Status of Blanford's Urial (*Ovis orientalis* [*vignei*] *blanfordi*) and Sindh Ibex (*Capra aegagrus blythii*) on the Dureji Game Management Area Balochistan, Pakistan

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INTRODUCTION

The geographical area of Balochistan Pakistan encompassing the Dureji Game Management Area (DGMA) is relatively rich in biological diversity and has been traditionally known for its abundance of wildlife, particularly game animals such as Blanford's urial (*Ovis orientalis [vignei] blanfordi*), Sind ibex or sara (*Capra aegagrus blythii*) and chinkara (*Gazella bennetii*). However, as far as can be determined, no formal surveys or ecological research has ever been carried out in the area so no estimates of wildlife nor base line population figures of the game species in the DGMA exist prior to formal protection.

According to the International Union for Conservation of Nature and Natural Resources (IUCN)-Pakistan, the DGMA was declared a wildlife sanctuary in 1972 based on a draft Wildlife Act (International Union for Conservation of Nature and Natural Resources 1998). It was later incorporated more formally under the Balochistan Wildlife Protection Act of 1974 with the Balochistan Government renewing its notification every five years. Under this status, a 133,122-ha portion of the wildlife sanctuary was designated as the DGMA. Based on this designation, the area falls under the jurisdiction of the Balochistan Forest Department. In reality, ownership of the DGMA is divided between the state, Forest Department, and local tribes. The primary tribal land owner is the Bhootani family.

Following legal notification in 1972, the Balochistan Forest Department attempted to provide some protection to the DGMA by appointing eight game watchers and

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one game guard from the local tribes (International Union for Conservation of Nature and Natural Resources 1998). Due to a paucity of financial resources for the management of protected areas in Balochistan by the Forest Department, the guard personnel were not well supported. Concerned about what they saw as declining urial and ibex populations, the Bhootani family took it upon themselves and added more game guards and increased protection. Currently, 38 game guards are supported by the Bhootani family in the DGMA with the primary focus on the protection of wildlife from poaching. Protection of the area since the early 1970s has therefore been primarily due to the Bhootani family's interest and commitment initially under the leadership of Sardar Umeed Ali Bhootani, and subsequently by his successor Sardar Saleh Mohammed Bhootani.

In the late 1990s, the Government of Balochistan received a request from LASMO Oil Pakistan Limited (LASMO) to drill some exploratory wells and upgrade an existing road within the DGMA. Since the purpose for establishing an area as a wildlife sanctuary is for the protection of wildlife and to provide undisturbed breeding, public access is legally prohibited except in accordance with rules laid out under Section 15(3) of the Balochistan Wildlife Protection Act. The Government of Balochistan can authorize such activities, but before making a decision on this request, they requested IUCN-Pakistan to do an assessment of the area in an attempt to determine the current value of the DGMA for wildlife.

IUCN-Pakistan carried out a rapid assessment of the DGMA between May 30-June 3, 1998 through field surveys and interviews with local people (International Union for Conservation of Nature and Natural Resources 1998). The surveys concluded that at least 18 species of mammals use the DGMA with an estimated urial population of 600-800, 300-400 ibex, and over 100 chinkara. The IUCN recognized that urial and ibex were the focus of limited trophy hunting managed by the Bhootani family and parts of the proceeds were used to protect both habitat and animals in the area. Because of this, IUCN concluded that this community-based conservation effort was largely responsible for the relatively

healthy state of the ungulate populations and recommended that the Government of Balochistan formally recognize and support the community-based conservation efforts in the Dureji area.

In 1998, the DGMA was established as a government sanctioned, official, community-based sustainable-use hunting area. As part of an effort to develop a population monitoring protocol for determining sustainable use harvest quotas, the Bhootani family requested assistance from the United States Fish and Wildlife Service (USFWS) to determine the population status and health of the urial and ibex. They also asked for recommendations to aid in preventing diseases from domestic livestock being passed to the urial population.

Based on an overall environmental impact assessment in 1999 of the proposed well drilling program in the DGMA conducted by Hagler Bailly Pakistan, an environmental consulting firm based in Islamabad, it was determined that the main issue was the potential displacement of urial from an 11-km^2 area around Hamalig Hill in the DGMA. Hagler Bailly was then commissioned to develop a range management plan to reduce domestic livestock grazing pressure in the area which would hopefully increase the food available to urials. The plan was implemented from March to September 2000 (Hagler Bailly Pakistan 2000A)

In April 2001 the USFWS Division of International Conservation and World Wide Fund for Nature-Pakistan (WWF-P) arranged for a team consisting of Mr. Michael R. Frisina, Wildlife Biologist, Montana Department of Fish, Wildlife & Parks; Dr. Michael H. Woodford, Wildlife Veterinarian and Chair, IUCN Veterinary Specialist Group; and Mr. Ghulam Ali Awan, Conservation Biologist, WWF-P to visit the DGMA to conduct a survey of the urial and ibex populations and to assess the disease threat. This was the first such survey done for the DGMA. The following report summarizes data resulting from the April survey and provides management recommendations.

CONSERVATION STATUS

The taxonomic status of urial is unclear, especially the designation of various subspecies. Some authors considered the Blanford's urial a separate subspecies (Clark 1964, Ellerman and Morrison-Scott 1966), while others consider it synonymous with the Afghan urial (*Ovis orientalis* [*vignei*] *cycloceros*) (Valdez 1982, Shackleton and Lovari 1997). All urial except for the subspecies Ladakh urial (*Ovis orientalis* [*vignei*] *vignei*) which is listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix l, are listed in CITES Appendix ll. Afghan urial are listed as vulnerable in the IUCN Red List (International Union for Conservation of Nature and Natural Resources 2000). Urial and Sindh ibex are protected under the 1974 Balochistan Wildlife Act.

STUDY AREA

The DGMA is located in southern Pakistan about 150 km north of Karachi near the town of Dureji in southern Balochistan Province (Figure 1). The area is a 130,122-ha series of mountain ridges running in a roughly north-south direction and adjacent plains with occasional rocky outcrops (Figure 2). Significant mountain ridges are the Bhuedar, Toj Jabal, and Kare Laki. The highest point of urial and ibex habitat in the study area is Mount Bhuedar at ~1,000 m. The elevation of valleys varies between 150 m and 210 m.

Although the area is arid with an average summer rainfall (June-September) of 149 mm, a drainage network of ephemeral streams and water courses flows from north to south into the Arabian Sea (Hagler Bailly Pakistan 1998). The Habb River is the only perennial water source. Freshwater is primarily procured from groundwater aquifers. The area's hydrology is based on torrential rain in the summer, which often results in localized flash floods. A number of springs that flow throughout the year exist in the study area. These springs, along with a few

water holes, are the primary source of water for people, livestock, and wildlife inhabiting the study area.

Urial, ibex, and chinkara are the large wild ungulates inhabiting the study area. Occasional sightings of jungle cat (*Felis chaus*), desert cat (*Felis silvestris*), caracal (*Felis caracal*), striped hyaena (*Hyaena hyaena*), desert fox (*Vulpes vulpes*), Asiatic jackal (*Canis aureus*), and Indian wolf (*Canis lupus*) have been recorded.

Significant game bird species include sandgrouse (*Pterocles indicus*), grey partridge (*Francolinus pondicerianus*) and chukar partridge (*Alectoris chukar*) with a variety of passerine and prey bird species.

The Habb River supports a threatened species of Mahseer fish (*Tor putitora*) and marsh crocodile (*Crocodylus palustris*).

The study area is within the “dry sub-tropical and temperate semi evergreen scrub forest” (Roberts 1991, Figure 3). Trees include *Acacia senegal, Acacia jacquemontii, Salvadora oleoides, Tamarix aphylla, Prosopis cineraria, Ziziphus mauritiana* and dwarf palm (*Nannorrhops ritchieana)*. Shrubs include the cactus-like *Euphorbia caducifolia*, *Capparis decidua*, *Commiphora wightii*, *Grewia tenax*, *Ziziphus nummularia*, *Withania coagulans*, *Rhazya stricta* and *Convolvulus glomeratus*. Common grasses are *Elusine compressa*, *Chrysopogon aucheri*, *Cymbopogon jwarancusa*, and *Saccharum spontaneum*.

Human land use is primarily farming and livestock grazing. The main agricultural crops include lentils, sesame seeds, and sorghum. Cattle, sheep, and goats occur throughout the study area, but are at relatively low density in the mid to high elevation portions of the study area. The human population is sparse and rural with most people living non nomadic lives in small settlements of 10 households or less.

The Government of Pakistan (Ministry of Petroleum and Natural Resources) has been allotted oil and gas exploration concessions (Dumbar Block) to LASMO and Premier Exploration Pakistan Limited. The concessions include all of the DGMA and parts of Sindh Protected areas. LASMO has requested permission from the Government of Balochistan to use and upgrade an existing road passing through the DGMA and drill exploratory wells inside the DGMA.

Figure 1. The Dureji Game Management Area is located in southern Pakistan 150 km north of Karachi.

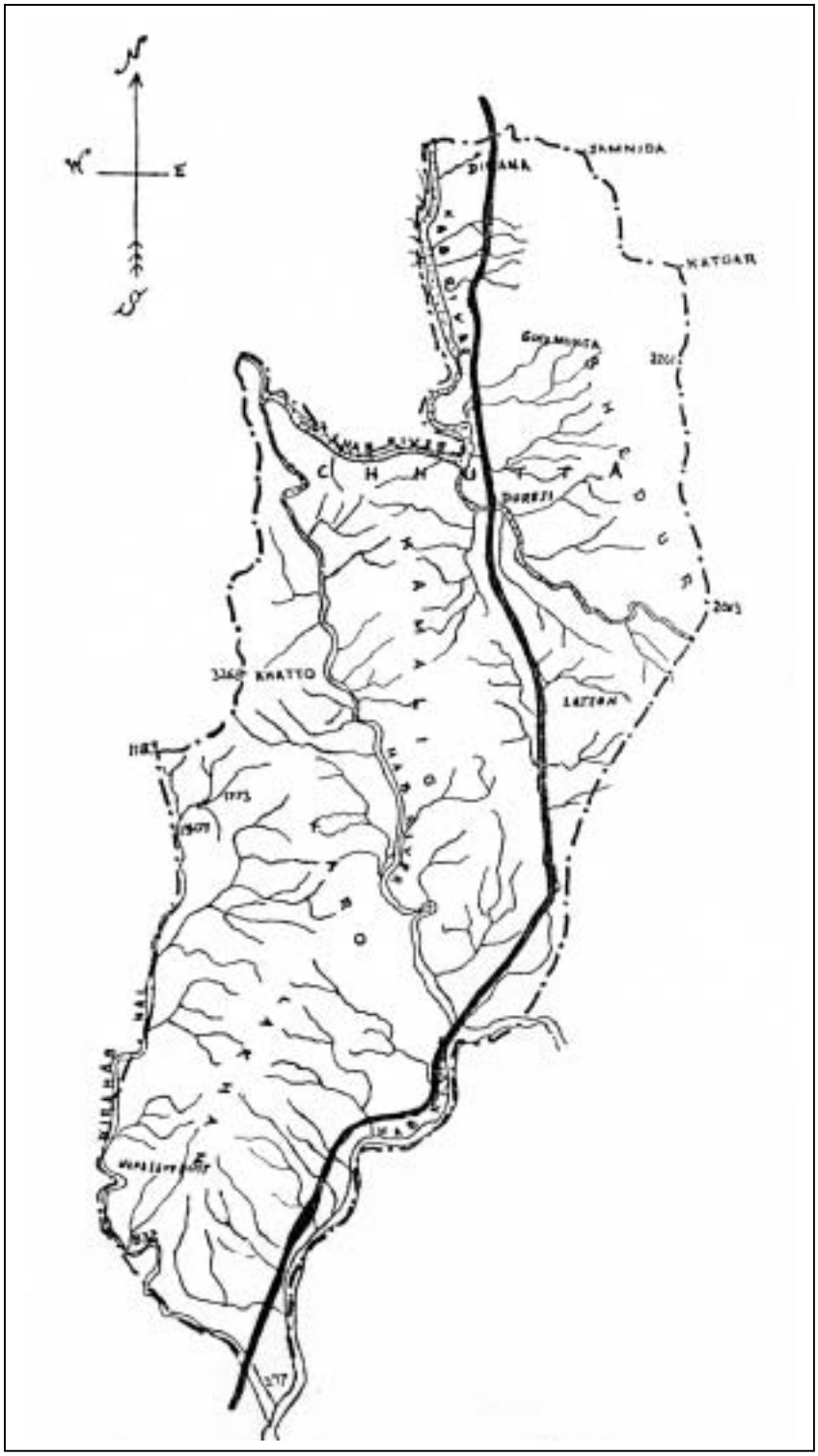

Figure 2. Sketch map of the Dureji Game Management Area showing the location of prominent geographic features. 2.54 cm = 6.4 km

Figure 3. The Dureji Game Management Area is within the sub-tropical and temperate semi evergreen scrub forest described by Roberts (1991).

METHODS

Urial and ibex were systematically surveyed within a 26,326-ha portion of the study area during a 4-day period from April 10 to 13, 2001. Areas selected for survey were portions of the DGMA inhabited by urial and/or ibex. There was not time to survey all urial and ibex habitat in the DGMA. Areas surveyed (Table1, Appendix A) were selected as a representative sample that could be efficiently surveyed within the limited time allotted. Surveys were conducted while walking predefined travel routes and from observation points. Drop off points, base camp locations and observation points were documented using GPS technology. Animals were observed with aid of 8X and 10X binoculars. One or 2 observation groups of 3 to 4 experienced observers went into the field each day to observe urial and/or ibex. Censuses were conducted on different portions of the study area each day to minimize counting the same animal more than once. When the possibility existed that the same animals were observed more than once, only the first observation was recorded to minimize error. Location and altitude of urial and ibex observation sites were recorded using GPS technology.

Observed urial and ibex densities were determined by dividing the number of animals observed by the size of the area surveyed. Size of the survey area was determined from a 1:75,000 topographic map using a dot counter.

Table 1. Area of urial and ibex habitat on the Dureji Game Management Area by location.

Number[1]	Location	Total Hectares	Total Km^2	Urial Habitat km^2			Ibex Habitat km^2		
				High Density	Low Density	Not Urial Habitat	High Density	Low Density	Not Ibex Habitat
1	**Lakhan(West)**	2,298	22.98	22.98	0	0	0	0	22.98
2	**Lakhan(East)**	4,665	46.65	0	46.65	0	0	0	46.65
3	**Lokhir**	7,667	76.66	0	76.66	0	0	0	76.66
4	**Karo(Center)**	2,495	24.95	24.95	0	0	0	0	24.95
5	**Karo(Outer)**	2,495	24.95	0	24.95	0	0	0	24.95
6	**Khatto**	4,832	48.30	0	48.30	0	0	0	48.30
7	**Hamalig(South)**	4,332	43.33	0	43.33	0	0	0	43.33
8[2]	**Hamalig(North)**	12,317	123.15	123.15	0	0	0	0	123.15
9	**Obai/Bhuedar(South)**	6,442	64.41	64.41	0	0	0	64.41	0
10	**Obai/Bhuedar(North)**	7,567	75.76	0	75.76	0	75.76	0	0
11	**Bagga**	2,382	23.82	0	0	23.82	0	23.82	0
Totals		***57,492***	***574.96***	***235.49***	***315.65***	***23.82***	***75.76***	***88.23***	***410.97***

[1]Number corresponds to number on Appendix A map showing detailed locations of each survey area.
[2]Shaded areas are locations included in the survey.

Through interviews with local game guards and assessment of general habitat characteristics (factors such as steepness, remoteness, productivity, etc.), each survey area listed in Table 1 (Appendix A) was rated as high or low density habitat for urial and ibex.

Each urial observed was classified into 1 of the following categories: adult female, lamb, or ram. Rams were classified by size classes based on horn length as follows: Class I (1-2 years old), Class II (3-4 years old), Class III (5-6 years old), and Class IV (>6 years old). Ibex were similarly classified except males were classified into 2 size classes: Class I (< 6 years old) and Class II (> 6 years old).

Horns from 9 adult male urial and 8 adult male ibex harvested by hunters were aged by counting annual growth rings (Geist 1966).

RESULTS & DISCUSSION

Urial

During the April survey 504 urial were observed (236 female, 63 lambs, 190 male, 15 unclassified). The 190 males were classified as 21, 25, 144 Class I, Class II, and Class III & IV rams, respectively.

Population Abundance

During the 4-day survey 126 urial were observed per day in the field, indicating urial are abundant in the DGMA. Urial were widely scattered throughout the area with many observed as single animals or in small groups of fewer than 5.

Population Density

During April 2001 a total of 263.32 km^2 of urial habitat in the DGMA was surveyed and a density of 1.9 urial per km^2 observed. Of this 187.56 km^2 was designated as high density urial habitat and the urial density observed in this type

was 2.3 per km^2. On the 75.76 km^2 of low density urial habitat surveyed, a density of 1 urial per km^2 was observed.

Population Structure

The observed April population structure at DGMA is summarized in Table 2.

Table 2. Urial (*Ovis orientalis* [*vignei*] *blanfordi*) population sex and age structure for the Dureji Game Management Area, April 2001.

		Percent			*Percent Rams by Size Class*[1]		
YEAR	***N***	**Ewes**	**Lambs**	**Rams**	**I**	**II**	**III & IV**
2001	489	48	13	39	11	13	76

[1]**I** = 1-3 years old, **II** = 3-4 years old, **III & IV** = ≥ 5 years old.

Rams

The largest proportion of rams in the population was Class lll (76%), indicating good survival of rams into adult age classes. Due to communication difficulties with local guides, we were not consistently able to classify mature males into the more specific age classes. During late December 1998 and early January 1999 the second author observed 69 rams in the DGMA. Their composition was 14, 18, 22, and 35 percent Class l, Class ll, Class lll, and Class lV respectively. These data indicate a good survival of rams into older age classes.

Ewes and Lambs

During early April ewes are having their lambs at Dureji. This may be why the percentage of lambs observed in the population was only 13 percent or 27 lambs:100 ewes.

Almost half of all urial observed were ewes. Had the survey been conducted after lambing was completed and lambs were old enough to travel with their mothers, the percentage of lambs observed would have been higher and the percentage of ewes observed lower.

For the aforementioned reason, data from this survey cannot be used to calculate an accurate ewe-lamb ratio for spring 2001. International Union for Conservation of Nature and Natural Resources (1998) estimated 600-800 urial in the DGMA. Hagler Bailly Pakistan (2000) estimated 200 urial on Hamalig hill and described a 10:1 ratio of mature females to young in the southern end of Hamalig ridge.

Population Estimate

To date, the only population data collected systematically within the DGMA is that collected during this survey. April is a poor time of year to census a urial population as ewes are scattered due to lambing, recently born small lambs are difficult to observe, and rams are scattered across their range. The result is a significantly lower number of total animals observed by sex and age class than would be observed during a time of year when ewes and rams are more visible such as the fall breeding season. Thus using data from this survey to make a population estimate provides a very conservative total population number.

To estimate the total number of urial within the DGMA, we multiplied the number of urial observed per km^2 in high density habitat (2.3) by the total amount of high density habitat (235.49 km^2) within the DGMA. Then the number of urial observed per km^2 in low density habitat (1) was multiplied by the total amount of low density urial habitat (315.65 km^2) within the DGMA. The estimates for low and high density habitat were then added together to produce an estimated population of 858 urial for the DGMA in April 2001.

Ibex

During the April survey 365 ibex were observed (170 female, 22 lambs, 173 male). The 173 males, were classified as 82 Class I (< 6 years) and 91 Class II (> 6 years).

Population Abundance

During the 2 days spent in that portion of the DGMA containing ibex habitat 183 ibex were observed per day in the field, indicating ibex are abundant in the DGMA. Ibex, although more concentrated than urial within their habitat area, were widely scattered with many observed as single animals or in small groups of fewer than 5.

Population Density

During April 2001 a total of 140.17 km^2 of ibex habitat in the DGMA was surveyed and a density of 2.6 ibex per km^2 observed. A total of 75.76 km^2 of high density ibex habitat was surveyed and the ibex density observed in this type was 3.8 per km^2. An additional 64.41 km^2 of low density ibex habitat was surveyed and a density of 1.3 ibex per km^2 observed.

Population Structure

The observed April population structure at DGMA is summarized in Table 3.

Table 3. Ibex (*Capra aegagrus blythii*) population sex and age structure for the Dureji Game Management Area, April 2001.

		Percent			*Percent Rams by Size Class*	
YEAR	***N***	**Females**	**Kids**	**Rams**	**I <6 yrs**	**II >6yrs**
2001	365	47	6	47	47	53

Rams

About half of the observed population was rams. The largest proportion of rams in the population was Class ll (53 %), indicating good survival of rams into adult age classes. Almost half of the male population segment was younger Class l males indicating good survival of kids during recent years. Due to communication difficulties with local guides we were not consistently able to classify mature males into more specific age classes.

Ewes and Lambs

During early April female ibex are having their kids at Dureji. This is likely why the percentage of young observed in the population was only 6 percent or 13 kids :100 ewes.

Almost half of all ibex observed were nannies. Had the survey been conducted after kidding was completed and the kids were old enough to travel with their mothers, the percentage of kids observed would be expected to have been higher and the percentage of ewes observed lower.

For the aforementioned reason, data from this survey cannot be used to calculate an accurate kid ratio for spring 2001.

Population Estimate

To date, the only population data collected systematically within the DGMA is that collected during this survey. April is a poor time of year to census ibex populations as females are scattered due to kidding, recently born kids are difficult to observe, and rams are scattered across their range. The result is a significantly lower number of total animals observed by sex and age class than would be observed during a time of year when nannies and rams are more visible such as the fall breeding season. Thus using data from this survey to make a population estimate provides a very conservative total population number.

To estimate the total number of ibex within the DGMA we multiplied the number of ibex observed per km^2 in high density habitat (3.8) by the total amount of high density habitat (75.76 km^2) within the DGMA. Then the number of ibex observed per km^2 in low density habitat (1.3) was multiplied by the total amount of low density ibex habitat (88.23 km^2) within the DGMA. The estimates for low and high density habitat were then added together to produce an estimated population of

403 ibex for the DGMA in April 2001. International Union for Conservation of Nature and Natural Resources (1998) estimated 300-400 ibex in the DGMA.

Disease

The observations recorded hereafter arise from observations made in the field during April 2001. Information was also gathered from conversations with Government veterinary officers, tribal leaders, village chieftains, shepherds, game guards and hunters. While the accuracy of most of the information is without question, it must be remembered that since it was not possible at this time to collect any pathological specimens from the wild sheep and goats (Caprinae), any diagnoses based on hearsay evidence must be considered presumptive.

Very little is known of the susceptibility of the wild Caprinae in Pakistan [Urial Ibex, Markhor (*Capra falconeri*) and Blue sheep (*Pseudois nayaur*)] to the diseases of the domestic livestock that share the range. However some idea of the likely risk of disease transmission can be obtained from previous accounts in the literature and from recent observations by Pakistani field biologists.

Susceptibility, too, will vary with biological parameters of the caprine in question. Age, gender, reproductive activity (rut), pregnancy, lactation, nutrition (drought and resulting competition for grazing by domestic livestock), and disturbance (hunting pressure, both legal and illegal) all have a bearing on an animal's immune status and its ability to resist the challenge of a disease agent.

External Parasites

In recent years a skin disease, presumptively diagnosed as Sarcoptic Mange, was reported to be affecting the Dureji urial and may have been responsible for some mortality, particularly in the older males after the rut (November and December). Sarcoptic mange is transmitted in domestic sheep and goats by close contact and so is unlikely to be transmitted to free-ranging wild sheep

unless these rub against rocks and tree stumps where infected sheep or goats have rubbed to relieve the irritation produced by the parasites. The mange mite probably occurs naturally on and in the skins of healthy urial and only causes overt clinical disease when the animals are stressed by malnutrition.

Unless debilitated by concurrent disease and/or malnutrition wild animals rarely carry heavy infestations of ectoparasites (ticks).

Warble flies and nasal bot flies, both of which parasitise domestic sheep and goats, probably also infect the wild sheep but do not cause significant disease in healthy animals.

Internal Parasites

Intestinal worms, lungworms and liver flukes all infect the domestic sheep and goats in the Dureji area and are probably to be found in the wild caprines, too. Under extensive range conditions these parasites are unlikely to cause significant disease in the wild caprines and gazelles unless these are stressed by drought and malnutrition.

The domestic livestock can be easily treated for sarcoptic mange, ticks, intestinal worms and lungworms by strategic injection with Ivermectin®. Treatment for liver flukes requires the administration of a specific flukicide.

Bacterial diseases

Anthrax

Anthrax is an acute and fatal disease of domestic animals and mammalian wildlife (and humans). The spores of the anthrax bacillus can persist for many years in infected soil or in an infected water source. The disease is not normally transmitted from one animal to another except when a carnivore (or a human) eats an infected carcass. Herbivorous domestic livestock and wildlife are usually infected by eating vegetation or drinking water contaminated by anthrax spores.

The location of infected areas and water sources is often well known. Protection of domestic livestock is achieved by annual vaccination. Anthrax is more prevalent in sheep than in goats in Pakistan and presents a potential threat to the urial population.

Viral diseases

Rinderpest

Rinderpest is still present and is the subject of an ongoing global eradication campaign. Wild sheep and goats are highly susceptible to this highly infectious and fatal disease which, in the past, has caused considerable losses of markhor in Chitral (1966) and Marco Polo's sheep (*Ovis ammon polii*) in the Pamirs (1907). The Global Eradication Programme of FAO renders it very unlikely that rinderpest will present a threat to the wild caprines at Dureji.

Peste des Petits Ruminants (PPR) or Goat Plague

This disease is caused by a virus closely related to rinderpest and causes an acute and fatal disease in sheep and goats. Urial and possibly ibex can be expected to be susceptible to PPR and if infected by contact with domestic sheep or goats, could die in large numbers.

A vaccine for PPR will soon be available for domestic sheep and goats and it is strongly recommended that when this becomes freely available, all domestic sheep and goats likely to come into contact with the valuable wild caprines should be vaccinated.

Once vaccinated the domestic livestock are protected against PPR for at least three years.

PPR is spreading rapidly throughout Pakistan and is causing great losses of sheep and goats. The infection of the Dureji urial and ibex with PPR virus could

result in severe losses. The flocks of nomadic herdsmen are often considered to be a source of infection of this dangerous virus.

Foot and Mouth Disease (FMD)

FMD is enzootic (endemic) in Pakistan and affects all cloven hoofed domestic and wild animals. Unconfirmed cases have been reported in the Dureji urial and in this case the affected animals were said to recover.

In areas where wild boar (*Sus scrofa*) occur along with wild Caprinae it is very important to limit the chance that these animals will contract FMD by making sure that they have no contact with infected domestic livestock. FMD infected pigs excrete huge quantities of virus, far more than sheep or cattle, and greatly increase the risk of infecting closely related (sympatric) wild ungulates. Vaccine for FMD is available for domestic livestock.

Sheep Pox, Goat Pox and Contagious Ecthyma

These three acute and often fatal viral diseases are enzootic in the domestic flocks in Pakistan and could present a serious threat to wild sheep and goats if these proved susceptible. If detected in domestic sheep and goats great care should be taken to avoid contact with the wild sheep. Vaccines are available.

POPULATION VIABILITY FOR SUSTAINABLE HARVESTING

Data from this survey, although limited, indicate the urial and ibex populations at Dureji are viable (e. g. Soulé 1987). The DGMA is a Government sanctioned community-based sustainable use hunting area. One requirement for the area is establishment of hunting quotas that will not negatively effect the population. For similar species and populations, Harris (1993) concluded that annual harvest of trophy males in numbers equivalent to 1 or 2 percent of the total population size can be maintained without negative consequences.

Using the approach described by Harris (1993) and the April 2001 population estimates of 858 urial and 403 ibex, a trophy hunting quota of up to 17 urial and 8 ibex could be established for the DGMA.

CONCLUSIONS AND RECOMMENDATIONS

Population and Habitat Management

- The urial and ibex populations at Dureji appear to be viable for both population and genetic processes and a sustainable use trophy harvest quota of about 17 male urial and 8 male ibex could be established without negative impact to the population.
- Periodic and intensive surveys for urial and ibex in the DGMA using protocols developed for this survey should be conducted during the fall breeding season to monitor population trend and adjust hunting trophy quotas.
- Future surveys should emphasize classifying Class lll and Class lV urial rams as separate age classes.
- Future surveys should emphasize classifying the ibex into more specific age classes. Mature males of trophy size and yearling males should be classified as separate age classes.
- A detailed analysis of the DGMA urial and ibex habitat should be conducted. This should include describing the variety and extent of plant communities present, the diversity of plant species present, and the ecological condition of soils and vegetation. The aforementioned information is essential for determining habitat carrying capacity for urial and ibex.
- All trophies harvested should be aged and standard physical measurements taken of the carcasses and horns. Field necropsy for disease, parasites, and assessing animal health at time of death should be performed on all harvested trophies. This might require special training for local staff, but provides essential data for population management.

Disease

- Most of the diseases of domestic livestock mentioned above present a potential threat to the urial and ibex populations on the DGMA where very large numbers of domestic animals share the mountain grazings with the wild caprines. However, all can be controlled or eliminated by strategic use of available medication and vaccines for the domestic livestock that may come into contact with the wild caprines.
- With a few exceptions, the susceptibility of the wild Caprinae to the common diseases of contiguous domestic livestock is largely unknown. One can, however, safely predict that anthrax (an environmental contaminant) where it occurs would be fatal to the urial and ibex. PPR (and rinderpest too) could cause very severe losses and PPR is probably the most dangerous disease of domestic sheep and goats to threaten the wild caprines on the DGMA.
- Since it is not at present possible to vaccinate widely dispersed wild ungulates in mountainous terrain, the best and only way to protect them from the diseases transmissible by domestic livestock is to ensure that the domestic animals are regularly vaccinated against the important diseases described here. They should also be strategically treated for external and internal parasites. By “strategic treatment” is meant the application of multivalent anthelmintics in the spring and autumn. This should reduce pasture contamination of the summer and winter grazing ranges. The health and productivity of the domestic livestock would benefit greatly from such a regime.
- ***Most important of all is to limit, or better eliminate, all direct and indirect contact between the potentially infectious domestic livestock and wild Caprines.*** In the case of the Dureji Estate this would entail preventing all contact between the domestic sheep and goats, unless these have been previously treated for internal and external parasites and vaccinated against PPR. A significant proportion of the 4,500 domestic sheep and goats, 2,000 cattle, 500 camels and 1,300

donkeys maintained at Dureji have occasional contact with the wild caprines, especially in the dry season and in times of drought when grazing on the lower ground is scarce.

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LITERATURE CITED

Clark, J. L. 1964. The great arc of the wild sheep. University of Oklahoma Press.

Ellerman, J. R., and T. C. S. Morrison-Scott 1966. Checklist of Palearctic and Indian mammals 1758 to 1946. Trustees of the British Museum of Natural History. London.

Geist, V. 1966. Validity of horn segment counts in aging bighorn sheep. Journal of Wildlife Management 30(3): 634-635.

Hagler Bailly Pakistan. 1998. Environmental Impact Assesment of Proposed Seismic Survey in Dureji Area, Dumbar Concession. (Study conducted for Premier Exploration Pakistan Ltd.)

Hagler Bailly Pakistan 2000. Environmental Impact Assesment of Exploratory Well in Dureji Area, Dumbar Concession. (Study conducted for Premier Exploration Pakistan Ltd.)

Hagler Bailly Pakistan. 2000A. Range Management Plan for Hamlig in Dureji Game Reserve. Final report to Premier Exploration Pakistan limited. Hagler Bailey Pakistan, Islamabad.

International Union for Conservation of Nature and Natural Resources. 1998. Rapid Assesment of Wildlife and its Habitat in Dureji Wildlife Sanctuary, District Lesbela, Balochistan. 32pp IUCN-Pakistan, Lahore.

Harris, R. B. 1993. Wildlife conservation in Yeniuquo, Qinghai China: executive summary. Ph.D. Dissertation. University of Montana, Missoula, MT.

Shackleton, D. M. and S. Lovari. 1997. Classification adopted for the Caprinae survey. Pages 9-14 in Shackleton D. M. (editor). Wild sheep and goats and their relatives. IUCN/SSC Caprinae Specialist Group.

Soule′, M.E. (editor). 1987. Viable populations for conservation. Cambridge University Press.

United States Fish and Wildlife Service. 2001. Appendices l, ll, and lll convention on international trade in endangered species of wild fauna and flora. US Dept. of the Interior, Fish and Wildlife, Division of Management Authority, Arlington, VA.

Valdez, R. 1982. The wild sheep of the world. Wild Sheep and Goat International. Mesilla, New Mexico.