremedihn et al., 2009).

Questionnaire survey

Genetic introgression of domestic goats (*C. hircus*) with Walia ibex (*C. walie*) was studied by assessing breeding strategies, production and grazing system employed by domestic goat producers in the area. From 17 peasant associations/ kebeles / found adjacent to the park, Debark, Adiarkay and Janamora district has five (5), one (1) and zero (0) peasant associations found in side the park respectively. Therefore, the study was focused on domestic goat population of Debark district. Modified questionnaires were set and data were recorded on the prepared format. The questionnaires adopted from the standard breed description list were developed by FAO (1986), International Livestock Research Institute (ILRI) and Oromiya Agricultural Development Bureau for survey of livestock breeds in Oromiya, Ethiopia (Workneh and Rowlands, 2004;

Table 1. Major constraints (pair wise ranking) of goat production in SMNP.

Constraints (N = 127)	Rank 1	Rank 2	Rank 3	Index
Feed shortage	17	6	2	0.21
Water shortage	29	5	4	0.32
Disease	7	2	2	0.09
Heat (increase in temperature)	6	0	2	0.06
Drought	19	6	5	0.23
Market	0	3	1	0.02
Breed	5	1	3	0.06
Mobility	0	0	2	0.01
Total	83	23	21	1

Index = Sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) given for an individual reason divided by the sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) for overall reasons.

Getachew et al., 2010) .To study breeding strategy, production and grazing systems as well as its contribution to genetic introgression, pre-designed, structured and self-administered questionnaires were prepared, tested and indices were calculated for each and over all reasons, criteria or preferences. The questionnaires were administered into three different categories of 137 respondents by enumerators recruited and trained for this purpose that is:

(1) The park and agricultural development office workers as well as tourist guides (N=64) and the results were compared and measured five points Likret scale measurements according to Koumar (2005).
(2) The farmers live within and near the border of the park and purposely selected (N=21) and involved in focus group discussions.
(3) Farmers live 7-10 kms far from the park, randomly selected (N=52) and provided with questionnaires and personal interviews were also held. Ten (10) questionnaires were rejected due to incompleteness.

Based on the questionnaires administered, information on goat production and management, feeding and seasonal grazing systems employed and constraints, goat breeding practices and public opinions about possibility of genetic introgression of walia ibex with domestic goats were captured. As a follow up focused group discussions were held with purposely selected farmers and park experts. The focus group was composed of youngsters, women goat owners, village leaders and elders who are known to have better knowledge on the present and past historical background of the SMNP and the walia ibex.

Phenotypic characterization

Phenotypic characterization of *C. hircus* and *C. walie* in the study areas were also employed. Similarity and differences such as facial profile, horn size and structure, coat type and colour, beard and grazing behaviour of the domestic goats were conducted and compared with *C. walie*. Phenotypic traits of domestic goats, walia ibex and the suspected hybrid goat were also correlated each other for similarities or differences among the traits measured to clarify if genetic introgression between the two species exist. The phenotypic characteristics of *C. walie* were studied by taking only four male and female in eight home ranges in the park (Buait ras, Sankaber, Ginch, Chenek, Sebat minch, Adarmaz, Muchila, and Dirni) and a total of 64 individual *C. walie* were considered and studied by the help of telescope and /or binoculars. About 8 - 16 male and female domestic goats (*C. hircus*) were also randomly selected in eight communal grazing areas like Adisgie Milli Gebsa, Abergina, Dibel and Argi ejona (found near and within SMNP) and Abbera, Sugsug, Tsehay mewcha and Teraboch (found far from the park) These goats were characterized by direct observation from a group of 8 – 27 total population found in each study site. As a whole, 64 to 128 individuals were characterized from 216 domestic goats considered.

Data analyses

Data collected through questionnaires were entered into statistical package for social sciences software (SPSS, 2007) for analysis. Preliminary data analysis like homogeneity test and screening of outliers were employed before undertaking the data analysis. Chi-square was employed to test independence/significance of categories in traits measured during criteria of selection and phenotypic studies. The correlations between high indices value and with next and correlation among phenotypic traits were analyzed using correlation analyses. Indices were calculated to provide ranking of selection criteria, feed sources, grazing methods and places, as well as main production constraints of goats as indirect elucidation of genetic introgression between *C. hircus* and *C. walie*. Index = Sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) given for an individual reason divided by the sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) for overall reasons.

RESULTS

Goat production system and major constraints

The majority of the farmers (84.1%) are engaged in crop-livestock mixed farming, the rest (15.9%) producing crop only. Goats are the second dominant species (24.2%) next to sheep (29.8%). Cattle population consists only 12.5% in the study area. Almost all of the farmers interviewed (96.9%) reported that the common goat production system is extensive and only 3.1% use semi-intensive systems of production. The major goat production constraints reported were drought, water and feed shortage with an index of 0.32, 0.23 and 0.21 respectively (Table1).

Feed resources and grazing management

The main sources of goat feed are natural pasture

Table 2. Goat feed resources, grazing methods followed and places of grazing in the study areas.

Parameters (N = 127)	Alternatives	Rank 1	Rank 2	Rank 3	Index
Feed sources	Natural pasture	47	21	15	0.70
	Established pasture	0	0	0	0
	Hay	1	3	1	0.04
	Crop residues	2	19	9	0.19
	Fallow land	4	0	1	0.05
	Concentrate	1	2	1	0.04
Grazing methods	Open grazing	53	48	15	0.91
	Herded	0	2	1	0.02
	Paddock	0	7	3	0.06
	Tethered	0	1	3	0.02
Place of Grazing	Free ranging	41	14	8	0.60
	Enclosure in restrict place	0	7	5	0.06
	In and round SMNP	6	18	28	0.36

Index = Sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) given for an individual reason divided by the sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) for overall reasons.

followed by crop residues with an index value of 0.70 and 0.19 respectively. The principal grazing methods commonly practiced in the area is free ranging grazing methods with an index of 0.91. Farmers live within and at the borders of the SMNP reported that the usual place of grazing for their livestock is communal grazing lands including in and around the SMNP with an index of 0.60 and 0.36 respectively (Table 2). About 95.3% of goats graze within and around SMNP during the dry season and only 42.2% of the goats graze around and within SMNP during the long rainy season.

Breeding practices and selection criteria

Breeding of goats in the study area is generally uncontrolled and 86% of the respondents reported that they practiced uncontrolled mating systems. Only 14% of the households tried to use controlled mating system. According to the respondents, the grazing system they followed makes it difficult to practice controlled mating system; however, they prefer to select breeding males than females. Both uncontrolled mating and free ranging grazing systems created opportunities for domestic goats and walia ibex to graze together and then apprehension to genetic introgression. The index revealed that selection criteria for breeding females was size, twining and mothering ability with an index of 0.28, 0.15 and 0.14 respectively, while for breeding bucks, it was size, libido and growth with an index value of 0.35, 0.13 and 0.11 respectively (Table 3).

The correlations of size with twining ability in Females and libido in males as well as pedigree in both males and females were tested. The result revealed that there was no significant correlation between twining ability and size ($r = 0.576$, $p > 0.05$) as well as libido and size ($r = 0.41$, $p > 0.05$). The relationship of pedigrees in both males and females were significant ($r = 0.828$, $p < 0.05$).

Genetic introgression

About 93.8% of park and agricultural development office workers as well as tourist guides agree that domestic goats regularly graze within and around SMNP for the last 10 years. About 25% of the farmers residing around the SMNP agree that they recognize the importance of cross-breeding between different breeds of domestic animals such as Holstein bulls with indigenous zebu cows to increase the productivity, growth and strength of their livestock. About 76.6% of the respondents believe that domestic goats have the probability of cross-breeding with walia ibex while grazing together. About 9.4% of the respondents reported that they have information about the cross breed between domestic goat and walia ibex (Table 4 and Figure 2).

About 95.2% of the park dwellers and the neighboring communities revealed that walia ibex graze with domestic goats at SMNP and 61.9% of the respondents reported that male walia ibexes travel beyond the range of the park for the last 10 years. About 76.2% of the respondents also believe that walia ibex can cross breed with domestic goats. On the other hand, 45.2% of the farmers dwelling far from the park (7- 10 kms radius) believed that domestic goats graze at SMNP but only 26.2% had the perceptions that walia ibex can interbreed with domestic goats while grazing together (Figure 3).

Personal interviews and focused group discussions

Table 3. Criteria used by farmers for selections of breeding does and bucks and their ranking.

	Parameter	Rank 1	Rank 2	Rank 3	Index
Selection criteria for breeding buck	Size	18	14	9	0.35
	Colour	1	4	0	0.04
	Character	3	2	2	0.06
	Availability (no choice)	3	1	0	0.04
	Adaptability	2	4	2	0.06
	Growth	7	3	2	0.11
	Prolificacy	4	3	2	0.08
	Age	2	3	2	0.07
	Libido	7	5	3	0.13
	Pedigree	5	3	1	0.08
Selection criteria for breeding does	Size	16	13	7	0.28
	Colour	2	3	1	0.05
	Mothering character	11	3	2	0.14
	kid growth	6	3	2	0.08
	kidding interval	7	4	2	0.11
	Twining ability	9	6	3	0.15
	Longevity	3	2	1	0.05
	Adaptability	0	2	0	0.01
	Pedigree	7	3	9	0.13

Index = Sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) given for an individual reason divided by the sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) for overall reasons.

Table 4. Respondents' opinion about genetic introgression of domestic goat (*C. hircus* and Walia ibex (C*. walie*).

No.	Questions where genetic introgression of domestic goat and Walia ibex was addressing.	Rating at five points Likret scale measurements, N = 64				
		Strongly disagree	Disagree	Un- certain	Agree	Strongly agree
1	Domestic animals graze inside the SMNP	0 (0%)	4 (6.25%)	0 (0%)	9 (14%)	51 (79.96%)
2	Domestic goats usually graze at the SMNP for the last 10 years.	0 (0%)	0 (0 %)	4 (6.25%)	46 (71.9%)	14 (21.9%)
3	Farmers residing around the SMNP use cross-breeding strategy to increase the productivity, growth and strength of their livestock.	6 (9.4%)	3 (4.7%)	39 (60.9 %)	7 (10.9%)	9 (14.1%)
4	Domestic goats have the probability of cross-breeding with Walia ibex when grazing together.	0 (0%)	0 (0 %)	15 (23.4%)	6 (9.4%)	43 (67.2%)
5	Farmers living around the SMNP graze their goats with in the park intentionally for cross breeding with Walia ibex.	38 (59.4%)	26 (40.6%)	0 (0%)	0 (0%)	0 (0 %)
6	There is/are domestic goat/goats which is/are cross breed with Walia ibex and has/ have similar physical structure.	42 (65.6%)	4 (6.25%)	6 (9.4%)	12 (18.75%)	0 (0 %)

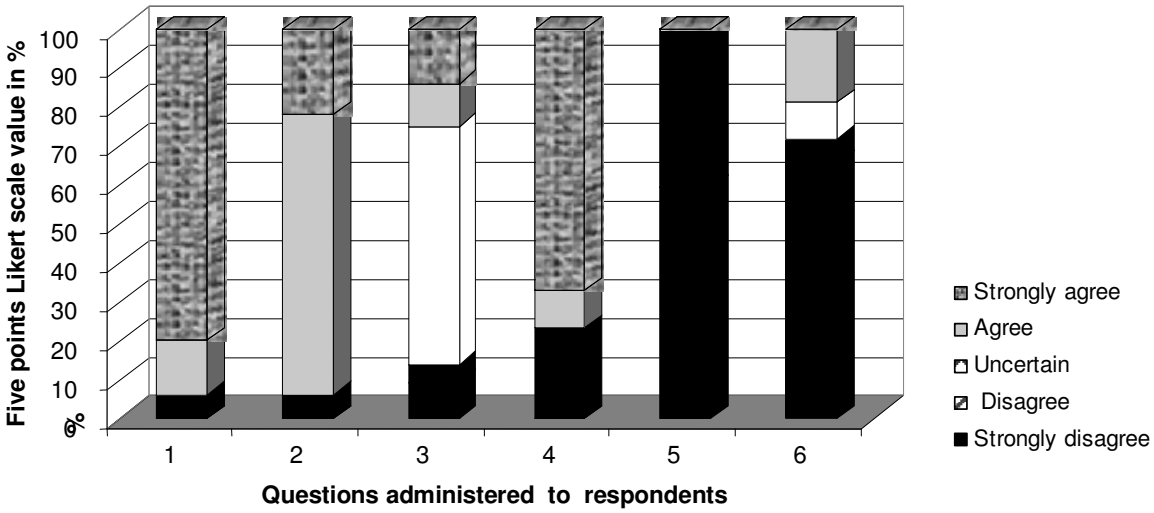

Figure 2. Public opinions about genetic introgressions of C. hircus and C. walie in five points Likret scale measurements. Key to number 1-6 indicated at x-axis: 1. Domestic animals graze inside the SMNP; 2. Domestic goats usually graze at the SMNP for the last 10 years; 3. Farmers residing around the SMNP use cross-breeding strategy to increase the productivity, growth and strength of their livestock; 4. Domestic goats have the probability of cross-breeding with Walia ibex when grazing together; 5.Farmers living around the SMNP let their goats graze with in the park deliberately for cross breeding with Walia ibex; 6.There is/ are domestic goat/goats which is/are cross breed with Walia ibex and has/ have similar physical structure.

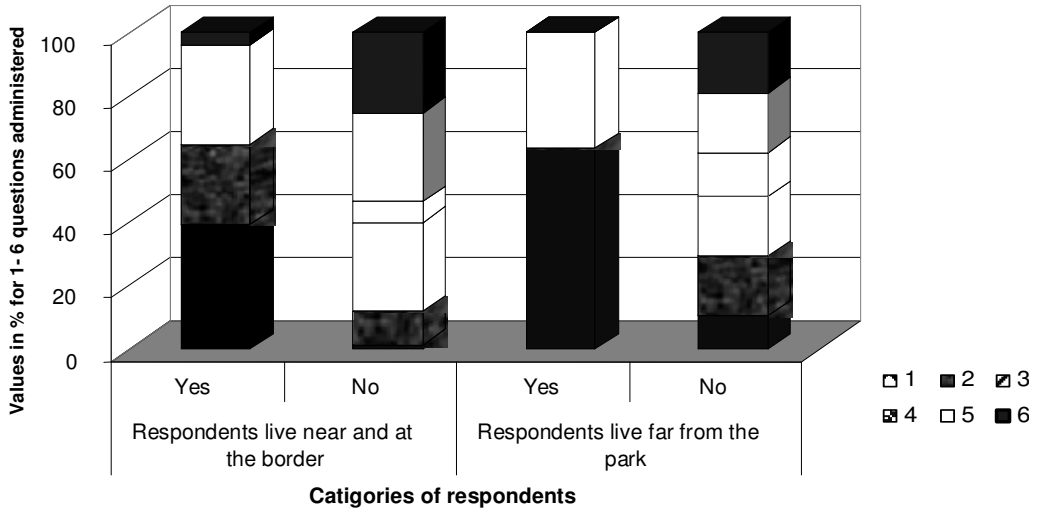

Figure 3. Public opinions (dwellers within and border and, far from the park) about genetic introgressions between *C .hircus* and *C. walie.* Key: The numbers 1-6 in the figure 3 refers to: 1. Have you ever seen Walia ibex and domestic goats grazing together for the last 10 yrs? 2. Have you ever seen male Walia ibex travel out side the Park Range? 3. Have you faced domestic goats and Walia ibex while rutting together? 4. Do you think that Walia ibex can cross breed with domestic goats? 5. Do you have any idea weather the farmers graze their goats with in the park deliberately for cross breeding purposes with Walia ibex? 6. Have you ever seen domestic goat/s, which is/are physically similar to Walia ibexes?

results with selected individuals indicated that walia ibex and domestics graze together at SMNP and rutting was common between these two species while grazing together. The interview with park experts revealed that a hybrid from sire walia ibex and dam domestic goats were reported by the farmers and pictured (Figure 4).

Phenotypic characterizations

Domestic goats (*C. hircus)* are social animals with matriarchal groups (of nannies/does and young) that can be included yearling bucks. Bucks are more solitary and are known to wander for several kilometers in search of

Figure 4. Offspring believed to be crossbred from male *C. walie* and female *C. hircus* of Ethiopia (The dam (left), hybrid (center) and sire (right).

females in oestrus, Goats are highly opportunistic in exploiting ephemeral types of feed and able to climb low branches of trees and are adept at covering steep rocky ground. They are very selective and able to target the leaves and flowering parts of herbaceous species including orchids, flowers, ferns and fruits. They have a predominantly straight (72%) facial profile; 28% of the goats have a concave profile. Virtually all males have horns, 77% being straight and pointing backwards, 15% curved and 8% spiral. The coat type is short and smooth with 49% plain colour, 43% patchy and 8% spotted. The predominant colour is red-brown (39%), the remaining goats being split between black, white and gray. Most males (86%) have beard. Both sexes of domestic goats have short, hairy tail type and pointed backwards (Table 5).

Both sexes of walia ibex (*C. walie)* have black and white markings on their legs and a gray-white underside. The dorsal area is coloured chestnut-brown and is darker in males. Females have lighter colour. At older ages, males develop both a black chest and elegant black beards. About 95% of walia ibexes have strait facial profile (Table 5).

They have a black stripe down the outside of their legs and a white garter above each hoof, broken on the hind legs by a black streak into the cleft of the hoof. Horns are semi-circular in shape, curved pack and random knots and age rings especially in matured males. Their tails are short with a brush-like tuft of black hairs and pointed strait down wards. Walia ibex are strictly crepuscular, only actively moving or feeding in early mornings and late evenings and are very lethargic and tend to hide under the shade of dense brush away from the intense noon sun and any nearby predators. Males tend to form larger groups than females (except during the rut). Females form nursery groups during the birth season. Walia ibex is both a grazer and a browser. A wide variety of grass and shrub included in the diet, the common ones are: grasses, herbs, shrubs, bushes, creepers and lichens.

Main traits of *C. hircus*, *C. walie* and the suspected hybrid goat were correlated. The result revealed that traits of *C. hircus* and *C. walie* ($r = 0.38$, $p > 0.05$) as well as *C. walie* and the suspected hybrid ($r = 0.21$, $P > 0.05$) were negatively correlated but the correlation between traits suspected hybrid and *C. hircus* ($r = 0.34$, $p < 0.05$) were positive.

DISCUSSIONS

The preservation of genetic diversity both within and among natural populations is a fundamental goal of conservation genetics (Keiper et al., 2000). Various genetic markers and PCR techniques have been used in a wide variety of ways to study genetic diversity. Non-invasive methods for gathering genetic information is one of the methods used to study species that are elusive, nocturnal, wide ranging or highly endangered to implement the study without having to capture or harm the animal (Creel et al., 2003).

Molecular markers, such as microsatellite variation, have been used to study the amount of hybridization between closely related species (Roy et al., 1994). Spatial distribution of alleles has been used to study local

Table 5. Traits characterized for comparison of domestic goats (*C. hircus*), Walia ibex (*C. walie*) and suspected hybrid goats at SMNP.

Traits measured		Domestic goats (*C. hircus*)		Walia ibex (*C. walie*)		Suspected hybrid goats	
	Specific traits	*%*	*Value*	*%*	*Value*	*%*	*Value*
Facial profile	Straight	72	0.72	95	0.95	100	1
	Concave	28	0.28	5	0.05	0	0
Horn shape	Straight and pointing backwards	77	0.77	0	0	100	1
	Curved	15	0.15	100	1	100	1
	Spotted	8	0.08				
	Semi-circular in shape, curved pack and random knots and age rings	0	0	100	1	0	0
Coat type	Short and smooth, plain color	49	0.49	25	0.25	100	1
	Patchy	43	0.43	10	0.1	0	0
	Spotted	8	0.08	0	0	0	0
Coat color	Red-brown	39	0.39	0	0	75	075
	Mixed black , gray, white	61	0.61				
	Chestnut-brown	0	0	75	0.75	0	0
	Dark chocolate	0	0	25	0.25	0	0
	Bear	83	0.83	25	0.25		
Tale type	Short, hairy and pointed backwards	100	1	0	0	100	1
	Short with a brush-like tuft of black hairs and pointed strait down wards	0	0	100	1	0	0

genes flow and population substructure (Allen et al., 1995). When molecular data are unavailable, the phenotypic diversity studies of species could be important to associate with genetic diversity (Rappa and Lorico, 2010) and hence phenotypic characterization was conducted to clarify the genetic introgression between the domestic goats and walia ibex.

The widespread occurrence of free-ranging domestic goats is raising fear that introgressive hybridization with wild populations might disrupt local adaptations, leading to population decline and loss of biodiversity (Randi, 2008). Burnand (1998) indicated that with the growing human population, the number of livestock grazing in the SMNP area has shown a marked increase and the high population of livestock poses shortage of feed for walia and other ungulates. The results of this study also showed that due to the prevalence of high shortage of water and feed resources, the park dwellers and the neighboring communities of the SMNP forced to graze their livestock within and around the park. This has negative impacts on the national park in general and walia ibex in particular with competitions of resources and introgressive hybridizations with their conspesifics. Voeten (1999) has revealed that livestock grazing impacts on native wildlife are an important conservation concern globally. Feeding with natural pasture, with open and extensive

grazing systems created opportunities to domestic goats to graze/browse within the park, together with walia ibex. Mishra et al. (2004) also reported that available rangelands are grazed by livestock and consequently, at the rangeland level, there is complete spatial overlap in areas used by livestock and wild herbivores.

The shortage of grazing land outside of the park forced the dwellers to graze their livestock to the ecosystem where walia and other endemic species inhabit. Rhymer and Simberloff (1996) disclosed that translocation of an exotic species into a novel ecosystem often results in hybridization between introduced species and related native genera where, few barriers to gene flow exist; this frequently leads to the rapid introgression of genetic and phenotypic characters from one species into another.

Though the mating system of goats employed was uncontrolled, the park dwellers and the neighboring communities understood that cross breeding with walia ibex increase productivity, growth and strength of their goats however, they claim that they are not deliberately graze their goats for crossbreeding purpose with walia ibex but to feed their animals. There were discrepancies in opinion between the park dwellers and the neighbouring communities, and communities dwelling far from the park that in the former, the majority knew that the domestic goats graze in and around the park and can interbreed with walia ibex while grazing together but in the later, about 45.2 and 26.2% only recognize that domestic goats graze and interbreed with domestic goats while grazing together respectively. Personal interviews and focused group discussions results with selected individuals disclosed that walia ibex and domestic animals graze together at SMNP and rutting was common between these two species while grazing together. Harrison (1993) indicated that being of practical concern, hybridization with invading species gives a valuable opportunity to observe the initial stages of hybridization and the opinion of the farmer confirms this initial stage of hybridization. In this study, interview with park experts revealed that an offspring/crossbreed goat from sire walia ibex and dam domestic goats were reported and the so called hybrid was pictured by park experts for further analysis.

Phenotypic characterization of the domestic and wild goat results including the suspected hybrid indicated that no phenotypic similarities were observed between the two species. The suspected hybrid resembles more domestic goats than walia ibex and molecular characterization was required to be sure about the hybrid since the genes of the domestic goat might be dominant and mask all the phenotypic character of the wild.

Introgressive hybridization among local wild populations and invasive organisms, together with habitat degradation and loss of ecological structure, unsustainable selective pressures for adaptation to global climate changes, overexploitation and loss of community structure, are acknowledged as the future emerging major threats to biodiversity preservation (Randi, 2008). Therefore walia ibex is becoming a threat from habitat loss and fragmentation besides being exposed to introgressive hybridizations from domestic goats in the near future. Allendorf et al. (2001) stressed that invasive species and translocated populations are threatening native populations by hybridization, raising risks of genetic extinction, loss of local adaptations or out breeding depression.

Conclusions

There is uncontrolled diffusion of free - ranging C. *hircus* to the National Park and *C. walie* out side their range. This is due to extensive production systems and shortage of feeds in the area. All these resulted in competition of resources as well as interbreeding fears between these two species. However, the over all results of explanatory survey, field observation and correlation of traits of C. *hircus*, *C. walie* and the suspected hybrid revealed that there is no genetic introgression between Walia ibex (*C. walie*) and domestic goats (*C. hircus*). The suspected hybrid goat also resembles more to *C. hircus* than *C. walie.* Nevertheless, *C. walie* is becoming a threat from habitat loss and fragmentation besides being exposed to introgressive hybridizations from *C. hircus* in the near future.

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