

### 4.3 The Natural Forests of Yemen

#### 4.3.1 Regular Forests (Shrublands)

Forests in Yemen? Many Yemenites themselves are astonished to hear, that still some real forests do exist in their country. For most of it the term forests is definitely emphatic, we might rather call them woodlands or shrublands. But the mapping by *World Bank* showed that still about 1.9 million ha do exist, mainly along the western and Southwestern Escarpment ('serral'). The bulk of it (72%) is Acacia-Commiphora-bushland with an average height of about 3m. Two of the species that are growing there, *Acacia gerardii* and *Commiphora kataf*, while not rare, are endemic. What means that these species do only exist in Yemen. Some seventeen species of Acacias can be found in Yemen. Their rough geographical distribution has been mapped by Khuleidi and van Scholte (1989 [Scholte; al Khulaidi; Kessler: *The Vegetation of the Republic of Yemen*. EPC, AREA, DHV-BV. 1991]). The distribution is based on altitude and climatological region. The composition is described, as well as the actual state (a bit optimistic) and problems. A more detailed description for the altitudinal distribution of trees has been done by Wood in 1982 for the Haraz project of GTZ.

Diversity is changing from place to place. While in Guma'at al Ameri the stands are almost pure *Acacia mellifera*, the areas around Taiz, with its high rainfall, show a rich mix of different Acacias and Commiphoras with *Ziziphus*, *Dobera*, *Balanites*, *Jatropha*, *Ficus*, *Terminalia brownii*, *Ceratonia siliqua*, *Tamarindus indica*.

The forest areas have been determined for the National Land and Water Conservation Project [*Woodland resources mapping project*, may 1993. Hunting Technical Services LTD. Table 6.1: *Regional Area Figures for Woodland Resources & Table 6.1.A: Summary* (p 75).] as:

regions	woodland	agroforestry & date palms	total
Coastal Plains	156166	5,181	161347
Escarpment & W. Mountains	1406008	381,064	1,786072
Central Highlands & Wadis	378463	36,944	411807
Mahra Woodlands	16809	0	16809
Junipers	2132	0	2132
<b>Total:</b>	<b>1,954978</b>	<b>423,189</b>	<b>2,378167</b>

Forest distribution correlates strongly with the rainfall, which reaches a maximum in the escarpment, especially in the areas of Ibb (800mm) and Taiz (600mm). That does not mean that the Ibb-

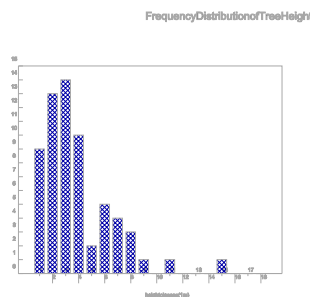
Taiz area is covered with forests. Due to the high rainfall, the agricultural productivity there is as well at a maximum - and so is population density. With the additional sheep and goat herds, population density has a rather adverse effect on forests. Still, that area is absolutely the greenest one in Yemen (except Jebel Houf). The farmers keep some trees and shrubs around their farms for fodder and to shelter the farm from winds. The latter effect is especially important in the Tihama, where the winds would otherwise ruin (sandblast) the large banana leaves. The most extensive agroforestry areas, whose total cover is about 400,000 ha, can be found in the Hadhramout.

### Results of Inventories done between 1988 and 1993.

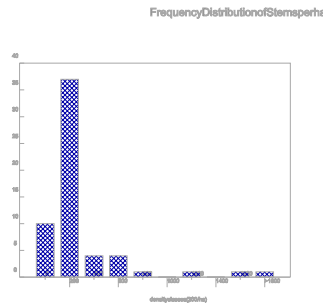
Some 87 inventory plots have been studied and summarized. The plots are mainly at Jebel Lawz (30 Juniper forests) and Jebel Bura' (19 valley forests, acacias and shrublands + 26 riverain woodlots of Wadi al Aswad with *Ziziphus*, *Dobera*, *Grewia*). 12 plots have been measured in the acacia woodlots around Sana'a. The plot size varies from 100 m<sup>2</sup> to 707 m<sup>2</sup>. All samples have been taken in a semi-randomised way using systematic grids. The result shows that forests and trees in Yemen are not too impressive. The average height of the trees measured was only **3.3m**, with a median of 3m. the highest plot average (from Bura') being 10m. The Eucalypts show already an exceptional average height of 15m! (but this result is produced by an even aged stand, while the real natural forest stands are mixed.)

### Tree height

The distribution is 'poisson'-like (skewed). There is a problem with low heights (1-3m). The count should be much higher, but as trees with diameters lower than 8cm have been excluded from the inventory - those diameters are lacking in the related height classes!

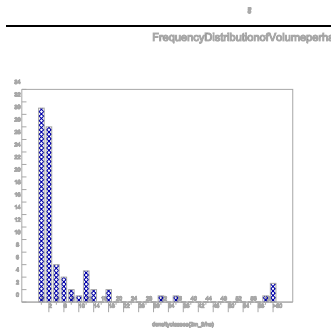


Density [stems per ha] The tree density (stem number per ha) shows a maximum of 2300 in the dense acacia stands. The average is 146. The median is again not reliable, as the measurement limit has been set to a bhd of 8cm. The real stem distribution curve would be poisson, without an ascending branch in the lower part, without median. 31 (38%) out of the total of 81 plots were empty, that means: no stem above 8 cm diameter - no woody biomass could be calculated!



### Volume per ha

The maximum volume found was 176m<sup>3</sup> at 'Jebel Bura' (1 large *Ficus* in plot!). Twice 60m<sup>3</sup> per ha have been found, one at Wadi Hamil (large *Salix subserrata*), one at Wadi al Aswad (*Ziziphus*). The average being 7.6m<sup>3</sup>. Again there is no median, as the curve is right skewed, without ascending branch.



### The National Inventory.

If we compare the results discussed above with those of Millington [*Woody Biomass Inventory*. Millington. Rep. World Bank 1986/1988], who estimated the forest area at 9.5 million ha with an average volume per ha between 10.4 (median) and 8.0 (mean), we have to take into consideration, that Herzog used 0.33 as a **form factor**, Millington, as well as Saadallah, used 1! The better value (see chapter 1.0.3) would be 0.5.

The mean volume per ha for Herzog would so be  $7.6 * 1.5 = 11.4$  m<sup>3</sup>/ha, for Millington  $8.0 * 0.5 = 4.0$ .

Still quite some space! In any case both values would have to be corrected for "a lot of zeros" (= zero-volume plots) to really represent "**the forests of Yemen**"! Here, in what concerns the area, there is the bigger error of Millington. As the results of the forest mapping show the real forest area is exactly **1/4** of Millington's estimate!

If we do now a very rough, hand knitted, in fact unacceptable

biomass estimate, based on the given data, we come to:

Herzog:	2.4 million ha	x 11.4 m <sup>3</sup> /ha	=	<b>27.4 million m<sup>3</sup></b>
Millington:	"	4	=	<b>9.6</b> "

In any case much less than Millington's estimate of 40-80 million m<sup>3</sup> and frustratingly little if we consider what this means in terms of wood available per head of population:

population: 14 million            **0.7 - 2.0 m<sup>3</sup> per person!**

Compared with the estimated annual use of fuelwood per head (0.5 m<sup>3</sup>) this indicates that the forests of Yemen are doomed, as the reserve is just sufficient for 1-4 years!

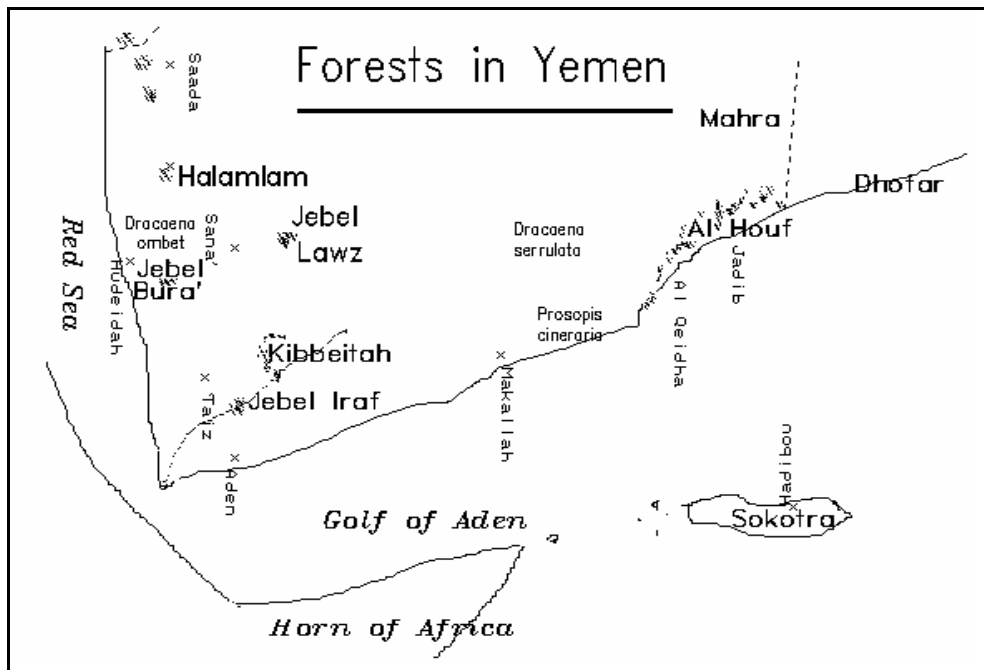
As neither the woodlands of Yemen are finished, nor the Yemenites do already eat their food cold, there must be some mistake in those estimates. Large parts of fuel must consist not of trees, but rather of grasses, forbs and shrubs! But neither of the above discussed inventories ever included shrubs.

Moreover agricultural residues and dung are used already now in large parts of the country (7% of energy consumption after World Bank evaluations), depriving the soil from fertilizer and organic matter. Luckily kerosene (34%) and gas (3% ?) replaced large parts of fuelwood already, especially in the urban areas.

This kind of regular forests is not quite impressive. But that's arid land forestry, and that's where care has to be taken. And it is a problem of management to care for those limited resources. Independent of the problem, how wrong the biomass estimates are, given the strong pressure of private fuelwood collection and commercial wood cutting those woodlands will be cleared in the next ten to twenty years (Millington 1988).

#### 4.3.2 Exceptional Forest Remnants

The most important remnants of natural forests that can be found in Yemen are at (1) Jebel Bura', (2) Houf, (3) Socotra. Additionally there are some two dozen areas with Juniper remnants (5) and a few stands with other rare trees (6).



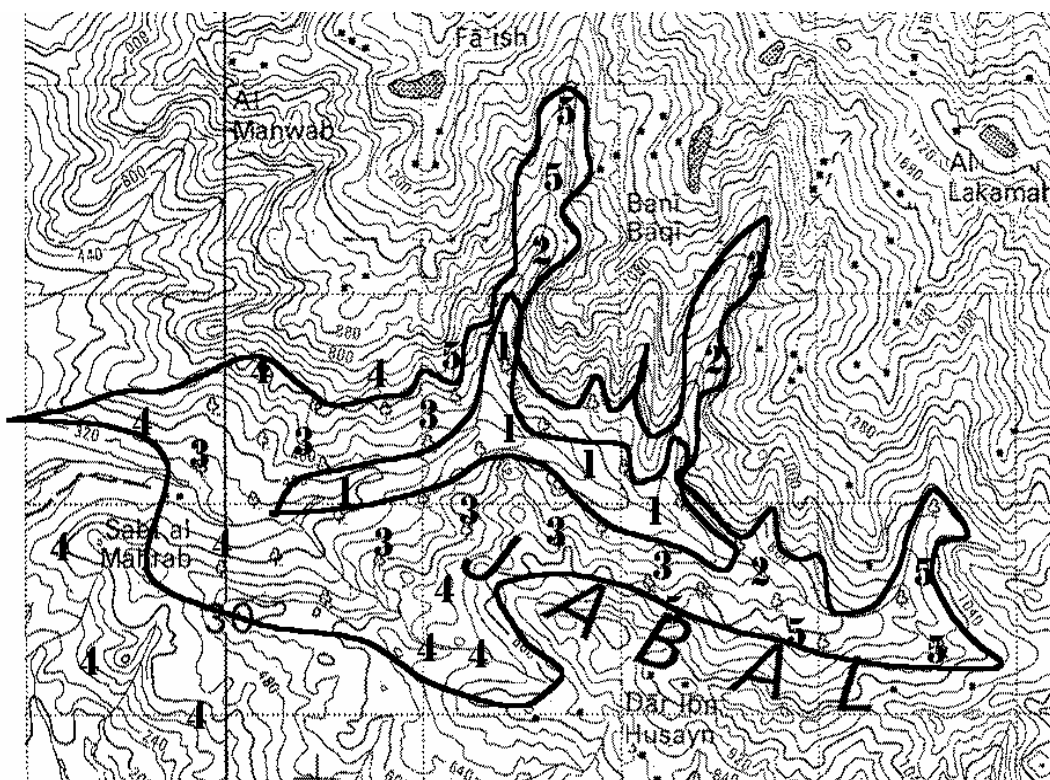
##### 4.3.2.1 Bura

Jebel Bura', about 50km east of Hudheidha, raises steep up from the Tihama. It is reached either by the road through Mansouria, Soukhna or following the track from Qutai south-eastwards. The study area, Wadi Rigaf's forest and the surrounding villages, covers about 50 km<sup>2</sup>. The topography is impressive, from the Tihama with an altitude of 300m, Jebel Bura raises up to 2200m at the district capital Ruqub.

Jebel Bura is a tertiary granite intrusion in the Tihama plain. Weathering and erosion formed some rather shallow colluvial and alluvial deposits. The main area of the adjoining Tihama is of the same origin, but the deposits are hundreds of m deep there.

The forest has been classified into five strata:

- 1) Intact Riparian (*Combretetum*): 48 ha (16%). Species (s. list on page 247): *Ficus* (7), *Trichelia*, *Tamarindus*, *Mimusops*, *Berchemia*, *Combretum* and *Ziziphus*.
- 2) Impoverished Riparian: 16 ha (5%).
- 3) Acacia: 112 ha (37%). Species: *Acacia asak*, *Commiphora*, *Berchemia*, *Phoenix*.
- 4) Impoverished Acacia: 32 ha (10%).
- 5) Phoenix & shrubs: 96 ha (32%). Species still present in the regeneration-strata: *Phoenix caespitosa*, *Tamarindus*, *Grewia*, *Barbeya*, *Acacia asak*, *Commiphora*, *Carissa*.



Jebel Bura', Wadi Rigaf: Forest Strata (grid distance 1km)

The total forest area covers about 300 ha, with a woody biomass of  $3700\text{m}^3$  (average:  $12\text{m}^3/\text{ha}$ ) - as found during the inventory. The determination of the form-factor (volume = form factor x basal area x height) showed that it is 0.6 for Ficus, that make up 80 % of the total volume; 0.4 for Eucalypts. The form-factor of 1/3 (formula of the conus volume) as used, did clearly underestimate the volume! The total tree biomass at Bura' is so rather  $5550\text{ m}^3$  (FF 0.5) or even  $7200\text{ m}^3$  /  $24\text{m}^3/\text{ha}$  (FF 0.58: 80% Ficus / 20 % others).

Those 300 ha are a third of the total study area where ethno-ecological aspects have been studied. That area includes the surrounding 18 villages (on the map - 27 in the field!) and has an area of  $50\text{km}^2$ . With the two additional forest remnants (Wadi Bussal: impoverished Riparian and Wadi al Aswad: Intact Commiphora) we have a total forest area of about 400ha, that means 12.5% forest cover for those two valleys with the last forest of Yemen! Or 2% forest cover for the whole Bura' district ( $210\text{ km}^2$ ).

From the other disperse woodlots only Wadi al Aswad has been studied and measured. There some nice stands of Commiphora have been found, with diameters up to 20cm.

#### The state of agroforestry and other trees:

- Dobera-Balanites parkland: disappearing, especially *Dobera glabra* doesn't produce any regeneration. Only old trees remained. The more hardy and thorny species as *Ziziphus* and *Balanites* take over.

- Breonadia salicina in higher wadis is still tended and used by coppicing or pollarding, but often it is removed and replaced by coffee.
  - Terminalia brownii is being kept in some village woodlots and seems to be the most important local tree here, as Cordias (with the Breonadias) have been removed to make place for more coffee.
  - Annona squamosa ("Khermish"), a fruit tree growing wild, can be found above and around Mahall al Harb.
- + Imported trees as the Azadirachtas are spreading! The cosmopolitan weed Ricinus as well (inadvertently). At both road ends inside Wady Rigaf they have been planted, as well at Muqattarah.
- In many Tihama villages, and besides the road inside Wadi Rigaf, Parkinsonia, together with Pitecollobium dulce, is spreading fast. Some older specimens are probably over 30 years old and must have been imported in the time of the British Colony from Aden.
- Eucalypts are present as amenity trees besides houses. Leucena has not been planted here before we brought it in 1991. It presents a certain risk of turning weedy and should only be used for the degraded areas around villages.

The main woody species (t: tree, s: shrub) encountered at Jebel Bura' are [after Wood 1982, Scholte 1988 & Herzog:]

latin name	shapename	in arabic	transcription
- <u>Abrus bottae</u>	s-t	asp, tenab	
- <u>Acacia abyssinica</u>	t	talh	
- " " var <u>macroloba</u> (ev. a distinct species)			
- <u>Acacia asak</u>	t	'asak	
- <u>Acacia ehrenbergiana</u>	s	selm	
- <u>Acacia mellifera</u>	s	suba	
- <u>Acacia oerfota</u>	s	oerfot	
- <u>Acacia tortilis</u>	t-s	sumar	
- <u>Acalypha fruticosa</u>	s	defran	
- <u>Adenium obesum</u>	t	aden	
- <u>Adenia venenata</u>	s	udein	
- <u>Anisotes trisulcus</u>	s	madh	
- <u>Balanites aegyptiaca</u>	t	heglig	
- <u>Barbeya oleoides</u>	t	kimb	
- <u>Barleria acanthoides</u>	s		
- <u>Barleria bispinosa</u>	s	kuleiba, wasr	
- <u>Berchemia discolor</u>	t	tumar	
- <u>Barleria prionitis</u>	s	shukheis	
- <u>Boscia angustifolia</u>	s	thou'	
- <u>Breonadia salicina</u>	t	derah'	
- <u>Cadaba farinosa</u>	s	assal, gorrah, sera'	
- <u>Cadia purpurea</u>	s	'unsharp	
- <u>Carissa edulis</u>	s	'arm, 'untur	
- <u>Ceiba pentandra</u>	t		
- <u>Celtis integrifolia</u>	t	tugah	
- <u>Commiphora abyssinica</u>			

var. <i>simplicifolia</i>	t	bisham, Murr, hijazi
- <i>Commiphora gileadensis</i>	t	
- <i>Commiphora kataf</i>	t	bisham
- <i>Commiphora myrrha</i>	t	bisham, kafal
- <i>Commiphora oppobalsamum</i>	t	balasam
- <i>Combretum molle</i>	t	'asam
- <i>Cordia ovalis (abyssinica)</i>	t	tanib
- <i>Delonix elata</i>	t	ramf, mashlikh
- <i>Dicrostachys glomerata</i>	t	gizir
- <i>Dobera glabra</i>	t	dhaber
- <i>Dodonea viscosa</i>	s	dodonia, shakth
- <i>Euclea schimperi</i>	s	bina
- <i>Ficus exasperata</i>	t	kishrif
- <i>Ficus glumosa</i>	t	modah
- <i>Ficus lutea</i>	t	labakh, bura'
- <i>Ficus populifolia</i>	t	ithab, modah
- <i>Ficus salicifolia</i>	t	ithab
- <i>Ficus sycomorus</i>	t	khanas, bura, sokam
- <i>Ficus vasta</i>	t	taluk
- <i>Grewia schimperi</i>	s	
- <i>Grewia schweinfurthii</i>	s	
- <i>Grewia tembensis</i>	t	shawhat
- <i>Grewia tenax</i>	s	khadar
- <i>Grewia trichocarpa</i>		
- <i>Grewia velutina</i>	s	neshem
- <i>Grewia villosa</i>	s	barig, berg al ahjus
- <i>Lycium shawii</i>	s	awsaj
- <i>Maerua oblongifolia</i>	s	meru
- <i>Maythenus sp</i>	t-s	
- <i>Mimusops laurifolia</i>	t	lebekh
- <i>Nuxia oppositifolia</i>	t	
- <i>Ochna inermis</i>	s	bina
- <i>Olea chrysophylla</i>	s-t	'utum
- <i>Oncoba spinosa</i>	s	unkab
- <i>Ormocarpum yemense</i>	s	rahd, hamrar
- <i>Phoenix reclinata</i>	t-s	shej
- <i>Pandanus odoratissima</i>	t	qadi
- <i>Piliostigma thonningii</i>	t	
- <i>Sagheretia thea</i>	s	'awsaj, zarb
- <i>Szygium gineense</i>	t	
- <i>Tamarindus indicus</i>	t	tamr hindi, homar
- <i>Tamarix aphylla</i>	t	ethl
- <i>Tamarix nilotica</i>	t	ethl
- <i>Tarenna graveolens</i>	s	sir
- <i>Teclea nobilis</i>	t	
- <i>Terminalia brownii</i>	t	go'a
- <i>Trichelia emetica</i>	t	ruqa
- <i>Ziziphus mucronatus</i>	t	'ulab
- <i>Ziziphus spina-christi</i>	t	sidr

#### Climbers:

- *Cassytha filiformis*
- *Caucanthus edulis*
- *Cissus rotundifolia*
- *Commicarpus plumbagineus*
- *Rhoicissus revoilii*

Herbs and grasses at Bura' - unique for Arabia:

- *Gymnema sylvestre*
- *Chloris mensensis*
- *Euphorbia pseudoholstii*
- *Eragrostis tenella*

Endemics of the area [Friis (1983) p, 525-532:]

- *Acaciā abyssinica* var *macroloba*
- *Anisotes trisulcus*
- *Barbeya oleoides*
- *Buxus hildebrandi*
- *Draceana ombet*
- *Juniperus procera*
- *Mimusops laurifolia*
- *Rosa abyssinica*
- *Tarchonanthus camphoratus*

Animals have not explicitly been studied by the forestry department. Some estimated 150 to 200 baboons (*Papio arabicus*, Hamadryas baboon, arab. *qird*, *rubah*) are roosting around at Bura', sometimes inflicting damages to the banana plantations. Their habit to break down the whole banana stalk when "harvesting" explains the disliking of the farmers. Associated to them the leopard. If the specimen shot in 1989 was the last one is not sure. A very shy, but still present animal is the porcupine (*Hystrix indica*, arab. *qumayra*, 'anasa, shibriza, am-shibriza).

The area is exquisite for birds and reptiles. Special are the following three endemics: *Varanus exanthematicus* var. *exanthematicus* (= *Varanus yemensis*) - the monitor lizard, new to the world, discovered at Sukhna in the Bura' region! *Pristurus flavipunktatus* (Geko) and *Agama adranitana* (agama lizard). Moreover there is *Pelobates syriacus* (freshwater terrapin), rare in Arabia.

Even a butterfly new to science has been detected (*Charaxes bernsdorffi*). Totally there are some 55 species in the area.

A local ant species (*dharr*, *qu'as*) is traditionally being collected and transferred to palm trees in the Tihama as predator against harmful insects.

Birdlife is regularly monitored by the ICBP, Cambridge, reports by Evans. The most important are [Evans, M. private comm. 7 may 1995.]:

- Raptors (11 species): Egyptian Vulture, Griffon Vulture, Shikra, Gabar Goshawk, Golden Eagle, Verraux's Eagle, Bonellis Eagle and African Eagle, Owl.
- Afrotropical birds: Arabian Waxbill, Guinefowl, Jacobin Cuckoo, Plain Nightjar, Nubian Nightjar, Black-headed Bush-shrike, Red-eyed Dove and Brown Woodland Warbler.
- Migratory birds of prey: Buzzard, Steppe Eagle.

Bura' has quite strangely been saved from total disappearance so far. The first question was, how could this forest survive there. The main theory was "inclination" (Scholte 1989). But the areas around Ruqub e.g. have an inclination of almost 100% and are terraced. The unhealthy climate is an other reason that has

been mentioned. Malaria is indeed epidemic in the plains and this might be one reason, as several abandoned hamlets could be found even inside the forest area.

But the main reason is surely, that this whole area of Wadi Rigaf and Wadi al Aswad is a family waqf, a donation in favour of the Begelis. Infringements had to be stopped by the administrators already in the time of the Imam. The northern parts of Wadi Rigaf, belonging to Magharib and Bani Baqi, are a waqf as well, but in favour of those villages, but limiting agricultural use and constructions.

Activities have been undertaken on several levels to protect and manage this forest:

Normative: Decrees, forbidding to cut green trees for fuelwood and forbidding clearings.

Agreements: Ali Hanish on the central farm may stay, but has to stop woodcutting and will not enlarge his farm.

With the Begeli Waqf: The area can be managed as National Park. The agreement of the administrator, Muhsin Jahja Ibn Jahja al Begeli has been registered on video the 4.8.1993.

Establishment of guard's house.

Local seedling production with Khamisi = income generation as incentive, the most important means of protection in all Yemen!

Plantations: Sanif as a village woodlot, Mahall al Harb as a bee-range, Wadi Bussal as afforestation and ex-situ conservation trial with natural species. (This one was stopped by tribesman claiming ownership. The matter is still open to discussion, as he did not present any papers substantiating his claim.)

Management of range in Wadi Bussal (Bani Baqi): This will pose the same problems as the introduction of sylvi-"culture". The locals have to be convinced, groups have to be formed, potential ways of "steering" (incentives & control) have to be developed. The technical aspects will again be the easier ones. What concerns "incentives", here again seed collection and direct seeding might create some jobs. What concerns "control", some (limited, on request) assistance from the government will be needed.

#### 4.3.2.2 Mahra

The Mahra governorate is situated just on the border to Oman. Its population and language (*Mehri*) are quite special. Mehri is related with the other South-Arabian languages as *Socotry*, *Gebeli* and *Harsousi*.

Jebel al Houf forms a 60 km long and narrow strip along the coast. It covers a total area of 30,000 ha. Those mountains receive some monsoon rain (up to 1000 mm) - but mostly wet deposits from mist. The time from June to August is described as: windy, hazy, foggy, cloudy and rainy. The soils are so saturated with water, that grazing and any movement is hindered. Large parts of the area being abandoned during this time. The forest-beduins move to the lower fringes of the forest.

After the estimations of 'Hunting Technical Services' the area consists of:

- 5000 ha almost closed *Anogeissus* woodland.
- 640 ha man made parkland.
- 560 ha mosaic of the both.
- 4400 ha *Commiphora-Acacia* woodland
- 3940 ha " " shrubland

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14540 ha  
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Bilaidi [Bilaidi, Al Kod - Report on Mahra, 20 sept. - 4 oct. 1989.] has classified the vegetation as follows:

- *Commiphora - Jatropha* (*dhofarica*) association on an altitude between 0 and 450m.
- *Anogeissus - Tamarindus* association between 500 and 900m, especially along water courses. Used for grazing, lopping and browsing. *Tamarindus* pods are strongly collected for food.
- *Boswellia-Euphorbia* association. Here especially *Olea africana* is overused for timber, fuel and fodder, mainly by lopping. The main species are: *Acacia senegal*, *A. spec.*, *Anogeissus dhofarica* (*A. bentii* after Miller?), *Boscia arabica*, *Commiphora abyssinica*, *C. gileadensis*, *Delonix elata*, *Ficus vasta*, *Maytenus dhofarica*, *Tamarindus indica*.

#### Reported Problems:

Uncontrolled woodcutting, enhanced by a new road and the abolishment of the forest law in the former South-Yemen. Regeneration for the following species is lacking:

- *Olea africana*
- *Anogeissus bentii*: because of its short lived seeds it needs the preparation of the soil by ploughing, especially to remove the herbal cover that is very dense during the rainy season.
- *Tamarindus indica*: seeds are collected as food and regeneration is hampered.
- *Boscia arabica*: seems to be really threatened.

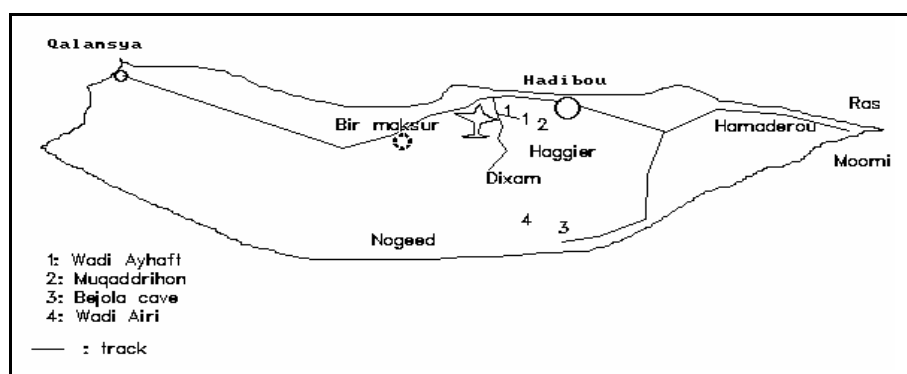
Grazing takes some toll on the forest. Each family owns 10-40 cows, 5-20 camels and 40-250 goats or sheep. Forest, range and pasture are used in traditional ways. While Bilaidi says [ibid p. 9:], that this form of land-use is "*Not at all compatible with new scientific and technological approaches of land-use*", it has to be mentioned, that in Yemen only at Houf and on Socotra traditional methods of range and forest management do survive. Those will have to be studied, as is actually being done on Socotra by Miller/Morris (RBG Edinburg/ Univ. Fife) and A. Jahja (GDFR, Sana'a).

Houf is the focal point of a NATIONAL NATURAL AREAS PROTECTION NETWORK, proposed by the author to GEF (*Global Environmental Facility*). As similar areas exist on the Omani side (Jebel Qarah), some joint transborder initiative was intended. Due to difficulties between the Omani authorities with the UNDP and later on because of the Yemeni war, all activities have been blocked so far.

#### 4.3.2.3 Socotra

Socotra is a small island (3625 km<sup>2</sup>) south-east of Mukallah, at the eastern tip of the Horn of Africa. It receives limited rainfall from the NE monsoon in winter (~ 130mm). The eastern as well as the southern part are much drier than the northern escarpment. During the dry SW monsoon in summer (April to September!) the island is not accessible, neither by ship nor airplane. The strength of the winds can be judged from the depressed growth of the trees (max. 1.5-2m high!) on the coastal plain. A nursery established there by a development project has been blown away! Still, Balfour already described permanent water courses. Such have been found by the april 1992 expedition as well.

The highest elevation is Jebel Haggier with 1419 m. Geologically the baserock is mainly granitic and gneissic. From the scarcity of sedimentary material Bonney (s. Balfour) deducts that Socotra has not been submerged during the Palaeozoic or Mesozoic period, what sustains the idea, that we have here some very old refuge of plants and animals.



The mountain area is encircled by a small coastal plain in the north and a large one in the south (Nogeed Plain).

There are several indications for an early formation (Perm) and separation from the African continent (Cap Guardafui - Tertiary), as:

- Little cover of marine sediments.
- Molluscae of very restricted geographical occurrence.
- Indigenous mammals are absent.
- An insular flora with [s. Balfour, p. lxx:]
  - Relatively large proportion of orders to genera, and of genera to species.
  - Relatively large proportion of endemic species and of endemic genera, and with a considerable amount of endemic variation.
  - Small proportion of endemic annuals.
- Peculiar physiognomy of some species in isolated groups: *Cocculus Balfourii*, *Nirarathamnos socotrana*, *Draceana cinnabari*, *Dendrosycios socotrana*, *Dorstenia gigas*.
- Three conspicuous types of vegetation:
  - dry desert region with intermingled tropical, sub-tropical and sub-temperate forms.
  - tropical
  - relics of a cooler and more temperate climate.
- Plants related with the flora of South-Africa, the Mascarenes, Cap Verde, and even America (*Thamnosma*, *Dirachma*, *Coelocarpus*).

Outstanding Botanical Features: Socotra shelters about 30% endemics, the highest rate in the region. Among the specifically threatened plants are the:

- Cucumber Tree (*Dendrosicyos socotrana* Balf.f.)
- Dragon Blood Tree (*Dracaena cinnabari* Balf.f.)
- *Punica protopunica*, the only relative of the domesticated pomegrenade (*Punica granatum*).

Reported Problems:

- Many plants disappeared reportedly, many (some mentioned above) are under pressure. Already overused trees are e.g.:
  - *Croton socotranus* for construction and fuelwood
- *Dendrosicyos socotranus* shows no regeneration on the coastal plains.
- Local lack of esteem for the unique vegetation (On the simple question, "where do we find some nice forests here ?", some islanders answered: "There are no forests on the island".)
- Partly quite strong grazing pressure and wood collection.
- More and more livestock is left untended, especially on the coast.
- New water storing cisterns (*khariif*) allow grazing during dry season, what leads moreover to a high concentration of goats around the watering points. In general the improvement of the infrastructure, as dams for water supply, port (planned east of Hadibou), airport and roads, as well as the gas and petrol prospection that has started on and offshore will increase the pressure on the natural environment.

Most of those problems are primarily due to the increase of the population. The rapid growth of the settlements on the coast is

leading to a loss of traditional knowledge and rules. The coastal area is profiting from the commercialisation of the rich fish grounds. A major problem for the local fishermen is the lack of facilities, especially of a fast boat needed to control international trawlers. At present the fishing cooperation develops establishes a cold store to improve export facilities. Some "development" was not so successful, as e.g. the telecommunication center. It was built with black and white stones flown in by army airplanes from Sana'a, worked for about three weeks in 1993, then a fuse broke down and had not been replaced half a year later.

The UNDP-run a water supply project. Already one year after the UN-volunteer had left, diesel pumps as well as hand driven pumps had broken down. The hand pumps were a kind of adapted technology: The whole system welded into a case, inaccessible, to protect it from damage by tinkerers and children. Unluckily some damage still happened inside the case and could not be repaired!

The visits by the Ministry of agriculture, the Ministry of planning and FAO did so far not lead to any project, only a "range and livestock improvement project-proposal". Anyhow. Miller & Morris claim, that the islanders are using the environment in a perfectly sustainable way, which they should be awarded for that and that only along the coast the "non-indigenous" (Arabic speaking population) is overusing it. But - The problem is, that two thirds of the population live on the coastal strip already and the proportion is increasing, due to the economic prospects of fishing!

To strengthen the sustainable local way of life as it still exists in the mountains, Socotra has been proposed as a (UNESCO) Man and Biosphere Reserve. As UNESCO does not dispose of funds, projects will mainly depend on GEF. Bilateral donors are unlikly not at ease with Socotra, as it is very remote and communications are difficult.

#### 4.3.2.4 Juniper Remnants

Yemen's Juniper stands are tertiary relics that have adapted to the incredibly harsh conditions of the dry Yemeni mountains. They can survive with as little as 150mm rainfall a year, but do much better in areas with more rainfall and on good soil. The reproduction only happens vegetatively. Seeds have a germination rate of as little as 1-3%. Seedlings are growing very slowly, a few centimeters a year only and they need constant irrigation. They don't survive a "drought" lasting longer than 2-3 weeks, what means that there is no potential for natural regeneration by seeds. But still those relics do represent an inestimable genetic potential for the country that should be cared for. The laboratory trials of the Range and Livestock Improvement Project at Dhamar and Prof. Kenan at Sana'a University succeeded in raising the germination rate to some 20% by stratification, etching by mechanical or chemical treatment.

Jebel Lawz in the Khawlan area, 50km east of Sana'a is the only

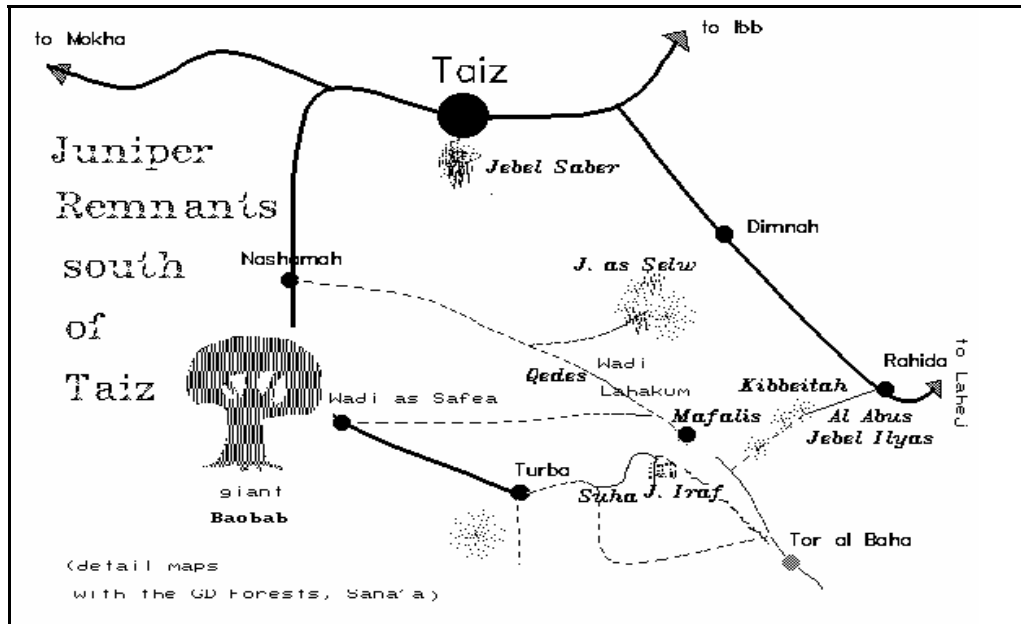
Juniper area that has been thoroughly mapped and studied [Herzog (1990): *Jebel Lawz: Inventory and Technical Management Proposals.*]. It can be reached either from the Dar es Salam checkpoint south of Sana'a on the Jihana road to the east through Al Hadirah, Al Dabat, Shawban, Marbak and Mahallein; or on the new Ma'arib road, the next petrol station past Jihana left, up the wadi and eastwards. The three-pronged fork formed by Jebel Lawz serves always as guide.

Jebel Lawz has a total cover of 264 ha, 220 ha of it dominantly Junipers with 2.4 m<sup>3</sup>/ha, 40 ha Acacias with 3.6 m<sup>3</sup>/ha and 4 ha Juniper-Almond orchards on terraces, showing what height (18m) and volume (125 m<sup>3</sup>/ha) can be reached by this species if soil and water are available. The estimated increase rates show the same picture. The Junipers show a radial increase of only 0.2 to 0.5mm per year(!) what results in 12m<sup>3</sup> for the whole area or 0.06m<sup>3</sup>/ha/y. For the second strata, where Acacias are dominant, the increase rate is some 0.09m<sup>3</sup>/ha/y, while for the Juniper-Almond orchard the radial increase rate is ten times higher (2-5mm) and the increase rate some 12%, 3/4 of what is produced by the Almonds. Those high productivity rates show the potential for wood production, if soil and water are available - as it is the case for abandoned terraces.

Besides the Juniper-Almond system, we only find Tamarix woodlots as traditional farm-forestry. They produce some 9m<sup>3</sup>/ha/y [Saadallah (1988): *Survey and Management of Natural Forests in YAR.*]. Tamarix is not very estimated, as it is a known host for mistletoe, a parasite heavily infesting the Almonds. Among the introduced trees, the "exotics", Schinus molle (*filfil*) is best adapted to the dry Highlands. It is being planted besides houses, roads, in parks and gardens of many villages and at Sana'a. The potential for tree planting at Jebel Lawz is limited. A photo guide, indicating specific ecological micro-niches for plantations, has been distributed along with seedlings. But when during the 1991 drought a man fell into the well and died, tree planting has been "forbidden" as a waste of water and stopped. The forest is still quite estimated and there is a wish to protect it, but the conditions are dire. The workshop in spring 1991 on means of protecting this forest, ended with a request of 12 forest guards! - one for each m<sup>3</sup> the junipers produce per year! It was sent by the project manager to the Ministry of agriculture, without comments or guidance from his part - and as can be imagined, without result. An example indicating a) economical limits of environmental protection, b) the local re-interpretation of forestry development as job creation and c) the cynical approaches international development experts develop over the time.

Protection of the juniper stands has already been initiated before over 50 years by the fathers of the actual sheikhs of Marbak and Mahallein.

The following map indicates roughly the areas where Juniper stands can be found on the Southern Highlands.



Jebel Iraf is situated on the former border between North and South Yemen, northwest of Tor al Baha, between Turba and Rahida. It is one of the most beautiful scenic sites of Yemen and should be included in the list of protectworthy areas. The view over the adjacent southern plains is marvelous. One can see as far as Aden, broiling in the coastal haze.

With some 50 ha it is quite a bit smaller than Qabaytah, but it has a much richer vegetation. The grass grows half a meter high. On the whole plateau there is only one small hamlet. The area is privately owned, except the army facilities near the peak.

It is accessible from Neshemah - Jebel Selw - Khedes - Wadi Lahakum (a remnant of "*Arabia Felix*") or Wadi as Safea, where stands the large **Baobab**, or Turba - Suha - Sureika - Mabaq. The road from Rahida, through Al Abous - Qabaytah - Mafalis can be used as well. It is quite good - but quite long. [A detour through Tor al Baha was always worth while, as before the civil war in 1994 one was always able to get a cold beer there, the excellent local *Sira*.] From Tor al Baha you have to move into the next wadi west and then follow this one northwards to Mabaq - Sukher. There get your last Pepsi and up it goes with an inclination over 30%, the car might start sliding, but earth walls protect it from tumbling over the edge! This was the first time that Abdou, my driver from As Selw, got scared.

Qabaytah (= Kibbeitah) is reached from Tor al Baha, Mafalis, then right; or from Rahida (new road) or Kirsh. The juniper areas in Qabaytah are quite large, but the best protected stands are on Jebel Ilyas, on the former border between North- and South-Yemen. They suffered a bit since the unification as many people moved back to the area to settle there. The roads are generally very good, here were real engineers (from the army) at work! It has been taken care of the runoff-water, that is led off the road at reasonably spaced intersections.

*Juniperus excelsa* and *Tarchonantus camphoratus*, a shrub with whitish, woolly leaves, in Arabic called "*Muqar*", are here associated as in the African mountains (e.g. at Jibouti, *La Forêt du Dail*).

The Junipers on Jebel as Selw grow even at an altitude of 1700m, what proves that their distribution and the lack of regeneration by seeds is not due to the temperature.

Al Abus is only one small watershed (about 30 ha) in an inter-mountain basin with agroforestry and above it some natural stands of Junipers. As well there are (at least) two specimens of *Dracaena (serrulata?)*.

Jebel Saber, above Taiz, presents the most easily accessible Juniper stands, most in private, beautiful agroforestry plots on an altitude of 2700-3000m. It was first mentioned by Botta in 1837. The view on Taiz and the landscape is worth the trip as well! From the road on the northern slope above Taiz you can see a lake north of Taiz. (Well, to be honest, it's not really a lake, it's a wastewater lagoon. But if you are an enthusiastic bird watcher, you might like to visit it. It hosts a lot of birds, some of them very rare, as the Bold Ibis. A similar place is the waste water lagoon North-East of Hudeidah.)

#### Other small juniper stands:

- Halamlam, west of the Sana'a - Amran - Hajjah road, just after the television tower, before the road descends to Kuhlan Affar (Wadi Sherres), turn left (about 3 km) to Halamlam. The most beautiful and impressive agroforestry system with Junipers!
- Jebel Nabi Shuaib (west of Sana'a). Mentioned by Deflers 1887, where he found one crippled specimen on the western slopes. Nowadays probably destroyed. Our driver Muhammed al Haifi knew the place. After his information there is something

- like three trees left.
- Yaslah Pass, mentioned by H. Scott 1937/38. Has in the meantime probably disappeared. New plantations have been done by the British project, with seedlings raised by Dutch livestock project. At the chicken farm, south of the pass, turn left and move a few hundred meters up.
  - Bilad al Bustan, south of Nabi Shuaib, E. Rossi 1939. Praised as very green area. Due to its strong use for fuelwood collection - in spite of the terrific tracks, most probably not in the best shape. The area was only visited once by the project and the car almost overturned. Moreover there are very few larger settlements. Any kind of control will be very difficult.
  - Jebel Aswad (Saada). mapped by P. Scholte. On Jebel Miftah, where areal photos have been taken in 1988, parallel to Bura' and Lawz, only one tree could be identified. The stands near the border have been heavily degraded in the following years. No project activities have ever been started, as the traditional "raids" (*ghazu*) nowadays target cars and no longer camels - and this area is very traditional!  
If relations with Saudi improve, some transborder initiative on Junipers might be started, as in the adjacent Assir mountains parts of the Saudi juniper areas have been put under protection.
  - South of **Turba** several small stands.
  - **Dhamar**, north, mentioned by Scholte.

#### 4.3.2.5 Rare Trees

On the northwestern wing of Bura' a relative of the Socotran Dragon Blood tree (*Dracaena cinnabari*) has been found, the *Dracaena ombet* (*anis*). The village land at Al Khadra and Al Kohl and some private lands (about 30 ha) of Muhammad Hussain and Ahmed Jahja Abdou, where the *Dracaena ombet* stands are, should be put under protection. *Dracaena ombet* is a very rare tree, only growing in Yemen and the Ethiopian Red Sea coast [While the botanists are not really sure, if it is a different species from *Dracaena serrulata*, that is not really rare. Requests to IUCN for information on that have never been answered.]. It would need the assistance of the government (and ev. international aid) to protect this as well as the other threatened species, especially the endemics. A protection law can now be issued in clear accordance with the Islamic law, as proofs the fetwa (no 5) of Zabara.

For *Prosopis cineraria*, a species in the south of Yemen, the potential for agroforestry utilization in the north, especially in the Tihama has to be tested. It is very recommendable to use this stem forming *Prosopis* more often. It has many advantages over the introduced *Prosopis chilensis*, that always stays shrubby and tends to invade agricultural fields. Unluckily the IBPGR study (Guarino) did not lead to any project or other activities. With the ongoing land-redistribution in the area of Maifa'ah,

those stands risk to be converted into agricultural fields! In August 1993 I heard that the Bedouins are preventing farmers from cutting the trees, as they are a highly estimated fodder source for camels. The use by those is very careful. I observed myself children collecting by hand, stripping the leaves from the branches! Still, in view of the political and economic changes that have taken place recently some urgent measures might have to be taken!

THE TREE, the absolutely outstanding one, is the **Baobab** (*Adansonia digitata*, arab: *Shajar Ibn al Gharib* - the "son of the stranger") at Al Barh besides the Taiz-Turba road. It has a circumference of 23m (reported by Evans) or 18m (bhd, as measured by Herzog). By hearsay two more of those giants are reported, in the same area. That there is no regeneration around might be due to different causes, first pollination is done by bats and second the seeds are a very good fodder. The nursery of Taiz has started the production of Baobab seedlings.

The last *Ceiba pentandra* (engl. *Kapok*) was cut at Manakha, Khamis Bani Sad, in 1984 [Reported by J. Evans: *The Yemeni Environment. Notable Trees of Yemen*. Middle East Times/Yemen, Vol X., No. 4., April 1992. p. 5:]. Together with *Antiaris toxicaria* (arab: *khala*), *Nuxia congesta*, *Trema orientalis* this was one of the trees that has been negatively selected. Due to its high quality wood, esp. its long straight bole, it has been reduced to naught by overuse. The cultivation is not easy in Yemen, as all of them are growing (have grown, what concerns the Yemen) in areas of high rainfall (Southern Sudan e.g.). Still it would be worth while to reintroduce it, especially for plantations of wadi banks, parks and gardens.