Suleiman Markhor (*Capra falconeri jerdoni*) and Afghan Urial (*Ovis orientalis cycloceros*) population status in the Torghar Hills, Balochistan Province, Pakistan.

Michael R. Frisina

A report to the Society for Torghar Environmental Protection and the United States Fish and wildlife Service

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Tanishpa Photo by N. Tareen

Khand looking south.
11/2/99 N31° 10.3 , E068° 22.8
2,808 meters

SKULL AND HORNS OF ARGALI URIAL (*Ovis vignei cycloceros*).

As presented in Lydekker (1913)

"Horns tending to turn outwards at the tips, and forming a more open spiral than in the other races, with the front angles prominent and occasionally showing a bended structure; basal girth in good specimens from 10 to 12 ¼ inches." (Lydekker 1913)

Note: Lydekker (1913) used the scientific name *Ovis vignei cycloceros*, which is synonymous with *Ovis orientalis cycloceros* in Valdez (1982).

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INTRODUCTION

In 1984, tribal leaders concerned with the decline of Suleiman markhor (*Capra falconeri jerdoni*) and Afghan urial (*Ovis orientalis cycloceros*) in the Torghar Hills of Balochistan Province, Pakistan, sought assistance from wildlife biologists in the USA. From this association, the Torghar Conservation Project (TCP) was developed (Johnson 1997a). The TCP was maintained informally until 1994, when an officially registered non-governmental organization, the Society for Torghar Environmental Protection (STEP), was established to administer the TCP. The TCP's primary goal is the conservation of markhor and urial. The TCP employs local tribesmen, who refrain from hunting in exchange for employment as game guards, charged with prevention of poaching in the Torghar Hills. The TCP operates on revenues derived from limited sport hunting. STEP currently employs 50 game guards (Tareen 1999). The project has effectively eliminated poaching, especially within the "core protected area" (Johnson 1997a). TCP's objectives of conserving markhor and urial populations in the Torghar Hills have been achieved while improving the well-being of local Pathan tribesmen (Johnson 1997b). STEP, with joint support from UNDP has developed water tanks and channels for agriculture in the Torghar Hills and constructed a water storage dam in the Khaisor Valley to reduce livestock pressure at Torghar (Tareen 1999).

To monitor effectiveness of the project, STEP conducted a systematic survey of markhor and urial populations in the Torghar area during November 1994. Professional biologist Kurt Johnson assisted STEP, through the U.S. Fish and Wildlife Service Special Foreign Currency Program in Pakistan. Johnson (1997a) estimated populations of 695 Suleiman markhor and 1,173 Afghan urial in the TCP area. As a follow up to the 1994 surveys, and to establish markhor and urial population trend, a second field survey was carried out with STEP in November 1997 (Frisina et al. 1998). Charles Woods, Florida Museum of Natural History, wildlife veterinarian Michael Woodford, and I worked with STEP personnel to accomplish the second survey. This

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paper presents the results of a third survey conducted in 1999 and compares the 1999 data with that reported for 1994 and 1997.

STUDY AREA

The TCP lies within the Torghar Hills, Toba Kakar Range, of Balochistan Province in west central Pakistan near the southwest border with Afghanistan (Figure 1). Suleiman markhor and Afghan urial are the only large wild ungulates inhabiting the study area. Habitat conditions for markhor and urial in the core protected area are favorable and were described by Frisina et al. (1998).

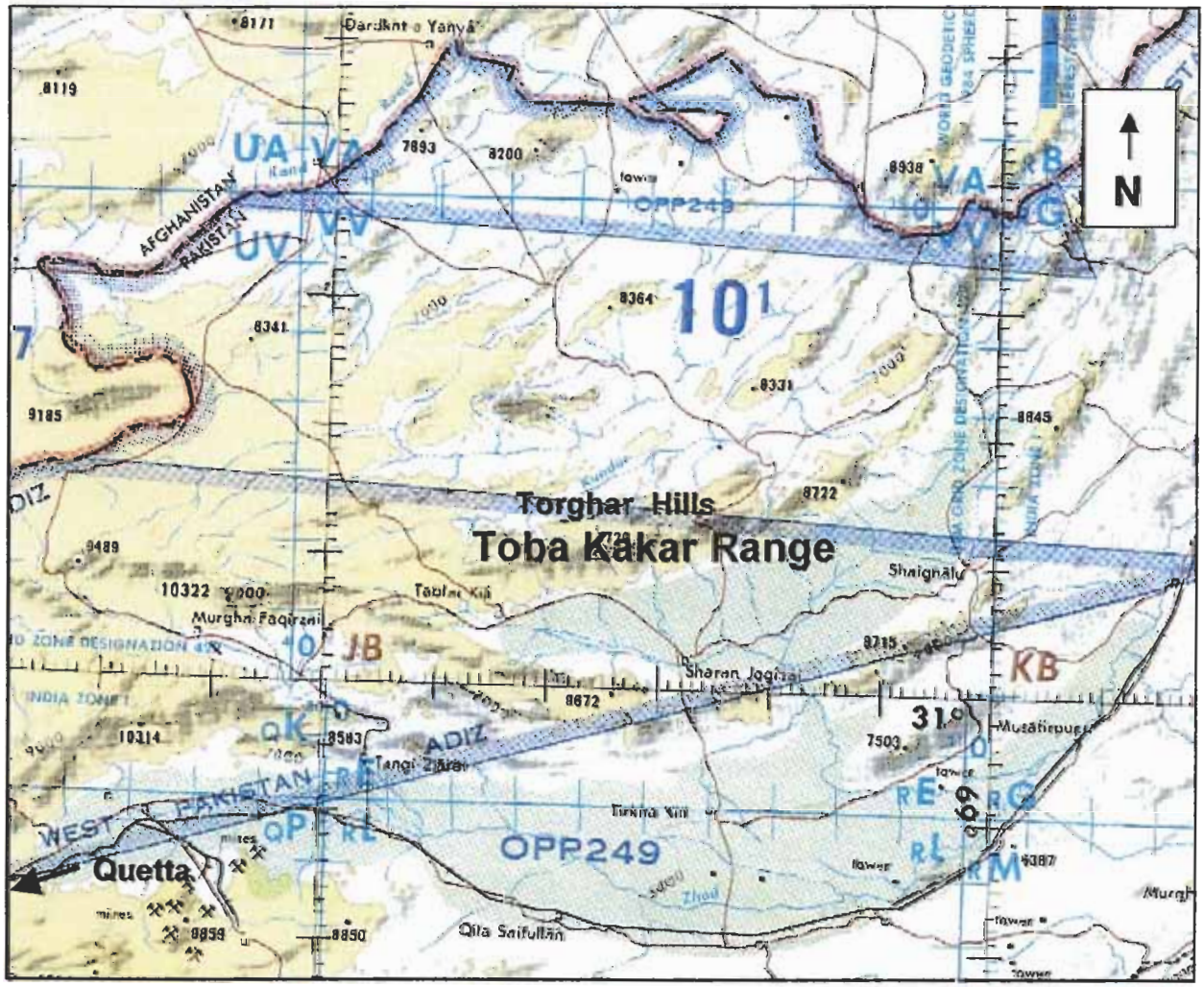

Figure 1. Location of the Torghar Hills and the Toba Kakar Range in Balochistan Province Pakistan. From Defense Mapping Agency Aerospace Center, Map ONC, H-8, 8. Scale 1:1,000,000

Physical Features

The Torghar Hills are a series of very rugged upturned ridges composed of sedimentary materials. The ridges are approximately 90 km long and vary from about 15 to 30 km in width. Johnson (1997a) described the TCP as a 300 km-area consisting of three parallel ridges separated by two NE-running stream drainages. The southernmost ridge has a north-facing slope that gradually rises to an elevation of 2,800 meters, and is dissected by several deeply incised drainages. The southfacing slopes drop precipitously from the crest forming a series of step-like cliffs to the Khaisore Valley. The northern ridges consist of steeply upturned rock layers resembling a series of parallel, jagged-toothed combs.

Climate

The climate is dry, with cold winters and warm summers. Violent dust and thunderstorms occur during summer months (Superintendent of Government Printing, Calcutta 1991). During July and August, the mean temperature is about 26° C. During winter, the temperature averages about 4° C. Strong winds are common. Total annual precipitation within the region varies from 18 to 27 centimeters. Most precipitation occurs between December and March. Severe drought conditions were prevalent in the Torghar Hills during 1998 and 1999 as evidenced by no rainfall and very little snow during winter (Jogezai 1999).

Vegetation

Balochistan is characterized by a very diverse flora, typically Persian in character (Burkill 1969). The study area lies within the "Balochistan juniper and pistachio scrub forest" and "Dry sub-tropical semi-evergreen scrub forest" zones described by Roberts (1997). Shrub-steppe plant communities dominate the semi-desert landscape of the Torghar Hills. Bunchgrasses, forbs, almond bushes (*Prunus dulcis*), *Ephedra*, *Artemesia*, and other shrubs occur along upland slopes with *Cargana* and *Tamarix* common in low lying areas and drainage ways where water is available. Wild rhubarb (*Rheum sp.)* is common in the highlands during years of good rainfall. Trees are uncommon, but juniper (*Juniperus macropoda*) and wild pistachio (*Pistacia macropoda*) are scattered across the landscape. The Balochistan Gazetteer (Superintendent of Government Printing, Calcutta 1991) provides a general description of the flora within Balochistan Province.

Agriculture

The predominant human land use is livestock herding with cultivated orchards of fruit and nut trees common in valley bottoms near human settlements. Herds of domestic goats, sheep, and camels are common. Cattle, donkeys, and horses also occur in limited numbers. As a result of severe drought conditions in the Torghar Hills during 1998 and 1999, several herders temporarily removed their livestock in search of pastures less affected by drought (Jogezai 1999).

CONSERVATION STATUS

According to Roberts (1997), Suleiman markhor occur in low numbers and have a limited distribution in Pakistan, including the rugged mountains of western Pakistan. Afghan Urial are more widespread and common than Suleiman markhor, but are not abundant (Roberts 1997).

Suleiman markhor and Afghan Urial are protected from poaching within the TCP by STEP. Both species are also listed in the Third Schedule of The Balochistan Wildlife Protection Act of 1974 as animals which can only be hunted under specific circumstances (Johnson 1997a). Suleiman markhor are listed as "Endangered" under the U.S. Endangered Species Act (ESA) (Fish and Wildlife Service 1997a) and are listed in Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Fish and Wildlife Service 1997b). The Afghan urial is not listed on either ESA or CITES. All markhor are listed as "endangered" in the IUCN Red Data Book (IUCN 1996).

METHODS

Markhor and urial survey areas (Table 1), survey methods, and population estimate calculations closely follow those described by Johnson (1997a) and Frisina et al. (1998). A seven-day survey was conducted from November 1 to November 7, 1999. November is the rutting season for Suleiman markhor and Afghan urial. This time period is similar to that used in 1994 and 1997 (Johnson 1997a and Frisina et al. 1998). The same five major survey areas described by Johnson (1997a) were used in this survey (Table 1, Appendix A). These spatially separated areas were selected to minimize the possibility of double counting.

Table 1. Size of survey areas and habitat quality reference within the Torghar Core Protected Area (Johnson 1997a).

Survey Location	Area (km^2)*	Markhor	Urial
Tanishpa	15.0504	High-quality Habitat	High-quality Habitat
Shin Narai	10.8693	Low-quality Habitat	High-quality Habitat
Khand	8.361	High-quality Habitat	Low-quality Habitat
Tor Ahgbarg	12.5415	Low-quality Habitat	High-quality Habitat
Kundar/Uria	15.0504	High-quality Habitat	Low-quality Habitat

*Converted to metric units using data in Appendix A (Johnson no date-c).

Each day during the survey, one or two survey teams of two to five people went into the field shortly after sunrise and selected a point from which to conduct the day's survey. The same survey points selected by Johnson (1997a) and as used by Frisina et al. (1998) were used in this survey. Morning and afternoon hours were spent continuously surveying the area through binoculars and spotting scopes. Data were recorded for the total number in each group and number in each sex or age category: lambs (.5 years old), adult females (1.5 years or older), adult males I (2.5 to 5.5 years of age), and adult males II (trophy animals of 6.5 years or more). It was not always possible to accurately classify animals observed at a distance, and some yearling males of both species may have been incorrectly classified as adult females. We were not able to consistently classify yearling females from adult females. The tribesmen were very good at classifying adult males at a distance.

Following Johnson (1997a) and Frisina et al. (1998), population estimates for markhor and urial in the core protected area and entire TCP were calculated using the following formula:

HQD X 300 sq. km. X %HGH

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HLD X 300 sq. km. X %LQH

=

Estimated Population Size in Core Protected Area

HQD = Pop. density for High Quality Habitat
300 sq. km. = size remainder of core protected area
%HGH = % of area High Quality Habitat

HLD = Pop. density for Low Quality Habitat.
%LQH = % of area Low Quality Habitat

Johnson (1997a) determined that 30 and 70 percent of the core protected area were high- and low-quality habitat for markhor, respectively. Urial habitat within the core protected area was similarly determined to be 40 and 60 percent high- and low-quality habitat, respectively. The remainder of the TCP, in addition to the core protected area, was determined to be 650 sq. km. in size and all low-quality markhor and urial habitat. The low-quality habitat density figures for markhor and urial were applied to the remainder of the TCP then added to the estimates for the core protected area to arrive at TCP population estimates. This same procedure and percentages were applied by Frisina et al. (1998) and to the current survey.

RESULTS AND DISCUSSION

All five locations surveyed for markhor and urial by Johnson (1997a) in 1994 were re-surveyed in 1999 (Tables 2 and 3, Appendix A). Frisina et al. (1998) surveyed a portion of the same five areas in 1997.

This approach to estimating population size provides conservative estimates, as it assumes all markhor within the survey areas were observed, obviously not the case. Even aerial surveys underestimate population density (Pollock and Kendall 1987). When conducting fall surveys utilizing a helicopter to count wild sheep, one can only expect to observe 20-50 percent of the population (Remington and Welsh 1989). Because of visibility limitations at Torghar due to extremely rugged topography, we observed a smaller proportion of the population than would be expected using a helicopter.

Markhor

During 1999, 293 markhor were observed in the TCP (Table 2). The sample consisted of 106 females, 73 lambs, and 84 males, and 30+ unclassified markhor. Observed males consisted of 6, 38, and 40, yearling, < 6 years, and ≥ 6 years age classes respectively.

Table 2. Markhor observations in theTorghar Conservation Project core protected area, November 1999.

					MALES			
AREA	**TOTAL**	**UNCL.**	**LAMBS**	**FEMALES**	**TOTAL**	**Yrlg**	**< 6 years**	**≥ 6 years**
Tanishpa								
Malao	167	30+	38	48	51	1	25	25
Arth	0	0	0	0	0	0	0	0
Garai	13	0	2	7	4	0	2	2
TOTAL	**180**	**30+**	**40**	**55**	**55**	**1**	**27**	**27**
Shin Narai	**2**	**0**	**1**	**1**	**0**	**0**	**0**	**0**
Kundar/Uria								
Oria	17	0	0	7	10	5	1	4
Salawata	6	0	2	3	1	0	1	0
Zercha	9	0	3	4	2	0	2	0
Surkham	0	0	0	0	0	0	0	0
Murdar	0	0	0	0	0	0	0	0
TOTAL	**32**	**0**	**5**	**14**	**13**	**5**	**4**	**4**
Khand	**52**	**0**	**18**	**23**	**11**	**0**	**4**	**7**
Tor Ahgbarg								
Walla	0	0	0	0	0	0	0	0
Saliwata	0	0	0	0	0	0	0	0
Whuchakai	0	0	0	0	0	0	0	0
Bazili	12	0	3	6	3	0	2	1
Salduchina	0	0	0	0	0	0	0	0
Kazhaguzha	8	0	4	3	1	0	0	1
Klaka	7	0	2	4	1	0	1	0
TOTAL	**27**	**0**	**9**	**13**	**5**	**0**	**3**	**2**
GRAND TOTAL	**293**	**30+**	**73**	**106**	**84**	**6**	**38**	**40**

Population Trend

During 1999, 293 markhor were observed in the same areas in which 135 markhor were observed by Johnson (1997a) in 1994 (Table 2). In 1997, Frisina et al. (1998) surveyed 3 of the 5 survey areas (Tanishpa, Khand, and Shin Narai) and observed 201 markhor. During 1999, 234

markhor were observed in these same 3 survey areas. Population trend is upwards. The data indicate a +117 Percent change between 1994 and 1999.

Population Density

Methods and habitat quality classifications provided by Johnson (1997a) were used to calculate a November 1999 population density of 1.24 and 6.86 markhor per km^2. for low- and high-quality habitats, respectively. Johnson (1997a) reported markhor densities of .47 and 3.22 per km^2 for low- and high-quality habitats in the TCP area in 1994. Using the same parameters, Frisina et al. (1998) reported a density of .68 and 7.90 markhor per km^2 for low- and high-quality habitats during a 1997 partial survey of the area. A comparison of data from this survey with data from the 1994 and 1997 surveys indicates markhor density in both low- and high-quality habitats has almost doubled since 1994.

Population Estimates

Johnson (1997a) reported a conservative population estimate of 389 markhor for the core protected area in 1994. Frisina et al. (1998) reported a conservative population estimate of 854 markhor in 1997. Using the same method of Johnson (1997a) and Frisina et al. (1998), a conservative population estimate of 878 markhor was calculated for the core protected area in 1999. These data indicate the markhor population has more than doubled since 1994. Given no change in the overall habitat and management situation, the markhor population can be expected to continue its increase.

In 1994, Johnson (1997a) reported a conservative population estimate of 695 markhor for the entire TCP. Frisina et al. (1998) reported a conservative population estimate of 1,296 markhor for November 1997. Using the same methods of Johnson (1997a) and Frisina et al. (1998), a conservative November 1999 population estimate for the entire TCP was determined to be 1,684 markhor.

Markhor are obviously responding well to management and protection by the TCP. As indicated by Johnson (1997a) and Frisina et al. (1998), when observational bias related to terrain and visual distance during ground surveys are considered, any errors in the estimates are on the conservative side. Johnson's calculation method also yields a conservative estimate.

Urial

During 1999, 153 urial were observed in the TCP (Table 3.). The observed population sample consisted of 65, 38, and 50 females, lambs, and males, respectively. Observed males consisted of 1, 26, and 23 yearlings, < 6 years, and ≥ 6 years age classes, respectively.

Table 3. Urial observations in the Torghar Conservation Project core protected area, November 1999.

					MALES			
AREA	**TOTAL**	**UNCL.**	**LAMBS**	**FEMALES**	**TOTAL**	**Yrlg**	**< 6 ears**	**≥ 6 years**
Tanishpa								
Malao	6	0	0	1	0	1	0	4
Arth	9	0	0	0	0	0	3	6
Garai	5	0	0	0	0	0	3	2
TOTAL	**20**	**0**	**0**	**1**	**19**	**1**	**6**	**12**
Shin Narai	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Kundar/Uria								
Oria	9	0	3	5	1	0	1	0
Salawata	0	0	0	0	0	0	0	0
Zercha	0	0	0	0	0	0	0	0
Surkham	23	0	8	13	2	0	2	0
Murdar	2	0	1	1	0	0	0	0
TOTAL	**34**	**0**	**12**	**19**	**3**	**0**	**3**	**0**
Khand	**5**	**0**	**1**	**1**	**3**	**0**	**2**	**1**
Tor Ahgbarg								
Walla	17	0	5	7	5	0	2	3
Saliwata	15	0	5	7	3	0	2	1
Whuchakai	26	0	6	16	4	0	2	2
Bazili	16	0	4	6	6	0	3	3
Saiduchina	12	0	3	6	3	0	2	1
Kazhaguzha	0	0	0	0	0	0	0	0
Klaka	8	0	2	2	4	0	4	0
TOTAL	**94**	**0**	**25**	**44**	**25**	**0**	**15**	**10**
GRAND TOTAL	**153**	**0**	**38**	**65**	**50**	**1**	**26**	**23**

Population Trend

During 1999, 153 urial were observed in the same area in which Johnson (1997) observed 189 urial in 1994. This difference of –36 urial is within the range of inherent accuracy limitations of the field survey method. Considered by itself, the data for total urial observed indicate population trend is stable or possibly slightly lower than reported for 1994. However, when the higher observed density of urial in low-quality habitats during 1997 and 1999, where urial are more difficult to see in small groups is considered, population trend is likely stable or even slowly increasing. Habitats preferred by urial are more subject to human land uses than those preferred by markhor (Frisina et al. 1998). During recent years urial may have distributed themselves more widely across the landscape as they are, more than markhor, forced to compete for limited resources with domestic livestock during periods of drought. The 59 lambs:100 females observed in 1999 is a marked improvement over the 9 lambs:100 females observed by Johnson (1997a) in 1994. Although late-winter data should be collected to verify over-winter lamb survival, the improved age ratio indicates the urial population is doing better than in 1994. During 1999 a small group of urial were sighted in Spin Ghar, outside the protection of the TCP, and are believed to have traveled from Torghar (Tareen 1999). Spin Ghar is located about 20 kilometers south of Torghar, across the Khaisore Valley.

Population Density

Methods and habitat classifications provided by Johnson (1997a) were used to calculate a November 1999 population density of 1.67 and 2.96 urial per km^2. for low- and high- quality habitats, respectively. Johnson (1997a) reported urial densities of .77 and 4.45 per km^2 for low- and high-quality habitats in the TCP area in 1994. Frisina et al. (1998) observed a density of 1.55 and 2.20 urial per km^2 for low- and high-quality habitats in 1997, respectively. These data indicate urial density in habitat considered high quality by Johnson (1997a) is lower than observed in 1994, but higher in low-quality habitat than in 1994. This could be a result of portions of the low-quality habitat base developing into high-quality habitat as a result of improved habitat security due to many years of protection from poaching.

Population Estimates

Johnson (1997a) reported a population estimate of 672 urial for the core protected area in 1994. Frisina et al. (1998) estimated a population of 543 urial for the core protected area in 1997. Using the same methods of Johnson (1997a) and Frisina et al. (1998), a conservative population

estimate of 656 urial was calculated for the core protected in 1999. These data indicate the urial population in the core protected area has remained relatively stable since 1994. After making a qualitative survey of habitat conditions, Frisina et al. (1998) speculated that the urial population might be at or near carrying capacity. This speculation was based on the obvious higher magnitude of livestock grazing occurring within urial habitats as compared to habitats used by markhor. Frisina et al. (1998) recommended a comprehensive survey of markhor and urial habitats be conducted within the core protected area and TCP. Habitat quantity and quality will ultimately determine markhor and urial population numbers.

A population estimate of 1,173 urial was reported for the entire TCP in 1994 (Johnson 1997a). Frisina et al. (1998) reported a conservative population estimate of 1,543 urial in 1997. Using the same methods of Johnson (1997) and Frisina et al. (1998) a conservative November 1999 population estimate for the entire TCP was determined to be 1,742 urial. This increasing population estimate, in spite of lower observed densities of urial in the core protected areas during 1997 and 1999, is a result of higher observed densities of urial in low-quality habitats during recent years. These higher observed densities in low-quality habitats might be partially a result of STEP's effective protection of urial from human disturbance and poaching.

Population Viability for Sustainable Harvesting

Data from this survey supports Johnson's (1997a) conclusion that the Suleiman markhor and Afghan urial populations of Torghar are viable for both population and genetic processes. Population factors important for the evaluation of viability were considered (Soule 1987). Population estimates indicate that since 1994 the markhor population has more than doubled in size, and the urial population is remaining stable or slowly increasing.

Productivity

Data for markhor in Table 2 were used to determine a November 1999 ratio of 69 lambs:100 females. This ratio indicates survival of lambs to November has improved since 1994, when Johnson's (1997a) data indicated a November ratio of 30 lambs:100 females. Data for urial in Table 3 were used to determine a November 1999 ratio of 59 lambs:100 females, indicating lamb survival to November has improved since 1994, when Johnson's (1997) data indicated a November ratio of 9 lambs:100 females. By comparison, a mean ratio of 47 lambs:100 females (Range 38.5 to 60, N = 5 surveys) for Ustyurt urial (*Ovis vigneri arcal*) and mean ratio of 67.5

lambs:100 females (Range 43 to 94, N = 4 surveys) for Turkmen urial (*Ovis vigneri varentzovi*) were calculated from data reported by Fedosenko (1998).

Sustainability of Males

Numbers of male markhor and urial observed during this survey are presented in Table 2 and Table 3.

Markhor

In 1999, 30 percent of the markhor observed were males older than yearlings. The comparative figure for 1997 is 25 percent (Frisina et al. 1998). In 1994, 13 percent of the markhor observed were older than yearling males. A ratio of 38 trophy males (≥ 6 years old):100 females was observed during the 1999 survey. Similarly, a ratio of 33 adult males:100 females was observed for a population of Heptner's markhor (*Capra falconeri heptneri*) in which illegal hunting had been controlled (Weinberg et al. 1997).

In 1999 a ratio of 3 females per trophy male (≥ 6 years old) was observed compared to a ratio of 5 females per trophy male in 1994 (Johnson 1997). The female classification category includes yearlings with older females, due to the difficulty of separating yearling females from older females during field surveys.

Urial

In 1999, 32 percent of the urial observed were males older than yearlings. The comparative figure for 1997 is 49 percent. In 1994, 24 percent of the urial observed were males older than yearlings.

In 1999 a ratio of 3 females per trophy male (≥ 6 years old) was observed compared to a ratio of 7 females per trophy male in 1994 (Johnson 1997a). As with markhor, the female category includes both yearling and older females.

The above data indicate trophy hunting has not significantly impacted the ability of markhor and urial populations to increase or maintain the male population segment.

Trophy Hunting Quotas

After examining the literature for similar species and populations Harris (1993) concluded that annual harvests of trophy males in numbers equivalent to one 1 or 2 percent of the total

population size can be maintained without negative consequences. Assuming a total markhor population of 878 for the core protected area, a sustainable annual trophy harvest in the core protected area could be up to 18 markhor. Assuming a total urial population of 656 for the core protected area, a sustainable annual harvest in the core protected area could be up to 13 urial. Through 1994, harvest levels at Torghar were not more than 3 markhor and 4 urial in any given year (Johnson 1997a). No hunting took place in 1997 and in 1998 there were no markhor and only 1 urial harvested (Tareen 1999). For 1999, 5 urial and one markhor hunt were booked (Tareen 1999). Harvesting of males within a limit of 10 to 20 percent of the replacement of the trophy-sized segment is considered by Wegge (1997) to be a safe and conservative harvest level for stable or increasing wild sheep and goat populations. Since markhor and urial have polygynous mating systems, the populations overall reproductive rate would be little influenced by loss of a small number of males (Caughley 1977). Harvest levels at Torghar are conservative.

CONCLUSIONS AND RECOMMENDATIONS

1. The markhor population is increasing both in the core protected area and the TCP. The 1999 estimated markhor population in the TCP was 1,684 markhor.
2. The urial population is stable within the core protected area, and stable or increasing within the TCP. The 1999 estimated urial population in the TCP was 1,742 urial.
3. Trophy hunting has not impacted the ability of markhor and urial populations to increase the male population segment. A sustainable annual trophy harvest for markhor could be up to 18. A sustainable trophy harvest for urial could be up to 13.
4. During March or early-April 2000, conduct a survey for markhor and urial in all five observation areas described by Johnson (1997a). This would provide an opportunity to monitor over-winter survival of markhor and urial lambs. It would also provide an opportunity to survey the urial population in late winter when they may be more concentrated in larger groups.
5. Once every 3 years, conduct an intensive survey for markhor and urial in the Torghar Hills, using all survey areas described by Johnson (1997a) during November (next survey 2002). Considering the remoteness of the Torghar Hills, available manpower, and difficult logistics, it is not practical to consider expanding the number of survey sites beyond those described by Johnson (1997a).

6. Conduct an annual production survey for markhor and urial during November and again in late-winter, gathering adequate sample sizes to monitor lamb recruitment and markhor and urial survival.
7. Complete a survey and inventory of markhor and urial habitats within the core protected area and TCP. A habitat survey is necessary to determine potential markhor and urial habitat carrying capacity, monitor habitat base maintenance, habitat quality, and predict factors limiting to markhor and urial populations.
8. Review the designated categories of low- and high-quality habitat assigned by Johnson (1997a). Adjustment may be in order as some habitats originally considered low-quality might now be high-quality due to improved habitat security resulting from many years of STEP effectively controlling poaching.
9. Begin monitoring domestic livestock numbers and their distribution by season within the TCP. This would provide an information base for managers to use for minimizing competition between wild and domestic animals within the TCP.
10. By testing domestic livestock, develop an information base of diseases present in domestic livestock within the TCP. This would provide an information base that managers could use to minimize the potential for disease transmission between domestic and wild animals.
11. STEP should develop a protocol for collecting physical measurements, disease, and parasite information from all markhor and urial harvested by hunters. This would provide a database useful for monitoring habitat quality and herd health.

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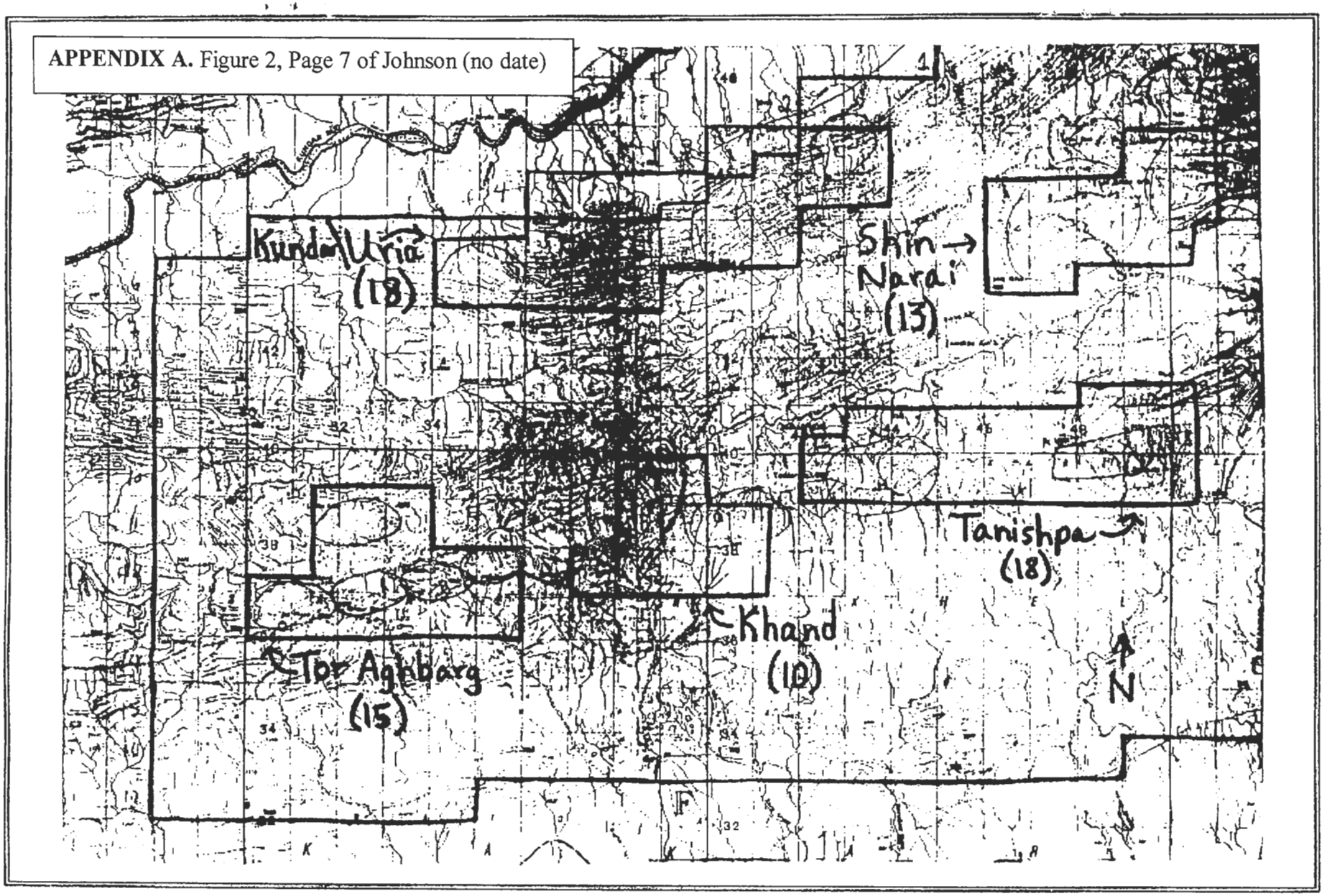


Figure 2. Major survey areas within the core protected area of the Torghar Conservation Project. Numbers in parentheses represent the number of 1,000-yard x 1,000-yard blocks contained within each major survey area.

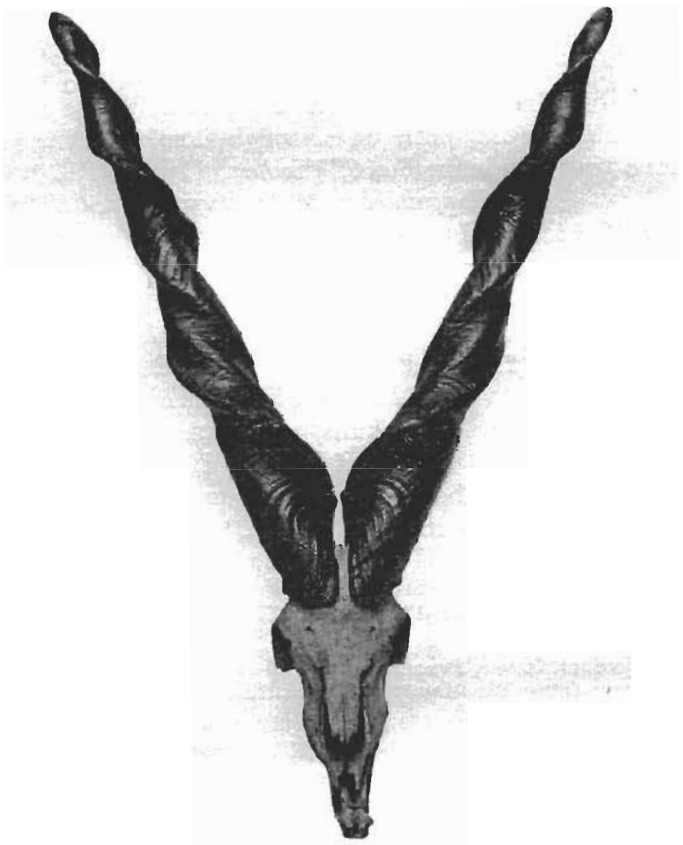
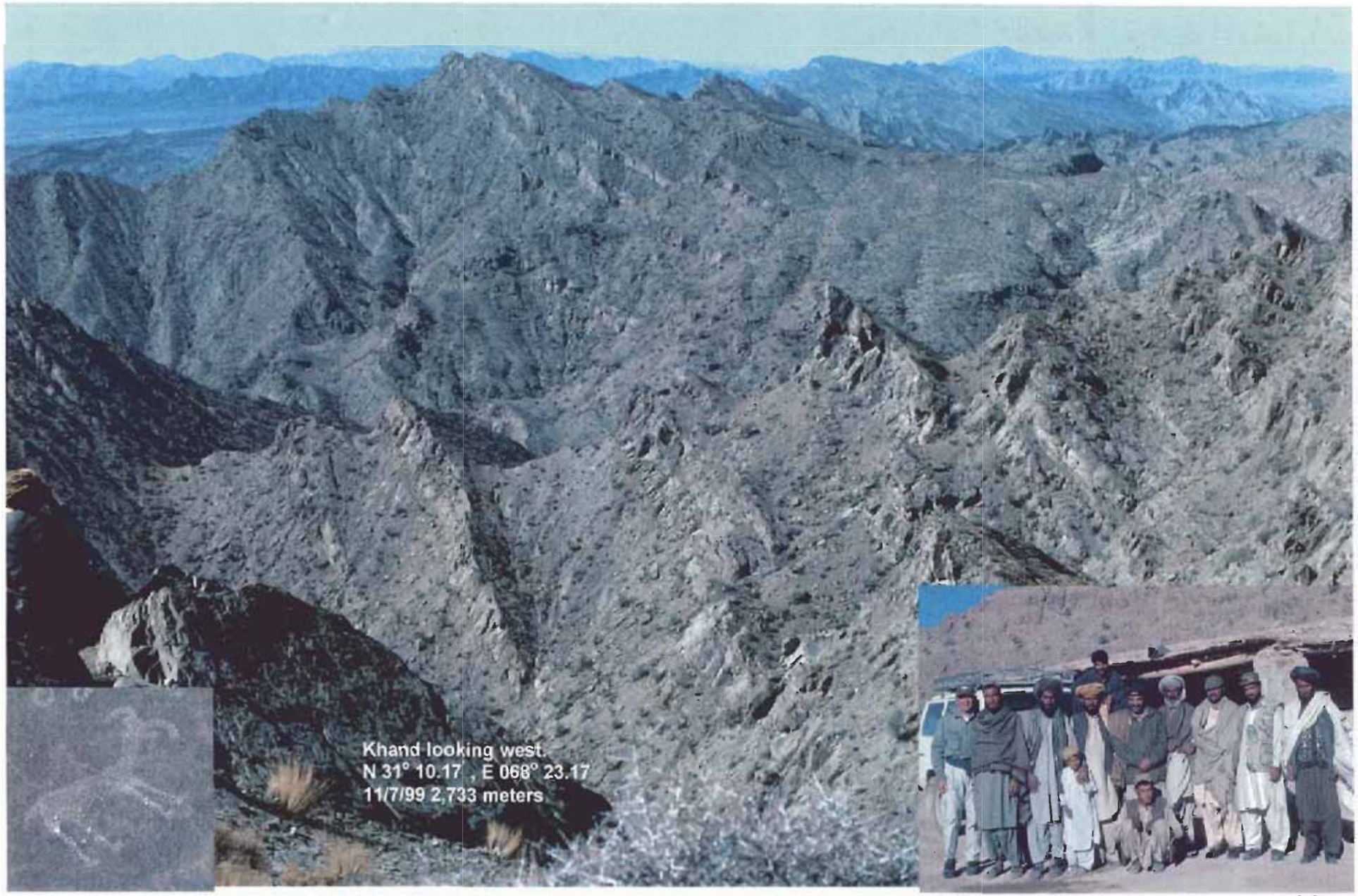


FIG. 44.—SKULL AND HORNS OF SULEMAN MARKHOR (*Capra falconeri jerdoni*).
From Ward's *Records of Big Game.*

As presented in Lydekker (1913).

" In the markhor of the Suleman and other Trans-Indus districts, including some of the hills in the neighborhood of Quetta, the horns are relatively short and form a regular straight cone, on the surface of which the front and hind keels are wound in a sharp spiral, forming in good specimens two to three complete spirals. " (Lydekker 1913)



Petroglyph Kumzair Pass
N 31° 13.8' , E 068° 26.4'
11/3/99 2,182meters

1999 survey crew at Tanishpa camp. 11/8/99
N 31° 11.8' , E 068° 28.1' 1,343 meters