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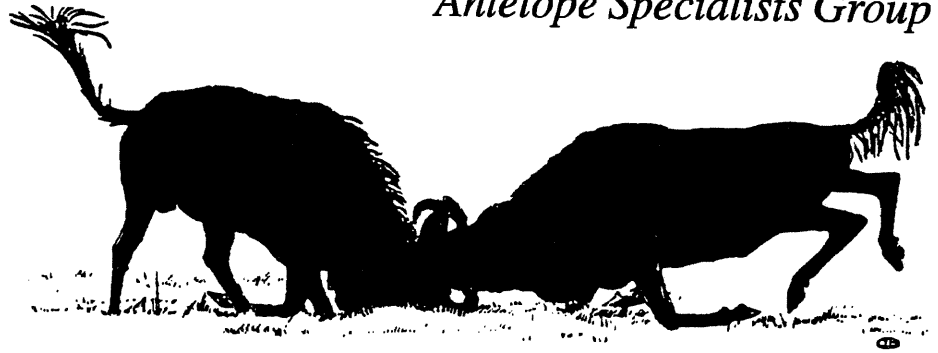
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Antelope Specialists Group



GNUSLETTER

ASG NEWS

**Contributions to Antelope
Projects**

There is no better way to give heart to the conservationists who are struggling to carry out antelope conservation projects than to proffer financial support. Several very deserving proposals are reported in this issue of the *Gnusletter*. (The Sudanese conservationist praised in the next paragraph is a test case.) It occurred to me that some readers might want to contribute to a worthy project and encourage the principal investigators by making a token donation, say of \$25-100. You can either send the money directly to the people involved, or c/o the *Gnusletter*, and I'll see that it is delivered.

IN PRAISE OF IBRAHIM HASHIM

A year ago, an initiative by Dr. Hashim's to determine the numbers and distribution of Soemmerring's gazelle in eastern Sudan was reported in the *Gnusletter* (vol. 13 (1&2): 11-12). In a recent letter (19 Jan 95), he comments on the lack of support he received.

"The Soemmerring's gazelle project has not been given much attention by international donors. There is a possibility of receiving responses after its publication in *Gnusletter*. However, a local safari company provided a 4WD vehicle and a small area of the gazelle range was surveyed. The presence of the gazelle in that area was not confirmed, but the possibility of its ex-

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istence is not ruled out. Still, we have a long way to go before reporting a final result. Nothing daunted, Hashim has submitted a new, far more ambitious proposal for a three-year survey of the northern Sudan (see under Regional Rundown). Not only is the project of outstanding conservation interest, but there is a compelling need to encourage conservation efforts in Sudan, which holds the most significant remaining antelope populations of any country except Tanzania.

The ASG is proud to have as a member a man who is leading the way to a renewal of conservation awareness in the Sudan. To appreciate how the civil war and other destabilizing events put conservation on hold in the Sudan, see the notice in the Regional Rundown about a seminar on wildlife conservation in Sudan, just received, that was held in Khartoum in 1985!

ERRATA IN VOL. 13 NO.3
Goitered Gazelle Range Map
Kay Schaller was not the only reader to note that the range map of the goitered

gazelle included with George Schaller's report on gazelles of Mongolia's steppe in the last *Gnusletter* depicted Tibet. At the time (November), George was in Laos; otherwise, no doubt he would also have had something to say. Anyway, the map, mistakenly scanned in from an earlier Schaller report on wildlife of the Tibetan plateau, shows the range of the Tibetan antelope *Panthelops hodgsoni*. And it isn't really an antelope, either, according to DNA tests, but a caprine. (More under Antelope News, in the Vu Quang oryx article.)

Berlin Zoos

Marvin L. Jones, who knows the history of zoos and their collections probably better than anyone alive, pointed out mistakes in the report of the Berlin Ruminant Conference I attended last October, and coincidentally exposed my own ignorance about zoos (not to mention geography).

"Be aware," he wrote (6 Jan 95), "that when you were staying at the renovated Tierpark Hotel in Berlin (it used to be a youth hostel for Eastern European students), you were NOT across the street from Berlin Zoo but Tierpark Berlin (hence the name of the hotel). Berlin Zoo is across the city near the Kurfurstendamm area. The Tierpark at the time of the Second World War was not a zoo, simply a large estate; the Tierpark was not opened until 1955. Thus there are two major collections in Berlin; I gather your group did not go to the Zoo, which has a very good antelope collection.

"The Institute that Dr. Hofmann heads has been there for many years; he has only been Director a short time (since the fall of the Wall), but it was built in the days of former Tierpark Director Prof. Dathe. Dr. Hofmann has, however, brought quite a lot of new people in and it now is better recognized. Having also had the pleasure of one of those buffets at the Tierpark hotel, your comment brought back a delicious memory."

MARTYN MURRAY

Although his present home in Edinburgh is a far cry from the Serengeti, Martin Murray^{ASG} is still absorbed in the results of his comparative study of wildebeest, hartebeest, and topi feeding ecology. One or both of his papers, Specific nutrient requirements and migration of wildebeest,

and Migration of wildebeest: the hunger of the long-distance runner, will be published in the forthcoming symposium volume on Serengeti NP research. In a 20 Nov 94 letter, he wrote:

"I thought you might like an update on what is going on in Scotland. Well, the most relevant past work is a chapter on the wildebeest migration (which I think I sent you) but which is still stuck in the logjam at University of Chicago Press awaiting publication in the "Serengeti II" book. It might be worth noting in the *Gnusletter* that I found low levels of phosphate in sera of migratory wildebeest in the north of their range (in the Serengeti/Mara ecosystem) which when taken together with evidence of a shortage of dietary phosphorus in grass leaf in the northern range (but high concentrations on the southeastern range), indicates that the pronounced southward migration at the start of the wet season may be in response to phosphorus deficiency. Other minerals including calcium and sodium were investigated without positive findings. These results, together with those of Sam McNaughton and Dirk Kreulen, demonstrate the importance of mineral surveys in management plans for conserving or expanding migratory herds.

"Currently I am still working on the processes which structure the grazing ungulate community in Serengeti, and I am in fact writing another chapter which will hopefully pull a lot of different aspects of the community together."

ANTELOPE NEWS

Vu Quang Oryx

Not an Antelope?

H. Thomas, of the Laboratoire de Paléontologie, Museum national d'Histoire naturelle, rue Buffon, 75005 Paris, has published a paper in *Mammalia* 58:453-81, which claims that *Pseudoryx nghetinhensis* belongs with the Caprinae not the Bovinae, and is therefore not an antelope. Here is the abstract of Thomas's paper, Anatomie crânienne et relations phylogénétiques du nouveau bovide (*Pseudoryx nghetinhensis*)

decouvert dans la cordillère annamitique au Vietnam.

Summary

The morphological study of the skull and dentition of the newly discovered bovid, *Pseudoryx nghetinhensis*, along the eastern slope of the annamitic cordillera in Vietnam, suggests a close relationship with the Asian Caprinae - serows and gorals - in spite of the primitiveness of the skull characters. Therefore our hypothesis is in contradiction with the conclusions drawn most recently by Vu Van Dung et al. (1993 b) who relate the new bovid with the Bovinae and support a provisional placement among the Boselaphini. These two proposals are here compared with the results of a phylogenetic analysis program using parsimony (Hennig 86 and Paup) based on a data matrix of 114 characters in 15 species of living bovid[s], largely taken from the matrix constructed by Gentry (1992). As a result, the parsimony phylogenetic analysis definitely confirms that the new bovid is not related to the Bovinae, although no close relationship is clearly established with the serows-gorals here unexpectedly not preserved as a monophyletic group. However *Pseudoryx nghetinhensis* appears obviously linked with the Caprinae as their primitive sister-group. As a matter of fact almost all characters which define the monophyly of the Caprinae are precisely retained in a primitive state in *Pseudoryx nghetinhensis*. Therefore one cannot exclude any close relationship with either of the Caprinae, in particular with the serows/gorals, a hypothesis which we still favour.

[Only the above summary was seen, lacking references.]

Not so fast! Is the ^{ASG} going to sit back and let this latest jewel in its crown be taken away and put in a different subfamily and claimed by another specialist group? (See articles on *Pseudoryx* in vol. 13 no. 3 and 12 no. 2 of *Gnusletter*.) Not likely! (I checked to see if Thomas is a member of the Caprinae Specialist Group. He's not.) Fortunately a stout defense of the Bovinae classification has been mounted by George Schaller (who is not a member of the ASG and has no ax to grind) and his colleagues, based largely on DNA evidence. A paper just published in *Oryx* by Schaller and Rabinowitz (1995) supports the view that

Pseudoryx can legitimately be considered an antelope—belonging therefore to the ASG. (But conceivably the wild cattle specialists will try to horn in.) Consider the following paraphrases and quotes from the Oryx article: The saola or spindlehorn bovid *Pseudoryx nghetinhensis* in Laos, by G. B. Schaller and Alan Rabinowitz. Oryx 29(2):105-114.

Physical Characteristics of Saola

"Based on DNA analysis, Dung et al (1993) placed the saola in the subfamily Bovinae, which includes wild cattle and buffalo (tribe Bovini), spiral-horned antelopes (Tragelaphini), and the nilgai antelope (Boselaphini)."

Following a description of the animal, partially based on fragmentary specimens of 10 saola (rarely more than the horns and top half of skull) acquired in Laos, Schaller and Rabinowitz write:

"The saola has a large fossa—6 cm long and 3 cm wide in one subadult male—on the lachrymal bone. This fossa marks the site of a preorbital gland (Dung et al 1993). Preorbital glands are absent in the Bovini and Tragelaphini but they occur in one other member of the subfamily, the nilgai.

"Most Bovinae are sexually dimorphic in that adult males have a larger body, longer and more massive horns, and often also a darker or more strikingly marked pelage than the females; indeed, the females of nilgai and some spiral-horned antelopes are hornless (Estes 1991). Any dimorphism in saola appears to be minor. . . In this respect the saola resembles the Rupicaprini (subfamily Caprinae), such as the serow, rather than other Bovinae."

"With which tribe in the Bovinae is the saola most closely aligned? Dung et al. (1993) tentatively placed the saola with the Boselaphini because it resembles the nilgai in some characters, such as the preorbital glands and the white markings of the pelage. Based on preliminary DNA analyses, the phylogenetic position of saola can be interpreted in two ways (P. Arctander and J. Gatesy, pers. comm.). Analysis of mitochondrial genes indicates that saola branched from Bovinae stock after the nilgai but before the Bovini and Tragelaphini split into distinct tribes. But nuclear gene analysis indicates that the saola and the Bovini split into separate evolutionary lines

after first the nilgai and then the Tragelaphini had done so.

"A detailed analysis of skull and tooth characters could help determine whether the saola's closest affinity lies with the wild cattle or represents 'a rather deep branch of the subfamily', as Dung et al. (1993) phrased it, but we unfortunately had no access to a complete skull. However, some of the saola's features that we examined are indicative.

"The preorbital gland is found widely among ruminants and is generally considered to be a primitive feature. Although only the nilgai and saola among the living Bovinae have this gland, it has also been observed in fossil Tragelaphini (E. Vrba, pers. comm.). A variable pattern of white markings on head and body is found not just in nilgai and saola, a comparison stressed by Dung et al. (1993), but also in the *Tragelaphini*, with some, such as bush-buck *Tragelaphus scriptus* and bongo *Boocercus euryceros*, also having a white band above the hoof (Estes, 1991). Indeed, mountain anoa also have white above the hooves and on the face. But in its combination of these features—preorbital gland, white markings and a narrow, antelope-like muzzle—the saola most closely resembles the nilgai and Tragelaphini.

"However, some of the saola's skull characters show an affinity to the Bovini. The frontal sinus of saola extends well into the base of the horn cores, a characteristic of the Bovini that is either not found in the other Bovinae or is present only in rudimentary form. Furthermore, the first incisor among the Tragelaphini is considerably larger than the others, whereas among the Bovini the incisors are of roughly equal size (E. Vrba, pers. comm.). We have not examined saola teeth, but the rather imprecise drawings in Dung et al. (1993) convey a Bovini pattern. In its body conformation and the shape of its hooves and horns, the saola is similar to the anoas, the most primitive living Bovini. These various characters suggest that saola belongs at the base of the Bovini clade before the lowest modern bovines evolved, as indicated also by nuclear gene analysis. However, the saola represents a startling combination of primitive morphological features retained from its antelope ancestry and of Bovini traits: it looks somewhat as if the head of an antelope has been attached to the body of a

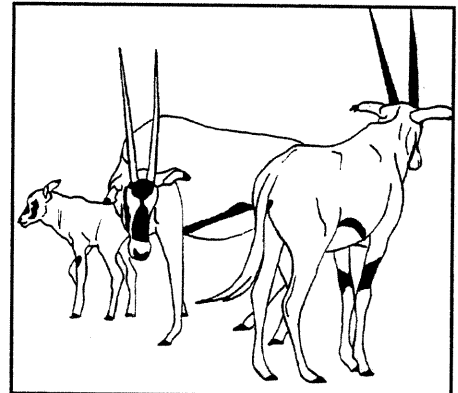
small buffalo. Given its unique characteristics, the saola may belong to a separate tribe within the Bovinae."

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Oryx Utilization and Social Organization

By Karsten Feuerriegel^{ASG}, Research Biologist (University of Hamburg, Germany). Current address: Box 44038, Nairobi, Kenya



Female with calf giving head-low threat to alpha male approaching in head-high dominance display.

Oryx Farming

The last herds of semi-domesticated eland and oryx in East Africa belong to Baobab Farm Ltd. located on the southeast coast in Kenya. Dr. Rene Haller, project founder and Baobab Farm MC, has kept eland and oryx antelopes on marginal limestone and shale quarry sites for 17 years.

The first 12 Fringe-eared oryx (*Oryx gazella callotis*), remnants of the Galana Ranch project, came to Baobab Farm in 1978 and thanks to the good management of Rene Haller and his team, Sabine Baer and Stephen Twei, nearly 100 head of oryx now live on the farm. Since the ban on the sale of wildlife products was lifted in 1990, the farm has sold around 20% of their whole oryx stock between 1991 and 1994.

The young bulls, sold as venison, fetched over twice as much as beef.

The behavior and day activity pattern of the "major group" makes it easy for a herdsman to guard the animals. Therefore the system could be classified as herding. Based on the traditional boma system (King and Heath 1975), all animals were penned at night.

The wildlife production sites at Baobab Farm are fenced and ante-mortem inspection is the rule. Veterinary treatment and seasonal supplement feeding of oryx could only be found under certain circumstances. Even husbandry (selection of alpha male by culling of young mature males) did not go so far as to cause a detectable divergence from the wild genotype. A further indicator for a more intensive system is the high degree of habituation. Therefore the term semi-domestic is applied.

The Study —

Between November, 1991 and March, 1994 I was at Baobab Farm to do research on oryx for a future PhD. My aim was to analyze some of the crucial ecological and behavioral factors of oryx farming. The basis of this survey is that sustainable farming schemes have to understand the animals' social organization and their ecological requirements as well as their physiological characteristics (Hediger 1979, Feuerriegel 1990).

At the International Symposium on Wild and Domestic Ruminants in Extensive Land Use Systems in Berlin (3-4 October 1994), I have presented some results about daytime budgets, companionship preferences, individual distances, and habitat preferences. This paper focuses more on an important social feature of the oryx: the mating strategies of the males.

Mating strategies —

Mating strategies vary across oryx populations. For example, territoriality has been observed in the fringe-eared oryx at Galana (Wacher 1988) but not in the Serengeti (Walther 1978). This may be related to the fact that the Serengeti population lives at the southern edge of [the subspecies'] range (Kingdom 1990). Territoriality is entirely absent in reintroduced Arabian oryx (*O. leucoryx*) at Yalooni in Oman, where individual dominant males stay permanently with the herd. Because annual rainfall and

primary production at Yalooni is far less than at Galana, the total range of Arabian oryx is much greater in extent and population density very much lower (Price 1988). Under conditions of small population densities, a territorial male would be unlikely to encounter many receptive females.

Oryx breed well under the domestic conditions at Baobab Farm. Annual rainfall on the Kenyan coast is between 800 and 1400 mm and Oryx densities are far higher than anywhere else in the wild. Males would be expected to be territorial. Aggressive encounters between fully mature males and serious fighting between a newly introduced male and the longtime master bull support this hypothesis. On the other hand, the alpha males were dominant rather than territorial. They tolerated young mature males when they had grown up in the same herd.

Oryx females, as in many other antelopes, need to separate from the herd when giving birth and at Baobab Farm many females regularly gave birth together within 2-4 weeks. The females came into postpartum estrus within 2 -3 weeks after giving birth; this was still the phase in which most calves tried to avoid detection. Although the alpha males made vigorous attempts to prevent females from joining the herd after giving birth, all females left their calves alone for considerable periods of time.

If the alpha males had spent all their time in habitats favored by females with calves, highly structured habitats but with lower pasture opportunities than those favored by the herd, they could not monopolize all mating opportunities, simply because they could not guard all estrus females successfully.

For example, the alpha male of one herd spent nearly half his time with the herd and half away from the herd. This behavior had another advantage: the detection of estrus females in the herd which, as first-time breeders, differed from the basic sequence [of multiparous females]. This might be the reason why, on a very few occasions, males other than the alpha could be observed mating receptive females. The social behavior of the alpha male could be described as a mixed strategy of a resource defense polygyny and female defense polygyny (Emlen & Oring 1977), or as a resource defense polygyny with a high tolerance of young mature males.

The daytime budget and rangeland results suggest that the social behavior of the alpha male causes a reduction in feeding time and higher percentages of ruminating compared to other males. Only males in excellent physiological condition could afford such a strategy.

In the next issue of *Gnusletter* I would like to give some details about another distinctive feature of oryx social behavior: calf creches.

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Nile Lechwe

Elisabetta Falchetti^{ASG}, Dirigente Zoologico of the Rome Zoological Garden, sent reprints of two short articles published in the *Boll. Zool. Suppl.* 68 (1994). They are reprinted here because they report interesting behavioral information in a publication that probably few ASG members would be likely to see.

Social Organization and Hierarchical Dominance in *Kobus megaceros* (Bovidae, Reduncinae) Captive Females. By Elisabetta Falchetti, Giovanni Bianco, Barbara Mostacci. Giardino Zoologico di Roma viale del Giardino Zoologico 20, 1-00197 Roma (Italy).

Estes (1974) numbers *K. megaceros* among the African Bovidae with the most advanced levels of social organization but we have no details relating to the social life of the species, lacking behavioural field studies. Twenty-one *K. megaceros* females distributed in two separate herds—consisting of one adult male, subadult males, adult females and their offsprings—were observed in the Roman Zoo, for 420 hours over two years, in order to investigate social patterns. The "Focal Animal Sampling", "One-Zero Sampling", (Altmann, 1974) and "Complete Record Sampling", (Slater, 1978) methods were utilized for data collecting.

A total of 1617 aggressive interactions, namely threat displays, bites and head buttings were recorded and examined in dyadic matrix. In one of the two herds (with similar results in the other) the individual aggressive interaction rate and the successful outcomes are positively correlated (Spearman coeff. 0.979; f. d. = 10, $p < 0.0005$). They significantly differ among females ($t = 5.62$; $p < 0.0005$), increasing with the female's age. A rank order was established through the dominance values, as the proportion of individuals dominated by each female relating to all the females they interacted with; an individual displacing or supplanting another was considered "dominant", and conversely "subordinate", the one retreating after an aggressive interaction.

In the examined herds a strong hierarchical age dominance appears, determining priority of access to both space and nourishing resources. The applied Landau test shows hierarchical linearity. It seems that adult males are more tolerant towards high ranking females. Individual rank order and weight are positively correlated (Spearman coeff. 0.89; $p < 0.0005$); this suggests that size/weight is the physical feature influencing the hierarchical dominance rank. The high-ranking females are the [ones] most involved in aggressive interactions. This fact and the large number of real [aggressive acts] suggest that the hierarchical sys-

tem does not prevent aggression completely in this species.

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Relationship between Dominance/Subordination and Colouring Patterns in *Kobus megaceros* (Bovidae, Reduncinae) Captive Males.

Elisabetta Falchetti, Allexandro Ceccarelli, Chiara Mantovani/
 In *Kobus megaceros* males the colouring pattern varies with age. Until two years old the male coat is sandy fawn like that of the females. Afterwards the hairs turn dark to varying shades of black; at the same time the nape, neck and middle of the horn area grow lighter. In the third year the deep white parts contrast with the darkening/blacking of the remaining body. This evident colouring pattern acts as a visual signal; it allows a) an easy assessment of the horn size, b) a recognition of the adult males, reducing the sexual competition among those in prime condition and the disturbance to the rest of the herd (Kingdom, 1971); it also emphasizes the male threat display.

At the Roman zoo, we surveyed for 4 1/2 years: A) three males nearly the same age (from two years old), housed as bachelors in their own enclosure; B) one adult male (from 10 years old), two young (from 14 months and from birth) housed in an enclosure with adult females and their offspring; C) one adult male (from 6 years old), housed in another enclosure with some adult females and their offspring. The colouring was recorded monthly, its intensity estimated by three observers independently and turned in a scale of 1 to 4. The disagreeing estimates were averaged. The outcomes of male aggressive interactions were also surveyed to assess the dominance rank.

Among the observed males:

The three A) bachelors acquired adult colouring between [the] ages of 2.6 and 3 years old; then two of these, after losing fights, turned to the subadult colour (one of these regained [adult color] after separating from other males);

The two B) young [males], both subordi-

nated, acquired a dull adult colouring after three years. They turned to the subadult colouring soon afterwards. After the adult male died, one of these returned to a bright adult colour and maintained it.

The B) and C) adult males, both dominant, did not vary their colour significantly.

The examined males significantly differ in the annual colouring changes and in the individual trend. We hypothesize that the observed colour changes "adult-subadult" occurred as a consequence of a subordinate condition influencing the adult individuals remaining with a dominant psychophysiological. The colouring regression towards the subadult state could reduce the stress and danger for the subordinate, lowering the aggressive interaction of the dominant animal who is more tolerant towards an immature, uncompetitive male.

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Steve Kingswood, Editor Center for Reproduction of Endangered Species, Zoological Society of San Diego, POB 551, San Diego, CA 92112-0551, USA

CAPTIVE BREEDING

ASG Survey of Current Research on Antelope Systematics

Prompted by the large number (207) of taxa identified by the Antelope conservation assessment and management plan and global captive action recommendations as needing taxonomic research, a survey of current research on antelope systematics was mailed to a number of individuals that are conducting research applicable to the taxonomy of antelopes. The survey addressed the following questions: (1) What species are you investigating?; (2) What questions are you investigating?; (3) What methodologies are you using? (4) Do your investigations involve specimens from captive or natural populations?; (5) Are you banking samples from the specimens of your investigations?; and (6) If so, what

kind and how? Here are the responses received to date:

RASHID AMAN (National Museums of Kenya): phylogeny and intraspecific genetic variation within local populations of bovids, including *Damaliscus hunteri* and *Hippotragus equinus*, using polymerase chain reaction (PCR) and sequencing of mitochondrial and nuclear loci.

PETER ARCTANDER (University of Copenhagen): population structure and phylogeny of African bovids using DNA sequencing and microsatellite variation.

FRANCOISE CLARO-HERGUETA (Parc Zoologique de Paris): karyotyping, taxonomic character, and chromosomal abnormalities of *Addax nasomaculatus*, *Damaliscus dorcas phillipsi*, *Hippotragus niger*, *Oryx dammah*, and *O. gazella beisa* using RBG-banding.

DAN GALLAGHER (Clontech Labs, Palo Alto, CA): chromosomal evolution and syntenic conservation of the Bovidae using chromosome banding and chromosomal fluorescence in situ hybridization.

ALAN GENTRY (Natural History Museum, London): classification, phylogeny, and zoogeography of Old World Miocene members of the Bovidae, Giraffidae, and Tragulidae using fossil morphology and cladistic analyses.

NICK GEORGIADIS (Washington University, St. Louis, MO): population structure and history of African species using mitochondrial DNA (mtDNA), Restriction Fragment Length Polymorphism (RFLP), and DNA sequencing.

COLIN GROVES (Australian National University, Canberra): systematic revision of Cephalophini, geographic variation in *Tetracerus*, *Boselaphus*, *Hippotragus*, and *Gazella bennetti*, and relationships of *Pseudoryx* using univariate and multivariate analyses, cladistic analyses, and external characters.

PETER GRUBB (London): distribution and systematics of *Cephalophus*, *Gazella*, *Litocranius*, *Madoqua*, *Neotragus*, and *Tragelaphus* using skull and body measurements and locality data.

ROB HAMMOND (Institute of Zoology, London): genetic variation, parentage testing, and genetic monitoring and management of wild (including reintroduced) and captive populations of *Gazella (dorcaspis)*, *G. gazella*, and *G. subgutturosa* using microsatellites and mtDNA (RFLP).

E. HARLEY, C. O'RYAN, AND W. REBHOLZ (University of Cape Town Medical School): systematics of Tragelaphinae and Cephalophinae, population genetics and population structure of *Syncerus caffer*, and systematics of gazelles and hybrid status of captive populations of Arabian gazelles using DNA sequencing, restriction site mapping of mtDNA, and DNA microsatellite analyses.

ARLENE KUMAMOTO AND STEVE KINGSWOOD (Zoological Society of San Diego): chromosomal variation and its effects on reproductive isolation in *Alcelaphus*, *Damaliscus*, *Gazella*, *Kobus*, *Madoqua*, *Neotragus*, and *Oryx* using chromosome banding, meiotic studies, and pedigree analyses.

TERRY ROBINSON (University of Pretoria): mtDNA phylogeography, molecular systematics, and comparative cytogenetics of *Cephalophus maxwelli*, *C. monticola*, *Hippotragus*, and *Oreotragus* using PCR, DNA sequencing, mtDNA (RFLP), G- and C-banding and silver staining of chromosomes.

HIROAKI SOMA (Tokyo Medical College Hospital): chromosomes of *Capricornis crispus*, *C. sumatraensis*, and *Nemorhaedus* using chromosome banding.

MARC VASSART (Ecole Veterinaire de Toulouse): phylogeny of gazelles using chromosomes, protein electrophoresis, and DNA sequencing.

ELISABETH VRBA (Yale University): systematics and the fossil record in relation to living diversity, ecology, and evolution of the Bovidae using basic systematic descriptions of new species, allometric analyses to understand heterochrony, cladistic analyses of skull characters, and molecular sequences.

Most investigators have at least some access to samples (skeletal or tissue) from natural populations, as compared to samples from captive populations, which in many cases, are of unknown origin. All respondents indicated that they are banking samples or using those already banked, such as skeletal material in museum collections. Although I expected that most researchers would be banking samples, it is worth emphasizing the importance of building such collection banks.

Although not presently engaged in taxonomic research, W. F. H. Ansell made some interesting comments that are worth noting here: "I do have some measure-

ments and notes on *Kobus leche* which I got from the Tervuren Museum collection in 1986, which raise some taxonomic questions. But I have not been able to work on this so far and am not likely to be able to do so in the foreseeable future. However, from the conservation point of view, the matter is somewhat academic as the species is extinct or virtually so in the areas concerned, i.e. northern Zambia and the adjacent part of southeastern Zaire. One thing that should be borne in mind about captive breeding of lechwe is that most, if not all, captive breeding stocks are *Kobus leche kafuensis* which, despite its limited range on the Kafue Flats, is probably the least threatened of the three recognized living subspecies."

Cytogenetic Studies of *Gazella* and *Madoqua* — During the past few years, Arlene Kumamoto and I, with the help of several colleagues, have completed three chromosomal studies on gazelles and dik-diks. Summaries of these studies follow (reprints are available):

Kingswood, S. C., Kumamoto, A. T., Sudman, P. D., Fletcher, K. C., and Greenbaum, I. F. 1994. — Meiosis in chromosomally heteromorphic goitered gazelle, *Gazella subgutturosa* (Artiodactyla, Bovidae). *Chromosome Research* 2:37-46.

We investigated chromosomal-pairing behavior in spermatocytes of *G. s. marica* ($2n = 31-32$) which were heterozygous for two chromosomal rearrangements (a Robertsonian translocation and/or an autosome-to-X translocation). Heterozygosity resulting from chromosomal rearrangements has been implicated in effecting biological speciation through reproductive isolation. As a practical matter, any reduction in fertility caused by the translocations would also have relevance to captive breeding programs established for the conservation of this endangered gazelle. However, our results gave no indication that these rearrangements reduce the reproductive fitness of male goitered gazelles.

Kumamoto, A. T., Kingswood, S. C., and Hugo, W. 1994. — Chromosomal divergence in allopatric populations of Kirk's dik-dik, *Madoqua kirki* [sic] (Artiodactyla, Bovidae). *Journal of Mammalogy* 75:357-364.

Having documented two chromosomal races (defined as cytotypes A and B; $2n = 46-47$) of captive Kirk's dik-dik represent-

ing East African populations, we were interested in studying the chromosomes of dik-diks in Namibia (*M. k. damarensis*). Two chromosomal rearrangements (a tandem fusion and a pericentric inversion) separated cytotype A from *M. k. damarensis* (cytotype D; $2n = 48$), and four rearrangements (two heterochromatic additions/deletions, a pericentric inversion, and an autosome-to-X translocation) separated cytotype B from D. Fertility data from the original study of captive animals demonstrates that cytotypes A and B are reproductively isolated (male hybrids are sterile). Because *M. k. damarensis* is not sympatric with East African *M. kirkii* and cytotype D is not represented in captivity, reproductive isolation of cytotype D cannot be tested directly. However, these data suggest an advanced stage of divergence in populations of *M. kirkii*, and we believe that it is reasonable to recognize these allopatric populations as semispecies.

The chromosomes of *Gazella bennetti* and *Gazella saudiya*.

Kumamoto, A. T., Kingswood, S. C., Rebbholz, W. E. R., and Houck, M. L. 1995 (In press). *Zeitschrift für Säugetierkunde* 60.

Gazella bennetti has been regarded as a subspecies of either *G. gazella* or *G. dorcas*, and *G. saudiya* has been placed with *G. dorcas*. Previous cytogenetic studies have documented differences in the chromosome number of these taxa, but banding studies had not documented the extent of homology between individual chromosomes. Variation in the diploid number of putative *bennetti* ($2n = 49-52$) and *saudiya* ($2n = 46-53$) was the result of an autosome-to-X translocation and four independent Robertsonian translocations. There were no fixed differences between *bennetti* and *saudiya*, but two pericentric inversions separated Pakistani *bennetti* from Iranian *bennetti* and *G. saudiya*. Several pairs of chromosomes of both species were only partially homologous with chromosomes of *dorcas* ($2n = 30-31$) and *gazella* ($2n = 34-35$), suggesting that *bennetti* and *saudiya* are reproductively isolated from *dorcas* and *gazella*. These data indicate that *bennetti* and *saudiya* are not conspecific with either *dorcas* or *gazella*, but based on our data, the taxonomic relationship between *bennetti* and *saudiya* remains uncertain.

Gazella saudiya May Have Hybridized with *bennetti*

Pim Rebbholz reports (letter to RDE, 20 Jan 95) finding mt DNA sequence differences in *G. saudiya* that probably indicate hybridization with *bennetti*.

"Recently I came across an interesting finding: When I sequenced part of the mitochondrial (mt) cytochrome b gene, I noticed that two *Gazella saudiya* from the same breeding center had quite different sequences. When I had a closer look, I discovered that there were two types of mitochondrial DNA present in this single breeding group. The two groups differ from each other in 2.7% to 3.7% of their nucleotides.

"This amount of difference is a typical amount between closely related species. Furthermore, one of the mt-types differs at least 3.3% from any other species, the original *G. saudiya* wild type mt DNA. The other type is closely related to two subspecies of *G. bennetti* (0.0% to 1.0% different) I sequenced, which indicates that this type originates from a *G. bennetti* subspecies, probably the Iranian subspecies. One of my collaborators, Arlene Kumamoto from San Diego Zoo, discovered that the karyotypes of some of the *G. saudiya* individuals are identical to those of the Iranian subspecies of *G. bennetti*. These two techniques tell us the same story: *G. saudiya* from the Bahrain collection has been hybridized at some stage with Iranian *G. bennetti*.

Since the *G. saudiya* is extinct in the wild and only known from less than 100 animals in captivity, it becomes extremely important now to select pure animals, if there are any left, for a rigorous breeding program. The main aim for the conservation of *G. saudiya* should be to identify other collections in the middle East that might have this species and then test those animals genetically to see whether these are genetically pure *G. saudiya*.

Zoo Animal Behavior and Welfare Course

The Edinburgh Zoo is offering a course from 17-28 July 1995 for people involved in the management and husbandry of captive animal populations. The course will update participants with the latest scientific theory in the areas of behavior and welfare, showing how this theory can be practically implemented in zoos, safari parks, wildlife centers, and reintroductions.

According to the course announcement, Edinburgh Zoo has an academic link with the University of Edinburgh in the area of welfare and environmental enrichment of captive exotic animals; research carried out by both institutions has led to changes in enclosure design, methods of feeding, etc. at the Zoo. This has resulted in a marked reduction in stereotyped behaviour and general boredom.

The subjects covered in the course, including animal behavior, animal welfare, environmental enrichment, and the global context of zoos, will be taught by leading researchers in these fields.

The course fee is £750. For further information and registration, contact Hamish Macandrew, UnivEd Technologies Ltd., 1 Marchhall Crescent, Edinburgh, EH16 5HP, UK. Fax 131 650 3474.

Book Review

By Marvin L. Jones^{ASG}

Exotics on the Range: the Texas Example, by Elizabeth Cary Mungall^{ASG} and William J. Sheffield. College Station: Texas A&M University Press, 1994, 265 pp, \$49.50, hardbound.

Exotics on the Range appears to be primarily intended for a narrow audience, namely the many Texas ranchers who have maintained on their property since the 1920's various species of non-native or exotic ungulates, including antelopes. These species may have been acquired solely for the personal pleasure of the ranchers or perhaps as a source of supplemental income through what the book refers to as "fee-hunting" but which in 1995 is more often referred to in the media as "canned hunts."

This book is enhanced with well-done figures, maps, tables, and color plates. It addresses several topics that pertain to the management of ungulates, such as behavior, species compatibility, population structure and dynamics, bachelor herds, reproduction, nutrition, and mother-calf relationships. Many of these topics will be of interest to ASG members who are responsible for the keeping of antelopes in captivity, especially those having very large enclosures of many acres but also those working with the average zoo collection.

Unfortunately, many of the chapters are based on information collected prior to 1988, such as overall population figures for the state. The detailed reading list, organized by subject matter, contains few cita-

tions published after 1987, except by the authors or other Texas-based individuals or organizations. Only Chapter 12--Income Options--presents information as of 1992. The majority of antelopes kept on Texas ranches were brought to the state starting in the 1920's, initially from zoological gardens directly, or via animal dealers. During the period 1965 to 1967, a number of African antelopes were imported directly from Africa by the ranches, but due to United States quarantine restrictions, they were placed at San Antonio Zoo. Young born to the 161 specimens were divided between the holding zoo and the rancher who provided the money for their acquisition and importation. The specimens included greater and lesser kudu, several gazelle species, white-tailed and brindled gnu, impala, hartebeest, lowland nyala, beisa and scimitar-horned oryx, springbok, and topi. Many reproduced quite well and still are a factor in the current American populations of these species.

As mentioned, much of the population data are based, at the latest, on 1988 figures, but even so, the number of individuals, either living behind fences or at liberty, is impressive. Examples include 21,000 blackbuck, 36,000 nilgai, 577 scimitar-horned oryx, 138 white-tailed gnu, 137 red lechwe, 144 sable antelope, and 91 bontebok. With the exception of the previously cited 161 wild-born individuals that came directly from Africa, founders of these populations were born outside of Texas, in zoos or private collections. In many cases, subspecies designations probably have not been known. It is quite likely that the 214 springbok on ranches originated both from South African and Angolan animals, and the impala population may contain both East and South African individuals. Thus, the conservation value of these populations is questionable. The book has a very good chapter on hybrids, but the subject of subspecies crosses is not addressed.

In Texas, there does not seem to be any stigma attached to the use of such animals for hunting purposes, as there might be in other parts of the United States; thus, the book does not touch on this highly sensitive issue. Currently, this issue makes it prohibitive for surplus ungulates from zoo collections to go to ranches that allow hunting.

Little information is presented with regard to the various Species Survival Plans underway in North American zoos and no infor-

mation about which ranches may be part of the International Species Information System (ISIS) or cooperating with studbooks. Yes, there have been re-introductions of Texas-bred species into the wild, such as blackbuck to Pakistan, and perhaps this is now taking place with other species, but with data from 1988, one is not sure.

This is a book that many ASG members will find fascinating reading, and it does contain a great deal of useful husbandry information.

REGIONAL RUNDOWN

SUDAN

In the letter (25 Feb 95) enclosed with the proposal printed below, Ibrahim Hashim explains the rationale for the survey of northern Sudan.

This letter is related to a biodiversity conservation proposal in the desert ecosystem of Sudan in which efforts directed towards wildlife conservation received meagre national and international support. Literally, the international support can be summarized as follows:

1. Dr. F. F. Darling, an IUCN expert, surveyed the whole country in 1961 and advised on wildlife policy and management in the Sudan.
2. In 1966, W. H. Holsworth conducted a short study about the possible effect of Rahad Link Irrigation Canal on Dinder National Park, which was funded by FAO.
3. A more detailed study of the Rahad Link Canal was done by W. P. Dasmann in 1972. This study was also funded by FAO.
4. In 1967, the Fauna Preservation Society and WWF funded the study of Radom Wildlife Area. Based on Mr. S. Field, the team leader's recommendation, Radom has been prescribed a National Park since 1983.
5. In 1993, GEF/UNDP supported Dr. Khushal Habibi, who prepared a project document for biodiversity conservation and management of Dinder National Park [as reported in the last *Gnusletter*].

Item No. 3 resulted in significant biodiversity conservation. Radom National Park is one of the best parks in Sudan, although it is facing increasing human and livestock trespassing. I am also optimistic about item No. 4 concerning biodiversity conservation and management in Dinder National Park.

Presently, my focus is on the desert ecosystem which contains five threatened species: addax, Scimitar-horned oryx, addra gazelle, Barbary sheep, and the ibex. In addition, dorcas gazelle, Rhim gazelle, and Isabelline gazelle also occur in the same habitat.

The research proposal entitled "Abundance and distribution of the threatened and unthreatened species in the Desert ecosystem of north Sudan" addresses the conservation of the threatened and unthreatened species by evaluating a management plan that would recover the desert ecosystem which has been neglected for a long time. The management plan incorporates the following:

- 1) Unthreatened gazelles existing in the desert constitute the major ecotourism [potential] in Sudan at present; populations of these gazelles should be assessed so they can be used on a sustainable basis.
- 2) Populations of threatened species and their habitats should be assessed throughout the desert. If viable populations are discovered, a management plan should be developed to perpetuate their survival. Exterminated species should be reintroduced.

The management plan incorporates local communities, local governments and an intensive education program in collaboration with universities and schools in the region. Because of its sparse human population, the desert can easily be controlled. I personally feel that a reserve at least protecting the animals during the breeding season is needed to guard the threatened and the unthreatened species.

Presently, an opportunity exists and it should be seized: The Government of Sudan has prepared and is now executing a Comprehensive 10-Year Strategic Plan that would terminate in the year 2100. In this strategy, the establishment of game reserves and national parks is secured. Specifically, the establishment of a national park in the desert is asserted. The General Administration of National Parks and Wildlife Conservation is anxious to have this park established in the near future. I

hope that some conservation organizations will seize this opportunity and start this biodiversity conservation program in the desert ecosystem as soon as possible.

I. Project Summary

1. Title of Project: Abundance and Distribution of the threatened species in the Desert Ecosystem of North Sudan.
2. Name and address of originator: Dr. Ibrahim M. Hashim, Wildlife Research Centre, C/O P.O. Box 30, Khartoum North, Sudan.
3. Name and address of project leader: Dr. Ibrahim M. Hashim, Wildlife Research Centre, C/O P. O. Box 30, Khartoum North, Sudan.
4. Date of Submission: February 1, 1995
5. Project period: Three years.
6. Funds requested: LS44,640,000 (US \$81,173)
7. Endorsement: attached.

Abstract

The first objective is to assess the abundance and distribution of the threatened species, including addax (*Addax nasomaculatus*), scimitar-horned oryx (*Oryx dammah*), Addra gazelle (*Gazella dama*), the barbary sheep (*Ammotragus lervia*), and the Nubian ibex (*Capra ibex*). A secondary objective is to assess other desert animals whose ranges overlap or abut the ranges of the endangered species. The second objective is to develop a management plan that integrates local communities with the protection of desert animals. This integration should be associated with an intensive education programme. The establishment of a reserve in the desert would be one of the first priorities.

II. Project Description

1. Objectives

The first objective of this project is to assess the abundance and distribution of the threatened species, including addax, scimitar-horned oryx, addra gazelle, the Kordofan barbary sheep and the Nubian ibex. A secondary objective is to assess other desert animals, including dorcas gazelle (*Gazella dorcas*), Rhim or Loder's gazelle (*Gazella leptoceros*) and Isabelline gazelle (*G. d. isabella*) that occur in the same habitat as the five endangered species.

The second objective is to seek a man-

agement plan that integrates local communities with the conservation of the desert animals and the desert ecosystems.

2. Background and Justification

Literature concerning desert animals in Sudan is scarce and obsolete. No systematic survey or scientific investigation about the desert animals has been conducted recently or in the past. Only preliminary observations are available, which were reported before 1970.

Addax, oryx, addra gazelle, Kordofan barbary sheep, and the Nubian ibex are threatened species that are listed in Schedule 1 of the Wildlife and National Park Protection Law; dorcas gazelle, Rhim gazelle and Isabelline gazelle are not threatened and so are listed in Schedule 3.

Addax

Addax are among the large desert antelopes that are adapted to the most arid part of the Sahara in sandy country as well as stony desert, always far away from any waterhole (Dorst and Dandelot, 1970). They are distributed in a long narrow strip across the Southern Sahara from Mauritania in the west through Mali, Niger and Tchad into Sudan (Simon and Geroudet, 1970). In Sudan, however, addax was distributed west of the Nile in North Kordofan and North Darfur states. An isolated population occurred east of the Nile in Kassala state between the Nile and the Red Sea in the early 50s (McKenzie, 1963, Simon and Geroudet, 1970, Schomber, 1963).

The extent of addax range in the desert is restricted by the temporal rains during which plants such as *Aristida*, *Boerharia* and *Cornulaca* grow rapidly and are sought by the addax (Dorst and Dandelot, 1970). The animals tolerate long periods without water and apparently their water requirements are provided by the diet which contains succulent plants (Dorst and Dandelot, 1970; Simon & Geroudet, 1970).

Addax activity begins early in the morning and evening and they resort to shade during the heat of the day; sometimes addax excavate shallows in sand in which they spend the night as a means of protection against cold (Simon & Geroudet, 1970).

Addax used to be quite common in Darfur state, but are now greatly reduced due to hunting tribes using firearms (Happold, 1966). One of the most recent reports writ-

ten about addax is by Lord McPherson of Drumochter who visited Darfur in 1968; he located a small herd of 12 adults and three calves in the Wadi Howar area. In addition, Nimir (1982) cited Lamprey (1975) who located addax in Jebel Terga in North Darfur during an aerial survey. Henceforth no record is available about addax throughout their range in Sudan.

Scimitar-horned Oryx

Scimitar-horned oryx, the largest desert antelope, occur in the range from Rio de Oro on the west coast of Africa to the Sudan. The Nile marks the eastern boundary of their range, yet it was noted on the eastern bank of the Nile in the district of Nubia (McKenzie, 1954, Schomber, 1963).

Like addax, the oryx inhabits arid scrub and desert (McKenzie, 1954). It prefers open, flat country with sparse vegetation and migrates over considerable distances (Schomber, 1963). The oryx used to be quite common in Darfur but is now greatly reduced, mainly because certain tribes hunt the animal with firearms (McKenzie, 1954; Schomber, 1963).

Addra Gazelle

Addra gazelle distribution is mainly in North Darfur and to some extent North Kordofan. The gazelle lives in small herds [but] up to 600. . . or more [aggregate] particularly during their seasonal movements (Dorst and Dandelot, 1970). No studies or surveys have been conducted about addra gazelle in Sudan.

Nubian ibex

The Nubian ibex occurs in rocky mountains of more or less desert character; the animals live at rather low altitudes between 7,500 and 13,000 feet, chiefly below 9,500 feet in more humid habitats and take refuge among bush, forest and upland vegetation (Dorst and Dandelot, 1970).

In the past, the Nubian ibex inhabited the mountain ranges of Eastern Egypt and the Sudan as far as the Eritrean border; the last survivors in Egypt were killed in the Rishrash reserve in 1953 (Schomber, 1963). At present the Nubian ibex is restricted to the mountains of the Red Sea in Sudan. . . The Nubian ibex is badly threatened as a result of uncontrolled hunting. Probably no more than 300 animals are left (Dorst and Dandelot). If well protected, their populations could increase, for breeding seems satisfactory.

Barbary Sheep

The barbary sheep inhabits dry mountains and broken country in the Sahara zone. It lives in family parties with an adult ram, several ewes, and youngsters. Herds of 3 to 6 are the average but may be larger, up to 20 at the end of the dry season. Old males are often solitary, as are pregnant females. Barbary sheep spend the warmest part of the day in shelters among the rocks and come down to the valley at night. They feed on the same desert plants as gazelles and like goats stand on their hind legs to browse and collect fruits. They are able to resist drought but come to water holes when possible.

The number of barbary sheep has decreased and is mainly restricted to isolated mountains in states of North Darfur and North Kordofan. In 1923, these animals were introduced into Sabaloka on the six cataracts of the Nile (Schomber, 1963), but have disappeared recently due to poaching.

Other Desert Animals

Dorcas gazelle, Isabelline gazelle and Rhim or Loder's gazelle are the desert animals that share the same habitat as addax, oryx and adda gazelle. These gazelles are not threatened, yet Dorst and Dandelot (1970) reported that Rhim gazelle are declining to a precarious level throughout their habitat due to over-hunting. According to Marjan, Hashim and El Faki (1993), ungulate trade in Sudan was almost limited to gazelles. Gazelles were mostly exported alive to the Middle East but no identification was made as to which species was exported most.

The endangered species and the other gazelles inhabiting desert ecosystems urgently need a survey to update their status so that a management plan can be developed to ensure their survival. Because of the vast and the rough terrain an aerial survey is paramount in confirming the existence of the endangered species in the desert, followed by intensive ground surveys in locations where these animals are seen.

3. Activity and Timetable

This study is anticipated to be completed within three years. It requires both extensive and intensive surveys. The extensive survey will be done by a small plane in March and August in the dry and the wet seasons, respectively. Once the threatened animals are seen and their ranges roughly determined, ground surveys will be done in the corre-

sponding months to assess the status of animals and their habitats. A progress report will be written at the end of each survey and a final report will be compiled at the end of the survey. In this report a management plan for conserving, protecting, restoring, and propagating the endangered species will be developed. This management plan would incorporate local communities and local governments . . . in the conservation and utilization of the animals.

[Regarding the] timetable for these activities. . . , if donations are made available, the first aerial survey will start in March 1996 and the second in August 1996.

Results of this survey will determine whether the study will continue or not, based on confirming the occurrence of the endangered species in the region. A progress report will be distributed to donors and institutions concerned at the end of each survey.

A final report will be compiled at the end of the study, which will address both the biological and social aspects of the surveyed area and will seek to integrate local communities with wildlife through education programmes in collaboration with universities and other institutions in the region.

The strategy for protecting desert animals will be based on Darling's (1961) recommendation that the government of Sudan consider the "possibility of establishing a desert type national park in the country, or failing a national park at the present moment, at least a large reserve for the desert species such as addax and oryx which have suffered serious restrictions of their range in Africa and Arabia". This recommendation was asserted by Happold (1966): "Since the addax and Scimitar-horned oryx are on IUCN's list of rare and endangered animals, a reserve with sufficient wardens and scouts to give total protection should be established in the very near future". It is worth mentioning that Schomber (1963) believed that traditional nature reserves appeared quite unsuitable and useless on account of the animals' long migratory range; [that] the only solution lay in making people realize the position, and in education. While educating people is paramount, I believe a reserve that at least protects the animals during the breeding season is needed.

The survey will be led by Dr. Ibrahim M. Hashim in collaboration with researchers from Department of Wildlife Science and

the University of Juba, sociologists from University of Nyala and University of El Fasher, and personnel from the anti-poaching unit of the Wildlife Administration.

4. Output

Expected outputs are that (1) People will realize the importance of Wildlife; (2) a sound management plan incorporating local communities will be developed; (3) a desert National Park or reserve may be established; and (4) up-to-date information about the species diversity in the desert ecosystems will be made available for the institutions concerned.

5. Expected follow-up

- i. Progress reports will be sent to donors, state governments and institutions concerned following each survey.
- ii. Expense accounts will be distributed to donors on a quarterly basis and any new events, changes or problems will be reported immediately.
- iii. Provided that the project proceeds according to plan, visits from capable echelon of distinguished organizations, e.g., IUCN, the Wildlife Conservation Society, etc. will be invited to facilitate and further the accomplishment of goals and objectives.

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Seminar on Wildlife Conservation and Management in the Sudan

The Proceedings and Abstracts of this symposium (282 pp), which was held in

Khartoum from 16-21 March, 1985, supported by the German Agency for Technical Development (GTZ), have just been published. In a covering letter, (22 Feb 95) the organizer of the seminar and editor of the proceedings, Dieter Ernst, says, "The reasons for the delayed publishing of the two booklets are manifold, but hopefully nevertheless useful for a better future of wildlife in the whole country and a new helpful impulse and a positive stimulus to all those working and interested in the field of environmental conservation in the Sudan."

Ernst, who gives his address as Kielerstrasse 148, D-22769 Hamburg, was formerly a lecturer in wildlife ecology in the University of Khartoum Department of Zoology. In his introduction to the Proceedings, Ernst writes:

"Today, the need for a 'National Conservation Policy for the Sudan' is of paramount importance and more urgent than ever and it must be implemented before it is too late. An overall Environmental Conservation Policy is the crucial fulcrum and is essential to ensure a balanced use of all natural resources."

ERITREA

In February, the ASG and the Institute of Zoology, a grant-aided institute of the University of London, whose director is Morris Gosling^{ASG}, jointly funded a preliminary two-week wildlife survey by Tom Butynski^{ASG}, Senior Conservation Biologist, who directs Zoo Atlanta's Africa Biodiversity Program from his office in Nairobi. The opportunity to gather information about the status of antelopes and other wildlife in Eritrea came about when Butynski was invited to participate in an international conference to review Eritrea's National Environmental Management Plan (NEMP-E).

An account of Tom's rapid survey will be presented in the next Gnusletter. Meanwhile, comments on the conference and information he picked up from the people he met are excerpted from his preliminary report.

"The NEMP-E is an excellent beginning towards reducing environmental degradation in Eritrea and planning for proper development and environmental recovery. I found that the NEMP-E lacked specifics in terms of

which mammal species are likely to require particular research and conservation in-puts. Based on the limited data available, I provided a listing of those mammals which are probably extinct or endangered in Eritrea, or for which Eritrea is a particularly important country for the species' survival. I suggested that the list be appended as an appendix to the NEMP-E."

[Information provided by Chris Hillman, Head, Resources and Environment Division, Massawa] "—Antelopes: No evidence of beisa oryx (*Oryx gazella beisa*) in the Dahlac Archipelago as reported in the literature. Dr. Hillman is collaborating with Dr. Gentry of the British Museum to determine the taxonomic status of the 'dwarf' Soemmerring's gazelle (*G. soemmerringii*) on Dahlac Island. Soemmerring's gazelle and dorcas gazelle (*G. dorcas*) are present near Massawa."

"I did not visit the coastal plain during my time in Eritrea. I did, however, talk to several people who had lived (fought and worked) in the area during the 1990s. Here is a summary of the impressions gained from these talks. The coastal plain probably holds some of Eritrea's best wildlife populations at this time. [See following article on Somalia coastal plain.] Due to a lack of fresh water, poor soils, and high temperatures, few people live in this extensive region. Indeed, the maps show few towns and villages along the 1200 km coastal plain and poor access to vast areas. The coastal plain from Massawa to the Sudan border remains largely unsurveyed. I was told, however, that it holds good numbers of Soemmerring's gazelle, dorcas gazelle, and ostrich, and some oryx, wild ass and tora hartebeest (*Alcelaphus buselaphus tora*).

"More specifically, I was told that gazelles were in particularly good numbers between Assab and Raheita on the Eritrea-Djibouti border with dorcas gazelles in herds of up to 50 animals."

"I held two meetings with Mr. Hagos Yohannes, Head, Wildlife Conservation Section, to discuss wildlife survey priorities for Eritrea and obtain a few reports on previous wildlife surveys in Eritrea and Ethiopia. . . Parts of the Gash-Setit Region and Burea Peninsula. . . are proposed in the NEMP-E as sites for Eritrea's first two national parks. . . Mr. Yohannes and I agreed that I would survey the Gash-Setit Region for one week. . . It was also decided that I

would devote the remainder of my time in Eritrea to a foot survey of the Semenawi Bahri. . ."

"It should be mentioned that nobody I met had ever surveyed, or even visited, the vast, remote region that covers the north-western one-third of Eritrea. The region has no motorable tracks, much of it is extremely rugged and there is a low human population density. My guess is that some of the best remaining wildlife populations in Eritrea will be found there. Because the security situation in this region was uncertain, my time was limited, and the Gash-Setit Region and Semenawi Bahri were Government priority areas for surveys, it was clear that the focus of my work in Eritrea would be on the Gash-Setit and Semenawi Bahri."

Getting to the northwest region was Butynski's original goal. Notwithstanding, the field work that he was able to carry out was sufficiently promising to be followed up. In the letter covering his preliminary report, he comments:

"Although the numbers of large mammals seen were disappointing, my impression is that wildlife populations in Eritrea, if still viable, will recover rapidly under the present government and the current high level of protection and concern. I have tentative plans to return to Eritrea in early 1996 for 4-6 weeks to walk into the most inaccessible parts of the Gash-Setit (2 weeks), see more of the Semenawi Bahri (1 week), survey the Guna Guna area (ground over 8000 ft. on the border with Ethiopia) (1 week) and, if Government will permit, survey extreme northwest Eritrea (2 weeks) where I suspect Eritrea's best remaining wildlife populations will be found. . . including tora hartebeest and Nubian ibex."



Speke's Gazelle, showing inflatable nasal pouch. Drawing by Fritz Walther.

SOMALIA

In the mid-1980s Thomas L. Thurow^{ASG} and his colleagues carried out basic research on Somalia's rangelands. Fieldwork on the coastal plain involved the first

study of Speke's gazelle. Because of other commitments (including research on the TransMara district of Kenya alluded to under Kenya in the Regional Rundown), Thurow has been unable to find the time to finalize and update his results for publication in a regular scientific journal. But he has consented to allow first drafts of two papers he wrote to be published in the *Gnusletter* because of their special interest for ASG members. The longer paper, specifically on the behavioral ecology of Speke's gazelle, will be published serially in subsequent issues.

Resource Use by Large Herbivores on the Coastal Plain of Central Somalia.

Thomas L. Thurow, Dennis J. Herlocker, Salim B. Shaabani, Richard M. Hansen

Abstract

Resource use patterns, in terms of movement and diet, were determined for cattle, sheep, goats, camels and Speke's gazelle (*Gazella spekei* Blyth) on the coastal plain grasslands of central Somalia. Water availability limited livestock numbers, therefore an abundance of forage was available throughout the study and the grassland remained in fair to good condition. Livestock were moved by their owners in response to water availability and when biting flies became excessive. Speke's gazelles do not require drinking water but they also moved away from high infestations of biting flies. These factors combined to prompt a predictable rotation of grazing pressure. The ungulates thus moved together throughout the year with no evidence of habitat partitioning between species in space or time. No relation was found between diet diversity and body mass. There was no significant disagreement in rank order for forage selection of the ungulates within a season. Species selection of forage differed between seasons but dietary similarities were not frequently higher in the dry season than in the wet season. There was no difference in trophic diversity between the native Speke's gazelle and the alien domestic sheep, goats and cattle. The fair to good condition of the grassland and the abundance of forage throughout the year enabled the ungulates to coexist while sharing similar movement patterns and diet.

Key words: herbivore diets, Somali grasslands, resource partitioning, trophic diversity, pastoralism.

East African grasslands are noted for be-

ing used by a diverse mixture of native and domestic ungulates. Discussion of the relative trophic natures of these ungulates is generally founded on a synthesis of studies conducted at different locations during different seasons or years. The scope of these studies was generally restricted to a portion of the ungulate community present. These factors constrain interpretation of dietary interaction between all members of an ungulate community and could account for the diverse conclusions drawn by previous diet studies of East African ungulates (Vesey-Fitzgerald 1960, Talbot and Talbot 1962, Lamprey 1963, Gwynne and Bell 1968, Stewart and Stewart 1971, Bell 1971, Field 1979, Jarman and Sinclair 1979, Kutileva 1979, Hansen et al 1985, Schwartz et al. 1985, Migongo-Bake and Hansen 1987).

The objective of this research was to determine the extent of resource partitioning in terms of movement patterns and botanical composition of the diets for all ungulates present on the study site located on the coastal grasslands of central Somalia. Data were collected from the same region during the same seasons. We sought to test three hypotheses: 1) smaller species show greater selection for foods than larger species resulting in body mass being related to trophic diversity; 2) diet and spatial overlap are greatest in the dormant season when forage is least available; 3) native ungulates are better adapted to the forage base and therefore have greater trophic diversity than alien domestic ungulates. Resource managers have frequently justified (without evidence) range management on the basis of the three hypotheses which we tested.

An 8-35 km-wide strip of perennial grassland occurs along 800 km of central Somalia coast between approximately 2°0'N and 6°20'N. The grasslands soil texture was sand and the relief was gently undulating, ranging in elevation from 0-50 m. The grassland was bordered inland by a dense *Acacia/Commiphora* shrubland. The study site was located in Ceel Dhere district (3°50' N, 47°10' E). Rainfall averages about 275 mm/yr and is restricted to two seasons (Gu' =April-May; Dayr = November). Annual precipitation is only 3-20% of evaporative demand. The temperature (20-30° C) and relative humidity (75%) are fairly consistent throughout the year (UNESCO 1979, UNSO 1984). Foliar

cover composition of the grassland was 49% grass, 25% sedge, 24% dwarf shrub, and 2% forb (Herlocker and Ahmed 1986). The grassland was unfenced and communally used by semi-nomadic pastoralists as grazing land for their livestock herds (composed of cattle, sheep, goats and camels). Speke's gazelle (endemic to Somalia and Eastern Ethiopia) was the only native ungulate present on the study site.

Methods

Seasonal shifts in population density of each ungulate species were determined along a 22 km census route that was oriented perpendicular to the ocean and the grass/shrub ecotone. The censuses were conducted by driving overland and counting all large herbivores that were within 500 m of either side of the vehicle. Practice prior to each census was used to maintain proficiency at estimating this distance. The absence of obstructions allowed an absolute census of the ungulates within the 1 km wide strip. Thirty two censuses were conducted throughout the study period of September, 1985 to June, 1987. The reasons prompting the nomads to move their livestock were documented through interviews.

Fecal samples were used to determine the botanical composition of the diets of each herbivore species. Fresh defecations were collected in November, 1985 and January, March and May, 1986. The November and May samples were during the growing season and the January and March samples were during the dormant season. About 5 g of fresh feces were collected from each of at least 30 fresh defecations of each ungulate species during each sample period. The 30 subsamples were composited in a labeled paper bag and were oven-dried at 65°C before they were ground in a mill through a 1-mm screen.

The 20 most common forage plants from the study area were collected and made into microscope reference slides. These 20 species composed 85% of all grassland foliar cover (Herlocker and Ahmed 1986). Diet was determined by the microscope microhistological procedure described by Sparks and Malechek (1968). Five microscope slides were made from each composite sample. Twenty microscope fields were examined per slide. The slide preparation and analysis were conducted by experienced technicians at the Kiboko Range Research Station, Kenya. Dietary similarity

was calculated to estimate the percent overlap between the ungulates' diets (Sorenson 1948). Spearman's rank order correlation coefficients were calculated to compare preferences of ungulates (Snedecor and Cochran 1967). The Shannon-Weiner diversity index (Shannon 1948) was used to provide indices of diet variety (Hurtubia 1973); i.e., high trophic diversity indicating high potential adaptability for a herbivore to select foods. Chi-square analysis (Snedecor and Cochran 1967) was used to determine if selection of forage was significantly different from foliar cover estimates collected on the study site during the mid-growing to mid-dormant seasons of 1983 to 1985 (Herlocker and Ahmed 1986). The perennial nature of most of the species and the similar meteorologic conditions during these years provide the rationale for a relative comparison of foliar cover with diet, although the collection periods of these data did not overlap. If $P < 0.05$ we assumed significant statistical difference was indicated.

RESULTS

Herbivore Movement Patterns

The nomadic pastoralists used the grass/shrub ecotone to delineate the physiognomic boundary between two traditional grazing areas. The livestock herds of the coastal grassland were primarily composed of cattle, sheep and goats which remained there throughout the year. The shrubland livestock herds were primarily composed of camels and goats which remained in the shrubland most of the year but used the grassland for short, specific periods.

The coastal grassland was differentiated by the nomads into three segments:

- Coastal Zone (deex). This zone is a 4-6 km wide strip extending inland from the ocean. Much of this zone is sparsely vegetated which reflects the effects of unstable soils associated with coastal sand dunes. Dominant species, in terms of relative foliar cover were *Cyperus chordorrhizus* (27%), *Cenchrus ciliaris* (20%), *Indigofera intricata* (13%), and *Aristida kelleri* (6%). Many temporary shallow wells are located within 1 km of the coast. These wells tap a lens of fresh water which floats on top of the denser salt water. The slow recharge rate restricts availability of fresh water as the dry season progresses.

- Bush/Grass Ecotone (balli). This zone is

a 4-6 km wide strip of grassland interspersed with low growing shrubs. Dominant species, in terms of relative foliar cover were *Cenchrus ciliaris* (15%), *Indigofera intricata* (12%), *Leptothrium senegalense* (11%), *Panicum pinifolium* (10%), and *Cyperus chordorrhizus* (9%). Deep wells were widely dispersed along this zone. These wells provide large quantities of water but are too widely spaced to enable livestock use of much of the ecotone during the dry season.

- Grassland Plain (bannaan).

This zone encompassed the grasslands which lie between the deex and balli. Dominant species, in terms of relative foliar cover, were *Cyperus chordorrhizus* (20%), *Indigofera intricata* (19%), *Cenchrus ciliaris* (13%), *Panicum pinifolium* (7%), and *Leptothrium senegalense* (6%). Wells were generally not located in the bannaan.

The temporal and spatial resource use pattern by the herbivores which inhabited the grasslands was very similar (Tables 1 and 2). All species freely grazed together. Water availability and biting fly infestations combined to prompt rotation of grazing use of the grassland throughout the year. The sandy soil prevented surface water catchment and overland flow. The hot dry winds of the Jiilaal and Xagaa dry seasons limit dew formation. Two species of tabanid biting flies (*Haematopota* spp.) were present for brief periods and were a substantial nuisance to herbivores and humans. The ribi fly was restricted to the shrubland where it emerged soon after the wet seasons began and remained abundant for about three weeks. It is a vector of a trypanosomal disease affecting cattle and especially camels. The gelmi fly was restricted to the grassland where it emerged several weeks after the wet seasons began. It is not known to be a substantial disease vector. Both flies induced herbivore migration from the infested areas.

The native ungulate community which historically inhabited the grassland were primarily Speke's gazelle and Beisa oryx (*Oryx gazella* Ruppell). Both species can cope with the region's limiting factor of no access to free-standing water. The oryx has a soft, durable hide which is highly prized by nomads and has been hunted to extinction on the study site. The Speke's gazelles were generally not molested by the nomads due to the tight control of guns by the So-

mali government and the stigma among some classes of pastoralists against eating meat of wild animals (referred to as the devil's livestock). Speke's gazelles avoided shrubland and were confined exclusively to the grassland. They freely intermingled with livestock if humans were not within about 150 m, which seemed to be the zone of security maintained between them and people. As Speke's gazelles were independent of free-standing water, their movement patterns differed from livestock in that they were not forced to move near wells during the dry season. They remained in areas of preferred forage throughout the year. Dormant season preferred forage areas were near the base of sand dunes where vegetation remained greener longer into the dry season, probably because plant roots were tapping water under the dune periphery.

Sheep and goats were grazed together and were tended by women and children. The base camps, at which these stock were corralled at night, were shifted to a new locality frequently (about every two weeks). Several male camels were kept by each family for the purpose of pack transport when moving to a new camp. Cattle generally roamed the grassland untended by humans except to provide water when the cattle returned to the well. The camel herds were tended by the men and the older boys. Large camel herds were present on the grasslands only during the late dry season and during biting fly infestations in the shrubland.

The average stocking density of large herbivores for the entire area was .046 AU ha⁻¹ sheep, .036 AU ha⁻¹ cattle, .018 AU ha⁻¹ goat, .008 AU ha⁻¹ Speke's gazelle, and .005 AU ha⁻¹ camel for a combined mean density of .113 AU ha⁻¹ (8.9 ha AU⁻¹). The AU used here (equivalent to 1 camel or 2 cattle or 10 sheep, goats or Speke's gazelle) is based on an estimate appropriate for pastoral Africa (Brown 1971).

Herbivore Diets

The growing and dormant season diets of the five herbivores studied are shown in Tables 3 and 4. Grassland foliar cover was dominated by monocots (67%) (Herlocker and Ahmed 1986). Camels had a significant preference for dicots (72%) in the dormant season but had a significant preference for monocots (80%) in the growing season. The proportion of monocots to di-

cots for the other herbivores did not significantly differ seasonally. Monocots were significantly preferred by cattle (95%), sheep (78%), and goats (78%). Speke's gazelle diet, composed of 60% monocots, did not differ significantly from foliar cover.

The similarity of diets between species is shown in Tables 5 and 6. Sheep and Speke's gazelle had the most similar diet between seasons (70%) and camels had the least similar diet (30%). Cattle (53%) and goats (58%) had an intermediate diet overlap. Spearman's correlation's between diets of paired ungulates revealed no significant disagreement between any combination. The diet of cattle and sheep showed significant agreement in rank order of plant taxa selected in both the growing and dormant seasons. Diets of Speke's gazelle showed significant agreement with sheep and goats in both seasons. Camel diets showed independent order of forage selection when compared with other species in both seasons except for the significant agreement with sheep in the dry season.

Diet overlap of all species with relative foliar cover was 52% in the growing season and 56% in the dormant season. While this general percent overlap remains similar, the type of forage species selected varied between seasons (Table 7). Cattle, sheep, Speke's gazelle and camel showed a significant difference between seasons in consumption of stoloniferous/rhizomatous invader species which formed lawn-like sod (*Cyperus chordorrhizus*, *Cynodon dactylon*, *Dactyloctenium scindicum* and *Coelachyrum stoloniferum*).

Cattle, sheep and Speke's gazelle showed a significant difference between seasons in consumption of decreaser species (*Panicum pinifolium*, *Heteropogon contortus*, *afrotrichloris martinii*, *Digitaria nodosa*, *Enneapogon schimperanus* and *Tephrosia* spp.).

Cattle, sheep, goats, and Speke's gazelle had very similar trophic diversities. The trophic diversity for these species did not change significantly between seasons. Trophic diversity of camels was significantly lower than that of the other ungulates and camels exhibited significantly lower trophic diversity in the growing season than in the dormant season.

Discussion

The rotational movement of the herbivores caused by biting fly infestations and

water availability did not allow concentration in one place long enough to cause severe deterioration of the forage resource (except at sacrifice areas in the immediate vicinity of large wells). Consequently range condition was fair to good throughout most of the grassland. A wide variety of forage species was shared by the herbivores. Forage preferences were similar among cattle, sheep, goats and Speke's gazelle. In general, during the growing season herbivores preferred forage species characterized by rapid, stoloniferous growth. These species are invaders (Herlocker and Ahmed 1986) which form a lawn-like sod on disturbed areas scattered throughout the grassland such as at abandoned camp sites or near sand dunes (Barker et al. in prep.). Herds of livestock often appeared to direct their grazing pattern by moving from one of these to the next. Invader species (particularly *Cyperus chordorrhizus*) became coarse and dry soon after growth ceased, perhaps prompting the shift in preference. The strong shift in camel diet from *Cyperus chordorrhizus* in the growing season to *Indigofera intricata* in the dormant season probably reflected the fact that browse tends to have lower levels of secondary compounds and retains high crude protein content in the dormant season (Lawton 1968). In the dormant season cattle, sheep and Speke's gazelle preferred forage species characterized as decreasers. This shift in seasonal selection of forage probably resulted from changes in forage nutritional quality. Both groups of forage species were well represented throughout the grassland, therefore movement patterns as well as shifts in diet were not prompted by different habitats. Research to determine relative nutrient content of the forage species between seasons would be useful for further interpretation of forage preference patterns.

Since all herbivores shared the same general preferences in forage and the same shifts in preference between seasons, it may be inferred that if these preferred species were more numerous diet overlap would increase. Many authors have asserted that diet overlap would increase as range condition deteriorates and forage becomes scarce. These data imply that diet overlap would also increase as range condition improves and more highly preferred forage species become available. Diet overlap would thus be expected to be low-

est on range where the highly preferred species have been eliminated or severely reduced and yet digestible forage is not limiting. Thus diet similarity should be interpreted in the context of range condition in that diet overlap on poor range may indicate a competition for survival whereas diet overlap on good range may indicate an abundance of highly palatable forage species and has little applicability in terms of competitive exclusion.

There was no clear relationship between dietary diversity and body mass. The relatively low diet diversity of the camel indicates that this species was not as well adapted to the grasslands as the other four species that were present. Indeed, most of the year the only camels present on the grasslands were individuals used as pack animals. The large herds of camels were primarily kept in the shrubland except during the late dormant and early growing seasons when water well distribution and biting fly infestations prompted them to move to the grassland.

The fair to good condition of the grassland and the abundance of forage in both seasons enabled the ungulates to coexist while sharing very similar movement patterns and diets. Livestock stocking rate was primarily limited by water availability in the dormant season. Therefore, livestock populations were not able to increase to a point that could result in widespread damage to the forage resource. The existing balance between utilization and available forage must be considered when planning water development projects that may allow the livestock numbers to increase beyond the carrying capacity. This is especially critical for pastoral societies which do not have an institutional or cultural mechanism to control stocking rate.

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Table 1. Livestock movement patterns on the coastal grasslands near Ceel Dhere, Somalia

	Grassland Pastoralists	Shrubland Pastoralists
Early Growing Season	Graze herds on good/excellent range condition sites on the balli and bannaan that cannot be grazed at other times of the year due to lack of well sites.	Biting fly (ribi) increases in the bushland Move herds to ecotone to escape ribi fly infestation.
Middle Growing Season	Biting fly (gelmi) increases on the grassland. Livestock moved to the coast where ocean breeze disperses the flies or to the balli where fly density is lower.	Move livestock to bush as ribi fly declines.
Late Growing Season	As rains end the gelmi fly declines and the livestock follow the fresh forage which dries from the coast first to the ecotone last.	
Early Dormant Season	Livestock graze the bannaan until the forage dries to the point where livestock must be frequently watered.	
Middle Dormant Season	Move livestock to the coast where numerous shallow wells allow dispersed grazing. Remain about one month until ticks increase and/or wells begin to dry.	
Late Dormant Season	Move livestock to deep wells scattered along the ecotone where dry forage is available, but the process of watering livestock is congested, time consuming and labor intensive.	Move livestock to deep wells on the ecotone where dry forage is available, but the process of watering livestock is congested, time consuming and labor intensive.

Table 2 Mean relative percent of the plants in the diets of ungulates during January and March, 1986 (dormant season) on the coastal grasslands near Ceel Dhere, Somalia¹

Plant Species	Cattle	Sheep	Goat	Speke's Gazelle	Camel
<i>Cenchrus ciliaris</i>	14	13		4-2	3-
<i>Leptothrium senegalense</i>	8	3		10	6
<i>Panicum pinifolium</i>	9	4		7	3
<i>Aristida sp</i>	1	4		1	2
<i>Heteropogon contortus</i>	9+	3		3	tr-
<i>Afrotichloris martinii</i>	tr	1	tr	1	2
<i>Digitaria nodosa</i>	8+	3	5	6	2
<i>Cymbopogon commutatus</i>	3	1	4	tr	3
<i>Enneapogon schimperanus</i>	17+	10+	4	11+	1
<i>Cynodon dactylon</i>	3	3	2	tr	1
<i>Brachiaria ovalis</i>	1	3	1	3	0
<i>Coelachyrum stoloniferum</i>	6	5	3	1	2
<i>Sporobolus brockmanii</i>	8+	2	1	6+	2
<i>Dactyloctenium scindicum</i>	1	tr	1	tr	tr
<i>Cyperus chordorrhizus</i>	4-	19	29+	15	6-
Other Sedges	0-	0-	2	1	0-
Other Monocots	6+	4	4	2	4
<i>Tephrosia sp</i>	0	4+	6+	12+	0
<i>Leucas sp</i>	0	0	2+	3+	0
<i>Indigofera intricata</i>	1-	7-	3-	16-	49+
<i>Jatropha obbiadensis</i>	0	tr	0	1	1
<i>Euphorbia cuneata</i>	0	1	3	2	9+
Other Dicots	1	10+	5	8+	13+

¹ Botanical nomenclature follows Hubbard et al (1981)

2 (+) and (-) respectively indicate a significantly ($P < 0.05$) greater or less portion of diet than would be expected if forage was selected based on foliar cover

3 tr = trace

Table 3. Mean relative percent of the plants in the diets of ungulates during November, 1985 and May, 1986 (growing season) on the coastal grasslands near Ceel Dhere, Somalia.

Plant Species	Cattle	Sheep	Goat	Speke's Gazelle	Camel
<i>Cenchrus ciliaris</i>	14	9	5-1	1-	1-
<i>Leptothrium senegalense</i>	1-	4	5	2	0-
<i>Panicum pinifolium</i>	tr-2	1-	1-	1-	0-
<i>Aristida sp</i>	3	1-	tr-	0-	0-
<i>Heteropogon contortus</i>	8+	6	1	1	tr
<i>Afrotichloris martinii</i>	5	3	5	1	4
<i>Digitaria nodosa</i>	5	5	3	1	tr-
<i>Cymbopogon commutatus</i>	1	0-	0-	2	0-
<i>Enneapogon schimperanus</i>	4	0	7+	4	0
<i>Cynodon dactylon</i>	14+	6+	6+	5+	0
<i>Brachiaria ovalis</i>	1	0	3	2	tr
<i>Coelachyrum stoloniferum</i>	6+	11+	6+	2	0
<i>Sporobolus brockmanii</i>	2	2	3	7+	2
<i>Dactyloctenium scindicum</i>	13+	7+	8+	2	0
<i>Cyperus chordorrhizus</i>	11-	16	18	26	71+
Other Sedges	0-	0-	0-	0-	0-
Other Monocots	5	6+	3	4	2
<i>Tephrosia sp</i>	1	1	2	8+	2
<i>Leucas sp</i>	0	0	0	tr	0
<i>Indigofera intricata</i>	2-	8-	18	18	8-
<i>Jatropha obbiadensis</i>	0	0	tr	3	0
<i>Euphorbia cuneata</i>	0	3+	2+	1	0
Other Dicots	4	11+	4	9+	10+

1 (ta and a-) respectively indicate a significantly greater or less portion of diet than would be expected if forage was selected based on foliar cover
aP < 0.05a.

2 tr = trace

Table 4. Matrix for percent diet similarity (upper right) and Spearman's rank order correlation coefficients (lower left) for food preferences for the ungulates of the coastal grasslands near Ceel Dhere, Somalia for January and March, 1986 (dormant season).

	Cattle	Sheep	Goat	Speke's	
				Gazelle	Camel
Cattle	—	59	53	45	25
Sheep	54	—	66	66	43
Goat	46	61	—	60	35
Speke's					
Gazelle	15	52	57	—	44
Camel	11	38	24	18	—

Table 5. Matrix for percent diet similarity (upper right) and Spearman's rank order correlation coefficients (lower left) for food preferences for the ungulates of the coastal grasslands near Ceel Dhere, Somalia for November, 1985 and May, 1986 (growing seasons)

	Cattle	Sheep	Goat	Speke's	
				Gazelle	Camel
Cattle	—	69	63	44	27
Sheep	75	—	72	57	46
Goat	68	69	—	71	41
Speke's					
Gazelle	27	54	58	—	51
Camel	36	54	43	41	—

Table 6. Percent similarity of diet with forage cover.

Ungulates	ALL FORAGE SPECIES		DECREASER SPECIES		SOD FORMERS	
	Percent Diet Similarity		Percent of Diet		Percent of Diet	
	Growing Season	Dormant Season	Growing Season	Dormant Season	Growing Season	Dormant Season
Cattle	48	46	23	43	44	14
Sheep	55	66	16	25	40	27
Goat	63	59	19	25	38	35
Speke's Gazelle	56	57	16	33	35	16
Camel	36	54	6	7	71	9

cultivation is also beginning to spread through the range-

lands these areas is as lucrative as maize production, it appears that as the land is subdivided through the ongoing adjudication process, the grasslands which remain will certainly be converted to maize fields within 3 years.

In terms of the existing system, three primary results will occur if by default the government and conservation agencies continue to do nothing:

KENYA

Development in the TransMara

Tom Thurow^{ASG}, who has been engaged in the GTZ-TDP TransMara Development Programme as a Consultant on Range and Pasture Management, expressed his concern about the rapid rate of farming and fencing of this important Maasai wildlife and cattle range in an 8 June 1994 letter to David Western, Director of Kenya Wildlife Services. (Thurow's paper on the Somali coastal plain is also included in this issue.)

Dear Dr. Western:

I am writing to provide an update on the land use pattern along the [Isiria] escarpment ridge which is the western border of the Maasai-Mara National Reserve. Unless substantive action is taken now, the TransMara rangelands which exist along this border will be converted to a maize monoculture up to the edge of the escarpment (i.e., the edge of the reserve). Indeed, this is the case for a 15 km stretch north from the Tanzanian border. The cultivation is pushing north at a rate of 5 km per year. Maize

from Loggarian east to the escarpment and south along the escarpment from Kirindoni. The soils and climate are very suitable for maize production in this region. As the land adjudication process continues, the current situation makes maize cultivation by far the most profitable use of the land.

Since Kenya needs to develop its food production potential, it is understandable that pressure exists to cultivate these extremely productive lands. So, what is the problem and why am I writing to you? As I am sure you know, even though the Maasai-Mara N.R. comprises less than 10% of the total land area of the Serengeti ecosystem, it is extremely important to maintaining the viability of large wildlife herds in the region. This is because the large and diverse ungulate community is dependent on the Maasai-Mara N.R. as a dry season pasture. Once every decade or so, a serious drought occurs which results in the forage being depleted in the Maasai-Mara N.R. and the semi-arid grasslands (which have not yet been converted to wheat fields) north and east of the reserve. The only reliable release valve in these critical years is for the herds to move up the escarpment into the productive Hyparrhenia/Themeda grasslands of the TransMara sub-district. Since no other current option of land use in

1. The important drought reserve release valve that the TransMara rangelands historically provided to the wildlife of the Maasai-Mara/Serengeti ecosystem will no longer exist. This will mean that dramatic die-offs of wildlife should be expected during the inevitable next drought.

2. The areas on the edge of the escarpment have exceptional scenic beauty as an overlook of the Maasai-Mara N. R. From the reserve looking west, the escarpment is the dominant landscape feature. Deforestation and settlement along the edge of the escarpment could pose a serious erosion hazard and would have a substantial negative impact on the view from the Maasai-Mara N.R. of the western horizon. Indeed, accelerated hill and gully erosion cutting down the edge of the escarpment into the Maasai-Mara N.R. is beginning to occur along the cultivation/reserve border.

3. The existing Maasai culture and the livestock/wildlife coexistence which currently exist will be erased from the region.

These should not be new revelations to anyone since there has been a host of previous documents which warn that action should be taken to prevent these outcomes (e.g., Environmental Action Plan for Narok District - Ministry of Land Reclamation;

Policy Framework and Development Programme - Kenya Wildlife Service; Identification Study for the Conservation and Sustainable Use of the Natural Resources in the Kenya Portion of the Mara/Serengeti Ecosystem— European Development Fund of the EEC).

I've visited with many of the Maasai who use the area. The consensus is that they would prefer to maintain their pastoral lifestyle in a way that is compatible with wildlife but it must offer them a realistic alternative to the substantial financial windfall that they can obtain from renting their land to agriculturists. To simply say (as is [the] current vogue of conservation organizations) that the people must be "educated" to understand the importance of wildlife and therefore develop a sense of responsibility for maintenance of the existing wildlife is naive. In fact, while many pastoralists acknowledge that wildlife is beneficial for the economy of Kenya, they also say that wildlife represents for them only costs (wildlife transmitted disease, wildlife depredation of livestock, wildlife competition for forage and water, etc.).

Revenues generated from tourism in the region barely trickles down to these pastoralists. The few, small developments in the region that have been paid for from government fees collected from tourists have usually been distributed by politicians as a personal or party gesture, with little reference to where the funds actually came from. Therefore the pastoralists are largely unaware that funds generated from tourism-use fees have been used to build the local primary school, community center, etc. Besides, these facilities are often surrounded by cultivated land; therefore most of the beneficiaries have nothing to do with costs borne by the pastoralists on whose land the wildlife depends.

Sorting out the Byzantine politics which swirl around this issue is far beyond the charter or capability of the GTZ TransMara Development Project. The objective of this project is to promote sustainable land use associated with the pressures and rapid changes that the region will be experiencing in the next decade. As a consultant to the project, I feel that maintenance of the wildlife land use option along the escarpment is highly desirable for the reasons discussed above. The forests and associated wildlife populations along the Migori River (which runs through the center of the

TransMara sub-district) are also under heavy pressure. It is apparent that these resources will be lost within the next several years unless the various agencies of the Government of Kenya sort out their policies regarding the region. Without substantive, prompt action these key areas will by default soon cease to be of use to most wildlife. Since this issue will be rapidly playing out during your administration of the Kenya Wildlife Service, I at least wanted to express these concerns so that you, as the key representative of wildlife interests of the Government of Kenya, are fully aware of the ramifications of what will be taking place.

Given the rapidly evolving situation and the complex political environment, it is probably too late for an NGO or private entrepreneur to implement a program in time to make it worthwhile for the land owners to maintain the livestock/wildlife land-use option. The land owners have clearly expressed that they will take the money from crops now rather than rely on future promises. I do not think any wildlife education programs will make any difference at this stage, given the legacy of decades of blatant neglect of the region's interests. I have racked my brain and discussed with many people of the region every possible solution to this issue that we could imagine. Given the short time frame during which action is required, the only viable option in my opinion seems to be to offer a wildlife easement contract directly to the people who use the lands upon which the wildlife depends. The terms of the easement should make the current wildlife/livestock land-use pattern at least as lucrative as conversion to cropland. Once the future of wildlife on these lands is secured, there will be time to encourage development of profitable enterprises that benefit from wildlife that can contribute to defraying the easement costs. Ideally the easements should be worded in such a way as to provide a financial incentive for the land users to maintain/improve the range conditions upon which the wildlife depend. There is sufficient information on the ecology of the region to put a range trend monitoring program on the ground to support this effort. I will return from the TransMara on 15 June and will be in Nairobi on 16-17 June before returning to Texas A&M University where I work as a professor in the Department of Rangeland Ecology and Manage-

ment. If you would like to discuss this during those days I will be able to meet with you at your convenience. . . . When I return to the U.S. I plan to distribute this information to relevant conservation organizations with the hope that it will galvanize action from them as well.

Update and Comment

To date, Thurow has received no response to this letter, neither from the KWS nor from the Narok County Council or Narok Senior Game Warden, to whom he sent copies.

The possible loss of the reserve pastures atop the Isiria Escarpment has concerned me ever since Richard Leakey, Western's predecessor as KWS Director, proposed to erect a fence along the western boundary of the Maasai-Mara National Reserve. A survey of wildebeest populations undertaken in connection with my doctoral dissertation convinced me that blocking access to areas of higher rainfall where wildebeest and other migrating herbivores could find water and forage during protracted droughts was the primary cause of the drastic decline of every major migratory population. If the future of the Serengeti migration is to be put at risk through inaction, at a time when an ecologist who understands the problem as well as anyone is actually the Director of the responsible Government agency, then I really wonder what hope there is of preserving any significant part of Africa's wildlife heritage.

TANZANIA

Proposed Survey of Zanzibar Antelopes

Andrew Williams^{ASG}, postgraduate student at Cambridge University, Tony Archer, Consultant with the Zanzibar Forestry Department, and Ali Mwinyi, Wildlife Officer in the same department, are undertaking a "Village Mini-antelope Conservation and Management Programme," beginning this June with a population survey of Ader's duiker, blue duiker, and the suni. Excerpts from their well-formulated grant proposal are printed here, in hopes that some institution or individual will feel like contributing to their minimal budget of \$4880, of which only \$1000 had been raised when Andrew sent the proposal to *Gnusletter* in late March.

Executive Summary

Three species of antelope occur on Zanzibar Island [also called Unguja]—the rare and endangered Ader's duiker, *Cephalophus adersi* (Thomas, 1918), the Zanzibar blue duiker, *Cephalophus monticola sundevallii* (Fitzinger, 1869) and suni, *Neotragus moschatus moschatus* (von Deuben, 1846). Ader's duiker appears to be becoming increasingly rare throughout its range: areas of the coastal coral rag thicket of mainland Eastern Africa and Zanzibar Island. Moreover, Zanzibar's three antelope species appear to be in overall long-term decline, and as such their future conservation and management is becoming increasingly important not only in terms of biodiversity conservation, but also in the context of maintaining traditional hunting practices that play an important role in the socio-economic and cultural life of rural Zanzibar.

Thus, as a continuation of the work already carried out by Archer (1994) and Mwyini as part of the Forestry Department's small antelope management programme, in building upon past studies (Swai, 1983) and, in the context of the IUCN/SSC Antelope Action Plan and the Pan African Decade of Duiker Research (1985-1994) (Wilson 1987), a survey is proposed to:

- (i) Establish the current sizes and the relative distribution of Zanzibar's antelope populations with the active participation of village hunters.
- (ii) Identify areas of degraded habitat and the rate of habitat degradation as far as is possible.
- (iii) Obtain more data on the biology of the antelope—particularly Ader's duiker.
- (iv) Achieve a greater understanding of the socio-economics and anthropological aspects of hunting.

The results of the survey will be analysed in relation to previous population estimates (Swai, 1983) and, in conjunction with data from existing village hunt registrars, it is planned that the project will provide:

- Comprehensive data on the current population size, distribution and status of each of Zanzibar's antelope species.
- An estimate of the extent and significance of areas of degraded habitat in relation to the conservation and management of the antelope.
- An analysis of hunting practices, attitude values towards wildlife, the importance of hunting in relation to the generation of

household income and a better understanding of the rural and urban small antelope market.

- Deriving from the above work, an assessment of the sustainability of present hunting practices and, where appropriate, an estimate of the current maximum sustainable yields for each species.
- Recommendations for the continued management and conservation of the antelope of Zanzibar in the context of a village wildlife programme and also a scheduled protected areas system.

The project aims to provide the required data necessary for the continued conservation and management of Zanzibar's antelope—especially Ader's duiker, a rare and endangered species. Also the project aims to maintain and strengthen the positive working relationship that exists between the Forestry Department and village hunters. It is hoped that this survey will help to stimulate further future development of the village wildlife programme.

The Mini-Antelope of Zanzibar

[This section deals with all three antelopes, but only the Ader's duiker information is presented here. Ed.]

The antelope population as a whole has suffered a general decline estimated at 20-30% in the last 2-3 years, although of late there may have been limited localised recovery. This recent estimate is part of a long-term decline over the past 20 years or so (Archer 1994), which is reflected by hunters who have reported that they no longer are able to catch nearly as many antelope as they used to 20 years ago.

Ader's duiker

Paa Nunga (local Kiswahili name)

The status of Ader's duiker has been classified as both 'critical' and vulnerable. In Unguja, Ader's duiker occurs predominantly along the eastern side and southern half of the island—in areas that retain substantial portions of undisturbed coastal thicket. Ader's duiker is absent from the much more densely inhabited mid- and northwestern parts of the island (with the exception of Tumbatu Island and the extreme north). . . Swai (1983) estimated the population to be about 5,000 and declining, a trend borne out by recent interviews with hunters in Zanzibar (Archer, 1994).

Rodgers and Swai (1988) report that the decline in the Ader's duiker population in Zanzibar is due to habitat destruction, in-

cluding uncontrolled harvesting of firewood, building poles and charcoal. Increasing levels of shifting cultivation are fragmenting areas of undisturbed habitat. Archer (1994) suggests that with the decline in the availability of ammunition (specifically shotgun cartridges), habitat destruction rather than hunting is now endangering the long term survival of the species.

Apart from Unguja, Ader's duiker has been described by Kingdon (1982) as widespread in the forests, woodlands and thickets north of Mombasa (Kenya) almost up to the Somali border. However, in the light of rapidly shrinking habitat and numbers, this may no longer hold true.

Rodgers and Swai (1988) suggest that Ader's duiker may occur in the coastal thickets north and south of Tanga (Tanzanian mainland) - possibly in the Sadani Game Reserve, north of Sadani town. 'Odd' skins of a red duiker have turned up in Zaraninge-Kiono on the Bagamoyo-Pangani border (about 75 km north of Dar es Saalam) (Rodgers pers comm. to Butynski & Williams).

Ader's duiker has been partially protected by law, both in Zanzibar and Kenya. In Zanzibar, the Ministry of Natural Resources ordered a closed hunting season in mid-1982 but the effectiveness of the implementation of this law was such that it has now fallen into complete disuse. The most recent amendment to the relevant legislation of 1919, entitled "Wild Animals Protection" was in 1959 (Archer 1994). Plans are afoot to restart the imposition of a closed hunting season in 1995, in the months of July and August. Archer (1994) reports that when asked about their opinion in regards to reintroducing a closed hunting season, the attitude of the older hunters was favorable, due not least to memories and the appreciation of much higher levels of antelope when the closed season was previously in operation.

Methodology of the Survey

(a) Survey techniques

Sampling and Trapping The main limiting factors when trying to select for any one particular survey technique are that much of the habitat of the small antelope is relatively thick bush, difficult to negotiate with generally a low range of visibility.

Koster and Hart (1988) and Hart (pers. comm. to Williams, 1994) state that it is

preferable to adopt more than one survey technique and that each technique should rest on different assumptions. Unfortunately, given the relatively limited period of time of two months allocated for the field work, it will not be possible to carry out two surveys of equal extent using different techniques and thus a composite of two techniques will be used.

Drive counts within specific delimited areas for each biotope will be used to quantify and verify an index of population density generated by much more extensive variable line transects and dung heap counts - see below and appendix 1.

The most recent extensive field work carried out has been by Bowland (1990) on the blue and red duiker (*C. natalensis*) in Natal. . . Bowland has published papers on the capture and handling of duiker. Duiker generally seem to be resilient and hardy animals and the drive count technique does not appear to adversely affect resident animals. Animals rarely if ever become dangerously entangled in the nets and since there are a good number of personnel involved, caught animals are usually de-netted in less than a minute and generally handled and released within 5-10 minutes.

Where two conspecifics are caught in the drive counts, they will be kept physically and visibly separate from each other. Efforts will be made to minimize the perception of one animal by another through scent detection. Isolation of captured animals is not anticipated to be a problem as rarely more than 4-5 animals will be caught per drive.

No anesthetics are to be used, and proper procedures will be adopted at all times where blood and tissue samples (ear clips) are taken from a limited number of animals by trained personnel - see appendix 1.

Experience of Animal Handling Personnel All personnel participating in the study have handled small antelope before—most extensively. The author has himself been present at drive counts in Zanzibar and is satisfied that no welfare problems are anticipated, especially since handling time will be reduced to a minimum. A set protocol of how animals from drive counts are to be handled will be established in the pilot study and then rigorously enforced. Tissue sampling will be carried out by a limited number of trained personnel - Archer, Mwinyi and Williams.

(b) Survey Procedure

Pilot Survey A short pilot survey will be undertaken to allow all the participants to be familiarized with study protocol and to enable teething and practical problems encountered while practicing the survey techniques to be rectified.

Main Survey The details of the main survey are still being drawn up but the following is presented to illustrate what is presently being considered:

(i) Drive counts will firstly be used to establish the number of animals within specific delimited areas - several study sites per biotope type. Unguja—excluding urban and heavily populated areas—will be demarcated into numbered grid squares. A certain proportion of the grid squares (to be decided upon) within each pre-designated biotope type will be randomly selected and then surveyed in a systematic fashion using drive counts.

(ii) Variable line transects and dung heap counts will then be carried out within the same delimited areas as the drive counts but also extended further to cover a much more extensive area of Unguja. At present, it is undecided whether transects will follow the course of paths—especially suitable for the thicket areas—or whether transects will be randomly placed across the island—especially suitable for less tall thicket and grassland areas. It is anticipated that transects may be up to 2-3 km long. Dung-heap counts will be carried out in areas of high thicket, where visibility is too poor for variable line transects.

(iii) A socio-economic survey will be carried out in the villages from which hunters operate. It is currently planned that it will, at least in part, be carried out in a rapid rural appraisal format, although it is anticipated that a substantial amount of data will be accumulated through incidental discussions with village hunters.

The aim of the survey is to gather much more data on hunting practices, attitude values towards wildlife, to investigate the impact of hunting in relation to household income, and to better understand the rural and urban small antelope market.

The results of the socio-economic survey will then be used in an assessment of the current sustainability of hunting in Zanzibar and in making management and conservation recommendations.

(iv) Habitat type and status in the drive count sites and at regular intervals along

transect lines will be surveyed and recorded. The vegetation classification will be in part based on the work of Swai (1983) and Beentje (1992) but also modified to take account of habitat quality - including measuring the density of general biomass using the half-site method.

(v) During the drive counts, every antelope caught will be tagged in the ear, samples may be taken and a record on each individual will be made and will include the following for each species:

Location and time of capture; measurements of body size; estimated age (using the eruption sequence of the teeth [e.g. Dubost, 1980]); sex; reproductive state if female; external parasites will be recorded, removed and preserved; blood and tissue samples (probably an ear clip) may be taken from some animals for epidemiological and population viability analysis as well as possibly for molecular phylogeny studies at a later date; collection of any skeletal parts encountered in the field, especially those belonging to Ader's duiker.

(vi) If time and funds allow, a small representative sample of individuals from each species will be tagged with radio collars and then tracked in order to obtain some preliminary data on territory size, daily activity patterns and movements, as well as to assess the practicalities of radiotracking antelope in Zanzibar.

(c) Local Professional Development

The survey is to be carried out as part of the Forestry Department's small antelope management programme and as such it will directly involve the participation of several Forestry Department personnel - particularly the wildlife officer, Mr. Ali Mwinyi, who has been instrumental in ensuring the programme's success so far. During the execution of the survey, Forestry Department personnel will be trained in biological and social science field techniques and in addition their local knowledge and skills will make an invaluable contribution to the success of the survey. It is hoped that by the end of the study, most of the local personnel involved will have received invaluable field and if possible data analysis training. Such experience will strengthen the resource base of the Forestry Department.

(d) Involvement of Local People and Educational Promotion

The participation of the village hunters in

this survey is very important, not only in employing their nets, skills and knowledge for the execution of the study, but also in ensuring that they see that they are involved in the management of their wildlife resources. Only by demonstrating to the village hunters now that their knowledge, skills and presence is valued and respected will any attempt at promoting a future village community wildlife programme be successful. Thus the continued involvement of local people in the small antelope management programme is central to its success.

Unfortunately, there will not be enough time to investigate approaches to launching a conservation publicity or education campaign and as such this lies outside the remit of the project. Nevertheless, through the active participation of the village hunters in the survey, through interviewing village households as part of the socio-economic study and, through everyday general dialogue with people, information will be disseminated to key groups. Recommendations about possible approaches to initiating/enhancing a conservation education campaign—for example in local schools—will be made in the final survey report.

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ZAMBIA

For those who would like nothing so much as to experience the wilds of Africa in solitude, here is a rare opportunity. Ghosts of safaris past! [Ed]

Wildebeest Migration in the Liuwa Plains

by Brendan Dooley

Behind a Basalt Dike, cutting across the path of the Zambezi River in the Western Province of Zambia, a huge flood plain has formed stretching some 300 km to the north and 80 km wide.

Annual floods spill over the Zambezi banks covering the alluvial sands. At the turn of the last century, the plains supported a huge number and variety of game and a fiercely proud people, the Barotse, from which the plains derive their name. Over much of these plains the game has been eradicated; isolated pockets of zebra and wildebeest are all that remain.

In the northwestern corner between two of the Zambezi's tributaries, the Luawanginga and Luambimba rivers, is a small park: the Liuwa Plains National Park, which preserves an environment similar to no other in Zambia. Through this reserve migrate possibly the largest remaining herds of wildebeest outside the Serengeti system. Some rather dated census [figures] number the population at 32,000 animals.

The wildebeest still migrate across the plains, moving east and south to the confluence of the Luawanginga and the Zambezi from October through to May. They then move northwest following the Luawanginga River, leaving the park boundaries in July, reportedly entering Angola. It is here in sparsely wooded country that they drop their young. Later moving eastward then southeast, the herds reenter the Liuwa Plains National Park. It is during this stage of their migration, which takes place in September and October, that most of the animals congregate in one large herd and are visually the most rewarding. One huge herd in an otherwise treeless plain must be a sight to behold. The westward migration is spread out loosely in nu-

merous small herds of up to 6000 animals feeding on the fringes of the plains where wooded islands and forests form the shoreline of this fantastic sea of grass.

Despite the number of wildebeest there are few lion. The dominant predators are hyena and wild dog (the hyena often following the wild dog and raiding their kills). The wild dog population is difficult to determine. Local game scouts place the number at a ridiculously high level but there are probably anywhere between 50 and 200 dogs.

Species diversity on the plains is high with many of the game being represented in varying numbers. One could expect to encounter numerous herds of zebra, often around 300 animals per [aggregation] deep in the plains, usually around numerous small depressions filled with water. Each of these water holes, or pans, attracts large concentrations of the most fantastic bird species which are considered rare in other parts of Africa: crowned cranes, wattled cranes, a variety of storks, ibises, ducks and waders are but a few of the large numbers of birds found on the plains.

Of particular interest are the oribi and tsessebe populations. Both species are very well represented. There are said to be 7000 tsessebe in many small herds along the fringes of the woodland. Oribi can be found all over the plains wherever the grass is short and water is near. I have no count but these are the most visible animals in the park.

Of the larger game species, there are few left. Elephants occasionally wander through, as do sable, eland and roan. Sitatunga, lechwe, buffalo, and impala are also present in low concentrations.

Sadly, as is the situation elsewhere in Africa, poaching is a massive problem. With the Angolan border not too far off, large numbers are shot both in Zambia and when the wildebeest herds enter Angola. Rumors of commercial slaughtering by Lusaka-based operators make very plausible stories.

Most of the herds have a few wounded animals limping along at the tail end of the migration. The rangers are anxious to make changes and continue to make fairly convincing efforts to protect the park. Pathetic equipment, lack of supplies, no vehicles nor available funds make their task formidable and rather ineffectual. Unfortunately, this is a legacy which is, sadly, part

of nature conservation in most of the Zambian parks.

One of the best ways to conserve the park would be to open it to a controlled form of tourism. Access is, however, difficult and quite tedious. Once in the park, there is only one track heading northwest. There are absolutely no facilities and at present one can camp anywhere. The main entry point to Liuwa Planes National Park is via Kalabo, a small town with a name and a pub, but little else. There are no supplies of petrol, but a fantastic air strip, capable of landing jets.

At Kalabo one needs to organize a long rope and a small pontoon (the rope is obtained from the Town Clerk) to cross the Luawanginga River. To reach Kalabo, there is a ferry from Mongu during the rainy summer months when the rivers are in flood; or [one makes] an epic trip following the Zambezi River on its western bank from Sitoti to Kalabo. This track, although only 180 km long, would take at least 10 hours in a powerful 4X4, or in an old "Landie" could take up to one and a half days. Please note that a 4X4 is essential and no petrol is available anywhere near the park. Mongu and Senanga are the only supply points.

I sincerely trust that this letter stimulates a few readers to visit the wondrous area where you are sure to be alone with some of the last great herds on the continent. The need to conserve these wide open spaces become more essential by the year and only through our efforts will this remote corner stand any chance of surviving.

For those who would like further information, maps, etc., please contact Brendan Dooley, Johannesburg, 793-3581 (business), 880-1178 (home), fax 793-3817; or P. O. Box 2378, Northcliff 2178, South Africa.

SAUDI ARABIA

Arabian Oryx Reintroduction

The National Wildlife Research Center's Oryx Breeding and Reintroduction Team of Marc Ancrenaz, Stéphane Ostrowski, and Alain Delhomme sent the following announcement of the release of Arabian oryxes in March.

The Arabian oryx has been immortalized in ancient Arab poetry as a symbol of beauty, majesty, power and life in the deserts of the Arabian Peninsula. Even be-

fore the first European explorers ventured into Arabia however, the Arabian oryx had begun a long decline in the face of hunting and encroachment by humans into once remote regions. The Arabian oryx found its last refuge in the vastness of the Empty Quarter, the great sand desert known as the Rub Al Khali, and it was there that the last wild Arabian oryx were shot by poachers in October 1972.

The Arabian oryx lived on in zoos and private collections throughout the world, and regained a foothold in the Arabian Peninsula when free-ranging populations were established in Oman.

The National Wildlife Research Center in Taif, Saudi Arabia, operating under the auspices of the National Commission for Wildlife Conservation and Development, is proud to announce the return of the Arabian oryx to the wild in Saudi Arabia.

On 28 March 1995 a group of 18 (9.9) captive-born Arabian oryx bred at the NWRC and a group of 3 (1.2) wild-born animals caught in Mahazat as-Sayd reserve (fenced protected area where a first population of oryx was established in 1990), were released by HRH Prince Sultan Bin Abdul-Aziz, from a holding pen in 'Uruq Bani Ma'arid—a 5,000 km² unfenced protected area on the south-western edge of the Rub Al Khali. The re-introduced oryx have been bred at the NWRC, the offspring of founders taken from the World Herd and from private collections in the Middle East. All of the oryx have been fitted with radio-collars; their movements will be followed by light aircraft and by rangers and biologists on the ground.

The staff at NWRC wish to thank all those people and organizations that have contributed to the Arabian Oryx Restoration Programme over the last nine years, and to share the news of this event with other conservation groups. We have learnt and are learning much from this re-introduction. More releases are planned, with the hope that in time the Arabian oryx will once more roam throughout the length of the Arabian Peninsula.

Sand Gazelle Reintroduction

Jacques Flammand^{ASG}, Project Director of the King Khalid Wildlife Research Center (KKWRC), gave notice of the proposed release of the Arabian oryx some months ago (5 Dec 1994), as it was planned to coincide with the release of sand gazelles by

KKWRC. He wrote:

"... we are about to embark on the most 'risky' release in Saudi Arabia to date in that this winter we are to release 110 sand gazelles (*Gazella subgutturosa marica*) in the 'Uruq Bani Ma'arid protected area on the western edge of the Rub Al-Khali.

"The gazelles were all captive bred at the King Khalid Wildlife Research Centre near Riyadh and they will be released in two groups of 55 after a period of pre-release holding in the reserve. It is the first time that they will be released into such a vast, harsh environment, where they will not only have to contend with the extremes of the habitat, but also possibly with competition with domestic livestock for the limited grazing resources.

"The reintroduction is to take place in a core area of the 'Uruq Bani Ma'arid reserve in which it is hoped the bulk of the gazelles will remain. Although people have been excluded from this core area and they have been asked to keep their camels out, the gazelles are likely to move further afield in time and come into contact with camels and people, who might even try to hunt them. However, the Rub Al Khali, or Empty Quarter, is a vast area and it is to be hoped that the gazelles will find ways of avoiding contact with humans and their flocks."

YEMEN

A Conservation Initiative

Jelle Boef^{ASG} has been involved in planning a wildlife survey and conservation program for Yemen for several years, along with several other present or past ASG members (Arnaud Greth, March Ancrenaz, Chris Hillman). The plans had to be put on hold when war broke out between North and South Yemen. Now that order has been restored, the plan has been revived, with the promised cooperation of the Government of the Republic of Yemen. The principal investigator from Yemen will be Dr. Mousa M. al Safadi, Professor of Biology in the University of Sana'a. Apart from Boef, the field workers will include Wolfgang Wranik and Tim Wachter. The project is summarized below, following an excerpt from Boef's covering letter of 23 Jan 95 to Mario Gimenez Dixon.

"At the time [Nov 93] you requested a full draft of the proposal for which we would like to obtain your assistance in raising required funds. However, events that ensued

(in fact starting as early as late 1993) prevented necessary arrangements to proceed and at the time I deemed it therefore unwise to submit a plan to you that would be without any guarantee about its implementation. Furthermore, communications with the Republic of Yemen had broken down completely, so it would have been quite impossible to contact our Yemeni partners should that need arise.

"Fortunately, the situation has very much improved (and continues to do so) and I have already been able to establish a rapport with the Environmental Protection Council, which holds the mandate for wildlife conservation and research in Republic of Yemen. They plan to include the proposal in their 1995 action plan and have offered to coordinate with concerned government departments. In effect, they wish to proceed swiftly with other conservation priorities, including establishment of a protected area network and formulation of wildlife and habitat protection legislation.

"The Environmental Protection Council have also requested a copy of the excellent ICBP report entitled "Biological Diversity Assessment in the Republic of Yemen" which reviews the current status of the Yemeni environment and outlines priorities for conservation action. The report specifically proposed a representation by IUCN be made to the Yemeni government to assist them with implementing conservation measures. A similar study commissioned by WWF to confront the burgeoning rhino horn trade in the Republic of Yemen concluded that only a high profile conservation project would generate the commitment required of the Yemeni Government for international conservation issues. Our project fits in perfectly with these recommendations and would present an excellent vehicle for IUCN to initiate conservation action in the Republic of Yemen."

Project Overview

Background Biological diversity faces a drastic reduction within the Republic of Yemen through rapid economic development and uncontrolled hunting of rare and endangered wildlife species. No wildlife conservation policies exist or have been formulated, neither have any protected areas been proclaimed for the purpose of protecting native wildlife. Current wildlife legislation remains diffuse at best and cannot be enforced without an adequately

equipped wildlife department. A comprehensive study into the distribution and status of Yemen's larger mammals has not recently been undertaken and a systematic survey is urgently needed to fully establish the significance of Yemen for various ungulate taxa and determine which populations are significantly viable to effect protective measures.

Species concerned The project will investigate the status of Yemen's ungulate species which include Nubian ibex (*Capra ibex nubiana*), three gazelle species (*Gazella gazella*, *G. dorcas*, *G. subgutturosa marica*) and the Arabian oryx (*Oryx leucoryx*). Potentially, two more gazelle species may occur depending on the tenability of present taxonomic knowledge. The basis for even attempting a survey of Arabian oryx is promulgated by persistent Badawin reports of its existence in Yemen's interior eastern desert provinces. The other major mammal order that is the subject of this survey concerns the Carnivora of Yemen, which include the elusive Arabian leopard *Panthera pardus nimr*, hyaena *Hyaena hyaena sultana*, Arabian wolf *Canis lupus arabs* and several smaller carnivores. Both ungulate and predator presence in habitats surveyed will be recorded by the project team and receive due consideration in the formulation of recommendations for conservation of wildlife in the Republic of Yemen.

Prime objective Efforts will concentrate on assessing the current status and distribution of Yemen's ungulate and carnivore fauna in order to determine priority areas for conservation. Emphasis will be placed upon quantifying individual populations, their viability and threats to their survival, in order to determine their importance for the species as a whole. In addition, controversy surrounds the validity of several Arabian gazelle taxa and the status of *Gazella bilkis* recorded from the central highlands is poorly understood. The project team hopes to clarify the taxonomic position of Yemeni gazelles.

The planned involvement of relevant government departments in field research (AREA and Wildlife Department of Ministry of Agriculture) will facilitate the subsequent formulation of policy recommendations for managing wildlife and developing a wildlife conservation programme relevant to the Yemeni context. External support to Sana'a University staff

and government departments will involve assistance with comprehensive biological field surveys, provision of technical equipment for future studies and expertise in veterinary care (for the captive-breeding venture) and wildlife management (protected area development).

Future plans Within the framework of the project it is envisaged to establish a captive-breeding facility at Sana'a University for endangered Yemeni fauna, that will serve as insurance against extinction, provide back-up for re-establishment, and assist with research into vertebrate physiology, taxonomy and genetics. This component will be pursued once the initial survey phase has been completed and candidate species have been identified.

Founders will be located from among captive herds already established and individuals captured for that purpose in an "Operation Oryx" type rescue mission. Greth reported several individuals were maintained in the capital Sana'a alone and several other herds are kept in various private collections (e.g. Aden).

Report and recommendations The final report will be edited in the three months after the survey has been completed and will be submitted to the Yemeni authorities, international conservation organisations and development aid agencies for follow-up action. Special emphasis will be placed upon sustainable development policies and participation and its benefits (tourism, wildlife utilization) to rural communities in wildlife conservation.

Methods Through literature searches and personal communication with local scientists standardized data sheets will be compiled recording past and recently reported distribution of gazelles and other ungulate taxa in Yemen. The information will be plotted onto grid maps of the Republic of Yemen.

Interviews will be conducted with Yemeni residents with knowledge of historical and/or current ungulate distribution in their area. Local guides will be selected according to their familiarity with local dignitaries' offices and their interest in the gazelle project, and employed on a daily basis for the entire project period to facilitate field studies.

The team will spend on average 7-10 days in each of the habitat types identified, make an in-depth analysis of vegetation present, and collect detailed observations on ungulate dis-

tribution, breeding, and food plant availability. Every study site will be systematically surveyed using random strip counts, line transects and indirect signs (dungpiles etc.) in order to establish the relative abundance of gazelles and other wildlife. All potential habitat accessible to four-wheel-drive vehicles will be traversed in an attempt to flush out resident wildlife.

Skulls, skins along with any blood- and tissue-samples collected will be deposited in the natural history collection of Sana'a University for further studies into genetics, taxonomy and basic animal physiology.

MONGOLIA

Last November, a letter from Badamjavín Lhagvasuren, newly appointed to the ASG on the recommendation of E. J. Milner-Gulland^{ASG}, announced the formation of a Mongolian society dedicated to the conservation of the Mongolian gazelle. Lhagvasuren is the executive director. Congratulations are in order for this Mongolian initiative; the ASG is pleased to offer moral support and communication with our network of antelope specialists through the *Gnusletter*. George Schaller's report on his recent survey of what he calls the last great steppe ecosystem, dominated by *Procapra gutturosa*, appeared in the last *Gnusletter*. Lhagvasuren's letter (edited for clarity) is a follow-on to Schaller's article.

Brief Information about the Society for Conservation of Mongolian Gazelle

At present the Mongolian gazelle (*Procapra gutturosa*) has completely disappeared in the territory of the Russian Federation and a small number remains in limited areas of China. Only in Mongolia does the biggest part of the *Procapra gutturosa* population survive.

Among 14 species of ungulates inhabiting the territory of Mongolia, the population of Mongolian gazelle is the biggest in number and area of distribution. Nevertheless, the Mongolian gazelle's area of distribution now includes territory of only four aimacs (provinces): Dornod, Hentii, Sukhbaatar, Eastern Gobi, while only scattered small gazelle herds inhabit the territory of South Gobi's Sevrey, Bayandalay, Bulgan somons, Uverhangai's Bogd somon, Dzavhan's Dorvoljin somon and Gobi-Altai's Khokhmorit somon.

The extent of Mongolian gazelle distribution is 130,000 km², a decrease of 70% compared to 50 years ago. In 20th century,

such a decrease in the population of Mongolian gazelle, of which the main population and range are in Mongolia, makes not only Mongolians themselves anxious but the World Community, too. Preservation of the Mongolian gazelle and increasing its population are becoming a crucial task for our country before the World Community.

Therefore on the initiative of a group of scientists and experts, the Society for Conservation of Mongolian Gazelle (SCMG) was founded with the main objective of preserving this rare creature of nature, to increase its population, to cultivate ecological thinking in people, and to study biological and ecological problems of this gazelle. Members of the society are not only residents of Ulaanbaatar, but also people from the countryside. Although the society was founded not long ago (1 July 1994), it already held a roundtable discussion on problems of the Mongolian gazelle in cooperation with the United Nation's Mongolian Biodiversity Project, American and German scientists, and local officials. Also the society, teamed up with German scientists and UN Mongolian Biodiversity Project, are planning to carry out an aerial census of the gazelle population.

The SCMG was founded with major financial and moral support from Germany's Brandenburg Federative Land's International World Nature Preservation Project (coordinator Mr. Henry Mix) and United Nations Mongolian Biodiversity Project.

The SCMG will conduct its own activities according to regulations of the Society approved at a June 1994 meeting. The Society consists of a President [Prof. Osoryn Shagdarsuren, DSc, "famous Mongolian zoologist"], the Executive Director [Badamjavín Lhagvasuren, research fellow, Dept. of Mammalian Ecology, Institute of General and Experimental Biology, Mongolian Academy of Sciences, who has carried out research on Mongolian gazelle population ecology since 1981], a Scientific Secretary [Luvsanjambyn Amgalan, Vice-Director of Institute of General and Experimental Biology], a Council and members.

In near future there is an acute necessity to protect decreased Mongolian gazelle's population and to carry out work for the reproduction of its population, to expand the area of its distribution with the aim of restoring its range.

It is necessary to reach joint agreement

on activities for the protection of Mongolian gazelle on the adjacent territories in China and Russia.

For a long time the Mongolian gazelle was the center of attention of researchers from many countries. At the present time biological and ecological research on Mongolian gazelle is carried out by the Institute of General and Experimental Biology of the Mongolian Academy of Sciences. Although a lot of research has been carried out, there are many problems, such as its seasonal migration direction, frequency, population genetic structure, pathogenesis, etc., still awaiting further research.

Particularly using advanced radiotelemetry methods based on observed areas inhabited by gazelles, migration in time, its frequency from satellite would help to understand not only specific characters of gazelle's life and its connection with nature, but also the influence of human activities and pasture usage on it. In the last 10 years in Eastern Mongolia many thousands of gazelles were lost in periodic epidemics.

It is the programme of the SCMG to carry out the above-mentioned activities. Our scientists and experts are ready to devote themselves to protection of the Mongolian gazelle; nevertheless, because of financial problems this unique species is exposed to danger.

The Society for Conservation of the Mongolian Gazelle is looking for cooperation with organizations and private persons who care about the future of the Mongolian gazelle.

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