



Traditional nomadic tending of trees in the Red Sea Hills



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ABSTRACT

There are recurring questions about the ecological sustainability of indigenous resource management and what traditional ecological knowledge and rationale underlie such practices. Pastoral nomads from the Hadandawa, Amar Ar, Bishaari, Ababda and Ma'aza tribes in the Red Sea Hills of Egypt and Sudan have relied on drought persistent *Acacia tortilis* trees for millennia. Presently, political, social and economic factors impose changes in traditional livelihoods and land use. Interviews and long-term field observations have documented traditional practices and underlying ecological knowledge about the use and tending of *A. tortilis* during all its growth-stages. A variety of local pruning practices, previously considered destructive by many outsiders, conform to good practice described in modern literature. Traditional “gardening” of trees protects, strengthens and renews these essential resources – and shapes this (hyper-) arid cultural landscape.

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1. Introduction

During the droughts of the 70s and 80s nomads and pastoralists in African drylands were accused of overexploiting and misusing natural resources in a fragile environment (Lamprey, 1983). Their “inappropriate” land use allegedly caused *desertification* (Davis, 2005; Herrmann and Hutchinson, 2005). Subsequently a better understanding of human influence and dryland ecology has emerged (Homewood and Randall, 2008; Niamir-Fuller, 1999; Vetter, 2005; Westoby et al., 1989). Drylands have been acknowledged to be *cultural landscapes* or *human-environment systems*, both concepts recognizing the importance of human influence and the long-term accumulated ecological

knowledge inherent in land-use systems (Andersen, 2012; Krzywinski and Pierce, 2001; Reynolds et al., 2007). It has also been recognized that researchers need to consider Traditional Ecological Knowledge (TEK) as a potentially important source of scientific information (Berkes, 2008; Davis, 2005; Reynolds et al., 2007).

For millennia nomads have adapted to climatic variability in drylands, with mobility as their key to resources and survival. In arid and hyper-arid areas of the Eastern Sahara, including the Red Sea Hills (RSH), pastoral nomadism has been a wide-spread, well-adapted and sustainable land-use system of great antiquity (diLernia, 2002; Kuper and Kropelin, 2006; Millennium Ecosystem Assessment, 2005). Pastoral nomads have probably moved about there since regional desiccation started around 5500 BP (deMenocal et al., 2000). Inasmuch as available resources have been scarce, their continued use over millennia must have been sustainable (Andersen, 2012). Indigenous populations have had to develop movement patterns, conservation rules and sets of management strategies, including complex rules of land and resource ownership, based upon a rational ecological understanding, and this TEK had to be preserved in collective memory (Berkes, 2008).

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The nomadism practiced in the RSH is based on tradition and territoriality. The nomads' mobility is circumscribed by socially defined rights of access and use that are centered on home areas and extended to more distant and broadly defined areas in response to variations in vegetation and availability of water. The traditions governing rights of use are transmitted orally and by example and exercised within the circles of family, section and tribe, where vital TEK can be seen to underpin the pastoral lifestyle.

TEK in ecosystems governed by slow dynamics, such as are found in arid lands, is of particular scientific interest. Important processes such as regeneration of vegetation normally happen on a decadal scale or even more slowly (Wiegand et al., 2004) and are best observed by people dependent upon them and resident where they occur. They become embedded in indigenous land use management systems and are transferred from generation to generation. However, while ecologically sound management systems, involving both ephemeral and arboreal vegetation, exist among several nomadic groups in North Africa and the Middle East, few are known in detail to the scientific community (Andersen, 2012; Davis, 2005; Hobbs, 1989, 2006).

Among pastoralists moving about in drylands herbs and grasses are a highly valued fodder resource, but limited in both time and space. Trees, on the other hand, are long-lived, drought persistent and green most of the year and thus constitute a vital resource, often aptly referred to as 'multipurpose trees' (Andersen, 2012). Here our focus is on the use and tending of trees among pastoral nomadic tribes in the RSH of Egypt and Sudan, with special reference to the *Acacia tortilis* (Forssk.) Hayne — a species widespread across African and Middle Eastern drylands and of great importance to many pastoral societies (Andersen, 2012; Hobbs, 1989; Lancaster and Lancaster, 1999; Stave et al., 2001). To our knowledge the nomadic tending of trees in the RSH has yet to be described in sufficient detail.

Presently political, social and economic globalization is accelerating in the North African drylands, eliciting changes in society, livelihood and land use (Millennium Ecosystem Assessment, 2005). As indigenous inhabitants depart and assimilate to a modern lifestyle, their land use and tending practices cease (Hobbs, 2007). In particular, the heritage of information that has maintained the millennia old cultural landscape of the RSH risks being lost in only a few generations. In a dryland region where trees recently have been reported to have high mortality and low recruitment (Andersen and Krzywinski, 2007; Shrestha et al., 2003), documenting the ecological knowledge underlying their indigenous management (Andersen, 2012) can be of vital importance for safeguarding these pastoral resources for future generations. Our aim is to record such knowledge while there are still informants who can tell us in their own terms how they understand and carry out their activities.

2. The Red Sea Hills and their inhabitants

The mountains of the RSH in Egypt and Sudan and the deserts adjoining them are a part of the Sahara desert east of the Nile (Fig. 1). There is a regional south to north moisture gradient, ranging from arid in its southern part (around 100 mm mean annual precipitation) to hyper-arid in its northern and central parts (around 10 mm). Despite extremely high spatio-temporal variability in rainfall there is an overall seasonal pattern, with winter rains in the north and both winter and monsoonal summer rain in the south. The whole region has hot summers (mean temperature of hottest month between 20 and 30 °C) and mild winters (mean of coldest month 10–20 °C), unless in the Guunub (Fig. 1) where the winter is warm (mean of coldest month 20–30 °C; Ayyad and Ghabbour, 1985). Phytogeographically the area belongs to the Sahara–Arabian region in the north and the Sahelian in the south,

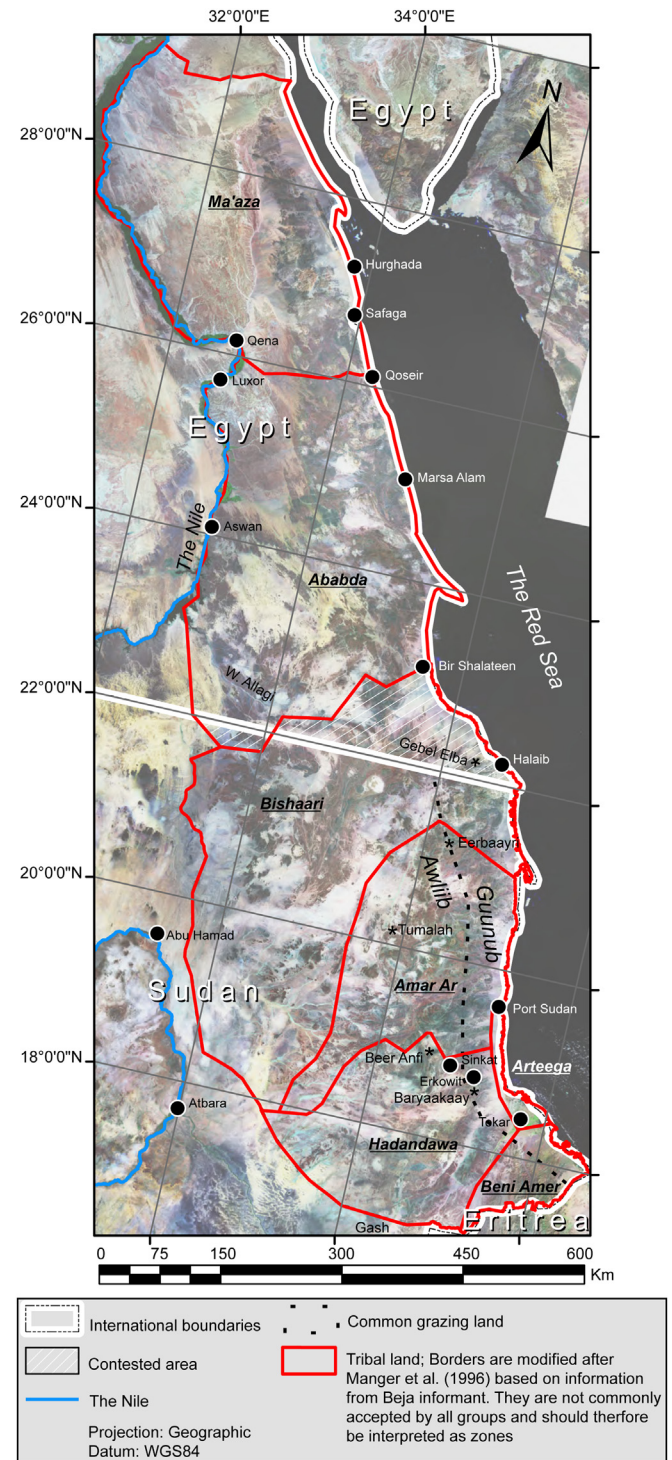


Fig. 1. The Red Sea Hills study area and tribal territories. The Tigre speaking Beni Amer and the Arteega are not included in this study. Among the Beja tribes in Sudan the coastal land receiving winter rain is called the *Guunub*, while the hills and inland desert to the west of the mountains receiving summer or autumn rain are called the *Awliib*. This distinction is important for the seasonal movement patterns. The *Awliib* is further divided into *Eetbay* (the area north of Tumulah to Bir Shalateen on the coast and Wadi Allagi in the west, receiving rains in September and October) and *Tamarab* (the area west of the hills south of Tumulah up to the Atbara River, receiving rains in July and August). Mist and dewfall, generally occur at higher altitudes in the whole RSH and are not confined only to the well-known mist oases at Gebel Elba and Erkowit.

with some elements from the Mediterranean region (Shmida, 1985).

To the east the entire region has a coastal desert plain with patches of mangrove forest and salt marshes. West of this the RSH create a montane desert, intersected by valleys (known locally as wadis or khors). Wide wadis draining west toward the River Nile create an inland desert. After torrential rainfall wadis flood, gradually accumulating deep moist soil layers optimal for sustaining arboreal vegetation (Zahran and Willis, 2009).

A. tortilis is the only permanent, arboreal species frequently occurring throughout the RSH. It is long-lived and drought enduring and constitutes the most important reliable natural resource for local nomads (Andersen, 2012; Krzywinski and Pierce, 2001). It provides products (e.g. fodder, fuel, timber) and services (e.g. shade, shelter) for people and animals, improves soil fertility, increases biodiversity, and can therefore be considered a keystone species (Andersen, 2012; Munzbergova and Ward, 2002).

Only two of the four sub-species of *A. tortilis* are relevant here, i.e. *A. tortilis* subsp. *tortilis* (hereafter referred to as subsp. *tortilis*) and *A. tortilis* subsp. *raddiana* (hereafter subsp. *raddiana*). Subsp. *tortilis* is rarely found in the Ma'aza and northern Ababda territory, and subsp. *raddiana* is rarely found in parts of the Amar Ar region. Subsp. *raddiana* is typically found in wadi beds, while in the southern area subsp. *tortilis* frequently occurs in the drier khors and on hillsides (Zahran and Willis, 2009). For local names of these sub-species and other arboreal species mentioned see Table 1.

The five major nomadic tribes are from north to south the Semitic-Arabic speaking Ma'aza and Ababda, and the Cushitic-Bidhaawyeet speaking Bishaari, Amar Ar and Hadandawa (Fig. 1). The Ma'aza originated in Saudi Arabia and settled in the RSH about 300 years ago (Hobbs, 1989). The Bidhaawyeet speaking tribes lay claim to being autochthonous and to have millennia old cultural ancestors among the Medjay and the Blemmyes (Pierce, 2012). Although now Arabic speakers (but see Riad, 1974), the Ababda share a common heritage with the Bidhaawyeet speaking Beja tribes.

All these tribes exhibit cultural traits that can be recognized as a similar heritage (Barnard and Duistermaat, 2012; Krzywinski, 2012; Krzywinski and Pierce, 2001), e.g. their segmentary kinship structure by which personal identity is rooted in family, clan and tribe. Moreover, all have moved about with their animals, principally to optimize the use of fodder resources and water. The degree and range of their movements have depended on the number and types of their animals (Hjort af Ornäs and Dahl, 1991) and on the aridity gradient which imposes increasingly rigorous demands on the pastoralists' adaptability the further north they live. Thus, the pastoralists' culture has been dynamic, in the past in part based on cattle, but in general relying for millennia on goats, sheep and camels (Arabian). People's survival has been bound up with the survival of their domestic animals, which in turn has been linked to

the abundance and survival of the trees in their tribal lands. Consequently, variation in climate, restrictions on access, and the requirements of animals and vegetation have combined into a complex cultural calculus that has been conveyed by oral tradition.

Today few Ma'aza practice traditional nomadic pastoralism, though until recently most moved about their wide and sparsely populated territory in search of seasonal grazing and water (Hobbs, 1989). The Beja tribes move in the Awliib for seasonal pasture after occasional summer rains, in the Guunub after winter rains, and in their mountain homeland, between khors and wadis, for more permanent arboreal browse (Fig. 1). In years when resources fail groups may move to the common rescue areas where there are trees on alluvial fans at the foothills of the mountains, or to the Gash or Tokar inland deltas, or to the Nile valley. Some people cultivate crops, mainly *durra* (*Sorghum bicolor*), using flood cultivation (sadd; Ar./kirraab; B.). This is increasingly more frequent in the south.

In pursuit of their lifestyle these tribes have long ruled in the Red Sea Hills. Currently, however, under pressure from such factors as governmental settlement policies, marginalization, poverty, globalization and tourism, nomads are abandoning their ancestral lands and nomadic lifestyle (Barnard and Duistermaat, 2012; Hobbs, 2007; Krzywinski and Pierce, 2001).

3. Materials and methods

The present study is based on structured, conversational, open-ended interviews involving clearly presented topics designed to elicit relevant responses that were conducted between autumn 2010 and spring 2013. The information obtained is supplemented by data gathered over more than 25 years of research and observation in the study area. The focused subject of trees was raised in a broader socio-environmental context. The use of common resources is a sensitive topic (Hjort af Ornäs and Dahl, 1991). Outside observers have frequently misconstrued tree tending involving any use of an axe as a destructive practice, and informants might be reluctant to disclose details if they thought their responses might portray their culture negatively. Therefore we always prefaced our interviews with a short presentation of the aims of our research.

All interviews were done in a relaxed, informal atmosphere and always in the local language, either Arabic or Bidhaawyeet, in close cooperation with qualified interpreters. As a rule interviews with male nomads took place where they stayed and in the shadow of their trees. Other tribesmen were often bystanders and joined in, and the proceedings occasionally took on the character of a discussion group, with people pointing out features of interest or drawing in the sand to clarify what they were saying. In keeping with local convention women conducted the interviews with female interviewees. Digital recording was used whenever it was acceptable to the informant.

We had already known some of our key Ma'aza and Hadandawa informants for many years, but most were new contacts made in the field (Table 2). In all cases we were at pains to contact informants who were or had been active nomadic pastoralists. Some were presently settled but had previously lived as nomads. The

Table 1
Scientific and vernacular names (h: Hadandawa, bi: Bishaari) of main tree and shrub species mentioned in the text (fr. abbr. for fruit).

Scientific name	Arabic name	Bidhaawyeet
<i>Acacia tortilis</i> subsp. <i>tortilis</i>	Samour	Saganeeb
<i>Acacia tortilis</i> subsp. <i>raddiana</i>	Sayaal	Tawaay
<i>Acacia ehrenbergiana</i>	Sallam	Dalaw
<i>Balanites aegyptiaca</i>	Heglig, fr.: Lalob	Shashot (h), Shashab (bi), fr.: Lalob
<i>Capparis decidua</i>	Tondob	Sarob
<i>Faidherbia albida</i>	Kharaaz, Haraaz	Kunteeb, Kwinteeb, Kwunti (h.); Kwilinsel, Kwilnti (bi.)
<i>Leptadenia pyrotechnica</i>	Markh	Agwait
<i>Zizyphus spina-christi</i>	Sidr/Nabq	Gabat, fr.: Nabaq

Table 2
Summary of tribal and gender (age) characteristics of informants.

Tribe	#Men	#Women	#Boys	#Girls
Ma'aza	2 (60+)			
Ababda	8 (30–60)	1		1
Bishaari	8 (20–70)	1	2 (16–17)	
Amar Ar	6 (37–70)	6 (40–63)	6 (7–16)	3 (13–16)
Hadandawa	15 (40–70+)	11 (25–60)	2 (7–11)	2 (10–12)

information gathered was based either on informants' own personal experience or on their insight into the activities of the group to which they belonged. The confidentiality and anonymity of informants have been secured in our database.

Special Bidhaawyeet concepts, place names etc. have been transcribed according to Talib and Swackhammer (2010). Central Arabic and Bidhaawyeet words are collected and explained in Appendix.

4. Results

Informants distinguished among and had special terms for different growth stages of *A. tortilis* (Appendix). After first flowering, *A. tortilis* produces pods and other products useful for man, e.g. wood, shade and fuel, and is considered a mature tree. Some informants found it difficult to distinguish between the two subspecies focused on in this study, but a distinctive character highlighted by most informants was the difference in phenology (Fig. 2). When both subspecies are present, they provide fodder products, referred to as *gifts*, throughout almost the entire year. Some informants said that for the animals their pods are like *durra* and their buds like fruit. The period after they shed their leaves is considered critical because it is impossible to distinguish between living and dead trees unless one tests the wood by striking them with an axe. Trees under water stress may look dry/dead for several years, but it is well known that another rain, up to 20 years later, can make them green again.

4.1. Caring for seedlings and weak trees

Informants recognized that consecutive rainfall events (varying from two to five) were important for the establishment and survival of recruits and that normally very few survive long enough to grow into mature individuals. Some informants stressed the importance of protecting seedlings from floods, trampling or being uprooted by browsing goats. Others said that goats did not eat seedlings and that it was floods and wind that damaged them.

Most informants thought it unnecessary to protect seedlings, saying “people don't care” or that it is God's business. Even so, several were familiar with protecting seedlings or actively protected them by “fencing” with stones and/or thorny branches (Andersen and Krzywinski, 2007). An Abadi said fencing serves as a

sign to prevent people doing damage accidentally, for “no one (intentionally) harms the new growing trees”. Helping seedlings by digging small runnels to trap rainwater for them is also mentioned. Both are more commonly done near places where people frequently stay and for seedlings of rare or important species such as *Zizyphus spina-christi*.

People also care for sick or weak trees by covering exposed roots with sand and supporting leaning trees or branches with poles to prevent them from falling. “A leaning tree is like a sick friend”. Attempts are also made to heal sick trees with smoke (from burning dung), based on the knowledge that insects don't like smoke. They also shake or prune to get rid of infected branches, thereby healing and renewing the tree. Of the diseases they try to cure, only wax-scales is considered lethal for the tree according to many informants.

4.2. Trimming young trees (*shiishaknooyt*)

Cutting off branches below canopy height on smaller subsp. *raddiana* was described as cleaning or “causing to attain maturity” (*shiishaknooyt*, B.; Fig. 3). This is done when a tree is considered strong enough to withstand harmful browsing, in order to make it grow faster/better and to strengthen its trunk. This practice gives a tree its typical shape, with one or two trunks and a clearly defined canopy that furnishes good, accessible shade. An “unmatured” tree, something rarely seen, will have dense branches lower down on its trunk which makes access and use difficult. “Maturing” can be done during any season, but an Ababda informant said that it is preferable to do it before the rainy season (September to October) during *Hamar al Oad* (July, Fig. 2) because rain afterwards will strengthen the effect of the “maturing”. The Ma'aza described a similar trimming, called *tas-liih*, which had stopped at least 30 years previously and had been done mainly to trees close to their homes or wells.

4.3. Shaking

Shaking trees, using the shepherd's crook, is a way to harvest seedpods, leaves, buds and flowers, without cutting (Fig. 4). It is done to help small stock, especially young and weak animals and for sheep because they do not climb trees as goats do. It can be done throughout the year, as long as the trees are productive (Fig. 2).

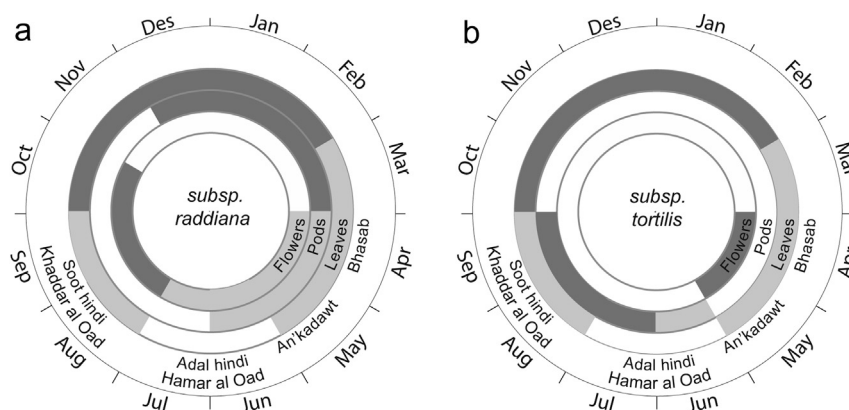


Fig. 2. Phenological calendar of annual availability of fodder products for subsp. *tortilis* (a) and subsp. *raddiana* (b). Dark gray indicates annual distribution of products, light gray its temporal variation and white the absence of products. Subsp. *raddiana* can flower up to three times a year, the first concurrent with the flowering of subsp. *tortilis* but without producing pods. The second time is “in July, when the stars are born, if there is no rain it gives only a few fragrant flowers”. The Ababda call this “false” bud *baram nojom*. A second type produces “real” flowering in August–October. Leaves are shed during the transition between winter and summer, or during *bhasab* (B.). Shedding is also connected with the time of dewfall or after rainfall. When all leaves have fallen, it is *hamar el oad* (Ar.) or *adal hindi* (B). One informant linked the season of greening (*khaddar al oad*; Ar.; *soot hindi*; B.) to when “the wind changes from east to south”. The Ababda refer to the season/time when all pods have fallen from subsp. *raddiana* as *an'kadawt*.



Fig. 3. Trimming a subsp. *raddiana*; before and after. The trimming is typically done when the tree reaches the height of a standing man, i.e. the *shigla* (Ar.) stage. Some Ababda and Hadandawa informants said that unlike browsing by livestock, browsing by hares and donkeys might harm and kill small trees. Cleaning the trunk of lower protective branches should not, therefore, be done before the tree is strong enough. *Balanites aegyptiaca* and *Zizyphus spina-christi* are also “matured”, but not trees of subsp. *tortilis*.

To avoid breaking branches (mainly a problem for subsp. *tortilis*), the shepherd’s crook should be hooked only over strong branches. Branches should not be struck, e.g. with stones, to bring down products because this poses a greater risk of harming the tree. If done with care, shaking “does no harm” and is “good for the tree”.

People used to collect pods to bring to weak animals and kids being weaned (Fig. 4), but now few people grind and/or store pods for longer periods. Several informants said that in order to increase the harvest one should refrain from or minimize shaking during flowering and until pods are ripe.

In some areas (e.g. Baryaakaay; Fig. 1) Hadandawa informants said that they preferred to take flowers that had fallen naturally and that these sufficed for their animals. However, careful shaking is permissible for weak animals. Some informants mentioned that it was important not to shake too much but to leave products for later because “shaking exhausts the products before the end of the season”. Ababda informants were not worried about using up products or interfering with seed production, but one pointed out that newly harvested (*janii*, pruned) trees should not be shaken for 1–2 years because this can reduce or prevent seed production.

4.4. Pruning mature trees

Branches, limbs and twigs are commonly cut off mature trees, either to “renew” them when they are drying, old or “weak” or to harvest fodder (Fig. 5). Previously this was commonly done to subsp. *raddiana* all over the RSH area and still is in many places, though mainly in Sudan. The Beja use the term *waak* for pruning

branches, and to distinguish the two types of *waak* they specify whether this is done to feed animals or to renew a tree. *Waak* for feeding uses only smaller, finger-thick top twigs. For pruning branches for feeding the Ma’aza use the terms *taghsiin* (larger/4 cm in diameter cut with an axe) and *gariid* (finger-thick cut with a knife). *Tahsiin*, meaning beautification, refers to pruning larger branches, e.g. to make the tree better able to withstand strong winds. *Waak* for renewal, which the Beja too describe as “making the tree beautiful”, involves the removal of all dry branches and in some cases all big/main branches (Fig. 5). The Ababda use the term *janii* to describe the removal of branches (normally 4–5 cm in diameter) for either purpose.

The Ababda and the Bishaari prune for both feeding and renewal, but some Ababda said that it is no longer common. Among the Hadandawa informants say that pruning of subsp. *raddiana* is mainly for renewal. For subsp. *tortilis* the rule is not to do *waak*, because the tree would stop growing (or grow too slowly), dry out, or die.

Waak for feeding consists primarily in harvesting unreachable fodder and is normally done during the dry season when animals are hungry and trees still have leaves. It can be repeated after two or three years (Fig. 5). Ababda informants say *janii* pruning for renewal is preferably done during the season of *Hamar al Oad* (see Fig. 2), just before leaf sprouting. A Hadandawa informant said it is done when the trees need it, but not when the southern winds are blowing (risk of rain before wounds heal). *Taghsiin/gariid* pruning can be done any time during a dry period, and can be repeated every year because it is done only to small parts of the tree. *Tahsiin*

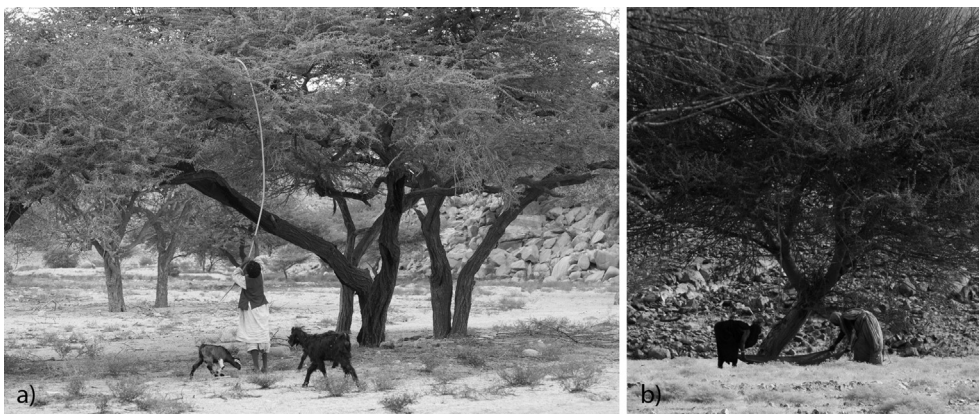


Fig. 4. Shaking for fodder (a) and collection of pods (b). (a) When the herder puts his crook (*mahjan*; Ar./*antiir*; B.) in a tree livestock go under the canopy and wait for fodder to fall down. A side effect of shaking is cleaning the tree from dry branches, dust and insects. The *mahjan* is also used directly to pick off dry branches that don’t fall when shaken. (b) People put a cloth on the ground to collect pods to bring to livestock. Storing collected pods was said to have been a common practice in the past. Dry pods could be stored from a couple of months up to a year, but after the next rain they were not good for the animals. Sometimes one tree can give more than two sacks of pods.

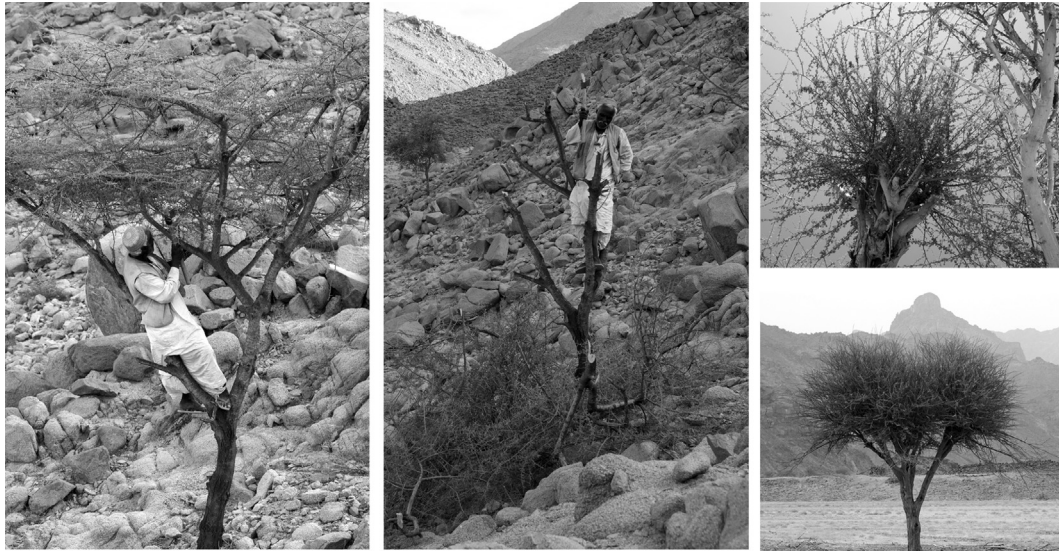


Fig. 5. Waak and regrowth stages. Renewal waak is done to a subsp. *raddiana* by axe (*malawt*; B.). It is customary to ask the tree for permission and to state the reason for coming, e.g. by saying *talabeen salam/talabenn e'ash*, literally “we ask for peace/we ask for living” or by invoking “the Name of God, the Compassionate the Merciful” (*Bism Allah al-Rahman al-Rahim*). *Waak* for renewal might remove all branches at once. This is not the case when branches are cut for feeding. It can become green and healthy already after 5 months, giving a dense growth of branches and after two or three years the branches produce flowers and pods and can be cut again. *Waak* for feeding is also done to such species as *Zizyphus spina-christi*, *Balanites aegyptiaca*, *Faidherbia albida* and *Capparis decidua*. Among the Ma’aza, people also practiced *gariid* on *Leptadenia pyrotechnica*.

pruning, however, can be done only in wintertime. Some people only did *waak* to renew trees they thought would dry out anyway, and therefore success was not guaranteed. The same informants disliked *waak* of subsp. *raddiana* for feeding, and said that it is an irrational use of resources or brings bad luck. Even so, they made an exception for hungry animals.

Performing *waak* requires skill. It should be done with a few strokes that leave clean cuts and don’t split the bark, thus preventing water from entering cracks and causing the wood to decay. A branch should be cut some centimeters below where it is dry. Ababda informants said that if a branch was cut too close to its base/collar, it would not grow back or that air would “go inside and harm the tree badly”. Branches should not be broken off. It is a common belief that poor pruning prevents regrowth and too much causes desiccation. The Ababda immediately sell camels that harm subsp. *raddiana* by breaking off branches.

The majority of informants said that pruning is good for a tree because it cleans it of dry branches, renews it, and keeps it “lighter” and young. With regular pruning the canopy of a tree is shaped and defined in size. Informants all across the region said that if pruning stopped, the tree would grow wildly, become “mad”, grow long heavy branches and dry out or fall/break due to the effects of wind or floods. “If you go to a wadi with no people in it, you will find that the trees look bad and dense because of dry wood,” one man reported; “You will feel that the trees cannot breathe”. According to some informants this implies that pruned trees have a longer lifespan than those left untouched.

The branches left over from pruning dry out on the ground and are normally used for firewood. Our key Ma’aza informant was the only one who mentioned two other uses of such branches, crushing the dried wood to feed small stock and making cordage from green bark (but see El-Awad, 1994).

4.5. Division of labor. Gender and age

Trimming and pruning are the domain of men, while women and children do most of the shaking. Both genders can perform each other’s tasks if “needed”. Children start helping with animals,

in particular young goats, from about the age of 5 (herding, milking and watering). They also shake and collect pods. Young boys follow their fathers and learn pruning from them.

5. Discussion

All informants expressed the importance of trees for their pastoral subsistence. This is evident in the efforts expended on trees, from seedling stage throughout the lifecycle, and most aptly summed up when a Hadandawa said, “When the last tree is gone, it is the end of the world.”

The particular importance of the two different subspecies of *A. tortilis* in focus here is due to their dominance in the Red Sea Hills cultural landscape. Another important point is their different but complementary phenology which secures provision of fodder throughout almost the whole year. Subsp. *tortilis* is highly valued for providing nutritious pods during the dry season. Both subspecies are comparable in nutrient values to another highly valued fodder tree, *Faidherbia albida* (Le Houérou, 1980; Miehe, 1986). The Maasai of Kenya also recognize *A. tortilis* as the best species for fodder for cattle, sheep, goats and donkeys (Kiptot, 2007).

5.1. Caring for seedlings and weak trees

The germination of *A. tortilis* seeds is enhanced by digestion by animals. Hence, simply keeping domesticated animals supports tree regeneration (Reid and Ellis, 1995; Wiegand et al., 2004), and this is well known among our informants and is also part of the TEK of the Turkana (Kenya; Stave et al., 2007).

The establishment of recruits is a bottleneck for long-term viability of tree populations (Andersen and Krzywinski, 2007; Wiegand et al., 2004). Protection of seedlings therefore makes ecological sense. Several reasons, partly contradictory, are given for and against protection. One informant said specifically that it is done to prevent accidental damage, for no one harms young growing trees, and several said that goats do not destroy seedlings. The popular notion that overgrazing is an inherent problem for dryland pastoralism has been challenged under the disequilibrium

paradigm (Homewood and Randall, 2008; Niamir-Fuller, 1999). Nevertheless, overgrazing may still be a problem for the establishment of recruits when nomadic movement is restricted or ceases (Wiegand et al., 2004). Studies of TEK have found, however, that overgrazing seedlings is not a major concern (Stave et al., 2007), for “if [goats] are herded properly ... they eat only leaves and pass on quickly; the stem [of young trees] regenerates” (Lancaster and Lancaster, 1999, p. 175). Some of our informants’ statements support this view, and fast-moving herding is often to be seen in the field. Traditionally, herding small stock is one of the normal responsibilities for children. They take different routes each morning and veritably run with the animals while playing, thus reducing chances for overgrazing. This traditional herding regime combined with the great ability of seedlings and saplings to resprout also prevents overgrazing (Andersen and Krzywinski, 2007; Bond and Midgley, 2001).

5.2. Trimming young trees

“Maturing” young trees is rather similar to “shredding” as referred to by (Rackham, 1976). We have not found any reference to or relevant study on this practice in any other comparable environment, but in gardening it is basic knowledge that trees should be pruned from their early stages to obtain a strong and functional structure (Gilman, 2011). It may be maturing that gives subsp. *raddiana* its characteristic shape (one main trunk and rounded crown) as described in botanical literature and floras (Boulos, 1999). This practice seems to be disappearing among Beja and Ababda groups, and is already lost among the Ma’aza.

5.3. Shaking

Shaking is the least potentially harmful technique, but it is still recognized that it involves some risk and should be done with care. Among the Beja it is therefore preferably done by women and children. Some informants feared that shaking would remove products from a tree too quickly and that this might harm reproductive potential by taking pods before they are ripe. No specific rules were mentioned in this regard, although such rules are known from other arid grazing systems (Davis, 2005; Hobbs, 2006). For example, the Turkana prohibit outsiders from shaking lest they harm trees (Kenya; Stave et al., 2001). Our Ababda informants showed no concern about using too many tree products, perhaps because now there are many trees but few nomads. There are still a few Ababda who practice shaking and try to combine it with a “modern” life, for example by transporting collected pods by car; and many Beja still collect pods.

5.4. Pruning mature trees

Pruning for harvesting fodder is evidently an old tending practice, depicted as early as the Egyptian New Kingdom (1539–1075 BCE; Andersen, 2012). It seems reasonable to assume that this took place at that time among pastoralists in the dryland bordering the Nile Valley. Among the Beja and Ababda pruning is the most radical intervention involved in normal tree tending. Previous studies show that it is common in the RSH, and in certain areas every tree exhibits traces of it (Krzywinski and Pierce, 2001). Presently pruning mature trees is most in evidence among the Bishaari and Amar Ar in the Eetbay, where trees can be seen in varying stages of regrowth (Fig. 5). Among the Ma’aza, an informant thought only a few elders still pruned trees, though it had been common in the 1940s and 50s. Pruning, as described by our informants and observed in field, is most similar to pollarding, a practice well-known both historically and presently in more humid areas (Le

Houérou, 1980; Miede, 1986; Petit, 2003; Petit and Watkins, 2003; Rackham, 1976).

Fear of harming trees seems to be why there are rules about how to prune: a rotation cycle of at least 2–3 years, a preferred season for cutting, and clean cutting only branches of a certain thickness only at certain places on them. Smaller finger-thick branches, without heartwood are preferred for pruning for fodder, while for renewal more radical cutting of branches up to 5 cm in diameter is done. For pruning European deciduous trees clean cutting of 5 cm thick branches (10 cm for strong compartmentalizing trees) is recommended (Dujesiefken and Stobbe, 2002), and the collar of the branch should be left intact (Shigo, 1984). Cutting off larger branches or injuring the collar increases the risk of infections (op. cit.). Although there is great variation in the details we learned from our informants, their “rules” approximate recommended practices (Dujesiefken and Stobbe, 2002; Gilman, 2011; Shigo, 1984).

The attitude among scholars towards traditional pollarding of trees shifted in a negative direction at the end of the eighteenth century (Petit and Watkins, 2003). This may have influenced western travelers in the 19th and 20th centuries as pollarding and lopping were counted among destructive activities, accused of retarding growth, being too intensively and carelessly performed, and leading to the death of trees (Floyer, 1893, p. 419; Jennings-Bramly 1910–11, as cited in; Hjort af Ornäs and Dahl, 1991; Miede, 1986; Piot, 1980). An experimental study has, however, concluded that intensive/yearly lopping/pollarding of *Acacia seyal* is harmful; pruning branches without heartwood was “what should be aimed for” (Piot, 1980).

Characteristics of dryland trees, such as longevity, resprouting, dense and highly impregnated wood resistant to infections (Andersen, 2012; Bond and Midgley, 2001) are adaptations that probably increase the capacity of these trees to respond positively to pruning. Acacias are also strong compartmentalizers, i.e. are able to seal wounds (Gilman, 2011). Nevertheless, it is well known among our informants that *waak* can be done harmfully, i.e. like topping (op. cit.). We have not, however, been able to cross-reference our interview information with field studies of the long-term performance of pruned trees.

Other indications of rational pruning suited to the local environment are cutting only branches out of reach for the small stock and/or camels, and not cutting branches off un-/low-productive subsp. *tortilis*. In the mist-influenced and species rich mountainous area of Baryaakaay, only “renewal” pruning is done, apparently because it is better to “store” abundant leaves on the trees. Informants reasoned that more intensive pruning for feeding is also possible where deep and permanent soil moisture is available.

Informants thought greater vegetative and fruit productivity from younger rather than older shoots/branches were positive effects of pruning. Such effects are achieved actively in, e.g. gardening and fruit-production (Tromp et al., 2005), although excessive sprouting is a negative side-effect of overly hard cutting that can eventually starve out a tree (Gilman, 2011). Another positive effect claimed by informants is the increased longevity of pollarded trees. This is also well known from e.g. ancient European oaks and explained by the fact that pollarding intervenes in a tree’s commitment to sustain a large biomass (Rackham, 1976). A reduced canopy will obviously make a tree more resistant to uprooting by strong winds and floods, and will result in a reduced transpiration rate that is an advantage during the frequent dry periods (Tromp et al., 2005). Longevity in dryland trees secures viable populations during recruitment ‘bottlenecks’ (Andersen, 2012), and continued renewal of branches by pruning prolongs the production of viable seeds.

5.5. Outlook

The tribes in the study area draw on a common heritage in tree tending, for, as an Abadi said, “all tribes ... live by the acacia (*sayaal*)”. There are, however, clear differences in the degree of tending practiced within the RSH.

Across tribes the Ma'aza and Beja exhibit two distinct stages in an on-going process of change. While both knowledge and practice are alive among rural Beja, there are almost no active pastoral nomad Ma'aza who know and follow old tending practices today. During the past half-century, as far as the Ma'aza have relied on trees they have only exploited them by shaking. Their tribal trees, however, already show signs of less use, in that they have a dense canopy, show no sign of recent trimming and have many dry branches. The limited information we obtained about the practice of pruning (*gariid*, *taghsiin*, *tahsiin*) and trimming (*tasliih*) among the Ma'aza was only gleaned after very direct questions and comparison with visual material of TEK gathered from the Ababda and Beja. Details are few, for our main informant had already settled in the 1970s.

Across generations there is a clear tendency for older informants to be pessimistic about the future of pastoralism, land use and tree tending. For instance, older informants said that the young are too busy, indifferent or lazy to do “maturing” of young trees although it is an important investment in the future. “Everyone cares for his own trees, but the young generations say, “What you are doing makes no sense, you should go to the town.” Still, some think that the young who leave for school will come back to their mountain homeland because “they have no other place to live.”

6. Conclusions

The five main nomadic pastoral tribes in the RSH of Eastern Sahara, the Hadandawa, Amar Ar, Bishaari, Ababda and Ma'aza, utilize, shape, and tend their vital *A. tortilis* trees during all their growth-stages. These time-honored practices may fairly be said to preserve an early stage in the development of arid land forestry. A variety of local practices — trimming (*shiishaknooyt* and *tasliih*) and pruning (*waak*, *janii*, *gariid*, *taghsiin* and *tahsiin*) — considered to be destructive by many outsiders, demonstrably conform to good pruning practices as described in modern literature. We can only speculate whether these practices actually increase the survival of trees, but the traditional “gardening” of trees still practiced in the RSH, in particular among the Beja, clearly has beneficial effects that undoubtedly protect, strengthen and renew the trees. This is how the desert dwellers have given form to their cultural landscape.

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Appendix. Local names and terms in Bidhaawyeet (B.) and Arabic (Ar.).

Name/term	Explanation
Adal hindi (B.)	“Red tree”. Refers to the period when all leaves are shed, and to the reddish color of the bare branches.
An'kadawt (B.)	The time when all pods have fallen from subsp. <i>raddiana</i> .
Awliib (B.)	Seasonal pasture area west of the Red Sea Hills, receiving summer and autumn rain.
Baram nojom (Ar.)	Flower bud, coming in June, only produced by some subsp. <i>raddiana</i> and not producing pods.
Bhasab (B.)	A short season from about mid March to the end of April, referring to the shedding of leaves.
Dehanoot (B.)	An adjective, used of a tree grown as tall as a sitting man, referring to the first stage of maturity and virginity, indicating that the tree has not yet produced any flowers or pods, the age of giving flowers being the age of puberty.
Durra (B.)	The cereal grain of <i>Sorghum bicolor</i> , used for bread and porridge in Sudan.
Eera saganeeb (B.)	Sapling of subsp. <i>raddiana</i> ; used by some Beja, with reference to the marked whiteness (<i>eera</i>) of its thorns compared to those of subsp. <i>tortilis</i> .
Gariid (Ar.)	Pruning of trees (smaller branches cut with a knife, among the Ma'aza), meaning “cuttings”, “chips” or “shavings”.
Guunub (B.)	Seasonal pasture area east of the Red Sea Hills, receiving winter rain.
Hamar el Oad (Ar.)	Period when all leaves are shed, related to the reddish color of the branch.
Janii (Ar.)	Pruning of trees (among Ababda), literally “harvesting”.
Khaddar el Oad (Ar.)	Season of greening, related to the color of branches.
Kirraab (B.)	Construction made of naturally occurring local sediments to slow down or harvest water for agricultural purpose.
Mahjan (Ar.)	Long stick used for shaking, the herder's crook.
Mirruug (B.)	“Shaking”, noun.
Mahrak (Ar.)	“Shaking”, noun.
Malawt (B.)	A small, sharp axe.
Mharagt (B.)	Staff used for shaking, the herder's crook. Also called <i>antiir</i> .
Sadd (Ar.)	Construction made of naturally occurring local sediments to harvest water for agricultural purpose.
Saganeeb (B.)	Mature individual of subsp. <i>tortilis</i> .
Samour (Ar.)	Mature individual of subsp. <i>tortilis</i> .
Sayaal (Ar.)	Mature individual of subsp. <i>raddiana</i> .
Shigilt (B.)	Small tree; among the Beja tribes this stage is defined as the size of a sitting bird (eagle).
Shigla(s)/Shigil (pl) (Ar.)	Small tree; among the Ababda this expression is used until a tree reaches the size of a man.
Shiishaknooyt (B.)	A noun denoting action, derived from the causative stem of the verb <i>shikin</i> (attain maturity), meaning “causing something to attain maturity” and used with reference to trimming lower branches from the trunks of young subsp. <i>raddiana</i> to help them mature.
Soot hindi (B.)	Season of greening, related to the color of branches.
Taghsiin (Ar.)	Pruning with an axe to remove larger branches than those cut off by <i>gariid</i> (among Ma'aza), meaning some variant of “branching out,” “spreading out,” “growing” or “growth”.
Tahsiin (Ar.)	Used about pruning trees e.g. to make them better able to withstand wind, only done during wintertime; meaning embellishment, beautification, improvement, refining or processing.
Tasliih (Ar.)	From the Arabic verb “to repair”— used with reference to trimming the trunk of a tree and cleaning the ground under it to make it accessible for people and livestock; similar to <i>shiishaknooyt</i> .
Tawaay (B.)	Mature individual of subsp. <i>raddiana</i> .
Waak (B.)	“Cutting”; pruning trees with an axe (branches are up to ca. 5 cm in diameter), used for either harvesting fodder or “renewing” a tree.

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