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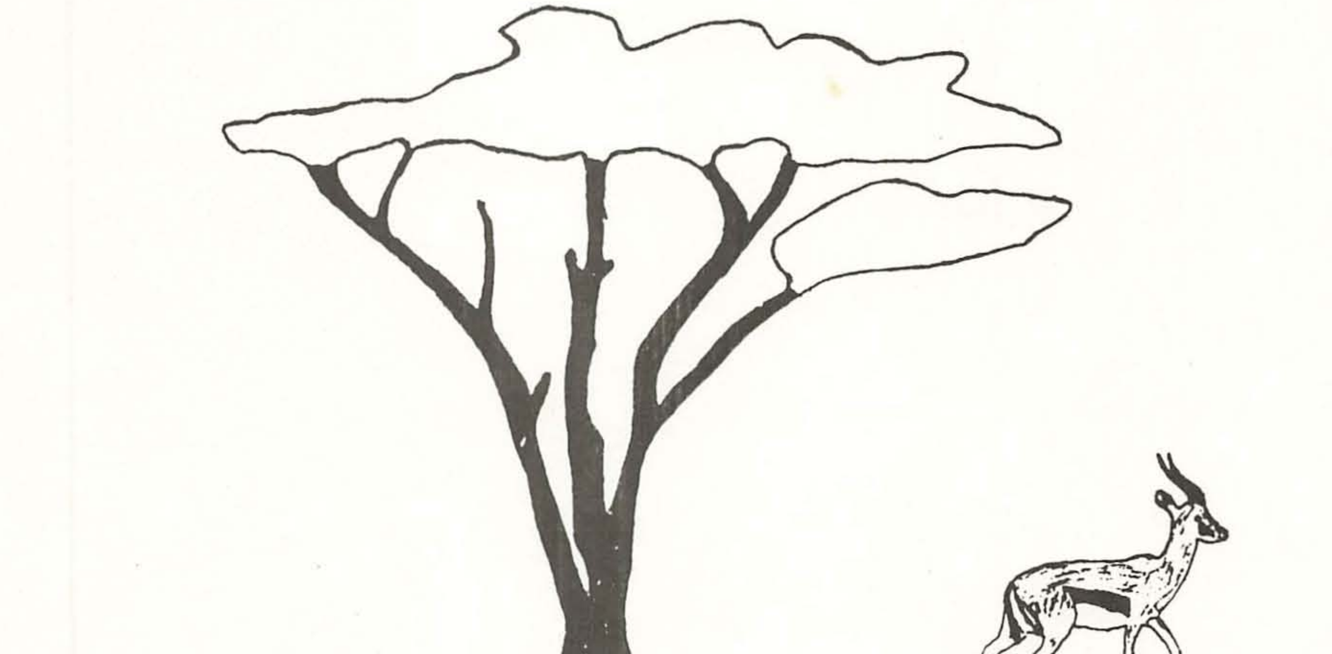

SOMALI JOURNAL OF RANGE SCIENCE VOLUME 2, NUMBER 2

The Somali Journal of Range Science serves as a forum for the presentation of scientific research pertaining to the study, management and use of Somalia's rangeland resources. This journal is published twice yearly. Articles relating to all aspects of natural resource research in Somalia are welcomed. Submitted manuscripts should follow the same general format as used in this issue. Papers should clearly and concisely state the purpose of the research. Unsupported hypotheses and rambling discussion should be avoided. The submission deadline for the next issue will be April 1, 1988.

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DRY-SEASON FORAGE SURVEY IN EASTERN HIRAAN REGION, CENTRAL SOMALIA

Peter Kuchar[1]

Arid regions like Somalia have a history of recurring droughts with concomitant stock losses. For example, an estimated 25% of all livestock in the country perished as a result of the 1973/4 drought (Clark 1985). Losses are expected, indeed the pastoral system of maximizing herd size is aimed directly at famine management: a nomad's correct reasoning is that the more animals he has going into a drought, the more he should have left at the end of it (Lundholm 1976, Perevolotsky 1986). Although recognized as part of the system, such stock losses are naturally not desired. Reduction in herd size and condition add to the economic burden of pastoralists' households: supplementary sources of income disappear, the increasingly more disease-prone animals need more care and capital, some must be sold so that emergency feed can be purchased, and the people may have to migrate long distances (Perevolotsky 1986).

In parts of central Somalia the Gu season (April-May) rains failed in 1986, the Dayr rains (October-November) also failed in some areas, and drought conditions developed through late 1986 and early 1987. There was talk of famine conditions, and of the urgent need to find sources of feed and water.

In late January Central Rangeland Development Project staff assessed drought conditions in the Central Rangelands (CR) (Fig. 1) and identified possible sources of feed and water for famished stock. My aim in this activity was to survey Hiraan Region for fodder availability. The exercise was cut short halfway through the survey, nevertheless I did manage to complete most of the eastern half of the Region.

This report presents the results of that survey and, supplemented by a preexisting plant data base, delineates natural feed sources and stocking rates for droughts of given lengths. It also serves as an example of some techniques that may prove useful in evaluation of feed distribution, quality and quantity in arid rangeland.

STUDY AREA

The area under consideration (Fig. 1) lies 200-300 km N of Mogadishu and covers 12,500 km^2. In E. Bulo Burte District a grid of cutlines (not all shown on the map) made the area eminently accessible. Altitude ranges from 110-380 m. The climate is hot semi-arid. Mean monthly temperature at Bulo Burte ranges from 27 C (July) to 31 (March) with an annual mean of 29

1 Author is Range Ecologist, Central Rangeland Development Project/Louis Berger Int., Inc. The field assistance of ecologist Bashir Barre Buh is appreciated, as is the biomass sorting by technician Bashir Ali Mohamed. Data reduction and map transfers were done by the latter and by ecologists Hussein Hagi Aden, Abdullahi Warsame and Mahdi Kidar. Thanks also to District Range Officer Abdulkadir Elmi for field support, and Dennis Herlocker and Tom Thurow for discussions. The continuing support of Project Manager Dahir Abby and Team Leader Bill Hargus is acknowledged.

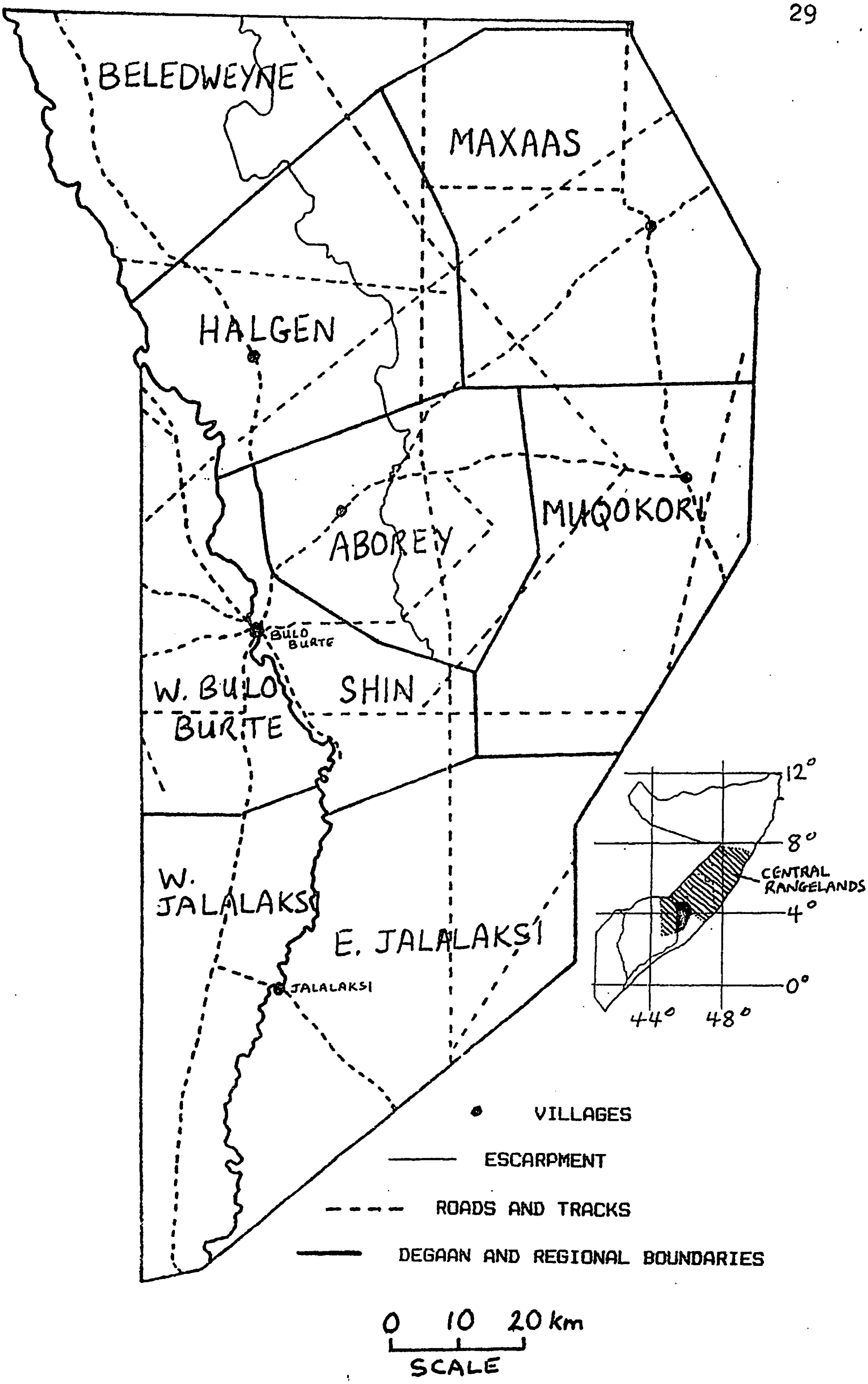

Fig. 1. Study area, with names of degaans (traditional grazing areas) and district segments.

C. Rainfall is bimodal (April-May and October-November), totaling 275-450mm/yr, highest in Jalalaksi and lowest in Beledweyne; it is highly unpredictable. Monthly mean relative humidity at Beledweyne ranges from 55-64% (Watson and Nimmo 1983/84).

Deep stable sandplains are the chief landform (Fig. 2, Table 1). In the south, stable dunes predominate, and there are a few relatively small active dunes. The eastern edge of the Region has shallow limestone soils, and the western side of the Shabelle Valley has a series of limestone hills and plateaus. The rest of the valley has sandy soils and an alluvial plain with silts and clays. Agriculture is the predominant land use on the alluvial and basaltic plains. Nomadic pastoralism prevails through the rest of the region.

Based on landform maps and descriptions by the Central and Southern Rangeland Surveys (Watson et al. 1979, Watson and Nimmo 1983/84) and on CRDP range surveys (Kuchar et al. 1985 and reports in prep.), 10 major Landform Types (LTs) have been delineated (Table 1, Fig. 2).

The climactic and, in most places, the current vegetation is deciduous thornbush dominated by Acacia and Commiphora species. Stands generally have 20-50% cover of 20-40(60) species of shrubs and small trees, 90-95% of these deciduous. The top layer is 2-6 m high with emergents to 10-12 m. Sizeable tracts have 1-2 m high shrubland. The major community in the largest range site, the hawd (deep infertile stable sands supporting bushland with grass patches), is codominated in most stands by Cordeauxia edulis, Acacia especially A. edgeworthii, and Commiphora especially C. horrida. Indigofera ruspolii is the top dominant in the dwarf-shrub layer. Boswellia microphylla is a locally abundant tree, and Caesalpinia erianthera is a canopy dominant toward the southern end of the hawd.

Except in small shallow bowls and in patches of alluvium the herb layer is poorly developed, and about 50% of the land has <1% crown cover of perennial grasses. In places, particularly on heavy soils, better-quality grasses can be abundant but the predominant forms are stemmy species of Aristida. In response to good rains a conspicuous but ephemeral layer of annual grasses and herbs may develop. As a feed it is probably low both in quality and quantity.

The vegetation structure of gypsum flats is very unlike the regional vegetation. Most stands are a mosaic of dwarf-shrub plains alternating with tree clumps. The sole dwarf shrubs are Limonium axillare and Suaeda micromeris, with a variable though often good admixture of the tough tussock grass Urochondra setulosa. The tree clumps, normally covering only 10-15% of the area, are mostly acacias especially A. nilotica, sometimes Euphorbia robecchii, and often surrounded by an open fringe of Commiphora myrrha, C. bruceae and Acacia reficiens.

All parts of the study area are utilized by stock but the closer the water the heavier the use, which is why a marked zonation of range condition is evident in relation to permanent water points (Kuchar et al. 1985). If the pattern of water availability remains stable, the ultimate limiting factor to stock production in the CR is the scarcity and low quality of feed in the dry seasons.

FEED SOURCES

A drought implies extended shortfalls of either or both of water and feed. As in the case of this particular drought, the two are often interrelated: water may be adequate but feed scanty in traditional grazing areas, while lack of water in areas with adequate feed prevents their

Fig. 2. Landforms of Hiraan Region.

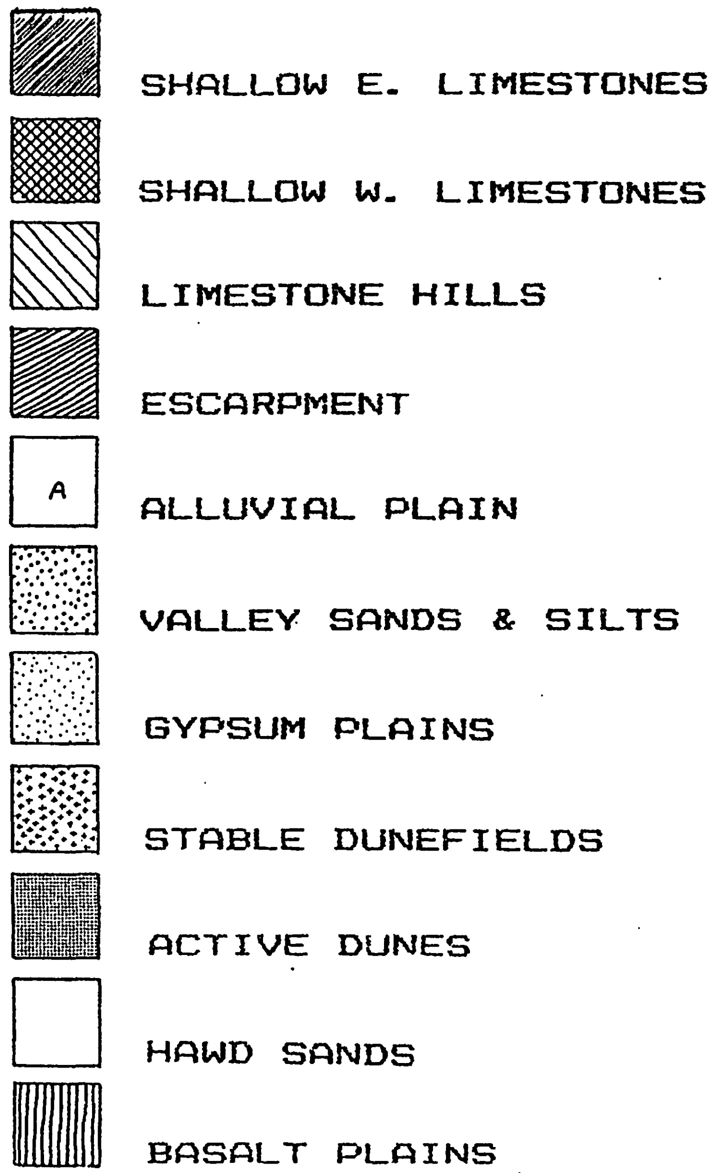
SHALLOW E. LIMESTONES
SHALLOW W. LIMESTONES
LIMESTONE HILLS
ESCARPMENT
A
ALLUVIAL PLAIN
VALLEY SANDS & SILTS
GYPSUM PLAINS
STABLE DUNEFIELDS
ACTIVE DUNES
HAWD SANDS
BASALT PLAINS

Table 1. Summary statistics on areal coverage of landform types.

DISTRICT or District Segment	BELEDW. segment	EASTERN BULO BURTE DEGAANS HALG.	MAXA.	MUQO.	ABOR.	SHIN	Sum	WESTERN B/BURTE segment	JALALAKSI EAST	WEST segm.	SUMS
1. SHALLOW E. LIMESTONES	3		669	271			940				943
2. SHALLOW W. LIMESTONES								1		106	107
3. LIMESTONE HILLS	478	301			81	73	455	322			1255
4. ESCARPMENT	43	73			66		139				182
5. ALLUVIAL PLAIN	272	106				81	187	519	531	645	2154
6. VALLEY SANDS & SILTS	64	359			336	196	891				1055
7. GYPSUM PLAINS						30	30		11	244	285
8a. STABLE DUNEFIELDS						164	164		1324		1488
8b. ACTIVE DUNES						3	3		13		16
9. HAWD SANDS	443	607	1484	1246	733	104	4174		161		4778
10. BASALT PLAINS								138		106	244
SUMS	1403	1446	2153	1517	1216	651	6983	980	2040	1101	12507

utilization. In January water was already being trucked to parts of the drought-stricken zone particularly Abudwak District, and the assumption in our work is that water sources would be developed or trucked into areas of good feed.

Feed sources can include:

(1) concentrates
(2) bulk feed, e.g. sorghum stover, trucked in from other regions
(3) bulk feed from local sources, chiefly farms in the same district or region; as stover, stubble or silage
(4) natural rangeland within the drought zone
(5) natural rangeland in another geographic area, to which starving stock would be trucked or trailed.

The aim in this particular exercise was to quantify feed distribution and abundance for point no.5. Some herds had already been moved into the study area from the drought zone, and recommendations were voiced on shifting more stock into those parts of Hiraan Region capable of supporting the animals.

Dry-season feed sources in natural semi-arid bushland include:

(1) evergreen woody plants
(2) deciduous trees and shrubs which have not yet dropped their leaves
(3) fallen leaves and fruit
(4) dry twigs
(5) dry grass
(6) fresh green biomass in riparian, seepage and shallow-groundwater areas.

In this study I have emphasized evergreen woody plants which are the main potential source of high-quality feed. I have attempted rough biomass estimates for the other components but it is my contention that, for reasons of access and quality, these are poor feed sources. Evergreen browse, on the other hand, is amply represented over large parts of the hawd by yicib (Cordeauxia edulis), with other evergreens adding marginally to the total available palatable feed. Source no.6 is virtually nonexistent in the study area.

METHODS

The steps in preparing feed-reserves maps were the following:

1. Drive along some major tracks and cutlines in the region. At stops selected for distinctiveness from preceding biomass units visual estimates were made for the following categories:

   a. Palatable* evergreens
      (1) % canopy cover
      (2) % available to camel (height <3 m)

   b. Palatable deciduous woody plants
      (1) % canopy cover of those in leaf
      (2) % available to camel

* Palatability information was taken from the literature notably the summary by Kuchar (1981-) and from palatability ratings collected by CRDP staff over the last 4 years (Herlocker and Kuchar 1985 and unpub. data).

(3) leafiness index, where 1 = full potential leaf and 0 = leafless, for leafy component only

c. % cover, mean height, mean clone diameter, and hedging rating of yicib whenever encountered at a stop

d. Basal cover of perennial-grass layer. Basal cover is a parameter relatively insensitive to seasonality, hence estimates or measurements from any season can be compared. Translating grass cover to biomass must consider offtake and growing-season effect on crown development. Standing crop estimates are therefore best made by correlating cover data and biomass data from the same time-periods and sites. Our data do not meet these criteria, but I believe that the estimate of 187 kg/ha of dry leaf, integrated over different areas, is an acceptable first approximation. This estimate was made by areally prorating biomass polygons hand-plotted using mapped stand data on grass cover transformed to biomass.

2. Compile information from 1984-86 surveys on yicib distribution (Table 2), cover of other palatable evergreens (Table 3), and grass cover. Due to an excellent grid of seismic lines, the stands represent a fairly uniform coverage of the area with an average of 1 stand per 15.6 km^2 of hawd.

3. Using results of dimension analysis (Table 4), compile a yicib biomass map by substituting biomass values for cover and dimension estimates that were taken in the field. The yicib biomass regressions are based on a sample of 50 plants representing a range of clone sizes, leaf sizes and hedging classes. Best fit was realized from the power curve relating leaf biomass to the ratio of crown area to hedging rating (Table 1). A scatter diagram of leaf size vs. clone biomass did not appear to show any relationship. Scatter diagrams of leaf biomass per unit area vs. (1) crown area and (2) crown volume appeared to show a weak relationship, but linear nominal and power regressions failed to give an r^2 better than -0.16.

4. Using double-sampling data and regressions from earlier and current surveys (Tables 1,2), a biomass map was compiled for other evergreen browse, grass, green deciduous component, and leaf litter.

I am confident that with these data a reasonably reliable regional picture of dry-season biomass obtains, despite often large stand-to-stand differences. Based on all 496 yicib stands, mean yicib leaf biomass per stand is 100±3 kg/ha ($p \leq .05$). No error estimate has been attempted for other feed components. Having a feed map, the next step was to use standard intake values to generate stocking estimates for various combinations of duration and offtake rate. Finally, recommendations were made on utilization of E. Hiraan available biomass.

Table 2. Summary statistics on coverage and feed biomass (tonnes) in the study area.

DISTRICT or District Segment	BELEDW. segment	EASTERN BULO BURTE DEGAANS HALG.	MAXA.	MUQO.	ABOR.	SHIN	Sum	WESTERN B/BURTE segment	JALALAKSI EAST	WEST segm.	SUMS	%
TOTAL AREA (km²)	1403	1446	2153	1517	1216	651	6983	980	2040	1101	12507	
YICIB AREA (km²)												
LOW COVER	139	358	252	292	171	25	1098	0	222	0	1459	41.5
MOD. COVER												
GOOD CONDITION	199	171	154	224	360	0	909	0	113	0	1221	34.8
POOR CONDITION	0	0	13	136	81	3	233	0	0	0	233	6.6
HIGH COVER												
GOOD CONDITION	300	20	202	63	5	0	290	0	10	0	600	17.1
POOR CONDITION	0	0	3	15	0	0	18	0	3	0	21	
SUMS	638	550	622	731	617	28	2548	0	348	0	3534	100.0
YICIB RESERVES (km²)	157	242	100	460	262	19	1183	0	90	0	1430	40.5
YICIB LEAF BIOMASS												
TOTAL	24935	8200	20786	12169	9235	112	50502	0	3904	0	79340	100.0
ACCESSIBLE	22816	6767	18837	7289	6189	33	39115	0	2854	0	64784	81.7
NON-YICIB EVERGREEN LEAF BIOMASS												
PALATABLE	2825	2162	2477	1655	1345	949	8589	3059	3473	7365	25311	100.0
AVAILABLE	1622	1181	1291	914	728	557	4671	1949	2285	6249	16776	66.3
ACCESSIBLE	1536	1039	1182	635	557	545	3958	1949	2232	6249	15924	62.9
GREEN DECIDUOUS LEAF BIOMASS												
TOTAL	746	1068	1308	715	1078	890	5059	847	3441	917	11010	100.0
AVAILABLE (59%)	440	630	772	422	636	525	2985	500	2030	541	6496	59.0
ACCESSIBLE	378	539	715	356	522	517	2649	500	2020	541	6088	55.3
PERENNIAL GRAMINOID BIOMASS												
TOTAL	16441	25389	49977	44243	33705	10883	164197	27863	30062	36806	275369	100.0
USABLE PORTION(50%)	8221	12694	24989	22121	16853	5441	82098	13931	15031	18403	137685	50.0
ACCESSIBLE	7386	10270	21741	14649	11381	5198	63239	13931	13114	18403	116077	42.2
LEAF LITTER												
TOTAL	30447	29155	49668	41389	30515	14513	165240	14977	47646	16676	274986	100.0
USABLE PORTION	20789	22546	37169	31121	22892	11600	125328	11982	37633	13341	209073	76.0
ACCESSIBLE	18899	17440	33131	21054	16707	11174	99506	11982	35617	13341	179345	65.2
ALL FEED SOURCES												
TOTAL BROWSE	28506	11403	24571	14539	11658	1951	64122	3906	10818	8282	115634	100.0
ACCESSIBLE BROWSE	24730	8345	20734	8280	7268	1095	45722	2449	7106	6790	86797	75.1
TOTAL GRASS & LITTER	46888	54544	99645	85632	64220	25396	329437	42840	77708	53482	550355	100.0
ACCESS.GRASS & LITT.	26285	27710	54872	35703	28088	16372	162745	25913	48731	31744	295422	53.7
TOTAL FEED	75394	65947	124216	100171	75878	27347	393559	46746	88526	61764	665989	100.0
TOTAL ACCESSIBLE	51015	36055	75606	43983	35356	17467	208467	28362	55837	38534	382219	57.4

NOTE: PALATABLE = all edible material.
AVAILABLE = all edible material available, without lopping, to camel. In the case of yicib, essentially all leaf is considered available.
ACCESSIBLE = all available exclusive of yicib reserves.

Table 3. Cover of non-yicib evergreen component by landform type (from CRDP - LBII range survey data set 1984-87).

	HABITAT TYPE	NO. STANDS EVALUATED	PALATABLE %	PALATABLE S.D.	UNPALATABLE %	UNPALATABLE S.D.	ALL EVERGREEN %	ALL EVERGREEN PALAT. PORTION	PALAT./ AVAIL. FACTOR	LEAF BIOMASS g/m² on 100% cover basis	LEAF BIOMASS all (kg/ha)	LEAF BIOMASS avail. (kg/ha)
1.	SHALLOW E. LIMESTONES	18	0.75	0.82	1.21	1.60	1.96	.38	.4	195	14.6	5.9
2.	SHALLOW W. LIMESTONES	21	1.34	1.39	0.57	1.01	1.91	.70	.5	185	24.8	12.4
3.	LIMESTONE HILLS	37	1.27	0.73	0.34	0.58	1.61	.79	.4	175	22.2	8.9
4.	ESCARPMENT	12	0.93	1.39	1.20	1.16	2.13	.44	.5	195	18.1	9.1
5.	ALLUVIAL PLAIN	42	1.90	2.02	0.73	1.08	2.63	.72	.75	210	39.9	29.9
6a.	VALLEY SANDPLAINS	24	0.30	0.32	1.35	1.77	1.65	.18	.5	190	5.7	2.9
6b.	SILT VALLEYS	22	0.68	0.51	0.29	0.45	0.97	.70	.5	190	12.9	6.5
6c.	WADIS & RUNOFF PLAINS	13	0.63	0.87	1.35	2.66	1.98	.32	.5	190?	12.0	6.0
7.	GYPSUM/PLAINS											
	excl. Limonium & Suaeda[a]	13	0.69	0.48	0.70	0.58	1.39	.50	.7	170	11.7	8.2
	incl. Limonium & Suaeda	17	8.04	6.95	13.12	9.35	21.16	.38	.95	225	177.1	168.2
8a.	STABLE DUNEFIELDS	16	0.51	0.69	3.66	4.52	4.17	.12	.5	175	8.9	4.5
8b.	ACTIVE DUNES	-	0[b]		0		0	-	0	0	0	0
9.	HAWD SANDS	51	0.56	0.61	1.64	1.25	2.20	.25	.6	180	10.1	6.1
10.	BASALT PLAIN	22	0.98	0.79	0.85	1.02	1.83	.54	.4	200	19.6	7.8
WEIGHTED MEAN[c]	excluding gypsum plains	227	0.95		1.06		2.01	.49				

a Including *Heliotropium* sp. = Tsaha 80, the ecological analogue of *Suaeda micromeris* which is absent in Jameeco Shin stands.
b Dune margins have some colonizers but overall cover is virtually nil.
c Proportional to area covered by each habitat type.

Table 4. Biomass formulae and values assigned to the various feed components. All feed component values in g/m^2 on the basis of 100% cover of the given parameter. Air-dry to oven-dry conversion factor was 7.5%.

FEED COMPONENT	FORMULA OR VALUE
EVERGREEN LEAF	
yicib	$y = Ax^B$, where y = leaf biomass (g) per clone x = clone area (m^2)/(hedg. rating +1) A = 707.15 B = 0.992 r^2 = 0.92 Other regressions tried: $y = Ax^B$ for mean clone area, $r^2 = 0.91$ log $y = A+B \log x$ mean clone area, $r^2 = 0.91$ $y = Ax^B$ for crown vol/hedg.rat.+1, $r^2 = 0.88$ $y = A+Bx$ for crown vol/hedg.rat.+1, $r^2 = 0.84$ $y = A+Bx$ for mean clone area, $r^2 = 0.69$ $y = A+Bx$ for area/hedg.rat.+1, $r^2 = 0.71$ $y = A+Bx$ for crown vol, $r^2 = 0.62$
Boscia minimifolia[1]	200
other capparids	150
Dobera glabra	300(est.)
Limonium	225
Suaeda	115
Opuntia[2]	13,500
LEAFY DECIDUOUS	
Acacia edgeworthii, A. turnbulliana	125
A. hamulosa	85
A. tortilis	55
A. zizyphispina	65
_A._ spp. (_horrida, mellifera, nilotica, perfota, ogadensis, oqadensis, reticiens, senegal, walwalensis_)	40
Albizia obbiadensis	20(est.)
Caesalpinia erianthera	25
C. oligophylla	40(est.)
Cassia ellisiae	40
Caucanthus edulis	70
Coffea rhamnifolia	55

where is Yicib value?

Table 4 (cont'd)

FEED COMPONENT	FORMULA OR VALUE
Cordia ovalis	110
Dalbergia commiphoroides	40
D. uarandensis	100
D. sp.	30
Dichrostachys kirkii	45
Gardenia fiorii	50 (est.)
Grewia spp.	80
Hildebrandtia africana	80
Ormocarpum	25
Tephrosia obbiadensis	25
Terminalia spinosa	20
T. spp.	25 (est.)
Ziziphus hamur	60
others (*Bottegoa*, *Boureria*, *Euphorbia cuneata*, *Lannea cotoneaster*)	50 (est.)
PERENNIAL GRASS (see Table 2 for source data)	
dry grass[3] standing crop	1870 x 0.5 usable
LEAF LITTER	
all sites except hawd	175 x 0.8 usable
yicib litter	300 x 0.2 usable

1 All evergreens excluding yicib are based on a total sample of only 10 plants.
2 Based on 1 sample collected from a hedge near Aadan Yabaal. The value of 13.5 kg/m² excludes 4.8% spines.
3 A separate estimate for saltgrass was not used due to the poor sample data.

Table 5. Graminoid samples taken during drought-survey field trip, all from non-random 1x1 m quadrats; 7.5% conversion factor was used for air-dry to oven-dry.

SAMPLE NO.	COVER TYPE	BASAL COVER (%)	STANDING CROP (g/m^2) TOTAL	PER 100% COVER	% GREEN
3	hawd bushland	7.5	113.9	1519	0
9	"	5	95.3	1906	0
17	Limonium flats	18	75.3	418	40.4
18	"	9	50.4	560	38.3
22	"	10	463.0 [a]	4630	20.6
28	hawd bushland	2	47.4	2370	0
29	"	10.5	276.6	2634	0
31	"	3.5	133.1 [b]	3803	0
c	"	–	–	1390	0

a Robust atypical clones.
b Not strongly topped.
c Mean of 6 samples taken 27 July 1985 in a hawd site.

RESULTS AND DISCUSSION

Yicib

Cordeauxia edulis is an acceptable and palatable dry-season browse particularly for camel and goat (Kuchar et al. 1985, Kuchar 1986). Animals newly introduced to yicib may initially ignore it (W.A.Hargus, pers. com.).

Yicib represents the largest component of high-quality dry-season feed in E. Hiraan and would clearly be the preferred natural feed source in this drought situation. In this survey, it comprised 16.9% of all available, accessible feed (Table 2) and about 85% of good-quality feed.

The distribution of yicib browse (Fig. 3) is conveniently seen as an outer 'shell' of low biomass, a broad inner zone of good biomass, and a few core areas of exceptionally high biomass. On a per unit area basis, yicib bushes in good condition have 300-600 g of leaf/m^2 of canopy. Thus for example a good stand of 10% yicib cover supports a permanent supply of a about 500 kg of high-quality browse.

In the study area, 3534 km^2 support yicib populations, of which 41% represents sparse and mostly decadent populations, 52% vigorous populations ranging from 4-25% yicib crown cover, and 7% dense but decadent populations (Fig. 3).

The thrust of range management in eastern Bulo Burte District is the preservation of yicib populations (Kuchar et al. 1985). Thus 41% of the yicib area, representing most of the decadent populations, has been designated for dry-season protection (Fig. 4). It is strongly recommended that the yicib reserve boundaries be respected, as an influx of extraterritorial browsers would only exacerbate an already unhealthy situation and accelerate the rate of elimination of yicib from the landscape.

Although the yicib reserves take up 41% of the total yicib area, they represent only 18% of the biomass. Conversely, the areas of dense yicib

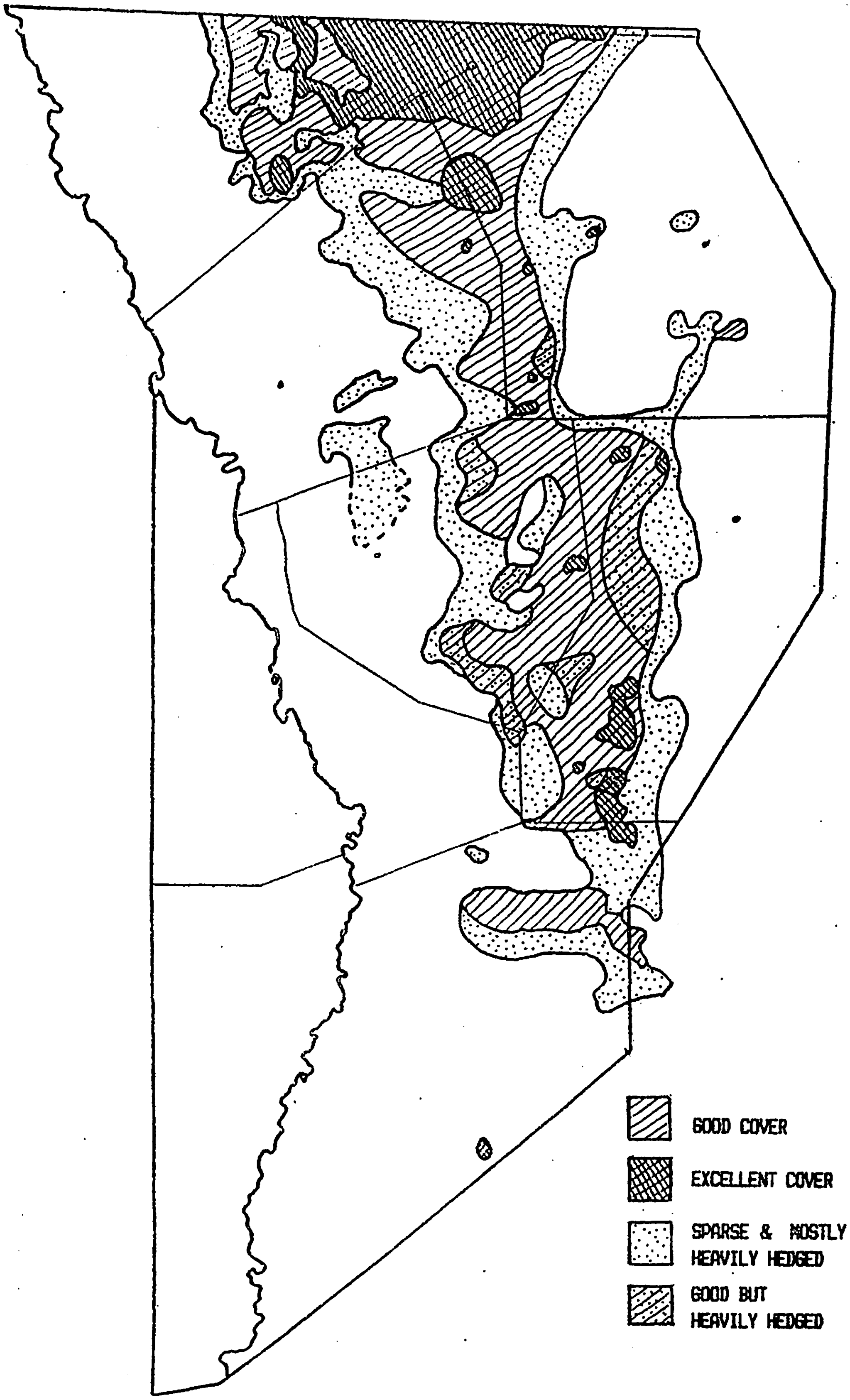

Fig. 3. Yicib distribution and status.

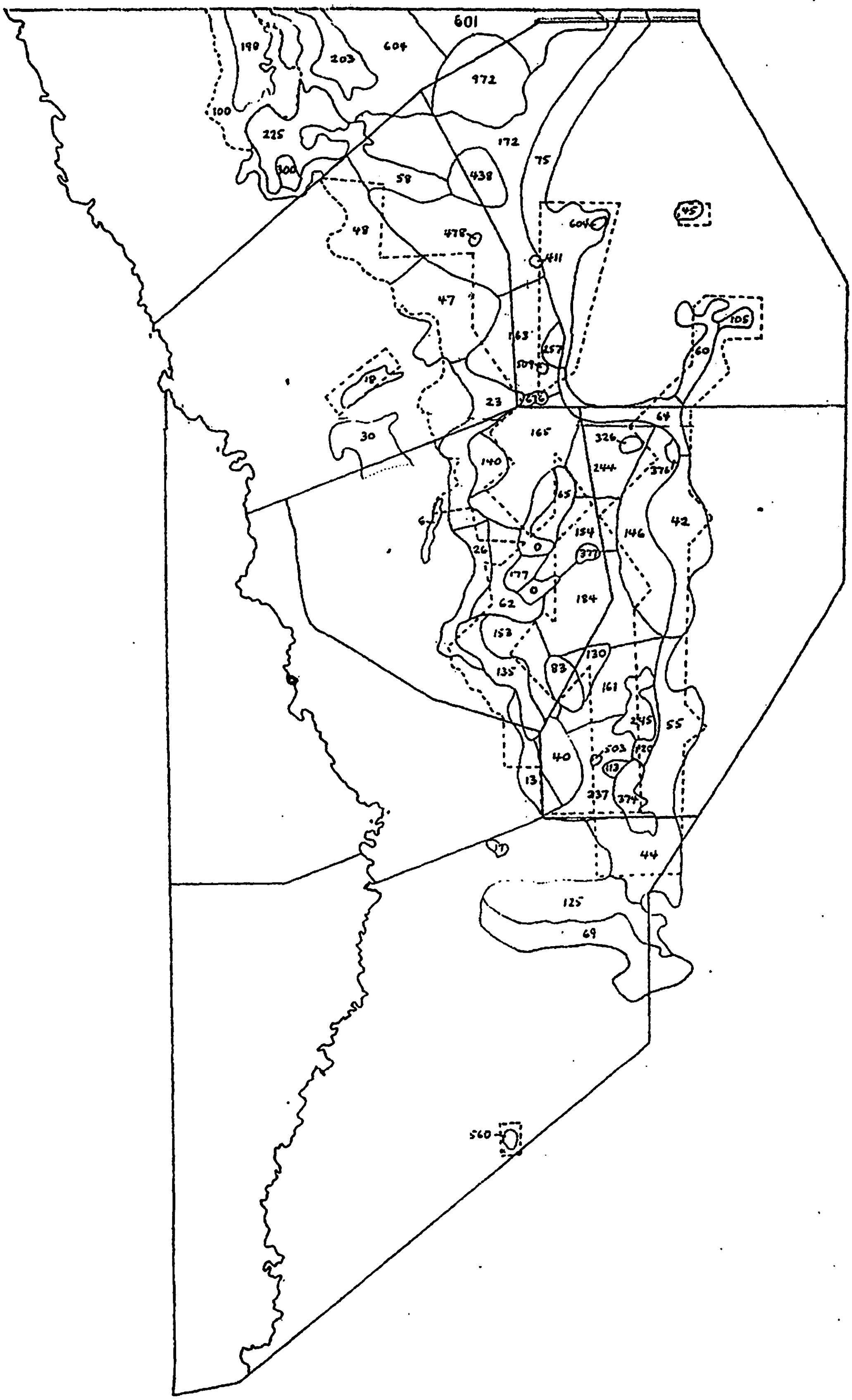

Fig. 4. Yicib leaf biomass (g/m^2). Dashed lines enclose proposed yicib reserves.

populations (as defined by Fig. 3) account for most of the yicib biomass though only a small part of the area. These are the preferred venues for drought-affected stock. The one big solid area of high-density yicib in the Bulo Burte/Beledweyne border zone has 32,475 T or 40.9% of all the yicib biomass in the study region. None of it has been set aside for grazing reserves, thus it represents 50.1% of all accessible yicib biomass while at the same time covering a compact zone of 456 km^2, which is only 12.6% of the area carrying yicib stands and a mere 3.6% of the study region.

I have not surveyed north of 4°45', but a number of people have mentioned the existence of large dense yicib stands in E. Beledweyne District, and that area should also be scouted for suitable famine stands.

Evergreen leaf excluding yicib

Non-yicib evergreen leaf adds up to 15,924 T of available forage (Table 2) which represents 4.2% of total forage supply.

The CR support about 10 genera of palatable evergreens, compared to about 80 genera of deciduous trees and shrubs (Kuchar 1986). The average 0.5 ha vegetation stand has about 5 species of evergreen plants (succulents included), of which 3.5 are present in greater than trace amounts. These are more or less evenly apportioned between palatable (1.7) and unpalatable (1.8) forms. In most plant communities these evergreens form only a small proportion of total plant cover or biomass (Table 3), the palatable forms averaging 0.95% and unpalatable 1.06% cover. Capparids in the genera Boscia, Cadaba and Maerua are the most frequently encountered evergreens. Though never present in more than about 2% total cover, they occur in most stands throughout Hiraan Region. Balanites is locally common. Cordeauxia edulis and Limonium are exceptionally abundant in Hawd Sands and Gypsum Plains stands, respectively. Limonium axillare is the codominant of most gypsum areas, where the average of 21% evergreen cover is composed of 33% Limonium and 59% Suaeda micromeris.

Evergreens such as capparids and Salvadoraceae are probably crucial for herbivores in N.E. African rangelands to survive periods of drought. Edwards (1948) noted that capparids may provide practically the only green leafy plants in the dry season in E. Africa. Additionally, some species have very high nitrogen content. Mean leaf crude protein of 11 African species of Boscia, Cadaba and Maerua (Kuchar 1981-) is 20.3%, and values as high as 35.8% have been recorded. McKay and Frandsen (1969) point out that leaf crude protein of some capparids is consistently high, often 25-30% throughout the year. Not all of this nitrogen is available. "Recent studies on the nutritional value of browse and forb plants in Kenya's rangelands showed that the feeding value of numerous species, especially browse plants, is substantially lower than commonly assumed based on crude protein analysis because of the high tannin content which lowers palatability, protein utilization and digestibility." (McDowell 1984)

Capparids are not highly palatable (Kuchar 1981-), notwithstanding Wilson's (1984) comment that they include some of the preferred and most palatable camel browse. Their uniformly heavily hedged condition in Hiraan Region reflects their dry-season value as evergreen browse, and not their palatability. This dichotomy extends to wild herbivores. For example, in a study of lesser kudu in E. Kenya, Leuthold (1979) noted that capparids are important dry-season foods even though the least liked of all the foods these animals will take. A few species of evergreens are poisonous and pastoralists have noted that when extremely hungry, stock may attempt to utilize them, with fatal result[5] J.B.Gillett (letter in E. African Herbarium, Nairobi) suggests that under famine conditions so many animals may die that owners may not bother to find out what specifically caused the deaths, which could well be through poisoning by eating plants normally untouched.

Suaeda micromeris is probably unpalatable; a bit may be eaten in the dry season but informants note that animals' mouths get very hot from it. One pastoralist noted that it can be well utilized in the early wet season, but presumably not in the dry season. Chenopod saltbushes have relatively high N, Na, K and chloride salts, which may have a number of deleterious effects on stock use, e.g. forcing much higher water needs, and if water is somewhat saline then stock will drastically cut down on intake (Leigh 1981).

Limonium, in contrast to the Suaeda, is highly rated by some pastoralists for camel and considered good for all other stock as well. It is said to help animals' appetites and they can get fat on it. Not all pastoralists think it is highly palatable, but none at least consider it inedible. Some Suaeda-Limonium flats have up to 20% cover of Limonium, representing almost 500 kg of palatable leaf totally available to all stock classes.

The 244 km^2 of Limonium vegetation in the W. Jalalaksi segment have 39% of all non-yicib evergreen usable biomass in the 12,500 km^2 study area. The rest of W. Jalalaksi District has another 700 km^2 of this habitat type and it extends southward into Middle Shabelle Region. W. Jalalaksi District alone therefore has an estimated 18,000 T of Limonium leaf. This is a feed source worth considering because it is fairly concentrated and totally accessible.

Although the Shallow W. Limestone stands represented in the study area have the usual low evergreen component, mention should be made of vegetation farther west which has Satanocrater. This palatable semi-evergreen shrub is the understory dominant in some stands and as such can represent a valuable dry-season feed resource. Had all of W. Bulo Burte District been included in this survey, Satanocrater would have figured prominently in drought-reserve issues.

Aside from the issue of low palatability, an inherent drawback of evergreens is that offtake must be kept low relative to that of deciduous plants. Evergreens tend to be slow-growing and have a low potential for compensatory growth which would enable them to replace tissue lost by browsing (Bryant et al. 1983). Because evergreen leaves are energetically expensive to replace, evergreens have evolved secondary chemicals making them unpalatable to herbivores. A few species (e.g. Balanites) are heavily armed. Though perhaps not directly comparable to our conditions, tundra data indicate a leaf growth-rate 5-10 times slower in evergreen than in deciduous shrub species (Bryant et al. 1983). The matter of defoliation extends to all woody plants, deciduous and evergreen. Frequent defoliation may result in plant mortality though moderate defoliation stimulates leaf and shoot production (Lay 1965, Trollope 1981).

Green deciduous leaf

Being well into the dry season, most deciduous trees and shrubs were leafless. The exceptions were (1) certain localities where part of the deciduous flora still had leaves, undoubtedly a response to later moisture retention in the soil; and (2) certain taxonomic groups, notably woody legumes. Based on the sample of 131 stops representing 200 records of individual plants, acacia formed 54% of deciduous green biomass, and all legumes 71%, apportioned among the 3 families as Mimosaceae 0.81, Caesalpiniaceae 0.10, Papilionaceae 0.09. Acacia tortilis was the most frequently encountered leafed-out tree; also frequent were A. zizyphispina, A. reficiens, A. hamulosa and A. edgeworthii. Some of these acacias are rated low as browse, but I have lumped all into the palatable category as they would likely be accepted by starving stock. Other frequent legumes were Caesalpinia eriantherа and Dalbergia spp. Frequently green non-leguminous plants were Ziziphus hamur, Terminalia spp., Grewia spp. and Gardenia fiorii. Although the first two stay green far into the dry season and are a potentially valuable feed source, Ziziphus leaf is difficult to harvest due to the plant's extreme thorniness, and the terminalias are uncommon in the study area.

The recommended "accessible" rates attribute rather high foraging success to livestock, and may perhaps be optimistic. In their Southern Rangelands Survey, Watson and Nimmo (1983/84) suggest these actual use factors (the proportion of the usable biomass that will be eaten by stock over a year under normal rainfall): trees 0.15, shrubs 0.3, dwarf shrubs 0.4.

Even if overestimated, the deciduous leaf category forms by far the smallest feed component at 6,088 T or 1.6% of accessible feed (Table 2). Furthermore, its scattered distribution (Fig. 5) makes it an unrewarding feed source for any number of starving stock. Finally, most of it is best (or solely) utilized by camel which are the least stressed stock class, while cattle, most severely affected by the drought, have minimal access to the taller shrubs and trees that make up this feed source. Lopping and hinge-cutting would be of marginal benefit in this specific case of a thin scattered population of near-evergreens such as acacias and could not be expected to support large numbers of starving animals.

Acacia tortilis is arguably the most important tree, indeed ecologically the most important plant, over large parts of arid Africa (Kuchar 1981-). It is abundant, drought resistant and semi-evergreen; its foliage is palatable and it produces large crops of pods avidly eaten by all stock. In parts of Africa this tree has been identified as a valuable provider of stock feed, the pods being particularly important in tiding animals over during dry periods when most plants do not meet minimum dietary protein requirements. For example, it is probably the most important dry-season browse in N.W. Kenya, a semi-arid region comparable to the CR. There its importance is tied in with its riparian distribution, with areas of exclusively riparian woodland supporting almost a third of the district's stock in the dry season (EcoSystems Ltd. 1985). Coppock et al. (1986b) found that in the dry season more than a third of dietary crude protein of sheep and goats was provided by the pods. In parts of Kenya individual ownership is frequently claimed over groups of trees (Edwards 1948).

In Hiraan Region A. tortilis tends to be a tree of upland rather than riparian habitats, and is certainly not abundant along the Shabelle River. Though widespread in the region, its canopy cover rarely exceeds 3% in any one locality. Most of its foliage can be made available only through lopping. Its pod biomass production in Hiraan is not known. It may be locally significant, but I do not believe it is a leading component of dry-season feed. The dominant acacias in Hiraan, notably A. edgeworthii, A. zanzibarica, A. reficiens and A. senegal, are more strongly deciduous and have relatively unpalatable leaves and/or fruit.

Perennial grass

Perennial grass standing crop in the study area was estimated to be 275,369 T (Table 2), averaging 220 kg/ha, of which 105 kg/ha was judged to be available. Its distribution is highly clumped (Fig. 6), with up to 1 T or more per hectare in some areas, but the majority of stands do not have enough grass biomass to support even one sheep/ha through the dry season. The grass category is nevertheless the second-largest feed source, providing

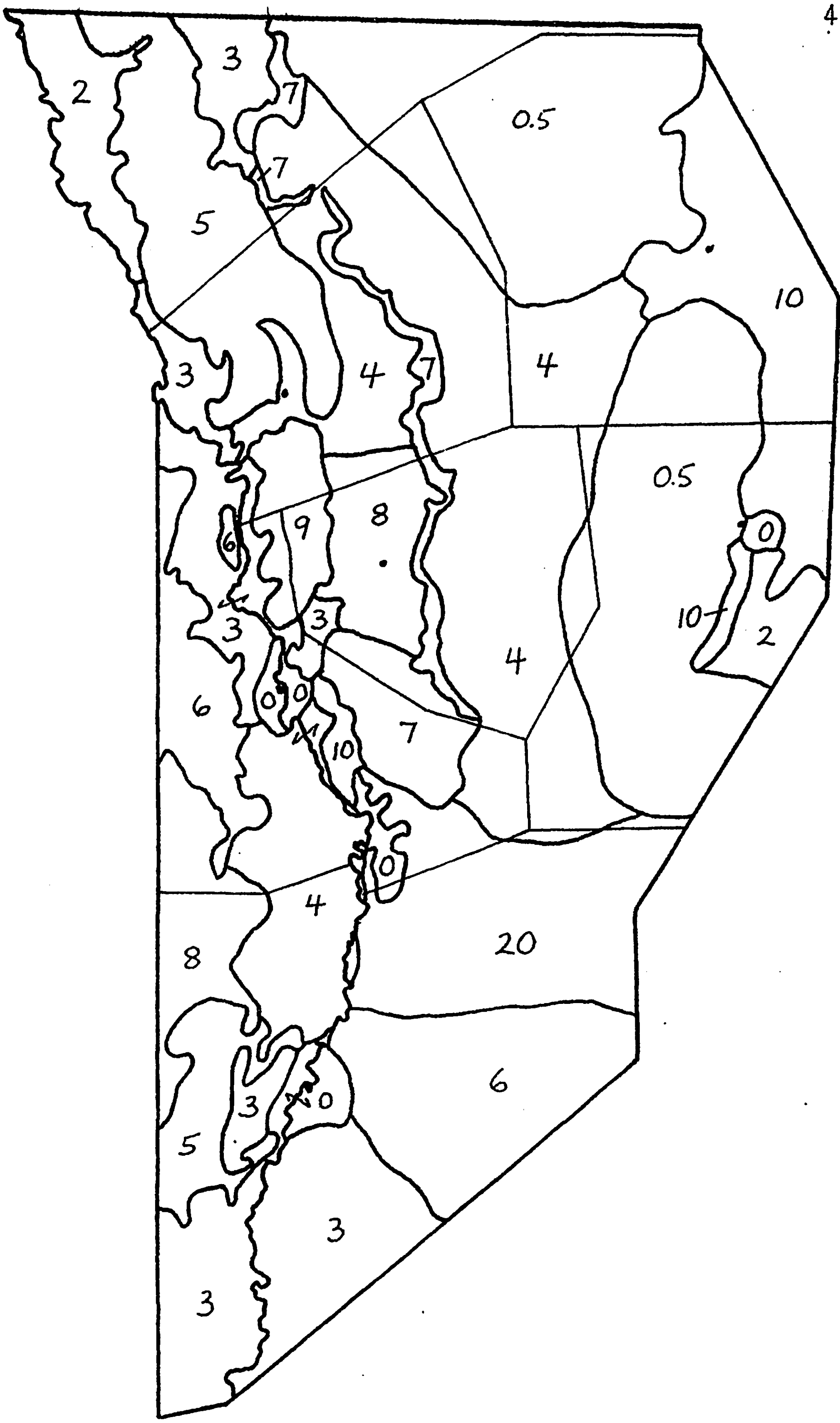

Fig. 5. Available green deciduous leaf biomass (kg/ha).

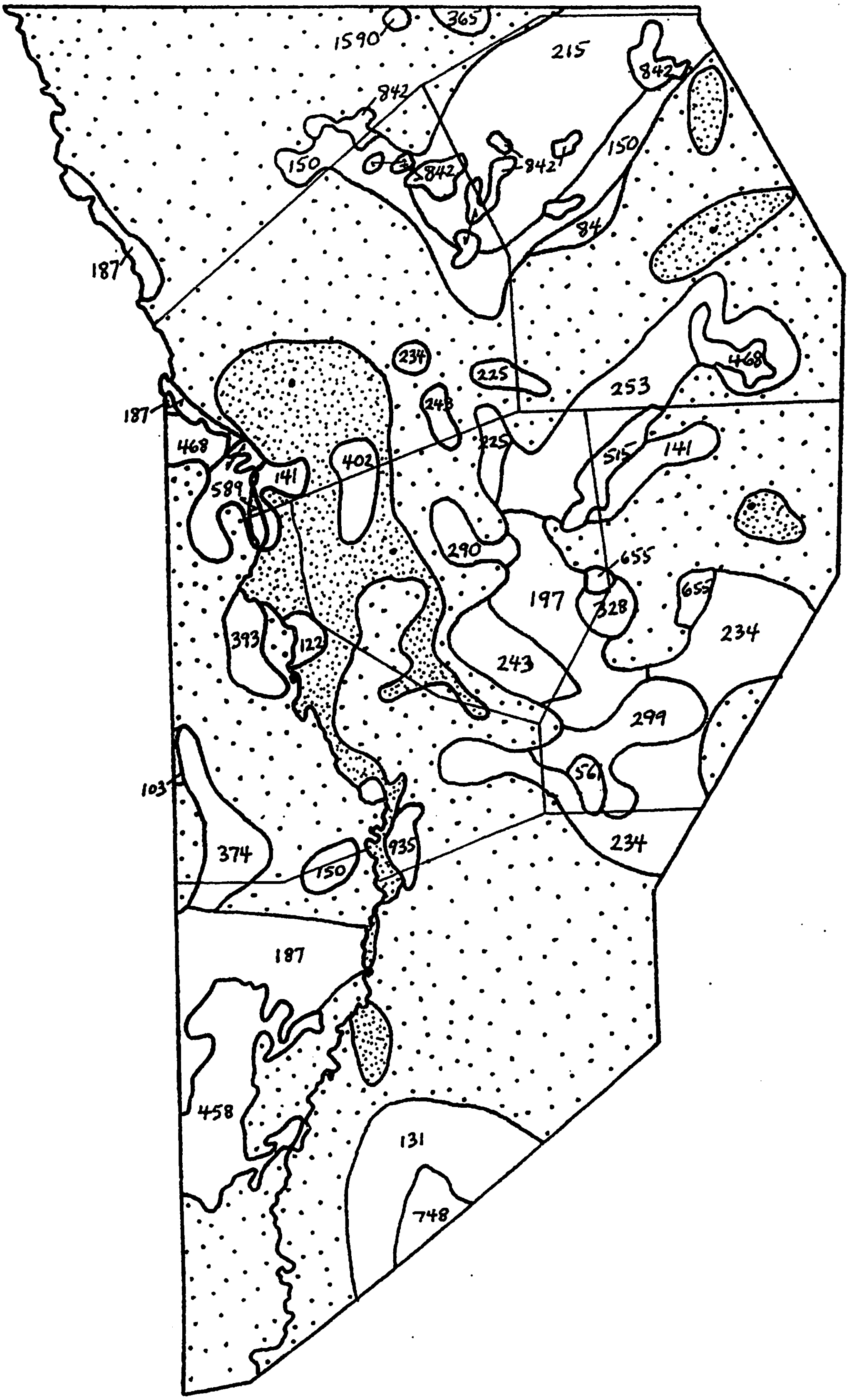

Fig. 6. Perennial grass biomass (kg/ha). (fine dots = 0; coarse dots = 0.3% cover, equivalent to 28 kg/ha of usable biomass)

almost a third of total available feed after attaching a 50% proper-use factor.

Grasses are undoubtedly the chief dry-season feed of cattle and probably sheep in arid regions. Various studies indicate that camels, though normally browsers, may also eat a lot of grass such as Aristida spp. in the dry season (Kuchar 1981-). In an arid-land study in Kenya, Migongo-Bake and Hansen (1987) found that although grass biomass was very low in the dry season it was still the major diet contributor for cattle and a large proportion of sheep, and also used by camels. They suggest that this increased demand on the grass resource in the dry season might have a negative effect on cattle production. A negative relationship can be seen between grass cover and distance from water in Hiraan Region (Fig. 6) and in other parts of the CR (e.g. Herlocker and Ahmed 1986). Perennial grass cover has similarly been much reduced in northern parts of the country (Hemming 1973). Clearly, grass cover and vigor have deteriorated through overuse, and large range areas currently with <1% grass cover or no grass at all have the potential for carrying up to 1 T of standing crop into the dry season. In a semi-arid lands study in E.-central Kenya, Ottley et al. (1978) concluded that with proper management the poor range could produce 2-20 times current production, the key being the enhancement and revitalization of perennial grasses.

Large-scale grass rehabilitation in Hiraan Region would be an unrealistic aim as it would ultimately have to involve destocking. Alternative feed sources would have to be sought.

Leaf litter

Livestock in arid regions may make much use of fallen leaves in the dry season. For example, in Afghanistan Casimir et al. (1980) found that if not supplemented, sheep and goats had to rely solely on fallen leaves and woody stems of dwarf shrubs. Unfortunately, most studies in Africa and elsewhere fail to evaluate if at all mention the role of leaf litter in stock nutrition.

Lack of recognition of the nutritional role of litter is further hampered by problems of biomass and feed assessment. Litter standing crop fluctuates through the year, with inputs by leaf-fall negated by consumption, wind transport, and small amounts of leaching and volatilization (West 1979). West's opinion that plant litter in arid ecosystems appears to have little overall effect on vertebrate distributions needs careful assessment.

Leaf litter in the study area is about 90% dicot and 10% grass by weight, and adds up to 275,000 T, which is comparable to perennial grass standing crop (Table 2). More of the litter category is rated available, however, with the accessible portion averaging 162 kg/ha. Litter forms the largest category of available feed at 46.7% (Table 2). It has a relatively uniform distribution but cover is highest in the hawd (Fig. 7). Biomass values in Hiraan Region are comparable to those of rangelands in eastern Kenya where Agnew et al. (1986) found 140-315 g/m^2 of organic litter on rocky slopes and ridges, 685 g/m^2 in zonal bushlands, and 195-275 g/m^2 on floodplains. These values probably include twigs.

The high absolute and relative biomasses of grass and of leaf litter may play a much more important role in dry-season stock survival than hitherto suspected. Leaf litter in particular is hardly ever recognized as a feed category in studies of pastoral stock energetics. Pastoralists say that the fallen leaves of many different trees and shrubs are eaten particularly by sheep and cattle. Even the leaves of some poisonous and/or unpalatable shrubs such as Phyllanthus somalensis can be eaten after

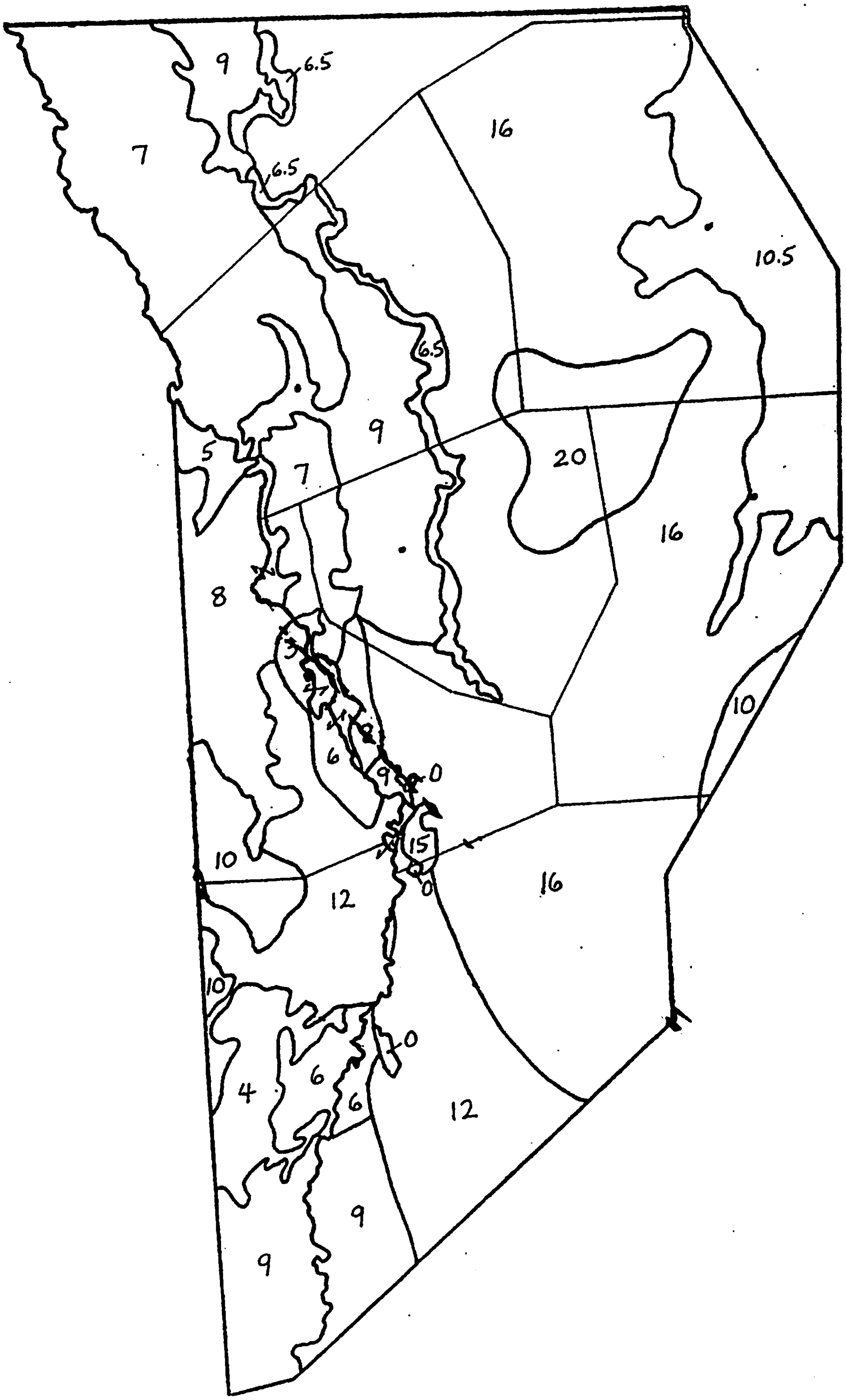

Fig. 7. Leaf litter cover (%).

falling. The nutritional role of leaf litter needs investigating, along with its seasonal dynamics of production, availability and disappearance.

Overall feed availability

All biomass components (Table 2, Figs. 4-8) add up to 382,219 T of available, accessible forage, averaging (yicib reserves excluded) 300 kg/ha. Assuming normal seasonal weather, viz. insignificant rainfall, the biomass picture should remain fairly stable for the next 2 or so months. The high-biomass noda (Fig. 9) should change little, under normal non-augmented browsing pressure, but there should be a definite decline in available biomass in areas already with low biomass. Field observations in May 1986 found that all yicib plants within at least 13 km of permanent water had been totally defoliated.

The range of feed availability values is surprisingly small among degaans, highest in Beledweyne segment (36.4 T/km^2) and lowest in Halgen (24.9 T/km^2). The reason for this apparent equitable distribution is the leading contribution by leaf litter which has a rather uniform distribution. Most of the degaans also have pockets of high grass cover which boost their feed totals. The higher total values in Beledweyne and Maxaas can be attributed to yicib, and of W. Jalalaksi to Limonium (Fig. 9).

The livestock population of the CR is an estimated 10.9 million animals (Table 6: Mascott 1986) representing 2,393,000 TLU's (1 Tropical Livestock Unit = 250 kg liveweight; camel = 0.8, cattle = 1.0, sheep and goat = 11.0; Le Houerou & Hoste 1977). The study area, which covers 8.39% of the CR, is prorated at 200,867 TLU. Other population estimates (Table 6) give a total TLU of 290,000-370,000, thus a value of 250,000 TLU is a reasonable compromise. At an intake rate of 2.5%/day (Wilson 1984), which may be 50% below wet-season rates (Coppock et al. 1986b), one TLU requires 6.25 kg/day, thus the whole stock population of the study area would need 1562.5 T of feed per day.

A proper-use factor of 25% for evergreen leaf would reduce total accessible feed to 321,688 T. These figures suggest that given adequate water sources, resident stock could easily weather a 3-month drought, but might be reaching the limit of feed opportunities after 6 months. The figures further suggest that if they ate mostly leaf litter and dry grass, supplemented with a little evergreen browse, the equivalent of 200,000 additional cattle or 2 million sheep + goats could be supported for 2-3 months within the study area. Logistically this would probably be impossible, as it implies feeding over all parts of the area, ignoring sociological and water constraints.

Logistically the soundest course would be to deploy stock within the zone of heavy yicib concentration. That way their movements could be monitored more easily, water could be delivered to several geographically close points, and negotiations as well as potential negative interaction with resident pastoralists would be minimized. With their concentrations of grass, leaf litter and evergreen browse, these areas could probably support a quarter to a half the total invasives mentioned, i.e. the equivalent of between 50,000 and 100,000 cattle or as much as a million sheep + goats.

Other local feed sources

This study treats only perennial grasses in the herb component, but a more intensive study of feed resources might do well to include annuals. Though generally disparaged as a poor feed source, due particularly to the

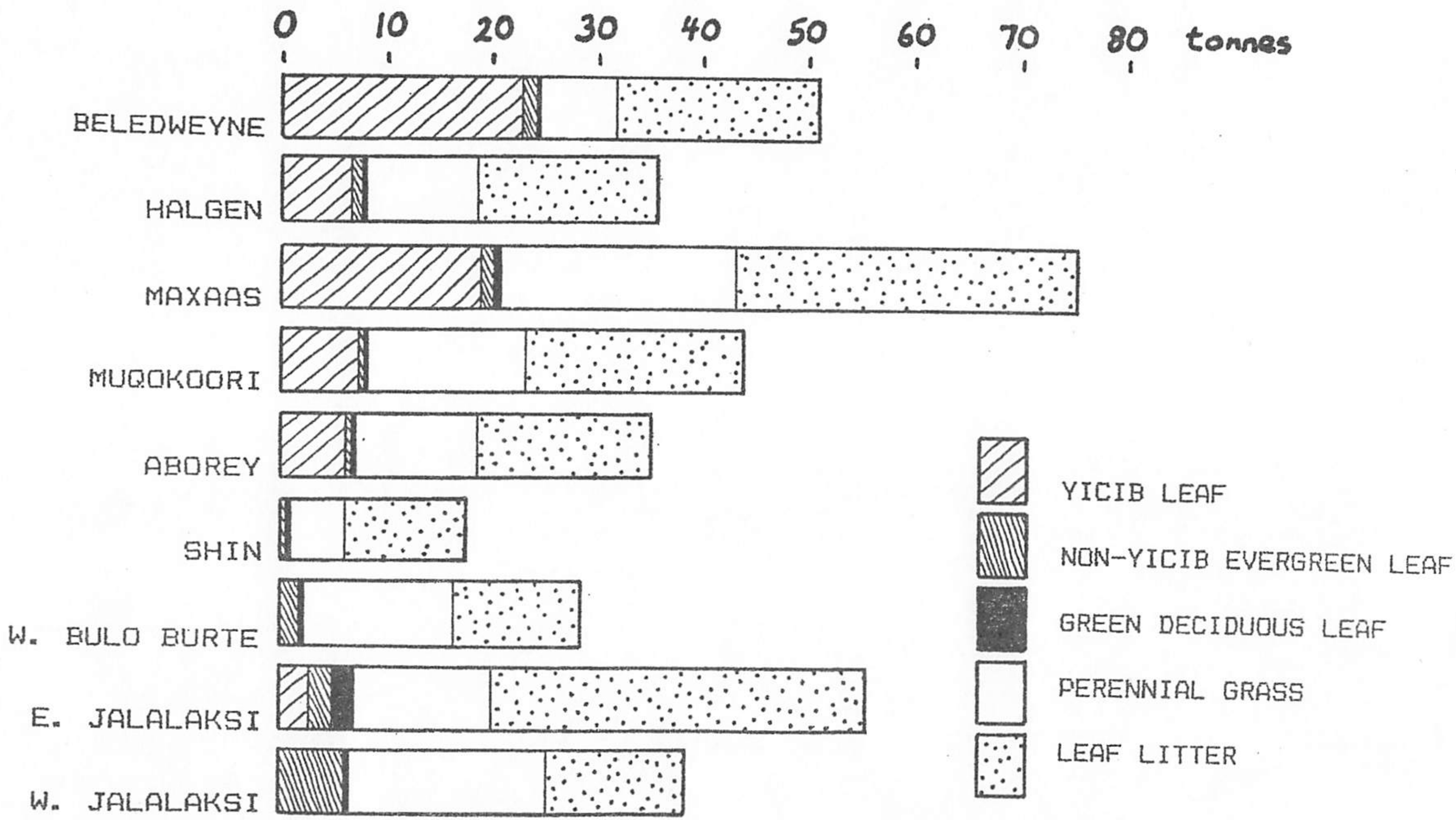

Fig. 8. Available, accessible feed components for each degaan and district segment.

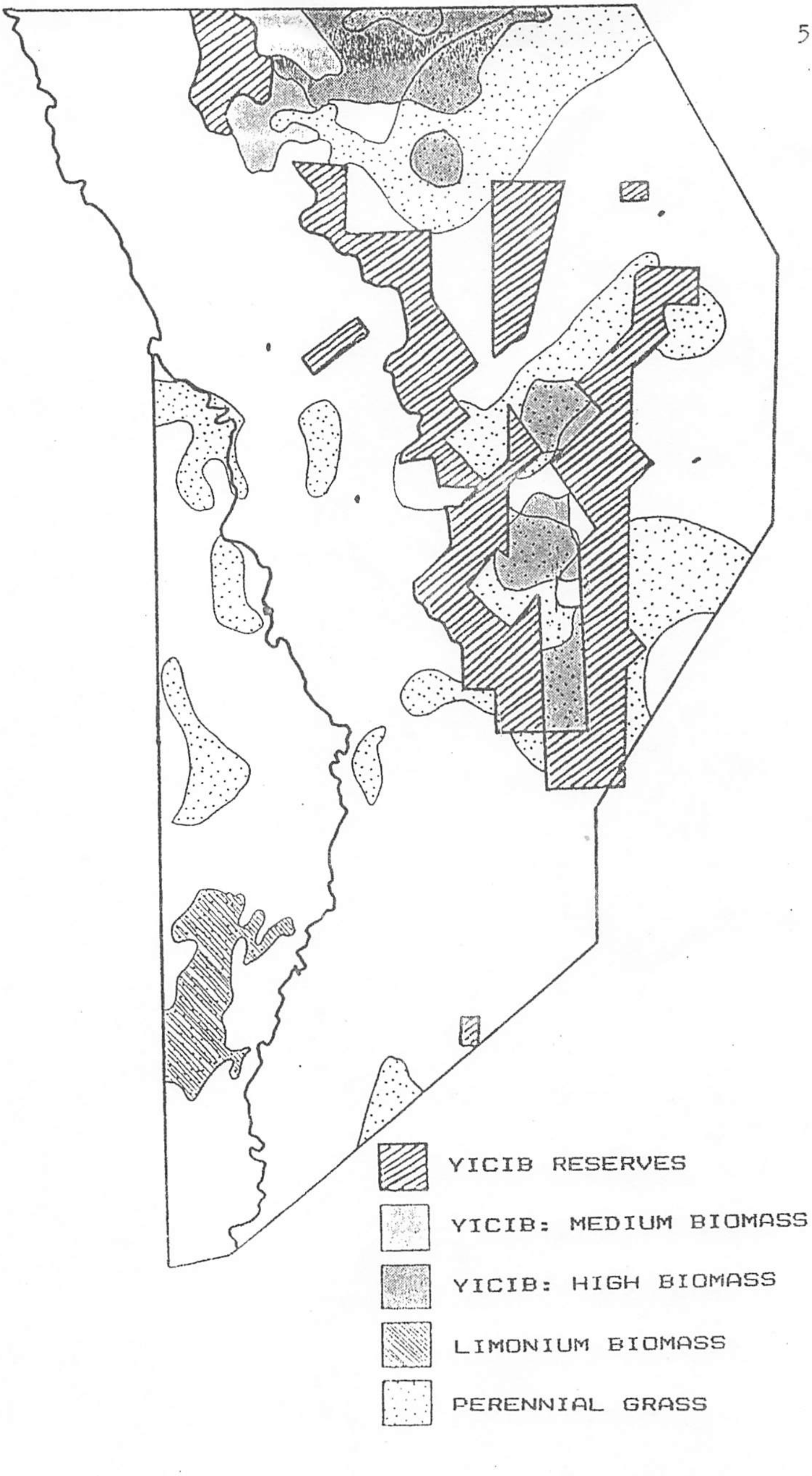

Fig. 9. Concentrations of dry-season feed.

Table 6. Estimates of stock numbers (in millions) for Bulo Burte District, Hiraan Region, and Central Rangelands.

SOURCE	AREA	YEAR	CAMEL	CATTLE	GOAT	SHEEP
Watson et al. 1979	Hiraan		0.36	0.21	1.36	0.36
	CR		0.64	0.31	6.45	2.20
Hussein 1986 & Elmi 1983	CR	1975	1.61	0.73	5.64	2.01
	Hiraan		0.46	0.17	1.16	0.29
	CR	1986[a]	1.8	1.0	7.2	2.7
Mascott 1986	CR		0.88	0.42	7.18	2.41
CRDP[b]	E.Bulo Burte		0.28	0.05	1.03	0.15
	Bulo Burte		0.49	0.19	1.39	0.28
	CR		1.29	0.50	3.66	0.74

[a] Extrapolated from countrywide estimates.
[b] Estimates by Non-Formal Education Component of CRDP, based on survey data.

extreme fluctuations between years in production and palatable proportion (Bogdan and Pratt 1967, Boudet 1976), their incremental contribution may be worth considering. Gintzburger (1986) wondered if the policy of range management of semi-arid zones based almost solely on perennial plants was technically sound and viable, and suggested that range improvement programs could make better use of annuals.

Twigs are another feed component ignored in this study, because it is doubtful if any twigs can provide maintenance feed value. However, current-year shoots and twigs are definitely utilized by stock. For example, pastoralists say that Indigofera ruspolii is eaten a lot by all stock in the dry season. The feed value of this and similar deciduous species needs investigating.

Finally, crop residues are doubtless an important feed component around villages, though their impact on the overall feed picture may be small. Nevertheless, any more detailed drought analyses or energy budgets would have to acknowledge the contribution of agriculturists.

Drought management: the mix and movement of livestock

Shunting animals back and forth during drought times is an effective famine-aversion strategy with much historical precedent. However, in our era it cannot be considered a satisfactory solution. Sedenterization has been a widespread phenomenon among nomadic peoples and this combined with the great expansion of agricultural land, particularly into areas traditionally used as dry-season and famine reserves, means that pastoralists are having to increasingly rely on unconventional local rather than distant feed sources, and it also means that the land remaining is subjected to unusually heavy grazing pressure (Lundholm 1976, Cossins 1984, Little 1984). Since livestock in at least some of Somalia's rangelands are already at or exceeding the carrying capacity, as witnessed by continuing range deterioration (e.g. Edwards 1944, Hunt 1951, Curry-Lindahl 1972, Hemming 1972, Kuchar et al. 1985), sudden influxes of stock into areas already heavily used by resident herds will have serious negative ecological and sociological effects.

Experts have often pointed out that range misuse and drought exacerbation is largely due to the wrong mix of stock. For example, Pratt (1984) decries the high numbers of cattle and sheep in arid African bushlands for which they are ill-equipped. He repeats a commonly held belief among anthropologists and ecologists, traceable back to Herskovits (1926), that cattle-keeping among pastoralists is much more a matter of attitude and preference, though attempts have been made to justify their inclusion in arid-land systems (e.g. Coppock et al. 1986b). Carrying large numbers of cattle through drought conditions is not only risky in the short term, but it severely diminishes range productivity and exacerbates range deterioration (Krummel et al. 1986). A famine-susceptibility map of Turkana District in Kenya by EcoSystems Ltd. (1985) indicates that the areas most prone to famine are dominated by cattle and those least, by camel. Ominously, Hemming (1972) observed that cattle-owning was on the rise among CR nomads who had formerly relied more exclusively on camel.

Camels have frequently been lauded as the best stock class for drought conditions. They may be the only species to maintain an above-maintenance concentration of dietary crude protein even in the worst times of year; goats are second-best and cattle the worst, liable to suffer nitrogen deficits for up to 6 months (Coppock et al. 1986a,b). Camel husbandry is stressed by Schwartz et al. (1983): "Increasing camel numbers would certainly lead to a safer subsistence for the pastoral population and would not as quickly or easily lead to disastrous overstocking and consequent destruction of the range as increases in numbers of cattle and small ruminants often do in similar environments."

The nomads of Somalia long ago anticipated the experts. The country has the world's highest camel population (Mukasa-Mugerwa 1981), and according to FAO statistics (Gall 1981) by far the highest ratio of goats to people of any country in the world. Goats, like camels, are particularly well adapted to hot and dry conditions (Gall 1981). In dwarf-shrub dominated arid lands they are much better than sheep at selecting an energetically effective diet in the dry season (Schwartz et al. 1984). This is probably why goats, in contrast with sheep and cattle, tend to increase dwarf-shrub use and decrease grass use in the dry season (Migongo-Bake and Hansen 1987).

Although camels are a stable and reliable component of stock ecology, especially valuable during drought, the rationale for multi-species holdings is that cattle and smallstock, though more vulnerable to drought, have a greater capacity for exploiting ephemeral periods of favorable resource conditions (Coppock et al. 1986a). A high dependence on camels may even bring failure. Fratkin (1986) contrasts two pastoral groups in Kenya on the basis of stock kept. The Ariaal have a generalist strategy which allows them to emphasize whichever stock class is appropriate for the current conditions, whereas the Rendille, more dependent on their camels, have a more stable population structure but at the same time not buffered against sharp changes, evinced by their current dependence on grain during the prolonged drought of the last decade.

Regardless the stock class, access to water is critical in permitting efficient use of range forage, therefore water development might be perceived as a drought-aversion technique. Unfortunately it only temporarily delays the inevitable feed crisis. Not only does uncontrolled water point development often lead to habitat deterioration and erosion of the productive base (e.g. Strain et al. 1972, Anon. 1977, Warren & Maizels 1977), but it may eliminate the very means of survival in a severe drought. In E. Hiraan the areas of thriving yicib are at least 25 km from year-round water points. Had these areas been successfully developed in terms of year-round water, there might have been much less of a case for bringing in starving stock.

Drought management: feedbanks

Whatever the perceived or real benefits of drought-warning systems (e.g. Mason et al. 1987), they cannot get around the fact that food and feed biomasses are the only real neutralizers. An inbuilt capability to dampen if not neutralize effects of drought is in accord with policies of self-sufficiency and self-determination. The attitudes of donor and relief organizations are changing too. In Kenya, for example, the framework of drought aversion is shifting from emergency relief toward integrated development leading to self-sufficiency (EcoSystems Ltd. 1985).

Food subsidies are an attempt to buffer populations against starvation, but food subsidies can also release the society from the need to slaughter cattle for food, which means growing herd size, intensified problems of range deterioration, and even greater dependence on imported food supplies (Krummel et al. 1986). They suggest crop storage - but they're talking about the ability to store over 4-8 years to alleviate drought impact, and they note that food storage will not work under higher population levels that are now the norm in pastoral regions. Nevertheless, agriculture is one of the most promising lines of inquiry into drought management. Agicultural byproducts and crop residues particularly forage legumes and residues from crop legumes can be employed effectively as supplementary protein sources for dry periods (McDowell 1984). But even crop residues are essentially an 'outside' source for the many pastoralists who do not farm and are unlikely, for cultural or ecological reasons, to do so. Drought or famine reserves at the regional or district level are the most logical means of satisfying their intermittent needs.

Each district, ideally each degaan, should have its own capability to buffer effects of drought. The economically most viable route is self-sustaining or self-renewing fodder sources. Famine reserves are a simple and commonly recommended intervention, but would probably meet much local resistance if firmly implemented as they would involve a rather large area of exclusion, as much as a fourth or a third of the total range. The rangelands are generally overstocked already. Furthermore, areas of good dry-season feed are, as this paper has shown, an exception, with yicib a glaring exception as it is a CR-Ogaden endemic having a distinctly limited geographic and ecological distribution. And, as good as the proven yicib areas are, they cannot begin to compare with the production capability of certain exotics. Yicib shrubs in excellent condition have leaf standing crops of 500-700 g/m^2, so a theoretic 100% shrub cover could carry 7 T/ha of leaf. I have seen no stand approach even a third this value, which, combined with a recommended offtake rate not exceeding 30%, suggests that annual leaf production (optimistically assuming 2 full leaf crops per year) in well-managed yicib stands would not exceed 1.5 T/ha. Considering the vagaries of climate and the slow rates of leaf production in evergreens, leaf production might be closer to 1 T/ha/yr.

The ideal of small range excisions combined with high palatable biomass can only be met by certain exotics of proven potential as big fodder yielders. Chief among these are certain legumes (e.g. Prosopis), chenopods

(<u>Atriplex</u>), and spineless cactus (<u>Opuntia</u>). For example, 400 km of fodder shrubs were planted in Libya during 1976-9, mainly spineless cactus, saltbush (<u>Atriplex</u>) and <u>Acacia</u> <u>cyanophylla</u>, in order to (1) provide reserves for seasonal food shortage in the dry season, and (2) form a buffer food reserve as part of a strategy for evading prolonged drought periods (Dumancic and Le Houerou 1981).

Cactus has a bad reputation as an invader and degrader of arid-land ecosystems. However, great success stories have been told of spineless cactus in N. Africa and other arid regions. Probably >1 million ha of spineless cactus are cultivated in the world as emergency fodder (Le Houerou 1980). <u>O.</u> <u>monacantha</u> was introduced into arid S. Madagascar and became a dry-season reserve for stock. When the cochineal insect was introduced it exterminated the <u>Opuntia</u>, and many cattle and their owners died of starvation (Jolly 1966). In the U.S., where eradication of spiny <u>Opuntia</u> has been a long-term concern, there has been some reassessment of the situation. For example, as Cruse (1973) notes, "Since the Texas drouth of 1949-56, a number of ranchers have refused to initiate eradication or control programs for prickly pear, preferring to preserve the plants for future drouth emergencies." In a paper evocatively titled "Plains pricklypear is a good forage for cattle", Shoop et al. (1977) first note that the common perception of pricklypear is as an essentially worthless livestock forage, a nuisance to man and beast, and a hindrance to grazing. Countering this, they cite literature extolling <u>Opuntia</u> both as a drought feed and forage. Their own research supports this: heifers readily ate pricklypear, indeed generally preferred it over hay pellets; DM consumption was increased by 43% and weight gain by 72%; there were no digestibility problems and digestibility was equal or superior to that of high-quality alfalfa hay. Cactus has been recommended as an emergency forage, as a supplement during the dry season or as a regular forage. In many arid and subarid countries it has proved an invaluable dry-season fodder. A cactus plantation in good condition can supply 100-125 T/ha of green fodder per year and regenerates continuously (CSIRO, van Swinderen 1969, Le Houerou 1976).

Irrigated grass swards are another possible source of emergency feed. A well-tended stand of Guinea grass (<u>Panicum</u> <u>maximum</u>) can yield 35-100 T/ha/yr as fodder production; up to 250 T have been realized with fertilizer application (Purseglove 1972). One could compress all the dry-season grass cover of perhaps 5-10 km^2 of CR into 1 ha of intensively managed Guinea grass fodder. Or, put another way, perhaps 150 head of cattle could be supported through a 3-mo drought on 1 ha of Guinea grass.

All the cattle and sheep in the CR, approximately 2 million TLU's, could be carried through a 3-mo drought by a million tonnes of feed which, if provided by a high-density crop such as cactus or irrigated grass, could be grown on 100 km^2, a tiny fraction of the CR. To be sure, there would be problems of establishment, maintenance and distribution, but the point is that a great deal of feed can be banked without any significant loss of normal grazing area. Furthermore, this system is merely a variant on the traditional lifestyle whereby pastoralists visited dry-season areas of proven worth. These have in many countries and cultures been taken away by the agriculturists, but can be returned as fodder farms and planted drought reserves.

<u>The role of remote sensing in drought management</u>

In a drought situation time is a critical factor, thus speedy data collection and analysis are paramount. A rapid-survey technique is called for, covering large areas (1000's of km^2) in short time periods (days), and giving data that are rough yet reliable and usable for planning purposes. Such a survey should also rely as much as possible on existing baselines; in our case this was possible through the data set compiled in the last 3 years for Bulo Burte District and applicable to a much wider area.

Ideally such a survey should also use (1) remote sensing, notably real-time satellite imagery to sort out sampling units, and (2) computer-assisted data analysis. A geodata plotter such as the Prime computer system would enormously accelerate the map-preparation process. Hand-plotting is tedious and subjective, and furthermore only a computerized coordinate system can adequately handle a multiple layered data set.

The Somali ecosystems have a unique flora and vegetation, an unparalleled array of gum- and resin-producing species, and enormous camel populations. Walter and Stadelmann's (1974) classification of deserts shows Somalia as clearly the only sizeable body of land in the tropics with an arid climate. All other desert and subdesert areas in the world have considerable temperature fluctuations throughout the year and occasional or common frost, and are considered subtropical and temperate-zone. Extremely few have a bimodal rainfall pattern (N Venezuela, SW Somalia, Sonoran Desert, Karroo). But the Somali-Chad arid-land system (as defined by Goodall et al. 1979) has one critical problem, and that is lack of information. Recent major works on tropical subarid and arid ecology have totally bypassed Somalia (Goodall et al. 1979, Evenari et al. 1985), evidently from dearth of information and not fear of duplication. Getting down to specifics, some of the questions for which answers are urgently needed are: What is the rate of leaf production in yicib? What degree of defoliation can it tolerate on a long-term basis? What is the nutritional role of leaf litter, and of dry grass? What production increment is supplied by crop residues? Answers to questions such as these will give us a much better base on which to plan and manage the range resource in normal as well as in drought times.

SUMMARY AND RECOMMENDATIONS

1. Dry-season natural feed sources in Hiraan Region are dominated by leaf litter, grass and yicib leaf, with other sources contributing only 6% of total biomass.

2. Total dry-season (February 1987) feed in the 12,500 km^2 study area is 665,989 T of which 382,219 T or 57.4% is available (reachable, usable) and accessible (outside of reserves). This represents an average of 30.6 T/km^2 or 300 kg/ha.

3. The distribution of biomass has a distinct peak in the Beledweyne/Bulo Burte boundary area where all three major biomass sources are present in large amounts and where yicib, the feed of highest quality, is also the most abundant.

4. Applying prudent offtake rates, it is estimated that the total feed would be able to support 500,000 TLU's in a 3-mo drought. Since the area has an estimated 250,000 TLU's of resident stock, 250,000 extra TLU's could be accommodated.

5. The above figures have been calculated on the basis of feed available to camel, the animal least affected by the drought. Less of the feed,

giving data that are rough yet reliable and usable for planning purposes. Such a survey should also rely as much as possible on existing baselines; in our case this was possible through the data set compiled in the last 3 years for Bulo Burte District and applicable to a much wider area.

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perhaps only 75%, would be available to cattle. On the other hand, cattle are much more likely than camel to utilize the largest component, leaf litter.

6. Baseline data are needed on livestock food habits in the dry season, particularly their use of leaf litter and evergreen browse.

7. Longer droughts in the Central Rangelands cannot be effectively thwarted by shunting animals around. Since it is undesirable to continue to rely on emergency relief, an endemic system of famine aversion should be developed. The recommended system entails reserves of high-biomass fodder such as spineless cactus or irrigated grass.

8. Experimental plantations of high-biomass feeds should be developed on a regional or ideally degaan basis.

9. Drought forecasting and drought surveys should make full use of remote sensing particularly satellite imagery, and the latest computer-assisted data-processing techniques.

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LIVESTOCK MARKETING IN THE BAY REGION OF SOMALIA

by

Orhan Saygideger and Alexander Dickie

A marketing survey was conducted at three major district markets of the Bay Region for a period of one year, beginning June 1984. The objective of the survey was to establish a data base describing characteristics of livestock and produce marketing in the Bay Region. The survey was initiated by the National Monitoring and Evaluation Facility (NMEF) of the Ministry of Planning to evaluate the impact of the Government of Somalia's 1983 adoption of a policy allowing farmers to sell sorghum and maize at free market prices. The report, Marketing Study in Bay Region by Saygideger (1986), describes in detail the methods and results of the survey.

This paper highlights methods and results of the livestock component of the Bay Region study. The purpose is to report the findings of the Bay Region study and lay the foundation for follow-on work being conducted by the Livestock Marketing and Health Project, in the Ministry of Livestock, Forestry and Range. Basic agriculture information related to economic activities of Somalia's rural population is rare or non-existent in the agriculture sector. At the time the survey was initiated, no marketing study had ever been conducted in the area.

Description of the Study Area

The Bay Region is the most important rainfed farming area in Somalia. The potentially cultivatable land is about 370,000 ha. The main crop is sorghum which is planted at the beginning of the Gu (April - May) and Dayr (November - December) rainy seasons. Crops are produced with a 400 to 600 mm average annual precipitation spread over the two rainy seasons, but droughts are common. Farm plots are shifted every three to four years using traditional farming practices. The rotation (fallow) cycle is around 40 years (BRADP 1979). Some farmers interplant cowpeas with sorghum. Groundnuts, maize, mungbeans, seasame, and tomatoes are sometimes grown as a small percentage of the area cultivated.

About 95% of the area (3.8 million ha.) is considered rangeland. It supports livestock populations of about 320,000 camels, 300,000 cattle, and 500,000 goats and sheep which fluctuate seasonally. Theoretically, livestock producers often have family ties that extend for hundreds of kilometers and thus may have grazing rights and marketing options linked to distant areas. The vast majority of the human population (about 300,000 people representing 90% of the region's population) live in rural areas and derive their livelihood from a combination of crops and pastoral livestock production.

Livestock market infrastructure in district markets is simple, generally consisting of no more than an agreed upon meeting place. The only criteria

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being that the place should be out of the way of vehicle traffic (livestock are frightened by noise and moving vehicles) and large enough to accommodate the local volume of trade. Despite the fact that temperatures often exceed 32° C, there are usually no watering facilities or structures to shade animals. The largest market of the region, on the edge of Baidoa, has a few rough shelters where tea and food are sold. The market at Buur-Akaba is located at the edge of town under a large fig tree. Merchants sell sweet tea and other refreshments to traders negotiating (resting) in the tree's shade. The Buur-Akaba market is typical of rural livestock markets throughout Somalia. The average number of animals sold daily range from 10 to 25 camels, 15 to 30 cattle and 20 to 40 sheep and goat. Sellers must buy a permit for each animal to be sold. Permits are good for 21 days. Sales are usually facilitated through local brokers called "dilaal", who are paid 4 percent of the sale price by the seller. Local government also collects a market levy of 4 percent.

Record keeping by local government is generally poor and not systematic. There is no standard form for collecting basic information. Information collected is limited to name of the seller, price received and the amount of the levy charged.

Methods

Pre-survey reconnaisance visits to the study area were made at the beginning of March 1984. Shop owners, vendors, livestock buyers and sellers, and government officials were interviewed. These interviews were useful in designing the survey program and questionnaires. Questionnaire testing and enumerator training was conducted in the local area.

The market survey was carried out in three district centers of the Bay Region. Baidoa (3°N; 44°E) is located in the center of the region. Kansa-Dhere, the second district center is 85 km west of Baidoa, Buur-Akaba, the third district center is 68 km southeast of Baidoa on the main road to Mogadishu. These three markets are the largest of the six district markets in Bay Region.

The survey team visited the Baidoa livestock market twice a week and the other two markets once a week. Sellers and buyers were interviewed to gather information related to marketing margins, distances traveled, reasons for trading, and other key information related to marketing activities. Buyers and sellers were selected at random. Interviews were usually held in a tea house in the market area. Sellers and buyers were interviewed together.

Livestock prices were sampled for cattle, camels, goats and sheep in three age classes and in four categories of body condition (excellent, good, fair and poor). A fourth age class, sucklings, were rare at the market and were excluded from the survey. Enumerators witnessed auction sales to record actual transaction prices. Enumerators identified the age group and body condition of animals by visual assessment. Prices for males and females in the classes and conditons mentioned were recorded separately. Age classes used are shown in Table 1. Mean monthly prices are reported as weighted average using the number of animals in the sample as the respective weights. Annual prices represent the simple average of monthly prices due to lack of total numbers of different animals transacted monthly.

Table 1. Age and class deliniations for livestock sampled in the market survey.

Type of animal	Sex	Class	Age	Somali name
Cattle	Female	Young	1 - 4 yr	Qaalin yar
		Mature, dry	5 +	Śac Guran
		Lactating	5 +	Sac Irman
	Male	Young	1 - 2	Dibi Yar
		Breeding	3 - 6	Dibi Qooran
		Castrated	6 +	Dibi Tuman
Camel	Female	Young	2 - 4	Aaran Dhidig
		Mature, dry	5 +	Hal Guran
		Lactating	5+	Hal Irman
	Male	Young	2 - 3	Aaron Lab
		Breeding	3 - 6	Baarqab
		Castrated	6 +	Goolal
Goat	Female	Young	.4 - 1.5	Ceesan Yar
		Mature, dry	1.5 +	Ri Guran
		Lactating	1.5 +	Ri Irman
	Male	Young	.4 - 1.5	Orgi Yar
		Breeding	1.5 +	Orgi Qooran
		Castrated	1.5 +	Orgi Tuman
Sheep	Female	Young	.4 - 1.5	Sabeen Yar
		Mature, dry	1.5 +	Lax Guran
		Lactating	1.5 +	Lax Irman
	Male	Young	.4 - 1.5	Baraar
		Breeding	1.5 +	Sumal
		Castrated	1.5 +	Tuman

Results and Discussion

There were two types of sellers observed in the market. Type one, the producer/stockowner, usually brought to the market as many animals as he/she required to obtain cash to buy food items and/or breeding females. Type two seller was the stockowner/dealer who brought stock he/she produced as well as stock bought from other producers in the bush or in and around the market. This type of seller was typically better capitalized and able to "play" the other buyers, whether producers or meat cooperatives.

Around 90% of the animals were trekked to the market from an average distance of 40 km. The majority of sellers were trekking their animals from distances ranging between 20 and 40 km. However, around 7% of sellers were trekking their animals from a distance of 100 km. Small ruminants were being trekked shorter distances than large ruminants. Buyers usually purchased animals for slaughter or for expanding their herds.

The majority of sellers (69%) sold stock for cash requirements associated with living expenses. Other reasons for selling were to minimize disease outbreak (18%) and to raise cash to buy breeding animals (13%).

Survey results indicate that about 30% of animals transacted in these local markets were cattle, 25% were camels and 45% were sheep and goats. The small number of animals sold each day suggests that the majority of sales were taking place outside the market. Presumably, the main reason for selling outside was to avoid paying market fees. Observation and information obtained in the markets indicate that there was substancial exchange of livestock in kind.

Destination of Marketed Animals

Over the year, 55% of all animals sold were destined for slaughter, 39% for production and 7% for export. Figure 1 shows annual percentage distribution of transacted animals by destination for cattle, camels, goats and sheep. About 50% of large ruminants and 60% of small ruminants transacted were consumed domestically. Forty percent of large and 35% of small ruminants were sold for production. The remaining 10% and 5% respectively, were purchased for exported outside the region.

Slaughter. The percentage of animals purchased for slaughter peaked in December (Figure 2). This peak coincided with "Mulid Al-Nabi", or the Prophet Mohamed's birthday, which occured on December 3th in 1984. Also, a high percentage of slaughter of small ruminants in June supports the general observation that people usually consume more goats and sheep during the Islamic holy month of Ramadan. Ramadan was between May 30th and June 30th in 1984.

Another partial explanation for fluctuation in volume of sales is that livestock production (especially conception/births) is tied to the two rainy seasons, the Gu (April-May) and the Dayr (November-December). Pastoralists have been observed to sell more cull stock at the onset of dry seasons. The authors believe that fluctuations in volume of sales and prices are primarily explained by religious holidays observed in the country, and the "Hadj" with its associated rise in demand for export animals. This is a special case for Somalia where 80-90% of all goats and sheep exported are destined for Mecca in Saudi Arabia, during the Hadj season. The Hadj is an annual pilgrimage by Moslems to Mecca where they are required to sacrific a live animal. The practice of sacrificing animals for the Hadj applies almost exclusively to the location of Mecca, but because of the number of animals required for this activity there is a stong impact on Somali rural livestock markets.

Slaughter is almost evenly divided between large and small ruminants, (Table 2). Approximately 66% of cattle meat derives from cull cows and mature males. A third of young male cattle are slaughted. Camels follow a similar pattern. For goats and sheep, 25% of immature male and 44% of mature males are slaughtered.

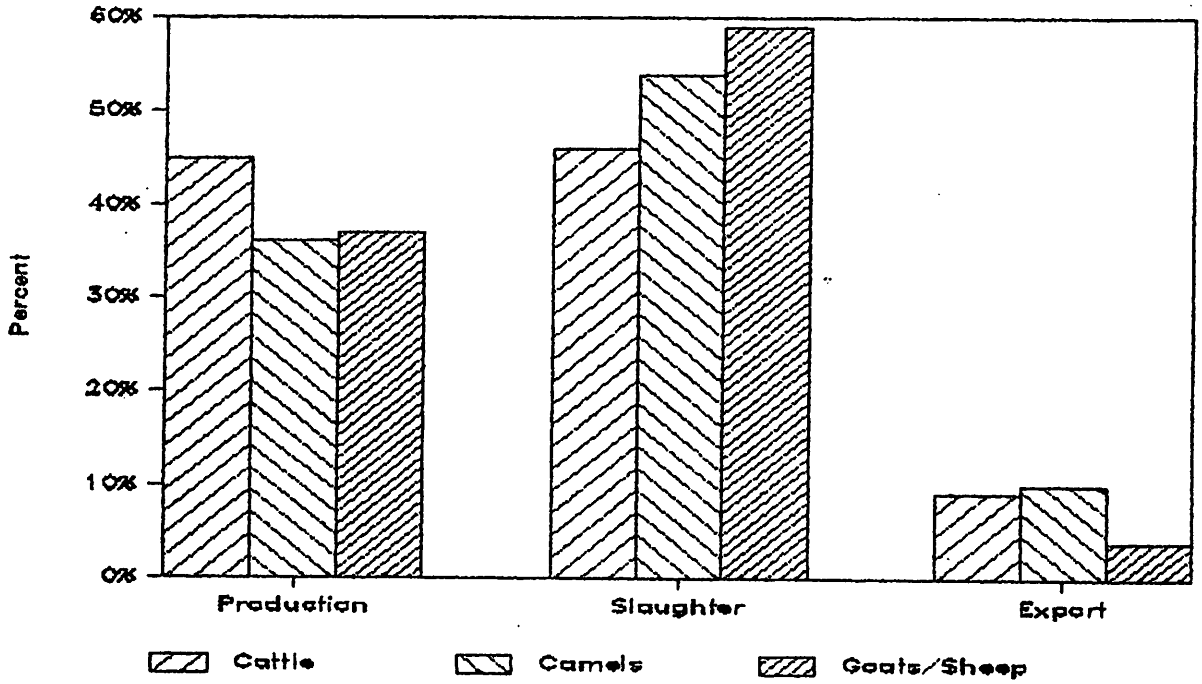

Figure 1. Percent distribution of animals destined for production, slaughter and export in the Bay Region of Somalia from June 1984 to May 1985.

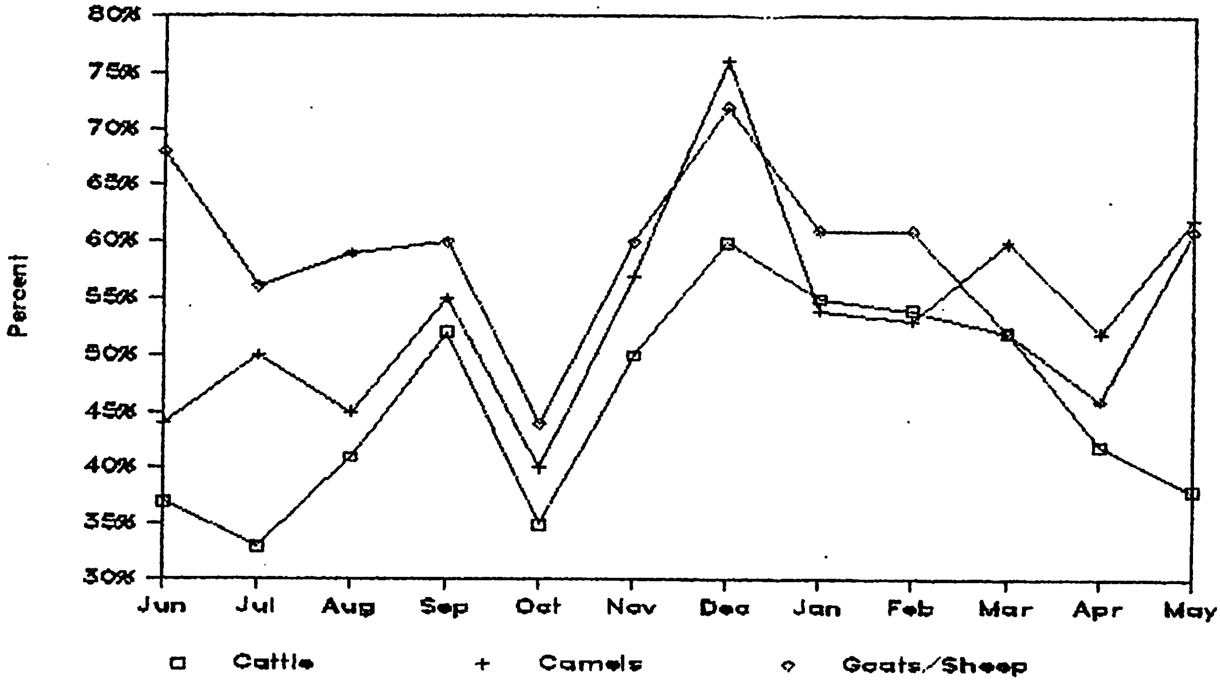

Figure 2. Percent of cattle, camels, goats and sheep marketed that were destined for slaughter in the Bay Region of Somalia from June 1984 to May 1985.

Table 2. Percentage distribution of slaughtered animals by age and sex.

Type	Male		Female		Total		% of Total
	I*	M	I	M	I	M	Slaughtered
Cattle	33	37	1	29	34	66	28
Camels	29	32	5	34	34	66	25
Total	31	34	3	32	34	66	53
Goats/Sheep	24	44	3	39	27	73	47

* Abbreviations: (I) Immature, (M) Mature.

Old, barren animals were the primary source of meat. Slaughter wa not equally divided between male and female in that young females were rarely slaughtered. Though the percentage of males slaughtered followed a different pattern for large and small ruminants, males constituted almost two-thirds of the total. This suggests that producers eliminated excess male stock and reduced retention of males for meat production. Scarce resources (labor, water and forage) were distributed in favor of female animals which have the ability to produce milk and reproduce.

The rate of slaughter of immature animals showed a slight upward trend during the wet season. Otherwise, the proportion of slaughter between immature and mature animals stayed much the same through the year.

For most people living in rural Somalia, prosperity is linked to the rains. A slight upward trend in the rate of slaughter at the onset of the rains is expected. People wait for the rains before committing themselves to such things as wedding ceremonies. This is also the time when farmers need cash for expenses associated with crop production (seed, tools, transport). With the rains animal body condition improves and thereby raises the supply of animals in good to excellent condition.

Production. It was found that almost 40% of buyers bought animals to expand their herds. About half of females purchased were destined for production, whereas most of the male animals were for slaughter. As expected, immature females formed the largest group of animals marketed for production purposes. Young female cattle, camels, and goats and sheep purchased for production were 52%, 54% and 50% percent respectively.

Livestock Prices

Livestock prices are subject to wide short-term and seasonal fluctuation. Fluctuations in the price of mature steers and bulls are shown in Figure 3. During the dry season, poor condition of animals causes their price to drop. However, the large drop in cattle prices can also be attributed to the 1983

Saudi Arabian ban on cattle exported from Somalia. Strong ecomomic impact of the ban lagged its enactment. Relative price comparisons are further complicated by high inflation rates in the Somali economy. Average monthly prices for cattle, camels, goats and sheep, by age and sex are listed in Tables 3, 4, 5 and 6 respectively.

Contrary to cattle prices, camel prices showed a stable and upward trend during the same period (Figure 4). Camel prices drop slightly during the dry season, but recovered quickly afterward.

Goat and sheep prices indicated consistent upward trends during the survey period (Figures 5 and 6). Small ruminants, especially male goats, were in great demand for meat consumption during the religious holidays mentioned above. High demand for export of almost one-third of small ruminants from Somalia to Jiddah Port, Saudia Arabia, during September and October is reflected in the steep upward trend of goat prices during those months. The Prophet's birthday (December 3, 1984) and the month of Ramadan (May 30 to June 30th, 1984) effected prices positively due to increase in demand.

Among sex groups, the average price of male animals were consistently higher than those of females for camels and small ruminants. But when broken out from the overall average, prices of young female cattle, camels and goats are higher than for young males. The average price of young male sheep was consistently higher than young females. The overall average price of small ruminants balances in favor of male animals because the price of adult mature breeding and castrated males is generally higher than the price of the breeding females (Figure 5).

The price structure and slaughter statistics suggest that stock owners retain brood cows for milk production. Findings of this study reinforce earlier observations made in the Bay Region and elsewhere in East Africa, that female animals constitute a high proportion of the total herds and flocks (Hunting Technical Services 1982, Meadows and White 1979, 1980).

Milk

Milk, especially camel milk, plays an important role in the daily diet of the Somali people. Yet, information about milk marketing is rare and dispersed. In the Bay Region, the market share of camel and cow milk were about 75% and 25% respectively. Around 80% of cow milk was marketed in the form of skimmed, curdled milk, as this kind of milk will not spoil as quickly as fresh milk. However, the market share of fresh and sour milks was almost equally divided due to the fact that fresh camel milk will not spoil as quickly as cow milk and sour milk is equally demanded by the consumer. There are relatively few sheep in the Bay Region and sheep and goat milk is typically not commercially available.

The majority of producers brought milk to the local market on camel or donkey, and to some extent on their own shoulders from an average distance of 15 km. Around 20% of milk producers used vehicles to transport milk. The cost of transportation was around .71 to 2.8 shillings per liter depending on the distance. The estimated average marketing cost, which included transportation and hiring stalls at the market, approximated .71 to 3.5 Somali shillings per liter, depending on whether sellers used trucks. This shilling cost was equivalent to 2.9% to 14.5% of the average price per liter of fresh camel milk (24.2 shillings) during the sample period.

Table 3. Cattle prices (Somali Shillings per head) by age and sex groups.

Months	Male				Female				Average Cattle Prices
	I.M.	M.B.	M.C.	Average	I.F.	D.M.B.	L.M.B.	Average	
June	1365	4020	4920	3050	2385	3215	4245	2990	3025
July	1400	4020	4880	3055	2540	2985	4460	2895	2980
August	1150	3490	4080	2595	2640	2770	4025	2820	2700
September	1410	3270	3700	1550	2670	2745	3935	2815	2670
October	1390	3380	3895	2620	2590	2835	4690	2880	2740
November	1180	2910	3455	2270	1505	2610	3900	2670	2455
December	1315	2840	3650	2340	2585	5278	5250	2905	2600
January	1220	2465	3115	2055	1920	1770	---	1850	1960
February	1350	2805	3290	2270	2105	2240	4405	2565	2315
March	1375	3770	3295	2650	2280	2639	---	2450	2560
April	1600	3545	3675	2735	2340	3175	5665	2920	2850
May	1410	3235	3965	2590	2130	2745	4000	2550	2570
Average	1350	3315	3825	2565	2410	2705	4460	2680	2620

Abbreviations: immature male (I.M.), mature breeding (M.B.), mature castrated (M.C.), immature female (I.F.), dry mature breeding (D.M.B.), lactating mature breeding (L.M.B.)

Table 4. Camel prices (Somali Shillings per head) by age and sex groups.

Months	Male				Female				Average Camel Prices
	I.M.	M.B.	M.C.	Average	I.F.	D.M.B.	L.M.B.	Average	
June	4275	9390	8900	6900	5730	9430	10830	7755	7320
July	4750	8610	9400	7115	6055	7100	11830	6870	7010
August	6020	8790	9400	7730	6635	6510	8790	6725	7290
September	5640	8245	9140	7340	6925	6375	9485	6850	7125
October	5505	9485	9805	7895	7105	6230	10335	6930	7420
November	5230	9195	10105	7690	7655	6390	---	7040	7405
December	5135	10305	10050	7995	8400	6795	---	7615	7830
January	5030	9835	9840	7705	7150	5140	---	6170	7030
February	5780	10200	10590	8345	6930	5365	---	6165	7390
March	5435	10270	10505	8190	7010	6470	---	6745	7555
April	6140	11510	10090	8730	.8650	6880	20000	7785	8315
May	5465	10530	11000	8410	7615	6915	---	7275	7910
Average	5370	9700	9920	7835	7155	6635	11750	6995	7465

Abbreviations: immature male (I.M), mature breeding (M.B.), mature castrated (Y.C.) immature female (I.F.), dry mature breeding (D.M.B.), lactating mature breeding (L.M.B.)

Table 5. Sheep prices (Somali Shillings per head) by age and sex groups.

Months	Male				Female				Average Sheep Prices
	I.M.	M.B.	M.C.	Average	I.F.	D.M.B.	L.M.B.	Average	
June	510	740	---	625	---	600	780	---	---
July	---	720	815	---	475	590	655	545	---
August	535	585	940	635	450	580	675	530	585
September	500	795	950	710	445	660	925	590	655
October	510	635	1045	665	575	765	---	670	630
November	650	995	1160	890	440	840	---	645	775
December	600	900	1140	830	325	600	---	465	660
January	---	---	---	---	---	---	---	---	---
February	485	955	---	775	445	685	---	570	655
March	650	1000	1035	870	560	755	---	660	775
April	675	1265	1195	1020	395	770	850	610	880
May	---	1120	1200	---	355	825	---	---	---
Average	565	885	1055	755	445	700	780	590	695

Abbreviations: immature male (I.M.), mature breeding (M.B.), mature castrated (M.C.), immature female (I.F.), dry mature breeding (D.M.B.), lactating mature breeding (L.M.B.)

Table 6. Goat prices (Somali Shillings per head) by age and sex group.

Months	Male				Female				Average Goat Prices
	I.M.	M.B.	M.C.	Average	I.F.	D.M.B.	L.M.B.	Average	
June	335	620	685	520	440	500	385	480	500
July	385	730	880	625	480	620	565	555	595
August	365	830	905	660	460	595	530	530	600
September	420	820	975	695	490	695	550	605	655
October	450	935	1310	820	550	775	980	695	760
November	415	815	900	675	515	710	750	625	650
December	420	875	1075	735	570	635	1100	650	695
January	455	805	1030	710	525	710	1080	660	685
February	475	860	1055	745	515	670	740	610	685
March	470	890	970	740	555	780	900	690	715
April	560	1090	1140	890	685	900	800	795	850
May	555	1075	1100	875	560	890	1000	755	820
Average	440	860	1005	725	530	705	800	640	685

Abbreviations: immature male (I.M.), mature breeding (M.B.), mature castrated (M.C.), immature female (I.F.), dry mature breeding (D.M.B.), lactating mature breeding (L.M.B.)

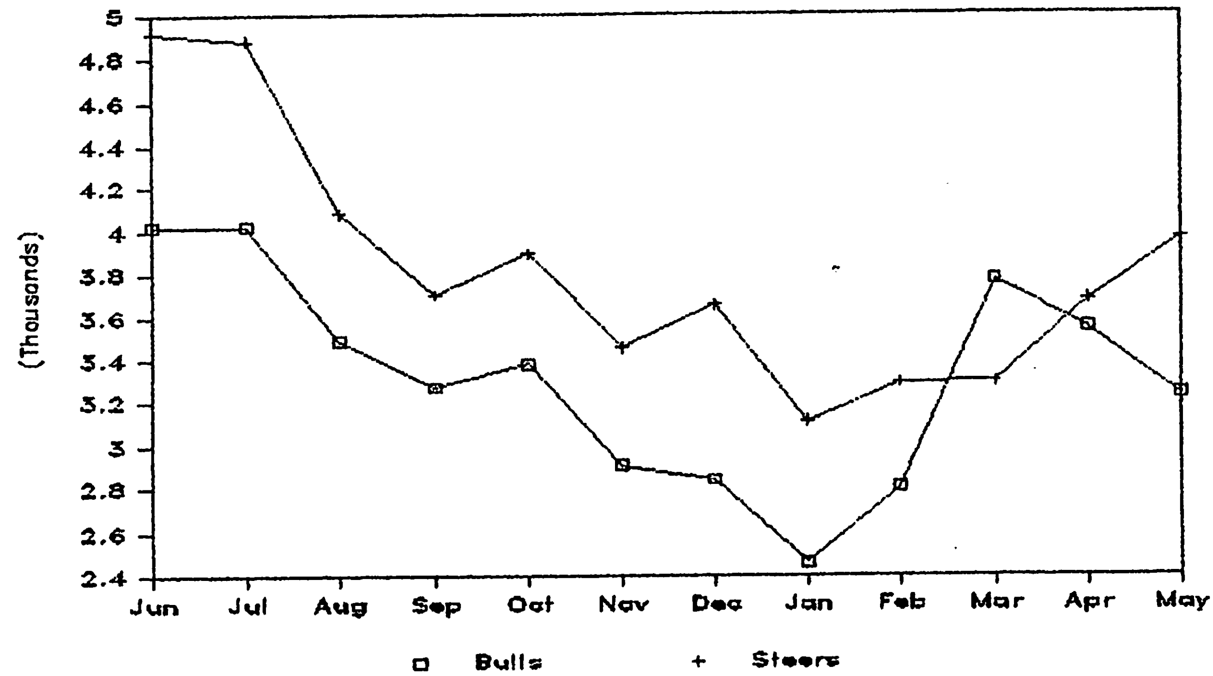

Figure 3. Steer and bull prices in the Bay Region of Somalia from June 1984 to May 1985.

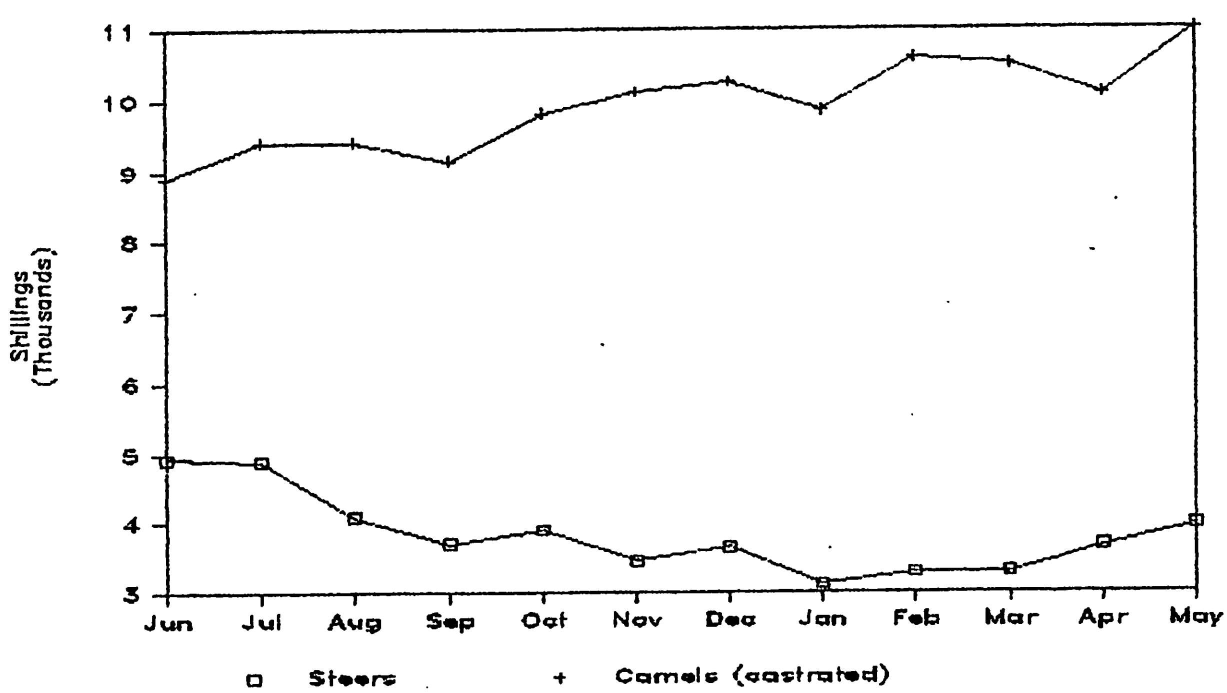

Figure 4. Comparison of average monthly prices for adult steers and castrated camels in the Bay Region of Somalia from June 1984 to May 1985.

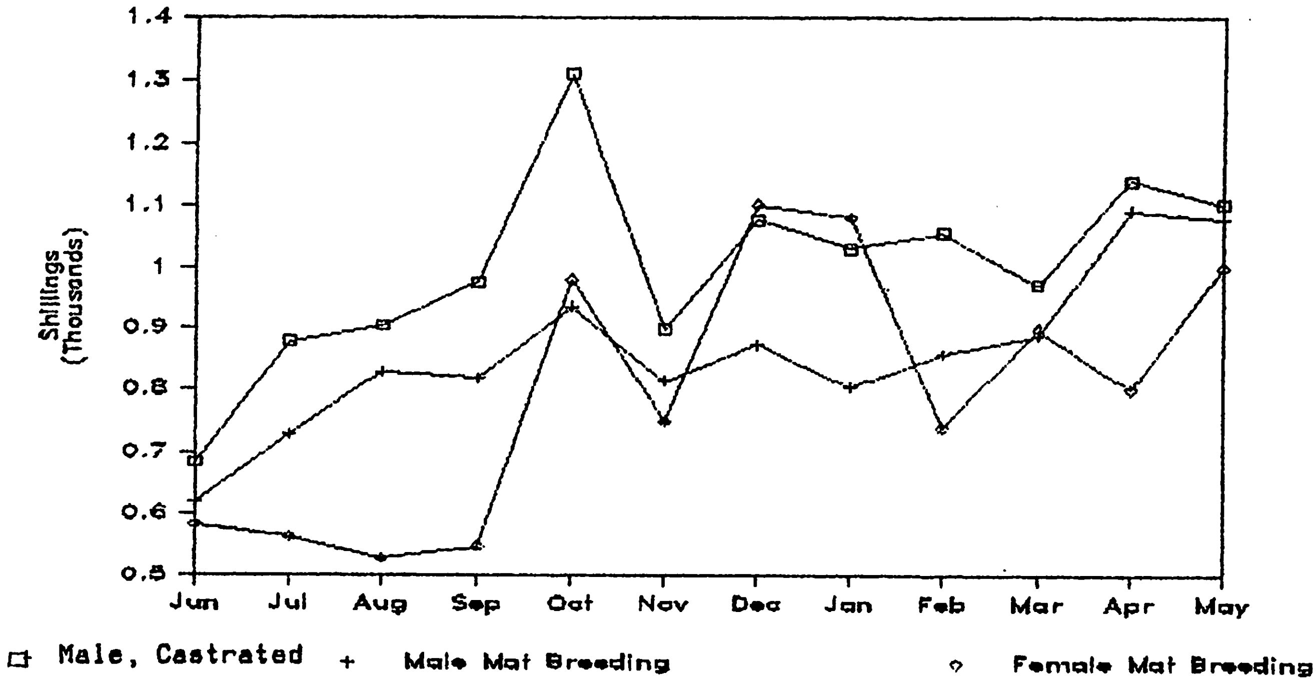

Figure 5. Comparison of average monthly price for three classes of goats in the Bay Region of Somalia from June 1984 to May 1985.

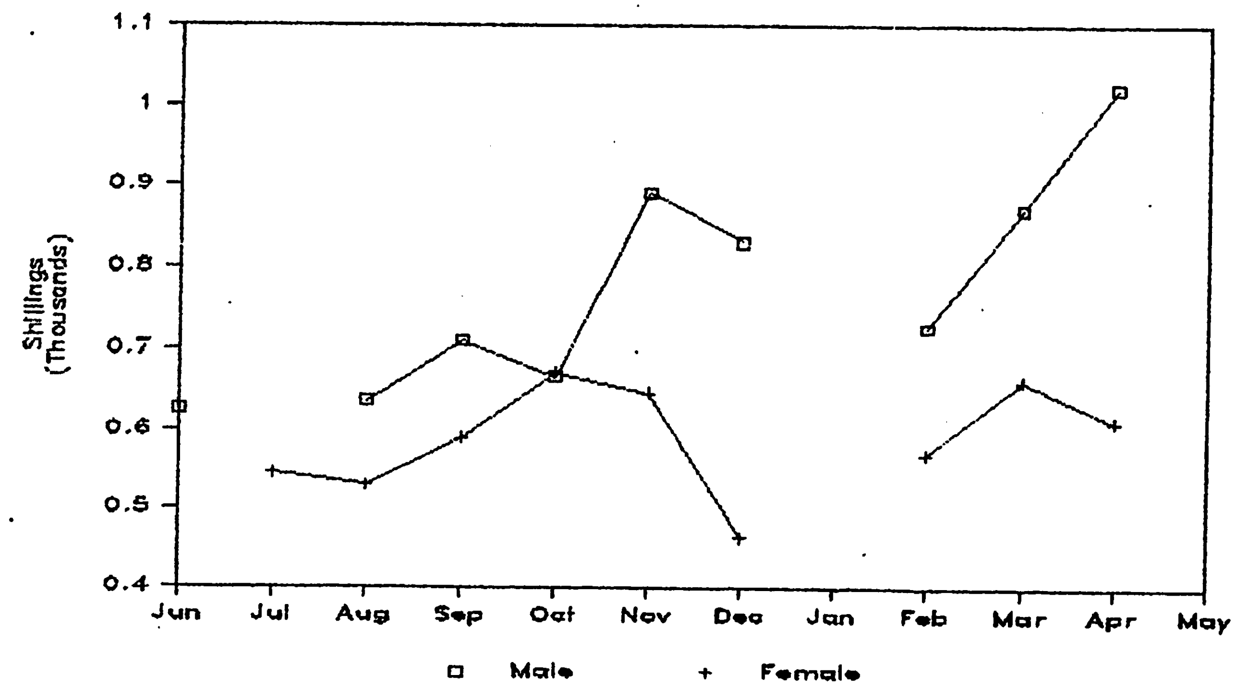

Figure 6. Comparison of average monthly price for male and female sheep in the Bay Region of Somalia from June 1984 to May 1985.

Milk prices were subject to seasonal variations. Fluctuations in average monthly prices for fresh and sour cow and camel milk are shown in Figures 7 and 8 respectively. During the two rainy seasons, prices showed a downward trend, as all domestic animals were in the breeding period and all bred females produced milk in that period. In between the two rainy seasons, milk prices increased progressively, and indeed more dramatically during the long dry season of Jilaal (January-March).

Fresh milk prices on the average were 12% higher over sour milk prices in the markets surveyed in the region (Figures 7 and 8). This difference varied according to seasons. As the fresh milk supply increased during the rainy season and less sour milk was demanded, a higher price margin was observed. Also, there was a 30% price increase from Baidoa to the Mogadishu market for camel milk, and a 20% price increase for cow milk. The margin increased dramatically during high milk supply season as prices in the producing area dropped sharply.

Grain

Milk and livestock are sold (or traded) for grain. The ability to make this exchange should lower the minimum number of animals required to support a household (Brown 1971). The seasonal exchange rate of milk:grain must be known to understand marketing incentives or household food budgets. Saygideger (1986) gives detailed information about grain marketing in the Bay Region.

Conclusions

Data and observations during the survey suggest that there is a considerable moneterized economy in the region. Traditional marketing systems were well established and local markets were lively and extremely busy almost everyday. Market infrastructure was minimal and bore no similarity to western standards/conditions, however it seems to have been entirely adequate in the context of trading activities in the study area. The presence of the local government at the market was mostly for tax collection. Thus, most of the livestock buyers and sellers avoided transactions at the market.

The information presented relates directly to range management. Specific animal husbandry practices are clearly evident in statistics describing the destination of marketed animals, while seasonal prices for different types and classes of animals suggest opportunities for investment. Somali pastoralists clearly produce animals for the market and respond predictably to demand for livestock. The market value of an animal bears directly on producers'/owners' incentive to invest in improvements. It is hoped that these socio-economic data will help range management specialists to better understand Somali pastoralists' needs and capabilities.

Prices and availability of livestock on the market fluctuate by climatic season. As always, range improvements such as water point development (water retention reservoirs and wells) should be examined in relation to potential economic return likely to be generated by users. Seasonal livestock prices are an essential component of any micro or macro analysis and policy planning exercises. Livestock market information is particularly important in Somalia where more than 75% of annual export earnings are from live animals sent to the Middle East. Prices and other marketing information can provide guidance to policy planners in shaping future policies and promoting exports through a set of tax and credit incentives.

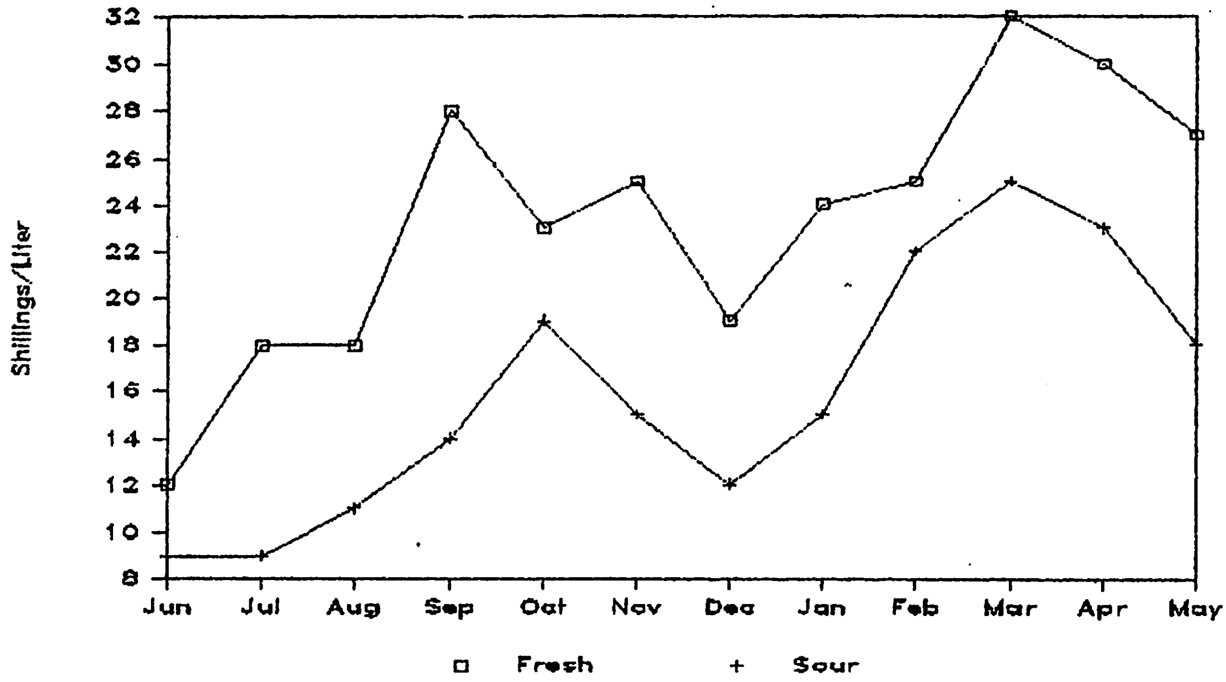

Figure 7. Average monthly prices for fresh and sour cow's milk in the Bay Region of Somalia from June 1984 to May 1985.

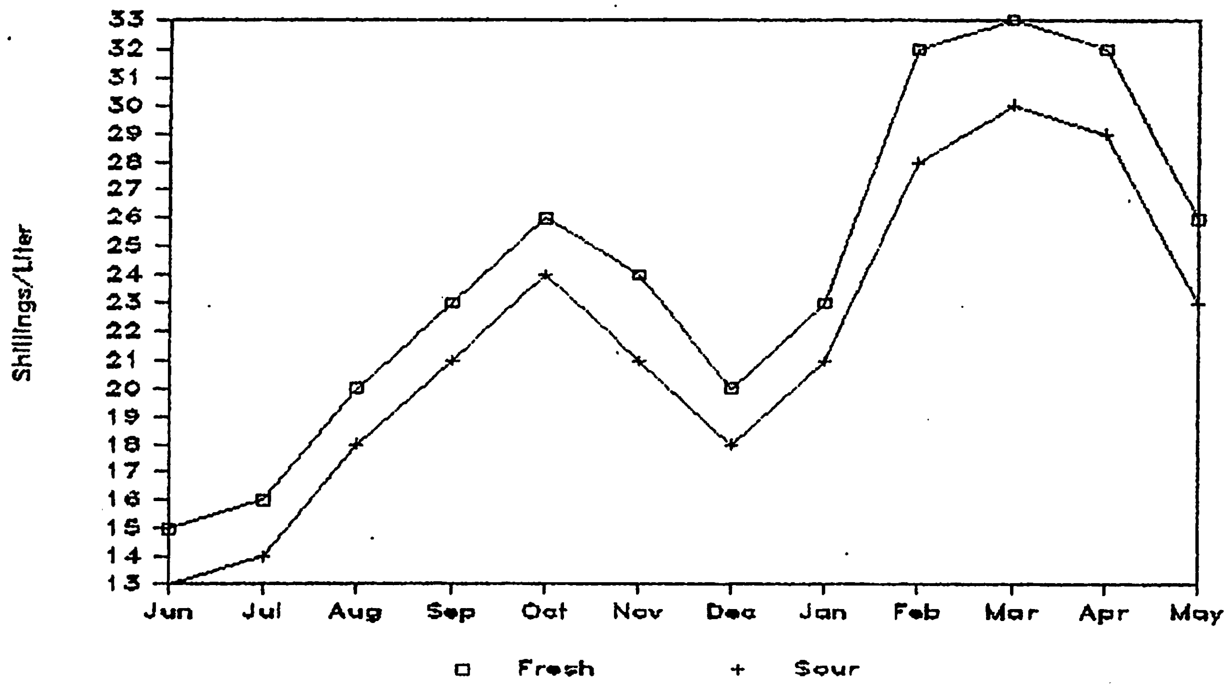

Figure 8. Average monthly prices for fresh and sour camel's milk in the Bay Region of Somalia from June 1984 to May 1985.

We believe that the data presented reveal basic trends of prices and other marketing characteristics of the free markets in the region. Experience gained in this study should serve as a guide for conducting other market surveys in Somalia.

Recommendations

A well designed record system for local government tax collectors in livestock markets could be a valuable contribution. If local governments could be enlisted to use the system it would tremendously enhance the availability of market information. Such a system might be cost effective, since it could significantly reduce the number of special/auxillary enumerators in the markets. Costs of training and supervising local government agents should taper off after the first year. However, tax collectors are far from ideal enumerators since they may be viewed as an unwanted manifestation of the government.

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NATIVE HERBIVORE POPULATION DENSITY ON THREE HABITAT TYPES NEAR AFGOI, SOMALIA

Ambara H. Abdi and Thomas L. Thurow

Very little information is available on the current status of mammalian wildlife in Somalia. Many of the native large herbivores were eliminated as land use pressure associated with heavy livestock grazing, firewood harvest and shifting cultivation increased over the past century. Historically the shrub dominated semi-arid rangeland of central Somalia was inhabited by a diverse herbivore community which probably consisted of African elephant (Lorodonta africana), zebra (Equus zebra), black rhinoceros (Diceros bicornis) warthog (Phalchocoerus aethiopicus), giraffe (Giraffe camelopardalis), lesser Kudu (Tragelaphus imberbis), bushbuck (Tragelaphus scriptus), Soemmering's gazelle (Gazella soemmeringi), Oryx (Oryx gazella), Gerenuk (Lithocranius walleri), dibatag (Ammodoras clarkei), Phillip's dikdik (Madoqua phillipsi), African buffalo (Syncerus caffer) and Abyssinian hare (Lepus habessinicus).

The objective of this research was to determine the composition and density of the herbivore wildlife community (ie., members of the orders Artiodactyla, Perissodactyla and Lagomorpha) which inhabited an intensively used rural area of Somalia's semi-arid rangeland.

STUDY SITE

The study site was located 8 km southeast of Afgoi, Somalia (2° 10'N; 45° 05'E). Precipitation averaged about 450 mm per year and was essentially confined to two seasons: Gu' (mid-April to mid-June) and Dayr (November).

Three general habitat types were deliniated on the study site: lightly-cut shrubland, heavily-cut shrubland and cultivated fields. The lightly-cut shrubland was located on land with a soil texture of sand. Canopy height was about 5 m and canopy cover was about 80%. Dominant shrub species were Acacia nubica, Acacia nilotica, Acacia tortilis and Acacia horrida (Ibrahim and Barker 1986). Herbaceous cover was sparce and was dominated by short-lived annual forbs such as Commelina foreskali and the grass species Aristida adscensionis and Cenchrus ciliaris. The heavily-cut shrubland was located on land with a soil texture of sand. The range had been cleared of most large shrubs. Canopy height was about 1.5 m and canopy cover was about 20%. Dominant shrub species were Dichrostachys cineria, Solanum coagulans, Acacia nubica and Acacia senegal. Herbaceous cover was dominated by short lived annual forbs such as Commelina foreskali and Priva adhaensis and grasses such as Aristida adscensionis and Dactylactenium scindicum. The cultivated fields had a soil texture of clay-loam and were essentially cleared of all native vegetation. Corn and sorghum were grown in the wet seasons. These crops (both the grain and the crop residue) were completely harvested during the dry seasons.

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METHODS

A census route was established in each of the three habitat types. The length of the transects were 1.5 Km on the lightly-cut shrubland, 2 km on the heavily-cut shrubland and 3 km on the cultivated fields. Transects length was determined by the longest route that could be walked on the study site while remaining well within a uniform land use habitat type. Three strip censuses were conducted in each habitat type in each season. Census routes were walked between dawn and 8:30 A.M., thus only one or two census routes were walked on any particular day. Dates during which the censuses took place were December 3-16, 1985 (Dayr), February 9-20 (Jiilaal), June 5-21 (Gu') and August 2-13 (Xagaa). The distance at which an animal was first seen was recorded for each individual sighted. Population density for each species was calculated according to the strip census method of Hayne (1949).

It was apparent that dikdiks where the primary native ungulate on the study site, therefore more detailed study of this species was conducted. Dikdiks actively maintain territories by establishment of scent marking posts (Tinley 1969, Herdrichs and Herdrichs 1969). Dikdik territories were mapped by observing dikdik movement patterns and recording the location of scent marking posts. This method provided an additional means to compare relative density of dikdiks between habitats.

Interviews with individuals who hunt wildlife on the study site were conducted to gain insight into how extensively the wildlife population was used. Also, natural history information known by these hunters was compared with our observations.

The difference in hiding cover between the two shrub sites was estimated by measuring vertical cover. The estimates were made on August 18, 1986, thus representing an approximation of vertical cover in transition from wet to dry season. A grid marked board was vertically positioned at 10 random locations in each habitat type. The observer estimated the amount of vegetation cover in reference to the board. Estimates were made in 10 cm increments of height between the ground and 70 cm height. When making the estimates the observer was sitting on the ground (eyes about 80 cm above the ground). Estimates were made at 10 and 20 m distances from the reference board. This procedure provided a rough estimate of hiding cover available for a small ungulate such as dikdik.

RESULTS AND DISCUSSION

Only four native herbivore species were sighted during the study: Phillip's dikdik, Abyssinian hare, bushbuck and warthog. Interviews with hunters confirmed that these were the only native herbivores that were still found in the region. A single sighting of one bushbuck (on the heavily-cut shrubland) and a single sighting of a group of four warthogs (on the lightly-cut shrubland) represented the only encounters with these species during the census periods. Dikdiks and hares were encountered more frequently; estimates of population densities for each of these species is presented in Tables 1 and 2.

No wild herbivores were sighted during the censuses of the cultivated fields. This probably reflected the intense land use which has resulted in complete elimination of native shrubland.

The Abyssinian hare population densities gave no indication of an obvious habitat preference between shrubland sites. The significantly higher population density of hares inhabiting the lightly-cut shrubland during the Jiilaal may reflect movement into the lightly-cut shrubland habitat. This habitat shift may result from the arid conditions which typify this season during which little browse or cover was available outside of the lightly-cut shrublands.

The lightly-cut shrubland had significantly more vertical cover than did the heavily-cut shrubland (Figures 1 and 2). The lightly cut shrubland also

Table 1. Population density (Individuals/Km^2) of Abyssinian hare on three habitat sites near Afgoi, Somalia.

Season	Lightly Cut Shrubland	Heavily Cut Shrubland	Cultivated Fields
Dayr	25a[1]	21a	0b
Jiilaal	37a	7b	0b
Gu'	0a	8a	0a
Xagaa	0b	19a	0b

[1] Means in the same row followed by the same letter are not significantly different (P < .05).

Table 2. Population density (individuals/Km^2) of Phillip's dik-dik on three habitat sites near Afgoi, Somalia.

Season	Lightly Cut Shrubland	Heavily Cut Shrubland	Cultivated Fields
Dayr	35a[1]	16b	0c
Jiilaal	34a	10b	0c
Gu'	56a	8b	0b
Xagaa	19a	5b	0b

[1] Means in the same row followed by the same letter are not significantly different (P < .05).

had a greater diversity and quantity of browse which has been documented to be the primary type of food consumed by dikdiks (Lamprey 1963, Hendrichs and Hendrichs 1969 and Tinley 1969). These differences in cover and browse between the two shrubland habitats probably account for the consistently higher population density of dikdiks in the lightly-cut shrubland habitat.

Details of Phillip's dikdik territorial behavior have not been previously published. In general, Phillip's dikdik territorial behavior appears to resemble that of Kirk's diddik (Madoqua kirki) (Hendrichs and Hendrichs 1969 and Tinley 1969). Phillip's dikdiks were typically seen in pairs, composed of an adult male and female. Never were more than three individuals seen together, in which case one was a juvenile that was presumably the offspring of the two adults. A single young was produced per pregency. Births occurred during the two wet seasons. Hendrichs and Hendrichs (1969) observed that Kirk's dikdiks chased their young from the territory when they were seven months old thus accounting for our observation of dikdik group size never being greater than three. Territory boundaries between family groups were marked by dung and scent gland excretions. The dung marking sites were characterized by a 0.5 - 1.0 m diameter circular area of bare soil with a 10 - 20 cm high heap of soil and dung in the center. A generally consistent pattern of fecal deposition was followed. The male approached the mound with his head held low. After smelling the mound he pawed the soil and old dung backward with his forefeet onto the

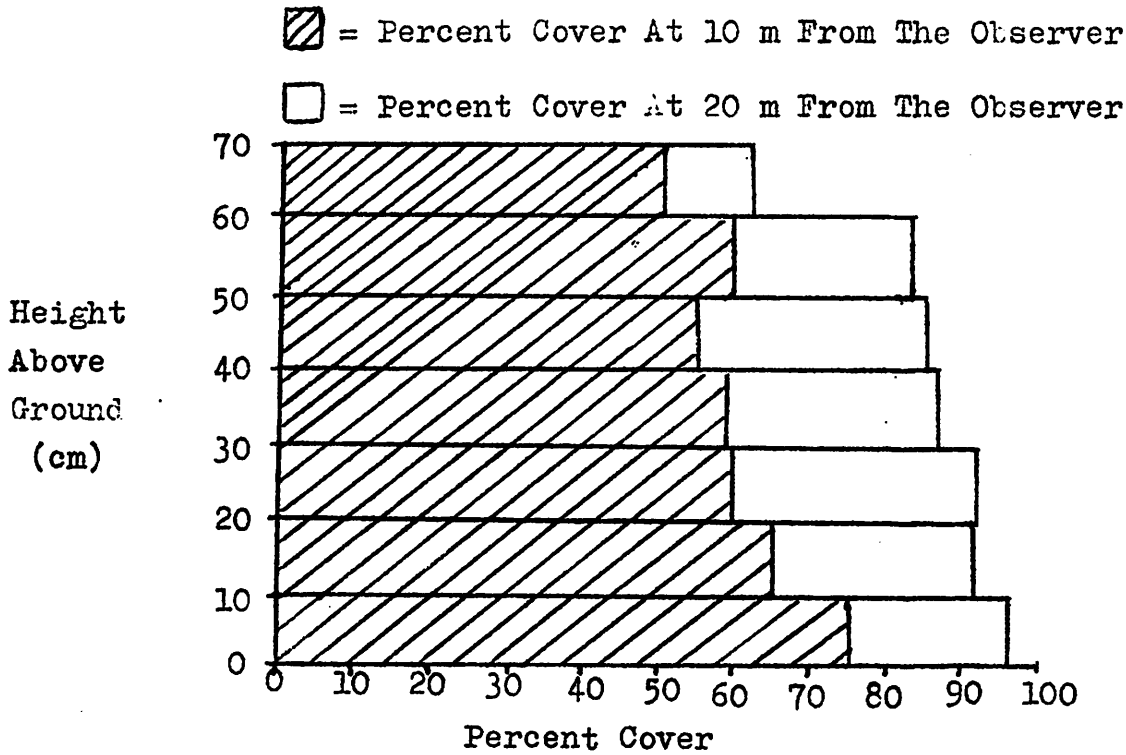

Figure 1. Vertical cover in the lightly-cut shrubland habitat type near Afgoi, Somalia.

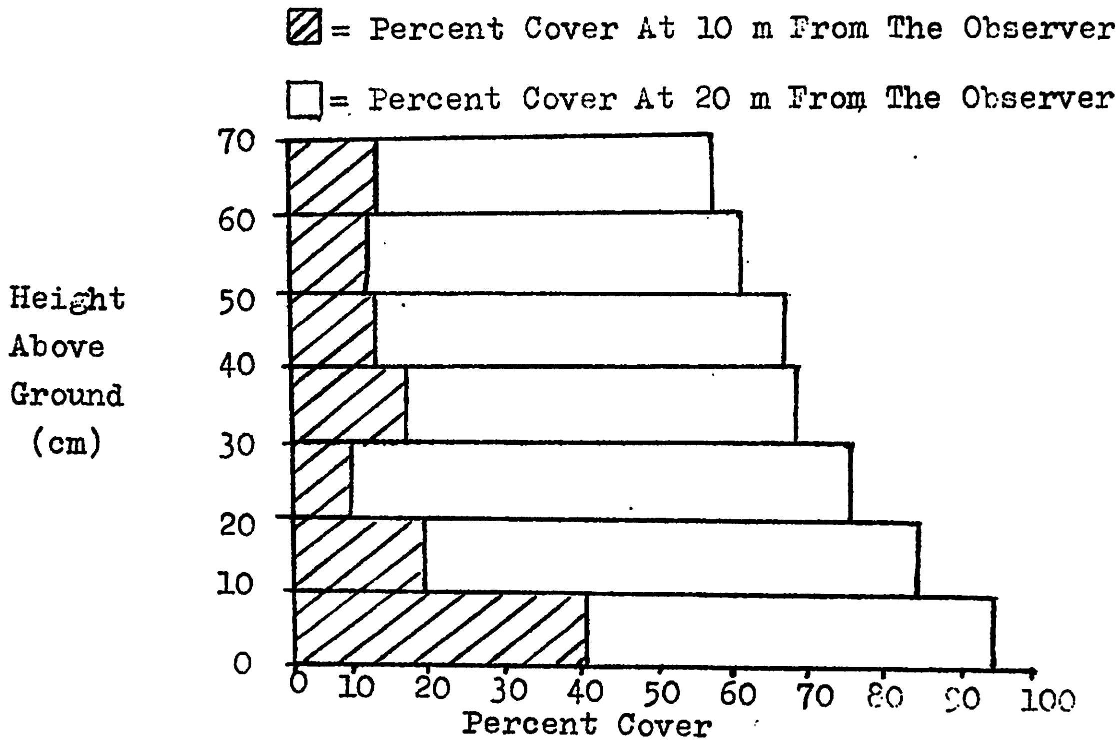

Figure 2. Vertical cover in the heavily-cut shrubland habitat type near Afgoi, Somalia.

center pile. He urinated and then deficated onto the pile. The female than followed the male by smelling the pile then urinating and deficating onto the pile. This pattern is very similar to that discribed for Kirk's dikdik (Tinley 1969). Phillip's dikdiks also marked twigs or grass stems throughout their territory with preorbital gland secretions. Phillip's dikdiks have pedal glands which could also be used as sources of scent marking (Pocock 1910). On one occasion two male dikdiks were observed during a confrontation at a boundary of their respective territories. The crests of both males were raised and the movements and false charges appearred tense and ritualized. No actual physical contact was made.

Three contiguous dikdik territories located in the lightly-cut shrubland were determined by mapping dikdik movement patterns and the locations of dung mounds. Dung mounds tended to be concentrated along border areas. The approximate areas of the three territories were 2.3 ha^2, 3.1 ha^2 and 3.8 ha^2. The respective boundary lengths were 550 m, 720 m and 870 m. Territories in the heavily-cut shrubland appeared to be much larger and less clearly deliniated. The relative low frequency of dung marking sites in the heavily-cut shrubland frustrated attempts to estimate territory size in that habitat. Observations of dikdik movement patterns in the heavily-cut shrubland indicated that territories were substantially larger and/or more poorly defined than in the lightly-cut shrubland. These observations on marking intensity and relative territory size concur with the census data which indicate that dikdik populations were more dense on the lightly-cut shrubland than on the heavily-cut shrubland. These data imply that as shrubland is thinned (usually prompted by the need for fuelwood) or cleared (usually for the purpose of planting crops) dikdik populations will decrease.

Interviews with hunters collaborated our research data indicating that dikdik population density decreased as shrub density decreased. On the study site hunting was only a part-time effort engaged in by a small portion of the population whose main income was derived from subsistance cultivation or pastoralism. Hunting activity was concentrated in the dry season when the need of food suppliments was greatest. The hides were generally not used. Most hunting was done by setting snares baited with fresh green foliage. Several hunters in the area used bows and arrows or nets. Larger species, such as bushbuck or lesser kudu, were highly prized for their meat by hunters, a fact which undoubtably contributed to the scarcity or absence of these larger ungulates on the study site.

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