Artificial Selection and Camel Management in Dhofar: a Feasible Analogy of the Prehistoric Practices

Ali Tigani ElMahi

Abstract: *In Dhofar, the traditional camel pastoralists continuously carry out artificial selection on their animals. This practice is part of the herds management, which targets certain essential objectives related to well-being of camels' herds and the herdsmen. The objective of this selection is to produce female camels that are good milking and males, which are good looking and decedents of good productive mothers. Artificial selection practice was examined through informal interviews with the traditional camel pastoralists in Dhofar. It is to perceive and comprehend its nature, the purpose and the reason for which it is very frequently carried out. Simultaneously, the paper examines the possibilities of artificial selection practice by prehistoric camel herdsmen in Dhofar. The traditional practice of selection can potentially offer a reasonable analogy for the prehistoric camel management.*

Keywords: *Camel, Camel Herdsmen, Animals, Dhofar, Oman .*

Introduction

Dhofar region is located in southern Oman touching the western bounders of Yemen (Fig. 1). Historical records indicate that it is an ancient region and had different human contacts. The various archaeological evidence attests early human groups occupying Dhofar from the Stone Age. The Indian Ocean and South Asia monsoon winds have created an exceptional ecological biotope in Dhofar. It is recognized that the monsoon winds first became strong around 8 million years ago (cf. Clift, Clark and Royden 2008-5-27).

Yearly, from June to September, the monsoon winds pass fog to Dhofar's high mountains, which then cause heavy rains and the growth of an ecoregion with dense woodland and lush vegetation.

In this environment, pastoral groups of camel and goats mainly inhabit and move seasonally within the vicinity of the region. On the other hand, cattle are found in high certain locations in Dhofar where their owners settle in particular areas. Only severe climatic conditions that rarely make them move with their animals.

In the following tables, ElMahi (2010: Table 3a and 3b, P.22) recorded the seasonal movements of the Dhofari pastoralists with their animals in Dhofar region.

Table 3a (ElMahi 2010: 22)

Season	animal	Area of distribution North and South of Jabal Gara
Winter/ summer	cattle	Al Khatum and Al Qatan
Winter/ summer	camels	Foothills and Al Qatan
Winter/ summer	goats	Foothills and escarpments

Table 3b (ElMahi 2010: 22)

Season	animal	Area of distribution North and South of Jabal Gara
Khareef Rainy season	cattle	Al Qatan, Al Khatum, Foothills and occasionally coastal plains

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Fig. 1: Dhofar region, Sultanate of Oman

Khareef Rainy season	camels	coastal plains and Al Nejad
Khareef Rainy season	goats	Foothills, coastal plains, and Al Nejad

In Dhofar, traditional pastoralists of camels and goats manage their herds through inherited aboriginal ways and methods. The management ways and methods developed through the pastoralists' long experience of acquaintance with and knowledge of their environment conditions. Indeed, this traditional animal management is an actual fixed procedure, often according to a definite established, logical, or systematic plan. It serves as a foundation for the welfare of both the herdsmen and the animals. Thus, it is part of their indigenous knowledge, which makes their management an early known expertise of its kind in the region. It provides and ensures long terms of advantages and secure persistence. In fact, traditional ways, and methods of managing the herds have always been part of the pastoralists' indigenous knowledge. Therefore, animal herds are continuously managed under the traditional knowledge of the Dhofari herdsmen.

In Oman, the traditional herds' management involves many procedures followed in achieving an end, which is for both the herdsmen and animals' benefits. Therefore, in Dhofar it is a customary pattern of arrangements in accordance with customs and traditional management of the herds.

This paper focusses mainly on the camel management and discusses one of the herds' management procedures, namely the implementation of artificial selection in the herds. It is the deliberate selection of particular features and qualities in the animals.

The Dhofari pastoralists are usually engaged in carrying out and conducting artificial selection on their herds. Yet, what is artificial selection? This paper will discuss artificial selection as part of the Dhofari camel pastoralists practices in managing their animals.

Moreover, the paper discusses the possibility that the practices of artificial selection by the current Dhofari traditional camel pastoralists can logically be an analogy with the prehistoric camel herders in Dhofar. Zarins (2oo1: 154) suggested that camel herders were found in Dhofar sometime after 1000 BC. However, the prehistoric camel herders did not leave behind any material evidence for archaeological investigations to unearth. Accordingly, it would be useful to examine artificial selection among the traditional Dhofari camels' herdsmen in detail, and subsequently, examine the possibility of a reasonable analogy in the practice of artificial selection between the traditional Dhofari camel herders and their prehistoric ancestors.

Artificial selection

It is necessary to contemplate the definition of natural selection before proceeding with this attempt. The definition of natural selection is quoted in the following details:

‘’Natural selection is the process through which species adapt to their environments. It is the engine that drives evolution. (cf.https://education.nationalgeographic.org/resource/natural-selection/).’’

‘‘Natural selection is the differential survival and reproduction of individuals due to differences in phenotype. It is a key mechanism of evolution, the change in the he ritable traits characteristic of a population over generations. Charles Darwin popularised the term “natural selection”, contrasting it with artificial selection, which is intentional, whereas natural selection is not.’’ (cf. https://en.wikipedia.org/wiki/Natural_selection).’’

‘’Natural selection is any selection process that occurs as a result of an organism’s ability to adapt to its surroundings. Artificial selection, on the other hand, is selective breeding that is imposed by an external entity, usually humans, in order to enhance the frequency of desirable features (cf. Understanding Evolution.’’

(cf.https://evolution.berkeley.edu/evolution-101/mechanisms-the-processes-of-evolution/artificial-selection/#:~:text=Farmers%20and%20breeders%20allowed%20only,which%20organisms%20get%20to%20reproduce.)’’

On the other hand, artificial selection is the process of humans seeking certain visible physical traits and production quality in the animals in order to produce offspring with such desired qualities. Therefore, artificial selection is neither related to survival the of the animal in certain environment, nor to the process of evolution. Indeed, it is the selection by mankind imposing it on certain animals against the selection of nature.

At a certain time during the Stone Age, the ecological interaction between man and certain animals changed over from predation to a completely different interaction. It started by unintended taming of some animals and eventually led to the domestication of these animals.

Bökönyi (1969:119) expressed the following:

“The capture and taming by man of animals of a species with particular behavioural characteristics, their removal from their natural living area and breeding community, and their maintenance under controlled breeding conditions for profit”

Therefore, domestication of tamed animals started when man interfered in the mating of these animals. It was by allowing certain male animals to mate and impede others. In essence, by this action man interfered and ended the process of natural selection in the genetic of the animals in his possession.

In addition, man imposed artificial selection on these animals by controlling their breeding. Therefore, the genetic of the domesticated animals was determined by artificial selection, which was imposed and managed for some practical purposes in the interest of man. Usually, artificial selection serves the characteristics of the animals’ physical appearance and productivity.

Henceforth, artificial selection is the process by which the pastoralists use animal breeding to develop by choice particular phenotypic traits. In effect, the herdsmen choose certain animal males to reproduce and have offspring together. The phenotypic is observable properties of an organism that are produced by the interaction of the genotype and the environment (cf. https://en.wikipedia.org/wiki/Selective_breeding).

This is a well-established practice and tradition among the camel and the goat herdsmen in Dhofar. In this management, the Dhofari camel pastoralists keep only one selected male in the herd. The selected male must have good physical and productive qualities. Such qualities necessitate that the male must be a descendant of good-milking females.

The question is why the traditional pastoralists in Dhofar intervene in the reproduction of their animals and permit only certain animals to breed? Among the Dhofari pastoralists, it is a common process in the breeding of animals, which they choose to maintain animals with certain opportune inheritable characteristics, which are suitable

and convenient for their particular occurrence.

The traditional camel pastoralists in Oman

In Dhofar, seven tribal groups take the camel as their key animal (cf. Janzen 1986 and ElMahi 2013):

[1] Bait Mashani.
[2] Bait Shahrah
[3] Al-Mashieki
[4] Al-Kathir (Jabal)
[5] Al-Mahra (Jabal)
[6] Al-Mahra (Nejd)
[7] Bait Khathir (Nejd)

The following table (1) shows the traditional camel pastoralists and their areas in Dhofar.

Table (1)

No.	Tribe group	Main areas
1		
2	Bait Mashani	Jabal al Qara
3	Bait Shahrah	Jabal al Qara + Qamr
4	Al-Mashieki	East of Jabal al Qara
5	Al-Kathir (Jabal	West of al Qara Jabal
6	Al Mahra	Barbazoon
7	Bait Khathir	Dhaboon & west

Among these tribal groups in Dhofar, the camel is highly appreciated and plays a central role in their life; not for being a source of food or a means of transport, but primarily for being the portrayal of wealth, prestige, and pride. In fact, camels are a measuring rod of the tribal status. Camels have gained a distinguished position in the pastoral culture, and they became an integral part of the cultural system in Dhofar pastoral environment. They are a means of endurance, admiration, and tribal privilege. Consequently, the Dhofari pastoralists give each camel in the herd a name. The pastoralists stress that each camel knows its name. In fact, the names describe the camel behaviour, physical features, and appearance. ElMahi (2013) studied these traditional camel pastoralists and concluded that the camel names are attentively selected. Furthermore, ElMahi (ibid.) documented the camels' names in Jabal al Gara, where the camels' owners believe that their names are form the bloodline of their animals. In fact, the action of giving names to the camels is an integrated element in camel management. Equally, it is part of the camel pastoralists' culture. The following table (2) contains the names in Arabic, English, and their meanings (cf. ElMahi 2013: table 7).

Table 2

Ser.	Name in English	Meaning of the name	Gender	Arabic name
1	Shebi	Not known	Female	شبي
2	Farha	Joy	Female	فرحة
3	Ashm	Optimistic expectation	Female	عشم
4	Sugira	Small	Female	صغيرة
5	Damah	Tear	Female	دمعة
6	Huglwnat	half- breed	Female	المهجن هجلونت
7	Ruseen	Not known	Female	روسين
8	Shohar	Not known	Female	شوهار
9	Mashrat	Not known	Female	مشريت
10	Safrir	شجرة شجرة وردة الصفار البضح	Female	صفرير
11	Ankab	Not known	Female	أنخب
12	Aroul	Not known	Female	أرول
13	Ambear	Not known	Female	عمبير
14	Aromi	Not known	Female	ارومي
15	Hanat	Not known		هنيت
16	Tafuf	Not known	Female	طفوف
17	Mugna	Not known	Female	مجنع
18	Aroham	Not known	Female	أروهم
19	Gazala	Gazelle	Female	غزالة
20	Maroks	Not known	Female	مروكس
21	Tumar	Not known	Female	تومار
22	Muagbat	Not known	Female	معجبت
23	Dargt	Not known	Female	ضرقت
24	Harir	Silk	Female	حرير

25	Qasi	Hard	Female	قسي
26	Duha	Dawn	Female	ضحى
27	Taieb	Kind or nice or good	Female	طيب

The herd management among the traditional camel pastoralists targets certain characteristics in the animals. Therefore, every herd of camels or goats has one single male. As a result, the herd whether camels or goats consists of females and one male. It is a constant and persistent tradition and practice among these pastoralists in Dhofar.

In Dhofar, informal interviews (El Mahi, 2013) took place with the camel herdsmen from 2008 until 2011. Meeting and talking to elderly herdsmen were advantageous and as it would cast light on those herdsmen's intentions and ambitions behind the application of artificial selection on their herds. The design and purpose of artificial selection is to ensure the good physical quality and productivity of their animals. Therefore, the male camel and buck must be carefully chosen and of a higher trait (Fig. 2). The elderly herdsmen emphasized that this particular male must be the descendant of well-known ancestors. His mother and grandmother must have been known for being productive. Again, the elderly Dhofari herdsmen stress that the father must have been good-looking and well sized, since the coming calves would generate the herd (Fig. 3). Accordingly, the elderly herdsmen pointed out that the potential female camels or goats are closely kept under observation before and after their pregnancy. These females are watched from the carrying of young in the uterus from conception to delivery.

To guarantee this management and fulfill its purpose, the Dhofari camel pastoralists keep a close eye on pregnant females. It is known that on delivery, a female camel habitually goes away from the herd. The herdsman, his wife and

Fig. 2: A newly born male calf is kept away fom his mother and fed by a bottle.

Fig. 3: A male camel with evident stature, physique and descended from a thoroughbred line.

two of his children follow closely this pregnant one. On delivery time, the pregnant camel will lay down on one side. Immediately, the wife of the herdsman covers the head and eyes of the camel, while the father sits facing the back of the camel to pull the newborn calf. One of the children will bring a female camel and her calf, which was born few days ago. The second one will stand ready close to his or her father while helping the newly born calf out. Once the

herdsman pulls out the newborn calf out, he takes off the placenta from it. He examines it and if it is a male, one of his children takes it far away from his mother. Again, one of his children will bring him a newly born calf of another camel and he covers it with the placenta; the placenta is a sac-shaped organ that attaches the embryo or fetus to the uterus during pregnancy in most mammals.

Then, the herdsman's wife will remove the cloth from the camel's eyes to smell and lick the calf covered by the placenta, and then allows to feed it. Thus, this female calf has two mothers to feed her, simply because she is a female. The new male calf is kept away and fed milk by a container like a bottle and kept away for sale or to use for food (Fig. 2).

This practice and arrangement highlight the sagacity and prudence in the traditional management of camel herds in Dhofar. Consequently, it is to maintain only females to constitute and form the whole herd. In essence, this is artificial selection, which is directed to sustain and conserve a specific gender in the herds.

Indeed, it was necessary to assess and evaluate the information provided by the elderly pastoralists in the above-mentioned informal interviews. Therefore, in addition to the informal interviews with elderly pastoralists in Dhofar, another meeting was carried out with two Dhofari camel herders namely, Ahmed Matoug Al-Mlgawi Al-Shari and Ahmed Said Hanswn Khshoub. The information they provided about the camel management procedures can be summarized under the following headlines:

Management of the herd

Females constitute the herd of the Dhofari pastoral groups. In each herd, there is one male. This structure of the herd is kept and employed by selling young male camels. The newborn male camels are taken from their mothers on the day they are born. This is conducted in the same way mentioned by the elderly pastoralists. Once a female gives birth to a male, her calf will be taken away from her and another female calf is covered by the placenta of the mother camel in order to be accepted. The intention behind this practice is as follows:

1. The newly born female will be fed from two female camels: one its original biological mother and the adopting mother.
2. The newly born female will have more milk by being fed from two female camels.
3. The newly born male camel will be fed in small quantity, while waiting to be sold or slaughtered when grownup.

Organization of breeding

The two Dhofari pastoralists report the following accounts concerning the organization of camel breeding. In the past, half of the herd was allowed to get pregnant, while the other half had calves and gave us milk. In fact, since breeding is controlled, they always keep one-half of the herd pregnant, while the other half keeps milking. The flow of milk must be all the year round.

The herd structure

All camel herds consist of females. Each herd is well balanced in its structure. It consists of pre-productive females and productive ones. Post-productive camels are not kept by the pastoralists because they share the other two categories in the pasture.

Male selection

A herd has one male to serve the females. The Dhofari camel herders report that the selection of a male to father the future calves is

not a regular practice nor is it conducted yearly. It is carried out only when the current male of the herd is about to get old.

The criteria recognized by the herders are as follows:

1. The male camel must be a descendant of a father with appropriate colour, stature, good physique and figure. It should be a descendant of a thoroughbred line (Fig. 3).
2. The colour. The most preferred colour is red. The second colour is a colour between red and black.
3. The selected male must be a descendant of a reputed line of camels known to the herders. Pedigree is the stone corner in this selection.
4. The camel must be a descendant of a good-milking mother with a good stature, physique, colour and figure (Fig. 4).

Seasonal movements

In the informal interview with Ahmed Matoug Al-Mlgawi Al-Shari, he stated the

"In the past, our movement was much more than the present. In the past, we were in continuous mobility. Now, we move less. The reason for being less mobile and the movement is transhumant is that there is less pasture and fodder at hand. We buy fodder for the camels because there is no sufficient pasture. One more thing, any household that moves much spends less, while those who settle down spend more".

Furthermore, the Dhofari informant (Al Shari) stresses that certain seasonal condition necessitates that the camel herders follow specific movements in the region. These movements are as follows:

a) During the rainy season, the pastoralists go as far as the coast plains such as Al Balid

Fig. 4: A marked male camel

and they even go westwards toward Al Magsail, which is not affected by the monsoon winds.

b) Then, by the end of the rain in September to mid-October, they go to the plains known locally as Al-Jarbaib.

c) By November, they go upwards towards higher grounds in Al- Khatum and Al Qatan.

Camel infatuation

Camels are completely infatuated by all camel pastoralists. It is the essence of their culture about camels, which is highlighted by values such as captivation, passion, and fascination.

Consequently, it is evident that artificial selection achieved by traditional pastoralists in Dhofar serves practical goals that ensure the pastoralists' survival and economic prosperity. It is not the numbers of the animals in the herd that matters, but the quality and productivity of the animals. In this concern, the Dhofari pastoralists differ from the pastoralists in Africa. Among African pastoralists, wealth and status are constantly determined by the size of one's herd. In Dhofar, the herd size and the numbers of animals are neither associated nor affiliated to prosperity or prestige and potency. Therefore, these practices specify and confirm

the undertaken tenet that security is in numbers.

Along these lines, it is essential to conclude that domestication, which took place in prehistoric times is in reality artificial selection. Then, the Dhofari traditional camel pastoralists are continuously engaged in the domestication procedures to the present time. Actually, what they do is to impede one of the mechanisms of nature, namely natural selection. It is known that the mechanism of natural selection causes species to change and diverge over time. Consequently, this results in more adapted creatures to their environment (cf. Natural History Museum https://www.nhm.ac.uk/discover/what-is-natural-selection.html).

It is unequivocal that domestication is artificial selection. Hence, selection of females and one male to form and compose a herd is the foundation of artificial selection. Moreover, selection of certain morphological features (colour, shape and size of the body, etc., in camel herds is an artificial selection. In addition, selection of a male, which is descendant from a mother with good productive qualities, is an artificial selection (Fig. 5). Finally, removal of newly born male calves from the herd is an act of artificial selection.

Discussion

Prehistoric camel pastoralists were probably roaming in parts of the Arabian Peninsula sometime ca. 3000 BC (cf. Zarins 1989). Their presence in Dhofar must have been sometime after 1000 BC. (cf. Zarins 2oo1: 154). Moreover, it is reported that Dhofar's mountains encompass and evince rock drawings of camels in scattered caves and rock shelters. In fact, there are about thirty-one rock scenes portraying camels recorded by Al Shari (1994: Figs: 55, 89, 91, 92, 94, 96, 97, 98, 140, 142, 162, 174, 178, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 210, 213, 231). Figurs (6 and 7) present rock scenes that portray camels in Dhofar.

In Dhofar, the environmental conditions caused by the monsoon winds are worthy of notice. It is an annual seasonal reversing wind accompanied by corresponding changes in precipitation. Accordingly, it is believed that Dhofar' environmental conditions came into existence around eight million years by the effect of the monsoon wet winds (cf. Clift, et al. 2008-5-27). Again, the monsoon causes wet and dry seasons throughout much of the tropics and with the Indian Ocean (https://education.nationalgeographic.org/resource/monsoon/).

Then, how did the prehistoric camel herdsmen manage their camels in Dhofar? Certainly, the environmental conditions instigated yearly by the monsoon winds, must have influenced the livelihood of the prehistoric camel herdsmen and their animals. Accordingly, they must have adapted themselves with their animals to such conditions.

On the other hand, the history of camels in Dhofar remains unknown. Archaeological investigations have not identified any archaeological sites that can possibly indicate the presence of prehistoric camel pastoralists in this region. ElMahi (2013) searched for

Fig. 5: Typical male camel when compared with females

Fig. 6: Rock scene of camls in Dhofar
After Al Shari 1994

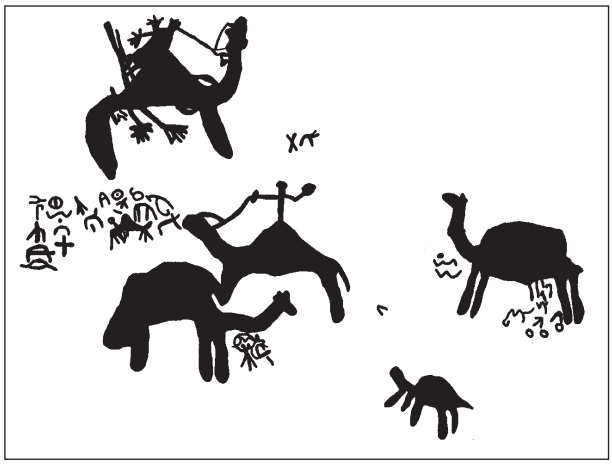

Fig. 7: Rock scene of camels in Dhofar
After Al Shari 1994

evidence of prehistoric camel pastoralists in Dhofar and concluded the absence of evidence. Therefore, archaeological evidence can neither clarify nor define such prehistoric practices.

Moreover, ElMahi (ibid.) searched the abandon sites occupied by the traditional pastoralists and excavated parts of them. Surprisingly, little archaeological material was recovered and none of it can indicate whether the sites were of pastoralists or not. This attempt showed that traditional pastoralists leave behind truly little material. The elderly traditional pastoralists stated they have little to leave behind something. Again, through informal interviews, traditional pastoralists stated that each family had little cultural material, which did not exceed more than seven kilograms in weight (ElMahi 2013:39). They were nomadic and had no fixed home and moved according to the seasons from place to place in search of grazing land and water. Indeed, they did not settle in one place for more than three or four days. Their movement was a cyclic movement for most of the year in search of pasture (ElMahi 2013: 26). Parallel to this, it seems reasonable to postulate that prehistoric camel pastoralists did not leave any evidence that can archaeological investigations discover.

Moreover, a family of the traditional pastoralists always has few animals not more than twelve camels (cf. ElMahi ibid.). Again, Janzen (1986:62) reported that a Dhofari family had around ten camels. Each family with such a small herd keeps moving across Dhofar region, which characterizes the life and adaptation of the Dhofari traditional pastoralists. Continuous movement is a way of life to face the unpredictable harsh environment conditions. Consequently, movement is a practical adaptation and a strategy to manage and bring about the herd.

Moreover, they are completely dependent on the milk of their camels. It is their staple diet and "mobile food items," which they take with them in their movements. For them, milk is always accessible, and the most reliable source of food in their environment. The milk supply is neither dependent on a certain season nor location. It is a food source which the herdsmen control and manage its supply and availability. Accordingly, their management of keeping a herd of females and imposing artificial selection on the herd demonstrates its practicality and worth in the herds' formation of productive females and a well-selected single male in the herd.

The question is what compels the Dhofari traditional camel pastoralists to follow such a regulated and determined management of artificial selection? The environmental conditions compelled them to adapt and hold on to this management. Indeed, their camels cannot withstand the force or effect of the seasonal environmental conditions. Their adaptation is directed to the availability or abundance of pasture and the ecological restrictions in Dhofar's environment. Accordingly, it necessitated the control of the herds' size to range between 12 t0 15 females. In informal interviews, traditional camel pastoralists explain the reason behind keeping a small number of females and only one male. Their answer specifies that the conditions and availability of pasture force them to keep a small number of females. Most of all, pasture must be for the female camels; they provide milk and calves, while one good male can be sufficient for the herd. Moreover, a small herd can easily be directed from one ecological zone to another in Dhofar. Therefore, the environmental conditions influence and compel such procedures and practices in the camel management. It is a traditional and established way of managing the camel herds. Merely, their management recognized that pasture is primary for the productive females. For this reason, a camel herd consists of productive females. Nonproductive females have no place in the herd. Indeed, under such management, these females are the factor of advantage to the pastoralists and the welfare of their herd. According to the Dhofari traditional camel pastoralists, it is certain that these females are a factor and circumstance of benefit to their owner.

The history of camels in Dhofar is to be looked at in the Holocene, the geologic epoch that followed the Pleistocene in 11700 BP. The Holocene includes the following five geological periods (cf. Walker et al. 2009):

1. Preboreal 10000-9000 BC.
2. Boreal 9000-8000 BC.
3. Atlantic 8000-5000 BC.
4. Subboreal 5000- 2500 BC.
5. Subatlantic 2500 BC. – To the present.

In Oman, the earliest evidence of the camel comes from the Early Bronze Age site of Ra's al-Hadd (HD-6) and C14 dated between 2890-2580 BC. (Curci et al. 2014). Thus, this is the oldest camel evidence in the Sultanate of Oman. On the other hand, Beech et al. (2009) assumed that camels were into Dhofar from Al Rabh Al Khali sometime after 3000 BC. Moreover, Zarins (2oo1: 154) proposed that the presence of camels in Dhofar was sometime after 1000 BC. Therefore, all the proposed dates indicate the possibility that camels were sometimes present in Dhofar during the Subatlantic period 2500 BC. This period of the Holocene was warm in the upper coordinates and dry in the middle (cf. de Menocal et al. 2000: 256-257).

Whenever, the introduction of the domestic camel took place in Dhofar, the environmental conditions of grass and lush vegetation must have been present. Clift et al. (2008-5-27) indicated that the monsoon winds influence and distinguish this region from as early as eight million years ago. Thus, it is clear that these environmental conditions are still dynamic in Dhofar. Consequently, it is indisputable that the monsoon winds have influenced the livelihood of the prehistoric camel herders. Accordingly, the environmental setting of this

region must have influenced the adaptation and culture of the prehistoric camel herders who entered the region in prehistoric times. Those herders must have adapted to the seasonality of the environmental conditions in the region. Dhofar's ecoregion of lush vegetation has certain limitations that compel the traditional herders to move seasonally through transhumant movements in certain areas and ecological zones. The six different ecological zones that mark the geographic features of Dhofar region, have been described by Miller and Morris (1988: xiii-xiv) in the following:

1. The coastal plain zone.
2. Foothills zone.
3. Escarpment woods and grasslands zone.
4. Al-Khatum zone.
5. Al-Qatan zone.
6. Al- Nejd zone.

The plant species available in these ecological zones are explained in the table below (cf. unpublished report 1996 by S. A. Ageib, the Ministry of Agriculture and Fisheries. Salalah - Sultanate of Oman):

Table 1:

No.	Ecological zone	Plants
1	The coastal plain	Scattered trees and shrubs include Acacia tortilis, Zizihus teucadermis, Tamarix aphylla, Cadaba baccarinil, Cadaba farinose, Commiphora spp., Caesalpinia erianthera, Adenium abesum, Euphorbia spp., Aloe dhofarense, Aole inermis.
2	The foothills	Trees such as Boscia arabica are common and shrubs including Comintphora spp., Grewia spp., Croton confertus and Jatropha dhofarica.
3	Escarpment woods and grasslands	Acacia Senegal, Commiphora spp., Mytenus dhofarica, Croton confertus and Blepharispermum hirtum. Al-Khatum: deciduous bushland and stemmed bushes are dominant in this zone at lower altitudes. They include Acacia Senegal, Commiphora spp., Mytenus dhofarensits, Croton confertus and Blepharispermum hirtum. Olea europaea, Euclea schimperi, Commiphora spp., Dodonaea ungustifolia, Carissa edulis, Rhus somalensis.
4	Al-Khatum	Deciduous bushland and stemmed bushes are dominant in this zone at lower altitudes. They include Acacia Senegal, Commiphora spp., Mytenus dhofarensits, Croton confertus and Blepharispermum hirtum. Olea europaea, Euclea schimperi, Commiphora spp., Dodonaea ungustifolia, Carissa edulis, Rhus somalensis.
5	Al-Quatan	Acacia etbalica, dracena serulata and Commiphora serulata.
6	Al-Nejd	Common plant species found in Al-Nejd are Boswellia sacra, acacia etbalica and Nonorhops richiana.

Therefore, any adjustment and adaptation to such environmental conditions necessitated seasonal movements to avoid the opposed, especially in the rainy seasons. Besides, pasture is not available throughout the year in every ecological zone of Dhofar.

Consequently, the state and conditions of the six ecoregions and their systems, which include the physical and biological characteristics and the processes and interactions that connect them, must have necessitated a specific adjustment and adaptation by the prehistoric camel herdsmen.

It is undisputable that the prehistoric camel herd management in Dhofar will remain beyond archaeological evidence. Such practices of managing animals do not leave any material evidence that archaeological investigations can unearth. The question remains; how the prehistoric camel herders managed their

animals in the environmental conditions of Dhofar. In this situation, it is justifiable to set up an analogy between the traditional camel management and the prehistoric one on the basis of the environmental conditions of Dhofar.

Throughout time, all organisms adjust to their environment in order to improve their chances of survival in the environment. Verily, adaptation is the process of adjusting behavior, physiology, or structure to become more suited to the conditions of the environment. Hence, it is quite possible that the prehistoric camel pastoralists must have adapted to environmental conditions with their animals in Dhofar. The monsoon winds commenced the present environmental conditions during prehistoric times. Indubitably, the prehistoric herdsmen who reached Dhofar region around 1000 BC. (cf. Beech 2oo9: 154) from the Arabian Peninsula had no other means to avoid such environmental conditions, but to adapt. It is evident that pastoralists with animals can neither escape nor evade such seasonal conditions as they are in Dhofar.

Undeniably, adaptation to such environmental conditions in Dhofar necessitated and compelled the prehistoric herdsmen with their camel to adapt to survive in the habitat and ecoregion of Dhofar. Consequently, it is acceptable that the prehistoric camel herdsmen must have set procedures of camel management similar to the traditional camel pastoralists. For those prehistoric herdsmen such camel management was crucially obligatory and was needed to secure their livelihood and surviving the limitations of such environmental conditions. This consolidates the proposed analogy between the contemporary traditional camel management and the management applied by the prehistoric camel herdsmen in Dhofar.

Conclusion

As we have seen in this study, investigating or studying traditional societies is highly useful in explaining and illuminating many aspects that archaeology quite often cannot explain. Thus, ethnoarchaeology remains to be a great aid in archaeological investigations. In Dhofar, the prehistoric camel herdsmen left no traces or evidence of their existence and their animals. Nonetheless, the study of the Dhofari contemporary camel pastoralists enables to establish a reasonable analogy that elucidates and gives a clarifying explanation about the possible existence of a similar camel management practiced by the Dhofari camel herdsmen in prehistoric times.

Prof. Ali Tigani ElMahi: Khartoum, Sudan. tiganielmahi@hotmail.com.

ملخّص: في إقليم ظفار بجنوب سلطنة عمان، يقوم رعاة الإبل بعملية الاختيار الموجّه (Artificial selection) في حيواناتهم، وهذا الاختيار يعمل على انتقاء ذكور إبل متميزة من نسل معروف؛ ويشكل جزءا من إدارة القطعان. ويهدف هذا الاختيار لتكون الإناث في القطيع متميزة في الحليب، بينما يتميز الذكور بجمال الطلعة والقوة. هذا البحث يعمل على الفحص والتدقيق في أسباب هذه الممارسة ودورها في خدمة الإبل وأصحابها؛ كما يسعى البحث إلى إيجاد تماثل وتشبيه مع ممارسات رعاة الأبل في فترات ما قبل الميلاد في إقليم ظفار. ويمكن أن تقدم هذه الممارسة التقليدية للاختيار تشبيها منطقيا لإدارة الإبل في عصور ما قبل التأريخ.

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