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Distribution and conservation of the Arabian Leopard *Panthera pardus nimr* in Saudi Arabia

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Abstract

Field surveys of populations and potential habitats of leopards in Saudi Arabia were conducted to assess the current distribution and status of the species. Related topics such as habitat characteristics of the current distribution, prey of the species, the human impact and conservation of the species were also investigated. Survey results from 153 sites showed that leopards had disappeared from their former range in the Median Mountains in northern Saudi Arabia. The species still survives in reasonable numbers in Hijaz and Sarawat Mountains. In spite of their rugged and arid locations, many sites were found to have shrubs, trees and waterholes. These sites provide habitat for the leopard's prey, such as hyrax, ibex and others. Results of this investigation reveal that there is a need for public awareness, involvement of local inhabitants, and establishment of protected areas to ensure the survival of the Arabian leopard.
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Keywords: Leopard; *Panthera pardus nimr*; Distribution; Conservation; Saudi Arabia

1. Introduction

The Arabian leopard *Panthera pardus nimr* is the largest and most widely distributed cat in Arabia. Its ecology and distribution, however, remain the subject of much debate. The caracal *Caracal caracal*, together with, wildcat *Felis silvestris* and sand cat *Felis margarita*, the Arabian leopard is believed to be on the brink of extinction (Nowell and Jackson, 1996). It is considered critically endangered in the IUCN red list of threatened species (IUCN, 1996). The presumed distribution of leopards in Arabia extends along the

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mountains from Haqel in the north-west of Arabia, down to Yemen, and in the mountains of Hadarmout to north-east of Oman and the eastern mountains of the United Arab Emirates. In Saudi Arabia, the leopard's habitat extends for about 1700 km along the rugged arid to semi-arid mountains along the coast of the Red Sea.

The distribution of leopards worldwide includes all of Africa except the Sahara. Their range includes the area to the north across Asia from southern Turkey and the Caucasus Mountains eastward to the Amur River in eastern Siberia, and through the Indian subcontinent, southern China and Sri Lanka (Bailey, 1993). Until recently, leopards were reported in a few remote areas of the mountains along the coast of the Red Sea (Harrison, 1968; Gasperetti et al., 1985; Nader, 1989; Harrison and Bates, 1991). They are also known to exist in remote areas in the mountains of Yemen and Oman (Harrison, 1981; Harrison and Bates, 1991; Shoemaker, 1993; Al-Jumaily, 1998; CAMP, 2002).

A few reports indicate recent sightings of leopards in Arabia (Nader, 1989; Al-Jumaily, 1998; Spalton, 2000). The actual distribution of the leopard in Arabia is not known exactly, mainly due to habitat destruction, killing and lack of ecological studies. Some reports indicate that the leopard population has decreased drastically in Arabia due to killing by shepherds and villagers after leopard raids on their livestock (CAMP, 2002). In addition, hunting of leopard prey, such as hyrax and ibex by local; inhabitant and habitat fragmentation, especially in the Sarawat Mountains, have made the survival of the leopard uncertain. In this context, knowledge of the status of existing leopard populations and habitat requirements of leopards could contribute to establishing a more sound conservation strategy for ensuring the survival of the species in Saudi Arabia. The purpose of this study therefore, was to conduct field surveys of some known and potential leopard habitats in Saudi Arabia.

2. Material and methods

The survey of potential leopard habitats was conducted during the period from 1998 to 2001, in the historic habitats of the leopard in Saudi Arabia. The known geographical distribution includes the Median Mountains, which extend from Aqaba to Jebel Asshiyatee (29°30′ N–28°00 N); the Hijaz Mountains which extend from Jebel Harb to the mountains west of Makkah (28°00 N–21°00 N), and the Sarawat Mountains which extend from west of Makkah down to the Yemen borders (21°00 N–17°00 N). The survey was designed to gather data on actual sighting of the leopard and its tracks, especially around waterholes and at the sites of kills.

Information about leopard distribution and status was gathered by the author from two main sources: active hunters and local shepherds from each location of leopard habitats. These sources were found to be knowledgeable about leopards and other wild animals of the area. Each leopard or track sighting was visited by the author or by a local hunter, and some sites were visited more than once. Some sites were not accessible. Personal contacts were made with hunters in each area through the assistance of local residents. This method was not successful with many hunters due to an enforced government ban on hunting leopards. This resulted in a shortage of information about some areas. Another factor hampering data collection was that many local residents, shepherds and hunters believed that the end result of our study would be the establishment of unwanted protected zone in their area.

A data sheet was designed to provide information about every site visited. It contains information about the presence of the leopard (seen, heard, killed, tracked) and the name and exact geographical position of each location taken by GPS at the site of the last-known sighting of a leopard. Confirmation of sightings or tracks was based on the ability of a person to identify the animal from pictures of carnivores, such as hyaenas, cheetahs, caracal and leopards. The data sheet also contained detailed information about each particular habitat, such as vegetation cover, prey species, waterholes, other wild animals and characteristics of the location including inhabitants and their activities. The data sheet of each particular site was filled out by the author with the help of the local hunters or shepherds. A map was developed to show all sites of observation, tracks and sites where leopards were heard or killed, and sites where leopards had been previously found but no longer existed.

3. Results

3.1. Distribution

Past records of leopard distribution in Arabia are shown in Fig. 1 (Gasperetti et al., 1985; Nader, 1989; Harrison and Bates, 1991). Records show that leopards were found formerly in scattered areas throughout the Median, Hijaz and Sarawat Mountains to northern Yemen. All previous reports showed that leopards existed in the Median mountain (North of 28°00 N). Most notable of these reports were those of Nader (1989), who reported eight new records in Saudi Arabia, five of them being new observations, and three previous observations in the Median Mountains. Records from our study indicate that leopards have almost disappeared from the Median Mountains. Our investigation of many locations of past records such as Jebel El-Tubaiq, El-Lawz, Zuhd and El-Shiati indicates that no leopard has been seen, heard or killed there for the last 20–25 years. Local residents confirmed that the last leopard was killed around 1970 in Jebel El-Lawz after a raid on goats. Meanwhile, information from local hunters and shepherds of the northern Hijaz Mountains at sites such as Jebel Harb, Sharr, Ad-Dubag, Shaiban and Harat Ar-Raha, indicates a total absence of the leopard for at least 15–20 years. Unconfirmed information (personal contact with local hunters), indicates, however, that the leopard was seen in 2000 in Jebel Ad-Dubag and Harb and in Sowaihel (Magna district) south of Haqel along the coast.

Findings of our study confirm the presence of leopards in Jebel El-ward, Aglab, Shaihoob, Wadi Amodan and Harrat Uwayridh. These areas are below 27°00 N. Our data also show that leopard numbers have increased in different habitats in El-Madinah and southward to Yemen border. Most notable of these habitats are Jebel Radwa, Jebel Wergan, the El-Fegrah area, Jebel Nees, Jebel Shada, Jebel Fayfa on the Yemen border (Fig. 2). In certain areas more than one Leopard has been seen. For example, two Leopard were seen in Jebel Wergan, two more were spotted in Jebel El-Gurnog, three in Jebel Megee, five in Abather north of El-Fegrah (a male and a female with three cubs), three in El-Taiybah west of El-Fegrah (a female with two cubs), three in Rehaba (female with two cubs), two were seen in Wadi Amodan, two in Ras El-Kedeweyah and three in Jebel El-Ward.

Table 1 summarizes sites visited during our field study of the leopard distribution range. A total of 153 sites were checked for the presence of the leopard population during the

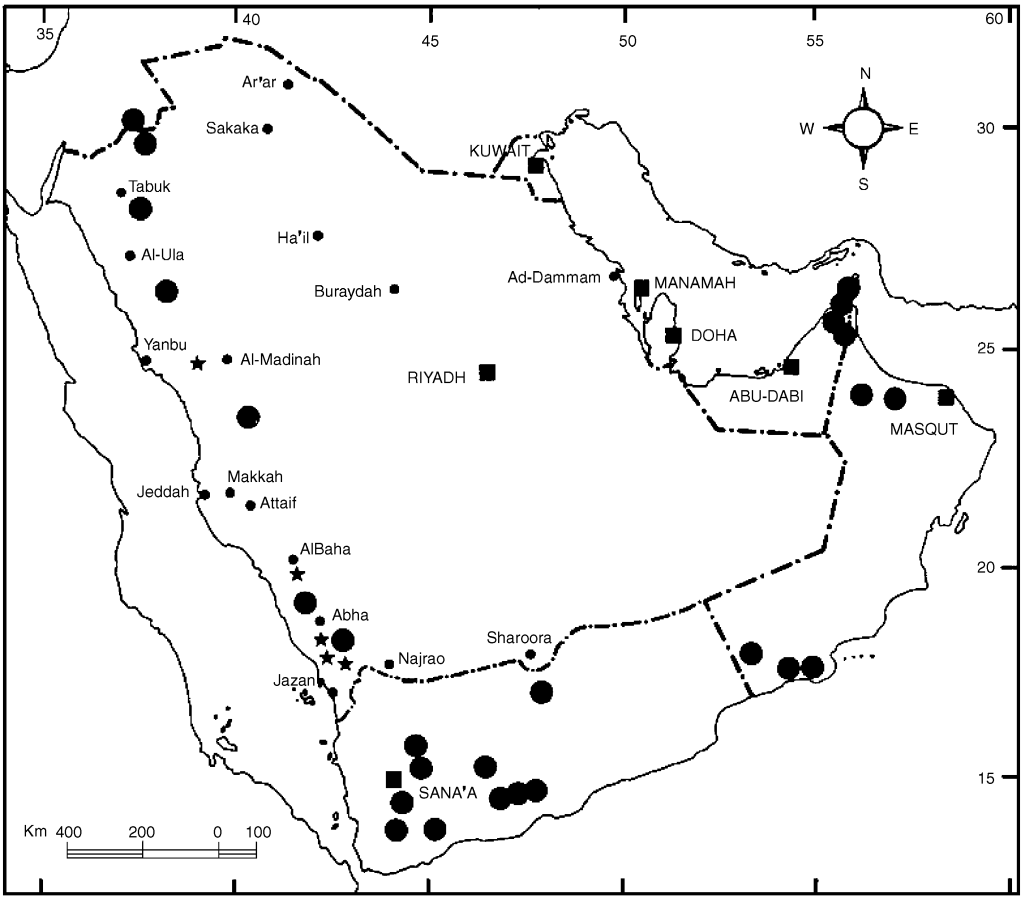

Fig. 1. Past records of occurrence of *Panthera pardus nimr* in Arabia. Large dots represent records of Gasperetti et al. (1985), Nader (1989), Harrison and Bates (1991) and stars indicate new observations noted by Nader (1989). Small dots represent cities.

period from 1998 to 2001. In 42 of these sites, a total of 65 leopards were actually seen by the investigator. At 11 of the 42 sites, male and female leopards with cubs were seen. In 38 sites the researchers observed tracks, detected voices and recently killed animals. In 15 of the sites which were known to have previously been occupied by leopards, no leopards were reported, and in 35 sites visited, leopards were reported to have been seen by hunters or shepherds in earlier times.

It should be emphasized that the sites which were visited during this field study represent a low percentage of the actual leopard believed to inhabit Saudi Arabia. There were many possible sites of leopard habitation which we could not reach nor could we interview persons able to verify the existence of leopards in the area. For example, we could confirm the presence of leopards in two sites only in Jebel Radwa, at a time we learned from the hunters that leopards were present in many locations along the mountain range which extends for more than 80 km. Similar conclusions were reached for Jebel Wergan, Shada,

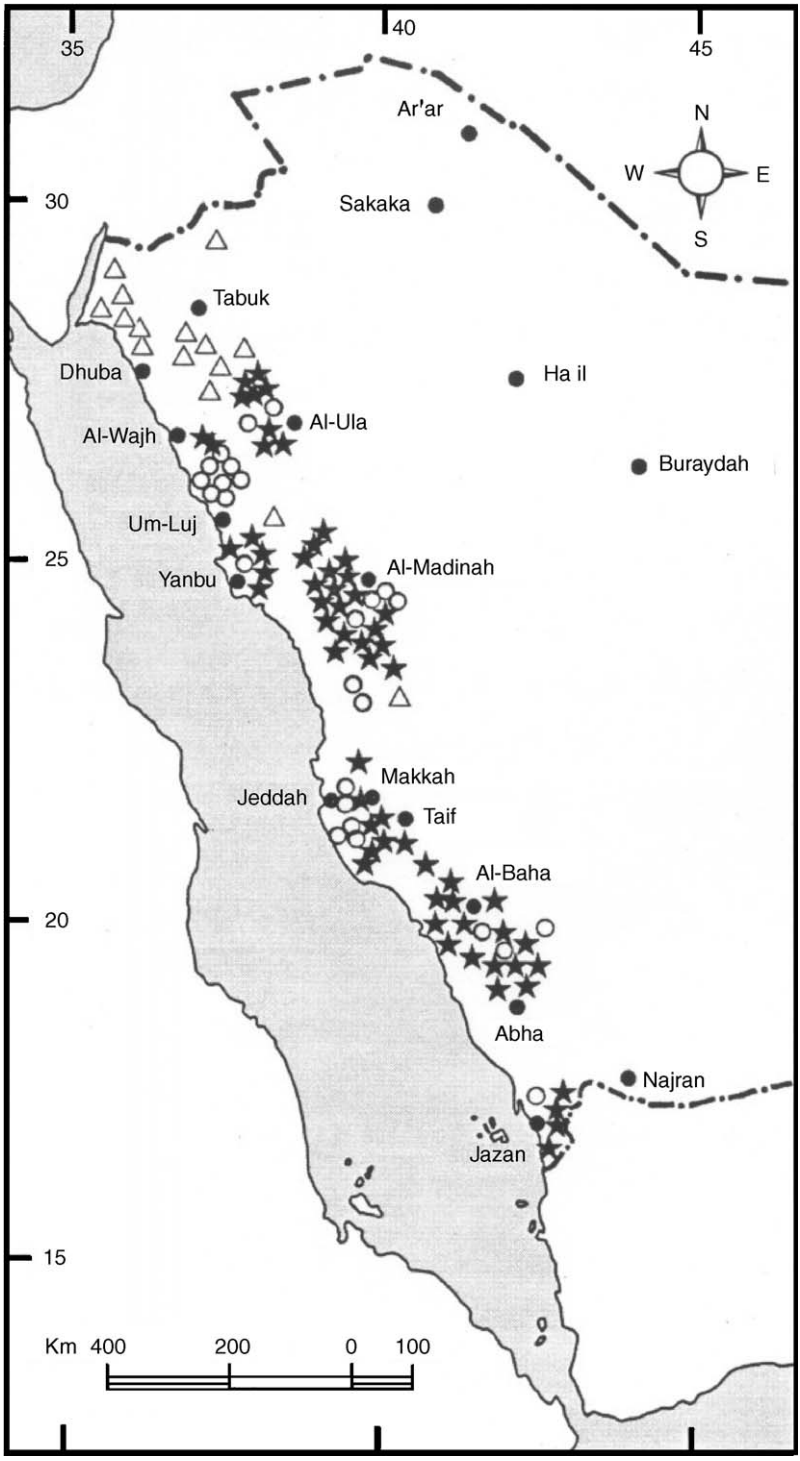

Fig. 2. Present distribution of *Panthera pardus nimr* in Saudi Arabia. Stars indicate sites of actual observation during our study. Circles indicate sites where leopards were reported but not seen, and triangles are sites where leopards were absent. (Stars may represent more than one site.) Dots represent cities.

Table 1
Sites visited of leopard distribution in Saudi Arabia (1998–2001)

Site name	Coordinates				Leopard details				Date
	N		E		Seen	Killed	Heard	Track	
H. Uwayred	26	38	37	39	1				1997
J. El-Kourah	26	30	37	33				1	1998
J. El-Ward (Shag Hameed)	26	24	37	13	3				1998
J. Aglab	26	16	37	09	1				1998
J. Aglab	26	16	37	09	1				2001
Talaat Morakh	26	18	38	10				1	1998
J. Ral	26	15	36	55				1	1997
W. El-Jezl (Reem)	26	15	38	05	1				1999
J. Nahar	26	10	38	15	1				2001
J. Aba El-Qeshae	26	08	37	32	1			1	1998
H. El-Zaben	26	05	37	51	1				2001
Ras El-Kedeweyah	25	56	37	58	2				2002
Talaat Wearah	25	50	37	48	1				1997
H. El-Qussah (Talaat Um Reem	25	49	38	06				1	1998
Amodan	25	44	38	05	2				2000
W. Amoudan	25	40	38	07	2				1998
W. Amoudan	25	40	38	07				2	2001
W. Omg	25	30	37	20	1				1999
Lewa Asmah	25	15	37	20				1	1996
J. Wergan (east)	24	00	39	14	1				1998
J. El-Gurnog (Rimah)	24	05	38	50	2				1998
Ras El-Gurnog	24	05	38	50				1	1998
Athaib	24	08	38	42	1				1997
Athaib	24	08	38	42	1				1999
Rhaba	24	09	38	41	3				2000
Rebegi	24	10	38	56			1		1998
Aba El-Gurair	24	10	38	45	1				2000
J. Megee (Alab)	24	11	38	57	3				1997
J. El-Hadhbah (Makrotha)	24	13	38	51			1		1997
El-Halaga (Ras Tasha)	24	13	38	52	1				1998
Qusaeb	24	14	38	53	2 (cubs)				1997
Sheib Ulegah	24	15	38	58				1	1996
Hazrah	24	16	39	07			1		1998
El-Dhaynah	24	19	38	50			1		1998
J. Radwa-Ras El-Najef	24	19	38	03				1	1998
El-Fegrah–Efja	24	23	38	52	1				1997
El-Fegrah-Efja	24	23	38	52	1				1998
Ar-Redayah	24	30	38	49				3	1998
Ar-Redayah	24	30	38	49	1				2000
W. Omgan (Abather)	24	30	38	30	1				1998
Abather	24	30	38	30	5[a]				1998
W. Amodan (Hurb)	24	30	38	05	1				1998
J. Radwa-El-Zaafer	24	25	38	20				1	1998
Ar-Rodoh	24	31	38	50	1				1998
J. Radwa-Khomal	24	30	38	05	1				1997
J. Radwa	24	31	38	10	1				1998
J. Radwa (Ras El-Shebah)	24	34	38	18			1		1998
J. El-Hamar (Molaih)	24	32	38	51	1				2000
El-Taiyabah	24	35	39	01	1				1998

Table 1 (*continued*)

Site name	Coordinates				Leopard details				Date
	N		E		Seen	Killed	Heard	Track	
El-Taiyabah	24	35	39	01	3				2000
El-Taiyabah	24	35	39	01		1			2002
J. Sobh (El-Samara)	23	31	39	02				1	1998
J. Wergan	23	59	39	15	2			2	1997
J. Dokhan	22	42	39	47	1				2000
J. Amer	20	58	40	13			1		1998
J. Judah	20	58	40	29			1		1998
J. El-Humeryah	20	56	40	22			1		1998
J. Ibraheem	20	27	41	09	1				1999
J. Nees	20	05	41	16	1				1999
J. Nees	20	05	41	16			1		2000
J. Dafna (El-Baha)	19	45	41	38		1			1996
J. Shada	19	44	41	23	1				1999
J. Shada	19	44	41	23			1		2001
J. Thahran (Wadi Taleed)	19	11	41	40	1				1996
Sudur Al-Yasaad El-Namas	19	08	42	15	1				1997
W. Syal	18	52	42	07	1				1997
Sudur Al-Khozaim	18	46	42	13	1				1997
Sudur Al-Obaid	18	38	42	14	1			1	1997
Sudur Al-Azzah	18	30	42	14				1	1997
Aqabat dhelea	18	02	42	29	1				1996
J. El-Hasher	17	28	43	03	1				1998
J. Fayfa	17	15	43	07	1				1998
J. Fayfa	17	15	43	07		6[b]			1999
Total					65	8	10	20	

J. = Jabal, H. = Harrat, W. = Wadi.
[a]Males and females with three cubs.
[b]Males and females with four cubs.

Bani Malik and other areas such as the mountains south of Al-Madinah to Makkah and areas south of Abha to Jazan.

3.2. Habitat and feeding habits

In the past, leopards were found in the Red Sea mountains and the adjacent lava plateau. Species of leopards' prey, waterholes and safe refuge were available in this area. Meteorological data show that the Median and the Hijaz Mountains are arid, with mean annual rainfall of less than 50 mm, while the Sarawat Mountains receive 200–500 mm of rain per year (Saga, 1998). Rainfall in the Hijaz and Median Mountains is irregular. Sometimes rain may not fall for several consecutive years.

Leopards were found to occupy remote and rugged high-mountain areas, that provided them with security and vantage points. Analysis of data recorded during our study showed that all the distribution sites of leopards were centered on sites of high altitudes (>1000 m above sea level). All leopards were found close to permanent waterholes and high in the mountains. In 38 of the 42 sites where leopards were actually seen, waterholes were within

3 km. These sites were also suitable for species of leopards' prey. At Ar-Redayah some 15 km north of El-Fegrah, leopards have resided for more than 50 years. Data also show that there were a number of sites which have been abandoned by leopards due to human influences such as roads and continuous hunting of ibex and hyrax.

In spite of the extreme aridity of the recorded leopard habitat sites, many sites support a reasonable number of trees and annual vegetation. The most notable vegetation in areas of leopard sightings in the Hijaz Mountain are *Retama retama*, *Acacia* sp., *Ziziphus* sp., *Artemisia judaica*, *Moringa percgrina*, *Dodonaea viscose*, *Periploca aphylla*, *Safaria vertrcalla* and many annual plants. In the Sarawat Mountains *Juniperus* sp., *Olea chrysophylla*, *Salvadora persica*, *Ochradenus baccutus* and many *Acacia* and *Ziziphus* species are found with many other annual plants.

Leopards were also found in the Uwayred lava plateau (Harrat Uwayred) north-west of Al-Ula city. This plateau is around 1000 m above sea level and contains several permanent waterholes. These water resources support leopard prey such as ibex, gazelles, hyrax and foxes. It can be assumed that leopards could be found also in other similar Lava plateaus such as Harrat Lunnayir, east of Umm-Luj, and Harrat Nawasif, south-east of Taif.

Numerous species of mammals inhabit in these leopard habitats. Some of these animals are important prey for leopards, such as the ibex (*Capra nubiana*), rock hyrax (*Procavia capensis*), hares (*Lepus capensis*), and in the southern part the baboon (*Papio hamadryas*) (Kingdon, 1990). Due to continuous hunting of ibex and gazelles by human beings, leopards have become dependent on hyrax in numerous places. Results of the present survey indicated that in more than 90% of leopard sites, hyrax are living close to leopard dens.

The major conflict between man and the leopard in Arabia originated from attacks and predation on domestic herds of sheep, goats and camels. To many shepherds and camel herders, the leopard is a pest that kills more prey than it eats. Sometimes a leopard kills 10–15 sheep or goats and eats only one or two. Most killings occur close to a leopard's den. In a few cases, it was reported that leopards attacked domestic animals in their enclosures, especially in the southern part of Sarawat where the villages are close to leopard habitat.

3.3. Conservation

The reduced leopard population in Arabia requires immediate action to avoid further losses and extinction. Recent reports point out that the number of leopards is decreasing drastically due to killing by hunters, and habitat degradation and fragmentation (Nader, 1989; Spalton, 2000). Three issues are addressed in the present study to ensure the conservation of the Arabian leopard in its natural habitat. These issues include public awareness campaigns directed to local inhabitants, ecological studies and establishment of protected areas of suitable leopard habitat.

That few people were aware of the presence of leopards in the mountains from Haql to Yemen is not surprising because leopards are nocturnal and secretive, occupying rugged and inaccessible high mountains. In many parts of the Kingdom, people organize hunting parties specifically to kill leopards. The story concerning the last leopard killed in Jebel El-Lawz was dramatic. Bait was connected by a string to a rifle. When the leopard moved the bait, a shot was fired, and the animal was killed.

For a large number of people, especially livestock breeders and Bedouins, a leopard is merely a pest. As has already been stated, a leopard kills more than one sheep or goat at a

time. Consequently, it is difficult to convince people that leopard conservation is important. Bedouins still living close to leopard habitats and local inhabitants of villages and townships near leopard sites represent an essential factor in efforts to promote conservation of the leopard. In fact, Bedouin activity and attitudes towards conservation could influence the success or failure of any strategy that is put forward.

Available data concerning the number, habitat and ecology of the leopards in Saudi Arabia are inadequate. Thus, ecological surveys of leopard habitat must be considered a high priority to allow development of an informed, effective conservation strategy. Obviously, establishment of protected areas within the leopard's range is urgent. Properly protected areas with good management strategies are needed to ensure the continued survival of these exceptional animals.

4. Discussion

Until late 1960s, the Arabian leopard was widely distributed in Arabia. It once existed in Haqel in the northern part of Median Mountains, in Hijaz and the Sarawat Mountains (Gasperetti et al., 1985; Nader, 1989; Harrison and Bates, 1991). It also existed in the northern Yemen highlands (Sanborn and Hoogstral, 1953; Stuart and Stuart, 1996; Al-Jumaily, 1998), in the mountains of Ras al-Khaimah and the eastern region of UAE and in the Jebel Samhan and Dhofar mountains in Oman (Spalton and Willis, 1999).

Our study shows that leopards had disappeared from the Median mountains and northern parts of the Hijaz mountains (Jebel Ad-Dobagh, Jebel Shar, Jebel Shaiban) north of 27° 30′ N latitude. Although Harrison and Bates (1991) reported *P.p. tulliana* in Jebel El-Tubayq in 1935, locals confirmed that the last time a leopard was killed in Jebel El-Tubayq was in 1965. In Jebel El-Lawz, the last leopard was killed after a raid on goats in 1970. No one could confirm the presence of leopards in any area of the Median mountains at present.

Our study confirms that the leopards' range in Saudi Arabia extends from Harrat Uwayrid and Jebel Aglab; Jebel Nahar, Jebel Shaihoob to Wadi Amoudan which is located south-east of Harrat Uwayrid. The present data showed that leopards are more often seen in certain areas, such as Wadi Amodan, Harrat El-Zabin; El-Fegrah area; Jebel Radwa; Jebel Nees; Jebel Shada; Jebel Fayfa; Jebel Bani Malik, than in others. These habitats are located high in mountains with permanent waterholes with reasonable vegetative cover. These permanent waterholes might not be so important to the survival of the leopard itself, as indicated by Kingdon (1990), but are essential for its prey.

Leopards are opportunistic hunters that prey on many species (Bothma and Le Riche, 1984; Kenneth et al., 1993). They need about 3 kg of meat daily (Kingdon, 1990). Bothma and Le Riche (1984) found that females with cubs usually consume more than males in the Kalahari Desert. The Arabian leopard seems to concentrate on small-to-medium-sized prey species such as gazelles, rock hyrax, hares, birds and possibly lizards and insects (Kingdon, 1990). The carcass of a large prey is usually stored in caves or lairs. Nothing was seen to be stored in trees in Arabia. Scat analysis should be done to determine the relative occurrence of different prey in the diet. In the Median mountains, continued drought might lead to decline of prey. Together with the killing and poisoning of the leopard, decreased availability of prey might bring about its extinction.

In most areas occupied by the leopard, extensive hunting by humans for gazelles, ibex and hyrax is conducted throughout the year, reducing the prey population in these areas.

This forces leopards to prey on livestock, especially sheep, goats and sometimes on small camels (Biquand, 1990). This in turn makes the leopard an enemy of herdsmen (Harrison, 1981), which makes hunting and poisoning of leopards inevitable in most cases. Other reasons for killing leopards are for personal satisfaction and pride, traditional medicine and hides (CAMP, 2002). Some leopards are killed accidentally when eating poisoned carcasses intended for wolves and hyenas.

A successful conservation strategy must promote the awareness of the importance of leopard conservation, employing the media and perhaps other sources for basic education programmes. The support and involvement of people living close to leopard habitats are vital in such efforts. This is true not only because they might affect the conservation of the leopard in one way or another, but also because they depend on their livestock which could be killed occasionally by leopards. Although it is not always practical, compensation for lost livestock from leopard predation should be considered (Anderson and Grove, 1989).

An important way to gain support of local inhabitants is to have them experience an economic benefit from protecting such a species (Bailey, 1993). Revenue from sources such as hunting rights and ecotourism, services such as roads and school employment in protected areas would encourage local residents to participate in leopard conservation. Furthermore, well-managed protected areas will ensure the continued survival of the species until other factors enhancing its survival become effective. Public awareness, fruitful consideration of the needs of local people and ecological studies may take years to be useful.

In this context, the concept of conservation and sustainable use of natural resources is deeply rooted in Islamic culture (Bakader et al., 1983). Emphasis on this issue should convince a large number of people to cope with the presence of leopard and their prey.

Additionally, a detailed study of leopard distribution and habitat requirement is needed for the management of the species. The ecological information needed include data on feeding behaviour, range use and reproduction. This information is of great importance to the survival of the species. There are many sites already surveyed and considered to be suitable for preservation for leopards in the plan adopted by the national commission for wildlife conservation and development. These areas include Jebel Fayfa, Jebel Al-Qahar, Jebel Shada (which has already been announced as a protected area), Jebel Nees, Jebel Wergan, Jebel Radwa and Harrat Uwayrid. The formal establishment of some of these areas is now urgent.

In conclusion, this paper speculates that the number of leopards in Saudi Arabia is greater than is widely believed. It is difficult, however, to determine the exact number of leopards in Saudi Arabia. Although the presence of a leopard might be recorded more than once, only a limited number of sites have been surveyed. For various reasons, including the vastness of areas covered in search of prey, secretive life style, natural alertness and inaccessible and rugged habitat, it was impossible to confirm the exact number of surviving leopards.

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