LAMBING SEASONS IN SUBSPECIES OF URIAL (*OVIS VIGNEI*) IN PAKISTAN

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Abstract - In 2000-2005, we quantified the onset and duration of lambing in three urial (*Ovis vignei*) subspecies in Pakistan. Onset of lambing in the southern populations was on average on day 31 (± 9.0 SE; n = 18; Julian date), two months earlier than in the northern populations (Salt Range; onset on Julian day 90 ± 0.95 SE, n = 6). The birth season in the southern populations of Afghan urial (subspecies *cycloceros*) lasted 1.7 times longer (61 days ± 5 SE vs. 35 days ± .70 SE) than *punjabensis* in the Salt Range. The southern subspecies had a more protracted lambing season and greater interannual variation in distribution of births than the northern subspecies. Onset and duration of lambing did not differ in two populations in the Salt Range. Population sex ratio and male age structure did not appear to affect lambing synchrony.

Keywords - Urial, *Ovis vignei*, lambing season, latitude, birth synchrony, Khirthar Range, Salt Range, Pakistan

J. Mt. Ecol., 8: 27 - 32

1. Introduction

Pakistan supports a rich diversity of wild sheep and goats and is a key country for their conservation. Wild sheep (*Ovis*) in Pakistan inhabit a wide latitudinal gradient, with diverse habitat types, ranging from sea level to over 4000 m altitude (Fig. 1). Three subspecies of urial, *Ovis vignei*, are found in Pakistan (Shackleton, 1997). Afghan urial (*O. v. cycloceros*) is distributed in the Torghar Hills (31°15'N and 69°00'E) and Hinglaj Ranges (25°30'N and 65°30'E) near Mekran Coast in Balochistan Province. It further extends into south-western Sindh (25°44'N and 67°10'E, populations 1-4, Fig. 1) in Khirthar Range. Punjab urial (*O. v. punjabiensis*) is distributed between the Jhelum and Indus rivers (32°41'N and 73°23'E,) in Kala Chitta and Salt Ranges (population 5, Fig. 1). Ladakh urial (*O. v. vignei*) are found around Skardu (35°17'N and 75°38'E), Gilgit and Chitral in the north (population 6, Fig. 1). Most of these populations occupy arid habitats and are small and fragmented. They are therefore vulnerable to many threats (Awan *et al.*, 2004).

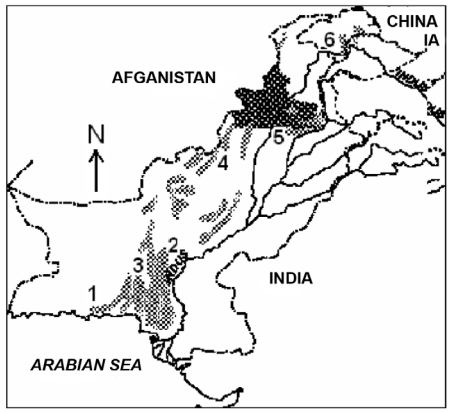

Fig. 1 - Distribution of urial (*Ovis vignei*) sub-species in Pakistan. (After Roberts 1997). 1= Hingol National Park; 2= Khirthar Range; 3= Dureji Game Reserve; 4= Torghar; 5= Salt Range; 6= Northern Areas. 1-4 = *O. v. cycloceros*, 5= *O. v. punjabiensis* and 6= *O. v. vignei*

Ungulates inhabiting temperate and arctic environments typically breed synchronously and the timing of births is highly seasonal (Ims, 1990). In northern environments, most births take place during the first two weeks of the parturition season (Festa-Bianchet, 1988a). Seasonality in breeding appears to be an adaptation to increased juvenile survival, and two hypotheses for synchrony in breeding have been suggested. Geist (1971) and Bunnell (1982) suggested that it is important that the young are born in time to exploit nutritious

forage during the growing season. Lactating females also require access to high-quality forage (Festa-Bianchet, 1988b). Predation pressure on newborns may select for a short parturition season, because predation and predators may be "swamped" if all lambs were born over a short period (Rutberg, 1987; Ims, 1990). Festa-Bianchet (1988c), however, suggested that it is unlikely that predation on newborns was a major selective force for a short parturition season in bighorn sheep because predation risk in lambing areas is typically very low. Festa-Bianchet (1988b) suggested that seasonal forage availability, that depends on rainfall, temperature and photoperiod (Rubin *et al.*, 2000), is an important factor in regulating breeding season in mountain ungulates. Hass (1997) hypothesized that a mild climate or unpredictable periods of forage availability in desert environments have relaxed selection for a well-defined breeding season.

Bunnell (1980, 1982), Thompson & Turner (1982) and Festa-Bianchet (1988a,b) reported that for North American *Ovis* lambing seasons varied in timing and duration according to the predictability and seasonality of the climate. Lambing seasons were later and shorter with increasing latitude, and altitude.

Unlike North American wild sheep, little is known about the lambing period of *Ovis vignei* in Pakistan. Edge & Olson-edge (1987) reported that Afghan urial in Khirthar National Park mate in August and give birth in early February. For Punjab urial in the Salt Range, Schaller (1977) and Awan *et al.*, (2006) reported a birth peak in April.

Thompson & Turner (1982) suggested that births should occur later with increasing latitude. We hypothesized that Afghan urial populations at low latitudes should exhibit earlier and longer lambing seasons than Punjab urial.

We studied Punjab urial in two areas of the Salt Range. The state-managed eastern section (referred to as ESR 32° 41' N, 73° 23' E) and the community-managed Kalabagh Game Reserve (KGR, 32° 52' N, 71° 39' E). In ESR, about a quarter of the lamb crop was removed by poachers, and all rams older than 6 years were eliminated by illegal shooting. In KGR, less than 5% of lambs were removed and about 34% of adult rams were aged 6 years or older (Awan et al., 2006). Noyes et al. (1996) suggested that conceptions in elk (Cervus elaphus) occurred earlier in heavily hunted than in unhunted populations. In reindeer (Rangifer tarandus), Holand et al. (2003) suggested that calving date was earlier in populations with even sex ratio and a balanced male age structure. Therefore, we tested the hypothesis that lambing period (onset and duration) differs between heavily hunted (ESR population) and lightly hunted (KGR) populations of Punjab urial in the Salt Range.

2. Methods

This investigation was conducted over six consecutive birthing seasons from 2000 to 2005. For each year and each population, we determined the total length of the lambing season (days) from first to last birth following Thompson & Turner (1982), and the number of days from first birth to the 75 percentile of births following Côté & Festa-Bianchet (2001) (Table 1).

During daily surveys, we noted herd size, sex-age composition, individual activity and reproductive condition of females (heavily pregnant or with a lamb). Onset of lambing was measured as the Julian date, the number of days from 1 January to the first birth. Peak lambing week of birth was determined by dividing the total duration of lambing into one-week intervals and comparing the percentage of births in each week.

We searched lambing areas in southern populations (1-3 Fig. 1) of Afghan urial in Hingol National Park (HNP, 1 Fig 1) and Khirthar Range (2 Fig. 1). In Khirthar Range we searched Mehal Kohistan Wildlife Sanctuary (Sari and Benir ridges), Khirthar National Park (KNP) and Dureji Game Reserve (DGR, 3 Fig. 1).

The first author spent 80 days (16 days per season from 2000-2004) collecting data in the southern populations, and an assistant spent 50 days of searching per lambing season per study area over the study period. The Torghar population (5 Fig 1) was visited in 2001 (5 days) and 2005 (7 days) and other information about the onset of lambing season was collected from the literature and the Society of Torghar Environment Protection (STEP). To investigate birth season in Punjab urial (5 Fig. 1), the ESR and KGR populations were sampled by the first author for 20 days during each lambing season.

For seasonality of birth season in Ladakh urial (6 Fig. 1), targeted interviews were held with shikaris (hunters), shepherds, and other knowledgeable people in the region (Diamer, Gilgit, Hunza and Skardu) in January (7 days) and August (3 days) 2003. The published literature (Schaller, 1977; Pfister, 2004) was consulted for the onset of lambing season.

Tab. 1 - Onset and duration of lambing from 2000 to 2005 in 5 urial populations in Pakistan.

Location and subspecies	Lamb births		Birth season	Days to 75%
	First	Last	(days)	of births
HNP *(Ovis v. cycloceros)*	12 Feb	1 Apr	50	30
KR *(O. v. cycloceros)*	31 Dec	12 Apr	62	48
DGR *(O. v. cycloceros)*	2 Feb	18 Apr	70	54
KGR *(O. v. punjabiensis)*	1 Apr	7 May	36	16
ESR *(O. v. punjabiensis)*	28 Mar	2 May	35	15

Data on temperature and precipitation for southern populations were obtained from weather stations of the Pakistan Meteorological Department in Hyderabad and Padidan (about 60 km from the study areas, with 108 and 30 years of data), where mean annual rainfalls were 191 mm and 108 mm respectively. Rainfall is related to the summer monsoon, with significant rainfall only from June to September (Fig. 2). Rainfall likely exceeds potential evapotranspiration only in July and August. Mean monthly temperature ranged from 19°C in January to 34°C in May and June. Short-term climate data from the Dureji Game Reserve suggests mean annual rainfall as low as 65 mm and mean monthly temperature ranging from 15 to 38°C (Hagler Bailly, 1998).
In the Salt Range, rainfall declines progressively from east to west, as evident from average annual rainfall data for 1961-1990 in the eastern (1239 mm), central (853 mm) and western (454 mm) sections of the Range. In the Salt Range, over 60% of precipitation falls during the monsoon (June to September) and 25% during the winter rainy season, January to April (Fig. 2). Maximum daily temperature is usually >40 °C in June, but the temperature often drops below zero in December and January (Awan *et al.*, 2006).
In statistical tests, data for different years from the same population were treated as independent samples (Bunnell, 1982). Potential correlations between latitudes and onset of lambing were assessed by Spearman's rank correlation and potential difference between Salt Range and southern populations were compared by the Mann-Whitney U-test. The SPSS 10.1 package was used for statistical analysis.

3. Results

The beginning of lambing in southern populations differed between years and areas. Onset of lambing in populations 1-3 (Fig. 1) was on average on day 31 (± 9.0 SE; n = 18; Julian date), two months earlier (90 ± 0.95 SE, n = 6) than on the Salt Range. Birth season in southern populations was 1.7 times longer than in the Salt Range (61 days ± 5 SE vs. 35 days ± .70 SE). The onset and duration of lambing in Salt Range (northern) and southern populations differed significantly ($p < 0.001$ Mann-Whitney U-test). Most births in southern populations occurred during February- March every year (Fig. 3) except 2002, when lambing started on 31 December 2001 and peak births were recorded in the third week of January (Table 1). The time to the 75th percentile of births also differed between the southern populations (mean 44 ±10.84 days n = 18,) and the Salt Range (15. 83 ±0.94 days n = 6, Table 1).
In the Salt Range, lambing was restricted almost entirely to April. The earliest observed birth was 28th March, and the last 7th May of the same year. Neither the onset nor the length

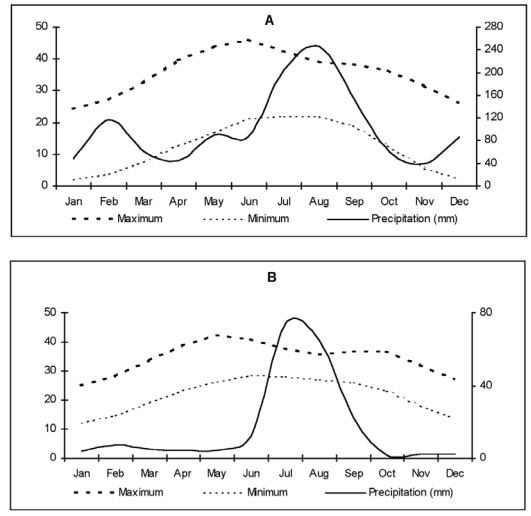

Fig. 2 – (A) Monthly mean temperature and precipitation averaged over 30 years (1961-90) in Salt Range, Pakistan. (B) Mean monthly temperature (1989-1999), and mean monthly rainfall at Hyderabad (for Khirthar Range) of 108 years for the period of available records from 1866-1999.

of the lambing season differed between KGR and ESR (Table 1). Most lambs (75%) were born within two weeks of the first observed birth. Parturition was therefore highly synchronized and less than 25% of lambs were born after 16th April in both populations.

Lambing season of Afghan urial in Torghar started in late April and continued to the end of May. Lambing period for Ladakh urial extends from late May to the end of June. Local hunters and villagers reported that there might be slight variation between years but peak births occurred from early to mid-June.

The onset of lambing in urial populations in Pakistan began later at northerly latitudes (n = 7 populations, r_s = 0.91, P <0.01, Fig. 3). The duration of lambing decreased at northerly latitudes (r_s = -0.89, P = 0.02), and the timing of the last recorded birth was weakly correlated (r_s = 0.45) with latitude.

4. Discussion

The parturition season in Pakistan Ovis began later and was more synchronized with increasing latitude, similarly to the results reported by Bunnell (1982) and Thompson & Turner (1982) for North American sheep. Lambing in the Salt Range (5 Fig. 1) was highly synchronized, with 75% births occurring within 2 weeks, suggesting that ovulation is related to changing photoperiod. In the Salt Range, peak vegetation growth occurs consistently at the same time each year because of the predictable precipitation pattern, favoring synchronized lambing. Synchronous birthing seasons are common among temperate ungulates and the pat-

Fig. 3 - Distribution of lambing season in Pakistan *Ovis* populations over a latitudinal gradient of 35 - 25° N. = onset and end of lambing, ■ = peak lambing.

Location and subspecies	Latitude (° N)	Elevation (m)	Lambing season observed	Reference
Hingol National Park *O .v. cycloceros*	25°	200- >1200		Present study
Khirthar Range *O. v. cycloceros*	25°	200- >1000		Present study
Dureji Game Reserve *O. v. cycloceros*	25°	200- >1000		Present study
Torghar *O. v. cycloceros*	31°	<2800		Present study & literature
Salt Range *O. v. punjabiensis*	32° 33°	250- 1500		Present study
Northern Areas *O. v. vignei*	35°	1000- 4200		Present study & Schaller, 1977

tern of a distinct birth pulse lasting 2-3 weeks is consistent between years and taxa (Festa-Bianchet, 1988c; Rachlow & Bowyer 1991; Gaillard *et al.*, 1993; Côté & Festa-Bianchet, 2001). Bunnell (1982); Côté & Festa-Bianchet (2001) and Holand *et al.*, (2003) suggested that the timing of birth in temperate ungulates is related to matching plant phenology and peak protein levels.

In the southern populations (1-3 Fig. 1), unpredictability in the timing of precipitation leads to a weaker selective pressure for a short lambing season. Thompson & Turner (1982) suggested that the extended season of southern bighorn sheep was due to the unpredictability of precipitation. Data from southern urial populations in Pakistan support this hypothesis. There were good rains in Khirthar Range in June 2001, when the rut started in July. Subsequently, lambing started in early January and was more synchronous (75% births in 36 days) than in previous years. Geist (1971) suggested that oestrus could probably be advanced or retarded by the level of the nutrition of the female.

In conclusion, onset and duration of lambing at southern latitudes appear to be influenced primarily by yearly changes in timing of precipitation and vegetative growth, while photoperiod is likely the main proximate factor for Punjab urial in Salt Range. Despite widely different hunting pressure, onset and duration of lambing were similar in KGR and ESR populations in the Salt Range. Population sex ratio and male age structure apparently did not affect lambing synchrony for Punjab urial in this study.

Acknowledgements: The study was partially financed by WWF-Pakistan, Houbara Foundation International, Premier Exploration Pakistan, Halcrow and Hagler Bailly Pakistan. We are particularly thankful to H. H. Malik Muhammad Asad Khan, the Nawab of Kalabagh for allowing us to study in the KGR and for their hospitality. We thank Sardar Naseer Tareen, Bhootani family Balochistan and Sindh Wildlife Department for their help and hospitality.

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