

A Review on: Distribution, Ecology and Status of Golden Jackal (*Canis aureus*) in Africa

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Abstract

The golden jackal (*Canis aureus*) is the most widely distributed of the three jackal species (*C. adustus*, *C. mesomelas*, and *C. aureus*). The golden jackal occurs in North and East Africa, South-eastern Europe, Middle East and South Asia up to Burma and Thailand. This implies that the golden jackal is a habitat generalist and occurs in a variety of habitats from savannah and woodland in protected areas, non-protected cultural forests and the associated pastoral areas, farmland with dense human populations. Golden jackals are opportunistic feeders, being both predators and scavengers. In East Africa, although they feed on invertebrates and a fruit, over 60% of their diet is composed of rodents, lizards, snakes, birds, hares and young of Thomson's gazelle. In Africa, golden jackals have been observed to kill the cubs of black-backed jackals. Jackals will feed alongside spotted hyenas, though they will be chased if they approach too closely. Population estimates for Africa are not available. Their number is shrinking due to anthropogenic causes. According to the IUCN (2004) list of threatened species, the status of golden jackal is "least concern". There are no other known threats, except local policies of extirpation and poisoning and can be considered as a species requiring no immediate protection with caution and knowledge that populations throughout its range are likely to decline.

Keywords: Anthropogenic causes, Golden jackal, Habitat, Population status, Predators

INTRODUCTION

The golden jackal (*Canis aureus*) is the most northerly and most widely distributed of the three jackal species (*C. adustus*, *C. mesomelas*, and *C. aureus*). It is the only jackal species that occurs outside the Sub-Saharan Africa. The golden jackal occurs in North and East Africa, South-eastern Europe, Middle East and South Asia up to Burma and Thailand. This implies that the golden jackal is a habitat generalist, similar to the coyote (*Canis latrans*) in North America (Bekoff and Gese, 2003). Both species are generalist predators with adaptable social systems that are able to exist in close proximity to humans and exploit agro-ecosystems (Macdonald, 1979). However, in some parts of their range, golden jackals have either disappeared or their numbers are shrinking due to anthropogenic causes (Jhala and Moehlman, 2004).

A variety of anthropogenic factors have resulted in the reduction in the numbers and geographic range of many carnivore species across the world (Gese, 2001). The design and implementation of recovery programmes for such species are partially dependent upon rapid and accurate assessment of their abundance and distribution. Many carnivore species are nocturnal, secretive and rare, making such assessments problematic (Gese, 2001), despite a proliferation of methods to estimate carnivore range and abundance (Wilson and Delahay, 2001).

According to Giannatos *et al.* (2005), dense vegetation usually associated with wetlands may provide cover for avoiding humans during the daytime and be an important limiting factor for the existence of golden jackals in close proximity to humans.

The golden jackal is a generalist predator and occurs in a variety of habitats from savannah and woodland in protected areas (Moehlman, 1983; Fuller *et al.*, 1989) to farmland with dense human populations (Pouche *et al.*, 1987; Jaeger *et al.*, 2007). This meant past, particularly where many of the larger predators have been eliminated, the golden jackal is the most abundant carnivore (Yom-Tov *et al.*, 1995; Krystufek *et al.*, 1997). The opportunistic behavior of golden jackals is illustrated by their catholic diet and ability to flourish where human rubbish is abundant (Macdonald, 1979; Yom-Tov *et al.*, 1995).

The golden jackal is a medium sized canid in the genus *Canis*, Family canidae, suborder Fissipedia, order carnivora (Clutton-Brock *et al.*, 1976). It is distinguished by its basic golden coat color that varies from pale creamy yellow to dark tawny hue on a seasonal basis, and a mixture of black brown and white hairs on the back (Jhala and Moehlman, 2004).

Unlike other jackal species, which are African in origin (Lindblad-Toh *et al.*, 2005), the golden jackal like the wolf, likely emerged from Asia (Lindblad-Toh *et al.*, 2005). The direct ancestor of the golden jackal is thought to be *C. kuruksaensis*, this canid native to Tajikistan (from late Pliocene to early Pleistocene (Rook, 2010)). Another prehistoric canid initially thought to be an ancestral jackal (*C. arnensis*), which was native to Europe, was later classed as more closely related to the coyote. Golden jackals likely colonized the European continent during the late Pleistocene.

The jackal is not as controversial or damaging as its larger counterpart, the grey wolf (*C. lupus*),

although in high-densities predation on small-sized stock does occur (Genov and Vassilev, 1991; Yom - Tov *et al.*, 1995). This species does not have such a negative image among hunters and rural people as the red fox (*Vulpes vulpes*), which is considered as a small-game eliminator and poultry-lifting animal.

According to the IUCN (2004) list of threatened species, the status of golden jackal is “least concern”. There are no other known threats, except local policies of extirpation and poisoning and can be considered as a species requiring no immediate protection with caution and knowledge that populations throughout its range are likely to decline (Jhala and Moehlman, 2004). Although regarded as a pest and constantly persecuted, its population has constantly increased over the centuries. Due to the low level of human – jackal conflicts, it seems that conservation measures for the species would be easier to enforce than with other sympatric canids.

Description and Taxonomy

Golden jackals are medium sized canids, and are considered the most typical representative of the genus *Canis* (Clutton-Brock *et al.*, 1976). Golden jackals resemble wolves in general appearance, but are smaller, lighter, have proportionately shorter legs, have more elongated torsos and shorter tails. The iris is light or dark brownish (Heptner and Naumov, 1998). Golden jackals in India tend to have shorter ears than their North African cousins. Adults are 74–106 cm (29–42 in) long, 38–50 cm (15–20 in) high at the shoulder and weigh 7–15 kg (15–33 lb) (Kingdon, 1977). The tail is straighter, shorter and brushier than that of wolves (Figure 1) (Voorst, 1959).

On average, the body weight of adult male and female golden jackals is estimated 6.6 kg and 5.8 kg, respectively with an approximate 12% difference between sexes (Moehlman and Hoffer, 1997). The belly underpart is light pale ginger to cream. Unique light markings on the throat and chest make it possible to differentiate individuals from the population (Moehlman, 1983). The tail is bushy with a tan to black tip. Females have four pairs of mammae (Jahla and moehlman, 2004). The skull of the golden jackal is more similar to that of the coyote (*C. latrans*) and the grey wolf (*C. lupus*), than that of the black-backed jackal, side-striped jackal (*C. adustus*), and Ethiopian wolf (*C. simensis*) (Clutton-Brock *et al.*, 1976). The dental formula is 3/3-1/1-4/4-2/3=42 (Moehlman and Hofer, 1997).

Table-1. Body measurements of the golden jackal (Moehlman and Hofer, 1997).

Feature	measure
HB male	793mm (760–840) n=6
HB female	760mm (740–800) n=3
T male	220mm (200–240) n=6
T female	205mm (200–210) n=3
E male	76mm (68–90) n=6
E female	80mm (75–85) n=3
WT male	8.8kg (7.6–9.8) n=6
WT female	7.3kg (6.5–7.8) n=4

(Key: HB = head and body measurement, T = tail length, HF = hind foot, E = ear, WT = weight)



Figure 1: - Golden jackal (Macdonald, 1979; Moehlman, 1983)

The skull of the golden jackal is less massively built than that of wolves, and have narrower and more pointed muzzles. The projections of the skull are well developed, but weaker than those of the wolf (Heptner and Naumov, 1998). In jackals, the anterior incisures of the nasal bones has a medial protrusion, unlike wolves (Harrington, 1982). There are 18 characteristics which distinguish the skulls of golden jackals from those of

domestic dogs. Among them, the jackal has a smaller inflation of the frontal region, a shallower forehead, smaller upward curvature of the zygomatic arches and a longer and thinner lower jaw (Mazin, 1996). Occasionally, they develop a horny growth on the skull, this horn usually measures half an inch in length, and is concealed under fur (Harrington, 1982).

The teeth are similar to those of wolves, but are overall more trenchant in character, particularly in the upper molars, which have higher cusps, are more slender and their cutting ridges much more developed. The canine teeth are thinner than the wolves, and the carnassials relatively weaker (Heptner and Naumov, 1998). Also, the cingulum on the external edge of the first upper molar is broader and more distinctly marked (Harrington, 1982). North African jackals tend to have longer carnassials than those living in the Middle East (Macdonald, 1992).

The winter fur is generally of a reddish-grey colour, with blackish or rusty red tips on the guard hairs. It is ochreous-rusty-reddish, with a black stripe above each eye. The lips, cheeks, chin and throat are white. The outsides of the limbs are ochreous-red, with the insides being of a light colour. The summer fur is sparser, coarser and shorter, with the same colour as the winter coat, only brighter and less darkly tinted (Heptner and Naumov, 1998). The hairs of the tail are about four inches long and of yellowish colour beneath, grayish above, and all tipped with black (Voorst, 1859). Jackals living in mountainous regions may have a greyer shade of fur than their lowland counterparts (Kingdon, 1977). Jackals molt twice a year, in spring and autumn (Heptner and Naumov, 1998). The color and texture of the fur tends to vary geographically (Bachrach, 1953).

It is the largest of the jackals, and the only species occurring outside Africa, with 13 recognized subspecies (Wozencraft, 2005). Although often grouped with the other jackals (the black-backed jackal, and the side-striped jackal) (Figure 2). The genetic research indicates that the golden jackal is more closely related to the gray wolf and the coyote (Lindblad, 2005). The Genetic evidence is consistent with the form of the skull, which also bears more similarities to those of the latter two species than to those of other jackals. The golden jackal is sometimes featured in the folklore and mythology of human cultures with which it is sympatric: in Indian folklore, it is portrayed as a trickster, while in Ancient Egyptian religion; it has a central role under the guise of Anubis, the god of embalming. Once thought to have been the ancestor of some dog breeds, the golden jackal can be hybridized with domestic dogs; the species may have contributed for breeding Ancient Egyptian hunting hounds (Routledge, 2002).

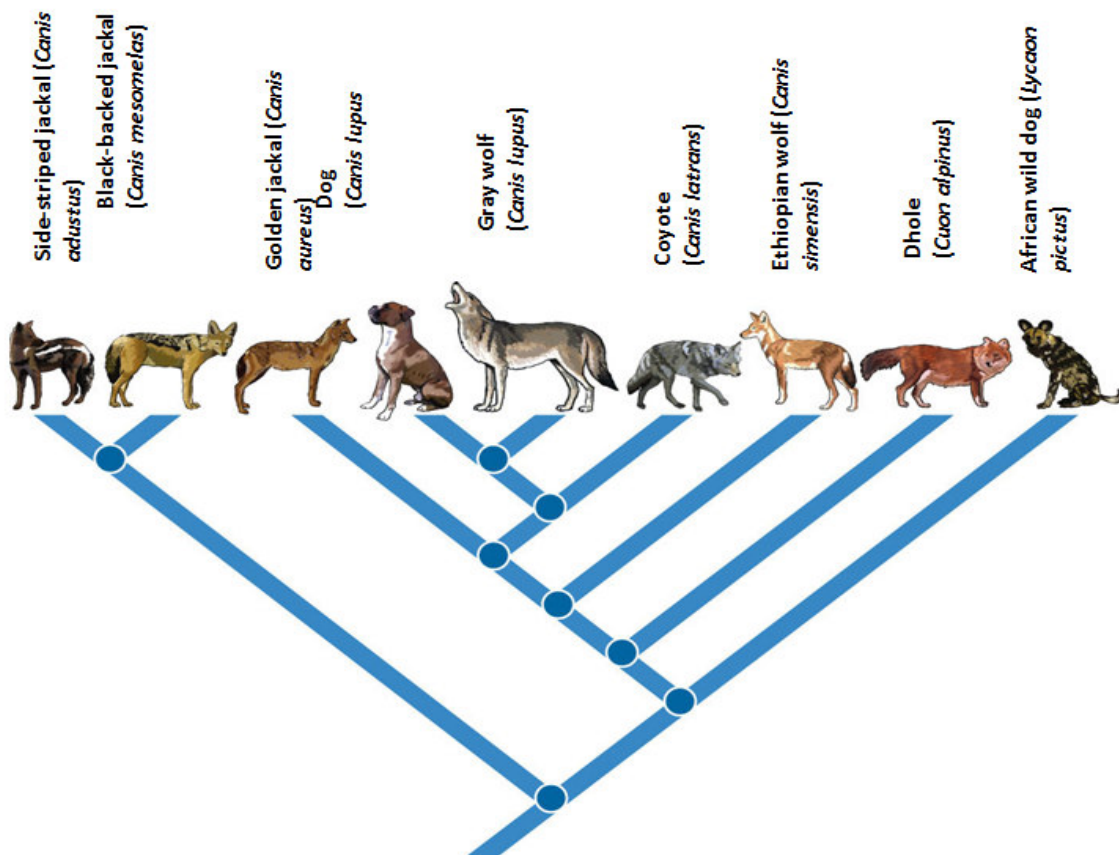


Figure 2. Phylogenetic tree of golden jackal and other Canids generated from 372 bp sequence of cytochrome b mtDNA (Source: Chen *et al.*, 2000).

As many as 12 subspecies are distinguished across the range (Wozencraft, 2005). However, there is much variation and populations need to be re-evaluated using modern molecular techniques. These are; *C. a. algirensis* (Algeria, Morocco and Tunisia), *C. a. anthus* (Senegal), *C. a. aureus* (Middle Asia, Afghanistan, Iran, Iraq, Arabian Peninsula, Baluchistan, northwestern India), *C. a. bea* (Kenya, Northern Tanzania), *C. a. cruesemanni* (Thailand, Myanmar to east India), *C. a. ecsedensis* (no-data), *C. a. indicus* (India, Nepal), *C. a. lupaster* (Egypt), *C. a. moreoticus* (South-eastern Europe, Asia Minor and Caucasus), *C. a. naria* (Southern India, Sri Lanka), *C. a. riparius* (Somaliland and Ethiopia and Eritrea), *C. a. soundanicus* (Sudan and Somaliland), *C. a. syriacus* (Israel, western Jordan).

Status and Distribution

The Golden Jackal is widespread and is fairly common throughout its range with high densities observed in areas with abundant food and cover. A minimum population estimate of over 80,000 is estimated for the Indian sub-continent. Population estimates for Africa are not available. On the African continent, Golden jackals inhabit the National Parks, non-protected cultural forests and the associated pastoral areas. In the Serengeti National Park, jackal density is as high as four adults per km² (Moehlman, 1989).

Black-backed jackals, golden jackals, side striped jackals, African wild dogs and bat eared foxes are sympatric in the Serengeti ecosystem and Rift Valley of Tanzania and Kenya reflecting the high density and abundance of food in the region (Wayne et al., 1989).

The golden jackal is widespread in North Africa and north-east Africa, occurring from Senegal on the west coast of Africa to Egypt in the east, in a range that includes Morocco, Djibouti, Kenya, Mali, Mauritania, Somalia, Sudan, Tunisia, Niger, Eritrea, Ethiopia, Algeria and Libya in the north to Nigeria, Chad and Tanzania in the south (Mohelman, 1983).

Golden jackals exist in close proximity to humans and obtain suitable day time cover and food materials from agro-ecosystems. In Bangladesh, they occur in intensively cultivated and human dominated areas (Poche et al., 1987). They have wide distribution in the Ethiopian highlands (Yalden et al., 1980). The Menz-Guassa highland is one of the Ethiopian highlands when the population density of this golden jackal is high even though most of the land is used for subsistence farming (Getachew Simeneh, 2010). Their spatial ecology on the farmlands adjacent to the Bale Mountains is studied well and showed distribution in a mosaic of farmlands, grassland and woodland (Ermias Admassu et al., 2004). However, their distribution is affected by the extensive flooding that occurs during the annual monsoon rains which force jackals to leave submerged areas for up to three months. Annual access to an area with suitable cover and a diet mainly of rodents are important factors influencing local abundance in the major agro-ecosystems (Jaeger et al., 2007).

ECOLOGY AND BEHAVIOUR

Golden jackals are opportunistic feeders, being both predators and scavengers. They tend to dominate smaller canid species. In the Serengeti, golden jackals feed primarily on dung beetles, grasshoppers and crickets, though they will also eat gerbils, springhares, hares, ground birds and their eggs, lizards, snakes, frogs, fishes, bulbs, berries and fallen fruit (Kingdon, 1977). In Africa, golden jackals have been observed to kill the cubs of black-backed jackals (Jahla and moehlman, 2004). In Israel, red foxes are a commonly occurring predator, and although smaller than jackals, their dietary habits are identical, and the two species are therefore in direct competition with one another. Foxes generally ignore jackal scents or tracks in their territories, though they have to avoid close physical proximity with jackals themselves (Anonymous, 2007).

In Africa, golden jackals often eat alongside African wild dogs, and will stand their ground if the dogs try to harass them. In South-eastern Asia, golden jackals have been known to hunt alongside dhole packs, and there is one record of a golden jackal pack adopting a male Ethiopian wolf (Lekagul, 1988). In India, lone jackals expelled from their pack have been known to form commensal relationships with tigers. The tigers have been known to tolerate these jackals: one report describes how a jackal confidently walked in and out between three tigers walking together a few feet away from each other (Richard, 1965).

Tigers will, however, kill jackals on occasion: in Amu-Darya region, tiger were known to frequently eat jackals (Heptner and Sludskii, 1992). Predation on golden jackal by lions has been seen in most populations, and lion predation is the most common known cause of death in some populations (Mills & Gorman, 1997). Competition with larger carnivores is an important force shaping the behavior, number, and distribution of golden jackal (Creel & Creel, 1996; Mills & Gorman, 1997).

Jackals will feed alongside spotted hyenas, though they will be chased if they approach too closely. Spotted hyenas will sometimes follow jackals during the gazelle fawning season, as jackals are effective at tracking and catching young animals. Hyenas do not eat jackal flesh readily: four hyenas were reported to take half an hour in eating one jackal. Overall, the two animals typically ignore each other when there is no food (Kruuk, 1972). Jackals will confront a hyena approaching too closely to their dens by taking turns in biting the hyena's hocks until it retreats. Striped hyenas have been known to prey on golden jackals in Kutch, India; one

striped hyena den contained three dead jackals. They are aggressive toward vultures on carcasses and will attack them if they land too close to them (Estes, 1992).

Habitat and Home Range

Golden jackals are habitat generalists. They are the most widely distributed of the three jackal species (*C. adustus*, *C. mesomelas* and *C. aureus*). Their ranges are extensive and include many areas of Africa, Asia, and Europe (Macdonald and Sillero-Zubiri, 2004). This confirms the special adaptation of the species to heterogeneous environmental conditions and the efficiency they have in adapting diverse habitats, similar to the Coyote in North America (Bekoff and Gese, 2003). Due to their tolerance of dry habitats and their omnivorous diet, the golden jackal can live in a wide variety of habitats. These range from the Sahel desert to the evergreen forests of Myanmar and Thailand. They occupy semi-desert, short to medium grasslands and savannahs in Africa. Golden jackals are opportunistic and will venture into human habitation at night to feed on garbage. Jackals have been recorded at elevations of 3,800m in the Bale Mountains of Ethiopia (Sillero-Zubiri, 1996). Golden jackals prefer dry open country, arid short grasslands and steppe landscapes (Figure 3).



Figure 3: - The preferred habitat type of golden jackal (Sillero-Zubiri, 1996)

The type of ecosystem, resource distribution and extent of human pressure determines the size of their home range. Their home range is estimated to range 11 to 20 km² (Macdonald and Sillero Zubiri, 2004). In *Acacia* woodland in Kenya, the range of a pair of golden jackal was recorded to be 2.4 km² (Fuller *et al.*, 1989). In Serengeti, the defended territory ranges from 1 to 3 km² (Moehlman, 1986). The largest home range size is recorded on farmland adjacent to the Bale Mountains National Park, Ethiopia, that varied from 7.9 to 48.2 km² for adult jackals and from 24.2 to 64.8 km² for subadults (Ermias Admassu *et al.*, 2004).

Food and Foraging Behavior

Unlike strict carnivore species, golden jackals are omnivores and opportunistic foragers.

They do not rely on persistent hunting. Depending on the availability, they use a wide range of food items (Macdonald, 1979). They feed on large and small mammals, birds, insects, fruits and garbage around human settlement areas.

In southern Greece, the most common food items of golden jackals are mammals and birds. However, the percentage of birds as a food item for golden jackals depends on the availability of bird carcasses as the capture of live birds is very difficult with a high percentage of failure (Kauanda and Skinner, 2003). In East Africa, although they feed on invertebrates and fruits, over 60% of their diet is composed of rodents, lizards, snakes, birds, hares and young of Thomson's gazelle (Moehlman, 1989).

Habitat conditions and changes are well indicated by the diet composition and feeding habits of predators. For example, in habitats with low density of wild prey, the frequency of domestic livestock predation and the extent of carcasses and garbage consumption increase. Predation on domestic livestock in central Niger, especially by the golden jackal has been identified by herders (Mschane and Grettenberger, 1984). Scat analysis of golden jackals in Niger showed that vegetable matters and invertebrates constituted the main identifiable items (Mschane and Grettenberger, 1984).

Rodents are basic food items among smaller mammals. Different studies have confirmed significant frequency in the occurrence of rodent species as a diet for golden jackals. It is reported as the primary prey to jackals (Lanszki and Helati, 2002), including bandicoot rats (Khan and Beg, 1986), wild ungulates, livestock and small mammals (Yom-Tov *et al.*, 1995). In agro-ecosystems of Menz-Guassa highland, rodents were the most

common food items throughout the year (Getachew Simeneh, 2010).

During their breeding season, golden jackals use diverse food items that are easily accessible and closer to their den. In Serengeti, they feed on larger prey and carcasses. A large variety but low quantity of invertebrates and small passerines, snakes, lizards, and fish are also found as food components for golden jackals and red fox at the time of cub rearing (Lanszki *et al.*, 2006). During the fruiting season, they feed on fruits showing their opportunistic feeding habit. Variety of fruits and vegetables, together with poultry and livestock are parts of their diet (Sarker and Ameen, 1990). Compared to the red fox, golden jackals showed quick response to food resource limitations. This is best exemplified when golden jackals shifted from small prey to other food items earlier when the availability of small mammals declined and also return to rodent hunting when available (Lanszki *et al.*, 2006). Golden jackals are medium sized predators (mesocarnivores) and hunt in solitary. They also hunt in pairs or groups increasing the likelihood of success when they encounter larger prey (Ermiyas Admassu *et al.*, 2004).

Group living is important to hunt large preys and defend carcasses. Golden jackals are successful at catching Thomson's gazelle fawns when hunting in pairs (Wyman, 1967). They have been observed to hunt on young, old, and weak ungulates that are heavier than their body weight (Kotwall *et al.*, 1991). They steal food from larger predators, usually waiting until they are done feeding before finishing off the carcass. They follow wolves on a hunt and scavenge wolf kills (Jhala, 1994).

Golden jackals live in small family groups consisting of mother and father together with some of their offspring, which serve as helpers when the mother has young puppies. Their social unit is basically built from a mated pair and its young (Ivory, 1999). Breeding pairs of jackals form annual residents that defend their cover (Jaeger *et al.*, 2007). They occasionally become gregarious when they feed on carcasses. Group size of 10 - 20 individuals each in highly clumped and defensible food resources are seen in Israel (Macdonald, 1979). Group strategies in the care of offspring have been observed in all social carnivores and could represent a second major factor, together with foraging strategies, in the evolution of social behaviour of carnivores. The sociality of golden jackals is elaborated at large in cub rearing. In golden jackals and black backed jackals, the previous year young may remain with their parents and assist in various aspects of raising the next litter, regurgitating food for them, guarding from predators and assisting the parents in hunting for food (Moehlman, 1983).

Single jackals typically hunt smaller prey like rodents, hares and birds. They use their hearing to locate rodents in the grass and then pounce on them by leaping in the air; they also dig out gerbils (*Tatera indica*) from their burrows. They have been observed to hunt young, old, and ungulates that are sometimes 4-5 times their body weight (Moehlman, 1983). During calving peaks of blackbuck (*Antelope cervicapra*), in Velavadar National Park, India, jackals were observed searching for hiding calves throughout the day with searches intensifying during the early morning and late evening (Moehlman, 1983). Although solitary jackals was observed hunting (n=4) and killing blackbuck calves (n=1), in groups (2-4 jackals) they were more successful (n=4), as has been observed for predation on African antelope fawns (Wyman, 1967). Indeed, cooperative hunting permits them to harvest much larger prey in areas where it is available, and cooperative hunting of langurs (*Presbytis pileata* and *P. entellus*) has been reported (Moehlman, 1983). Aggregations of between 5-18 jackals have been sighted scavenging on carcasses of large ungulates (Moehlman, 1983), and Macdonald (1979) report of similar aggregations on clumped food resources in Israel.

In Velavadar National Park, hundreds of harriers animal (*Circus macrourus* and *C. pygargus*) roost communally in the grasslands during the course of winter migration. Jackals were observed to stalk close to roosting harriers and rush at them attempting to catch one before the harriers could take off and gain height. In several areas of India and Bangladesh, jackals subsist primarily by scavenging on carrion and garbage (Poche *et al.*, 1987). They have the habit of caching extra food by burying it (Kingdon, 1977).

Social organization

The social organization of golden jackals is extremely flexible depending on the availability and distribution of food resources (Macdonald, 1979; Moehlman, 1983; Moehlman and Hofer, 1997). The basic social unit is the breeding pair, which is sometimes accompanied by its current litter of pups and/or by offspring from former litters (Moehlman, 1983, 1986, 1989).

In Tanzania, golden jackals usually form long-term pair bonds, and both members mark and defend their territories, hunt together, share food, and cooperatively rear the young (Moehlman, 1983, 1986, 1989). According to Moehlman (1983) out of a total of 270 recorded jackal sightings in the Bhal and Kutch areas of Gujarat (India), 35% consisted out of two individuals, 14% of three, 20% of more than three, and the rest of single individuals. Moehlman and Hofer (1997) give average group size as 2.5 in the Serengeti, Tanzania, while average pack size in Velavadar National Park is 3.0 (n=7).

Scent marking by urination and defecation is common around denning areas and on intensively used trails. Such scent flag posts are considered to play an important role in territorial defense (Moehlman and Hofer, 1997). Although Moehlman (1983) reports maintenance of year-round exclusive territories in Tanzania and in

India point out towards the flexibility of social organization depending on available food resources. Recent data obtained by telemetry from the Bhal area of India suggest that most breeding pairs are spaced well apart and likely maintain a core territory around their dens (Moehlman, 1983). Jackals were observed to range over large distances in search of food and suitable habitat, and linear forays of 12–15km in a single night were not uncommon (Moehlman, 1983). Non-breeding members of a pack may stay near a distant food source such as carcass for several days prior to returning to their original range. Recorded home range sizes vary from 1.1 to 20km² (Kingdon, 1977), depending on the distribution and abundance of food resources.

Affiliative behaviours like greeting ceremonies, grooming, and group vocalizations are common in jackal social interactions (Golani and Keller, 1975). Vocalization consists of a complex howl repertoire beginning with 2–3 simple, low pitch howls and culminating in a high-pitched staccato of calls. Jackals are easily induced to howl and a single howl evokes responses from several jackals in the vicinity. In India, howling is more frequent between December and April, a time when pairing takes place and breeding occurs, perhaps suggesting a role in territory delineation and defense (Jaeger *et al.*, 1996).

Reproduction and Denning Behavior

Jackals are strictly monogamous. Their adult sex ratios are equal, and their male and female helping behaviour and dispersal are equivalent (Moehlman, 1989). Once the mate and territory are established the pairs spend a lot of time scent marking. Near estrus, semi-aggressive fighting will end and the pair attachment bond reaches peak. The male frequently checks the readiness of the female. Mating has been observed at different months in different countries. In Tanzania, mating typically occurs from October to December with pups being born from December to March (Moehlman, 1989) but reproductive activity commences from February to March in India and Turkmenistan, and from October to March in Israel (Golani and Keller, 1975). As with other canids, mating results in a copulatory tie that lasts for several minutes (Golani and Keller, 1975). Availability of food supply is a limiting factor for reproduction. The time of birth in golden jackals, however, coincides with abundance of food supply, for example, the calving of Thomson's gazelle in the Serengeti (Moehlman, 1983).

Females are typically monoestrous, but there is evidence in Tanzania of multiple litters (Moehlman, 1983). Gestation lasts about 63 days (Moehlman, 1983). Moehlman and Hofer (1997) give mean litter size as 5.7 (range=1–8) in Tanzania. In Tanzania, Wyman (1967) reported an average of two pups emerging from the den at three weeks of age. Pups are born blind and their eyes open at approximately nine days and their teeth erupt at 11 days after birth (Moehlman and Hofer, 1997). Lactation usually lasts for 8–10 weeks. Once the lactation period has concluded, the cubs are driven away by their mother. Offspring from a previous litter may stay with their parents to help them rear their next litter, though their sexual behaviour is suppressed (Estes, 1992). Sexual maturity occurs at 11 months, while males become so after one year, though they only acquire an adult build after two years (Kingdon, 1977).

Dens may have 1–3 openings and typically are about 2–3m long and 0.5–1.0m deep. Young pups could be moved between 2–4 dens prior to joining their parents. In Tanzania, both parents and 'helpers' (offspring from previous litters) provision and guard the new pups. The male also feeds his mate during her pregnancy, and both the male and the 'helpers' provision the female during the period of lactation (Moehlman, 1983, 1986, 1989; Moehlman and Hofer, 1997). The 'helpers' are full siblings to the young pups that they are provisioning and guarding, and the presence of 'helpers' results in a higher pup survival (Figure 4) (Moehlman, 1986).



Figure 4: - pups of golden jackal (Kingdon, 1977)

The estrus cycle begins in early February and during warm winters in late January. Spermatogenesis in males occurs 10–12 days before the females enter estrus, and during this time, their testicles triple in weight.

Estrus lasts for 3–4 days. Females failing to mate during this time will undergo a loss of receptivity which lasts for 6–8 days. Mating occurs during daylight, and concludes with a copulatory tie. The pair is monogamous, and will remain together until one of them dies. Males take part in the raising of their young, and will dig burrows (Heptner and Naumov, 1998).

Competition

Golden jackals have been observed to appropriate the dens of Bengal foxes (*Vulpus bengalensis*) and porcupines (*Hystrix indica*), and also to use abandoned grey wolf (*C. lupus*) dens (Moehlman, 1983). Jackals often scavenge off the kills of larger predators like lion (*P. leo*), tiger (*P. tigris*), leopard (*P. pardus*), spotted hyaena (*Crocuta crocuta*), dhole (*Cuon alpinus*) and grey wolf (Moehlman, 1986; Jhala, 1994). Jackals have been observed following grey wolves on a hunt and scavenging off wolf kills without evoking any hostile reactions from wolves (Jhala, 1994).

Adaptations

Jackals are generalists, adapting to local abundance of food resources. This adaptability permits them to occupy a wide variety of habitats and utilize a variety of food resources. A body with long legs allows jackals to trot for large distances in search of food (Moehlman, 1983).

THREATS AND CONSERVATION STATUS

Over its entire range, except in protected areas like National Parks and Sanctuaries, the jackal population is steadily declining. Traditional land-use practices, like livestock rearing and dry farming that were conducive to the survival of jackals and other wildlife, are being steadily replaced by industrialization and intensive agriculture; wilderness areas and rural landscapes are being rapidly urbanized. Jackal populations adapt to some extent to this change and may persist for a while, but eventually disappear from such areas like other wildlife. There are no other known threats, except for local policies of extirpation and poisoning (for example, Israel and Morocco). Jackals may occasionally be hunted as a game species and eaten, as has been recorded in Morocco (Moehlman, 1983). There is no significant trade in jackal products, although skin and tail are occasionally sold.

Spotted hyenas have been observed to kill and feed on golden jackals (Kingdon, 1977), and the same probably holds true of other large carnivores. Jackals are often chased and sometimes killed by feral dogs when they approach human habitation. Skin diseases like mange and ectoparasites like ticks and fleas are common in jackals in areas where they occur at high densities. In Tanzania, golden jackals had positive serological test results to canine parvovirus, canine herpesvirus, canine coronavirus and canine adenovirus (Kingdon, 1977).

Human-wildlife conflicts have long history, since the beginning of the human era. Livestock predation by mammalian carnivore is one of the most frequent sources of conflict between humans and wildlife throughout the world (Mazzoli, 2002). Conflicts arise primarily because of competition between people and predators for shared and limited resources like wild herbivore and habitat. Many predators kill prey species that humans hunt, harvest or farm for and occasionally they may even kill people (Caro and Fitzgibbon, 1992). Domesticated breeds which have lost their anti-predator behaviours are easily killed by wild predators (Polisar, 2003).

Across the globe, the frequency and extent of economic cost of conflict between human and carnivores are increasing due to the expansion and growth of human population (Karanth *et al.*, 1999). Large home ranges of carnivores draw them into recurrent resource competition with humans. In addition, human exploitation of natural herbivores may reduce the availability of wild prey to predators and can increase the likelihood of attacks on livestock. The problem becomes serious when the resources have economic value and the predators involved are legally protected (Thirgood *et al.*, 2000). Under a variety of demographic, economic and social pressure, human alteration of carnivore habitat has led to escalated conflicts. If the habitat in which they live consists of areas large enough to support them, with sufficient food resources and of the influence of human on their habitat decreases, these animals tend to avoid man and his domestic animals (Naughton-Treves *et al.*, 2003).

People around protected areas develop negative attitude towards wildlife as a result of livestock predation by wildlife. The effect is highly pronounced among communities with subsistence economy (Olie *et al.*, 1994). Perceived economic losses due to livestock depredation often lead to retaliatory responses by agropastoralists. In many developing countries, lack of involvement by government and private agencies in human-wildlife conflicts, reflects, in part, priorities in other income sectors. Often the only perceived solution by the local people to predator problems is extermination (Sekhar, 1998). These include carnivore persecution and opposition to wildlife sanctuaries close to farms.

Human negligence plays an important role in many predation incidents (Yom-Tov *et al.*, 1995), where losses could be prevented by greater vigilance during grazing, preventing animals from straying, and returning herds to enclosures in day light. Livestock guarding dogs represent one of the most cost-effective methods of mitigating livestock predation. Dogs were found to be more effective at preventing coyote predation on sheep than any other technique (Ogara *et al.*, 1983). Studies have shown that livestock losses are not necessarily

correlated with predator density. Livestock losses to wolverines were a function of prey availability, rather than the abundance of predators (Landa *et al.*, 1999). As revealed by a study in Kenya, high densities of leopards (*Panthera pardus*) have less impact on livestock than might be expected. Kills of sheep by coyotes were not correlated with the number of coyotes (Conner *et al.*, 1998).

In Hungary and Greece, the jackal was recorded in the Red Data Book as extinct species.

It had disappeared from Hungary by the beginning of the 20thC, which was an indigenous and common predatory species of the country until the end of the 19thC living in bushy and wetland areas of Hungary. Changes of natural habitat and persecution of mammal predators caused the decrease in population (Demeter and Spassov, 1993). However, through repatriation process, immigrants have been arriving in the southwest since the beginning of the 1990s (Helati *et al.*, 2000). After absence of a half century, they became again a common predator in the southern part of Hungary (Szabo *et al.*, 2009). Similarly, in Greece, the species which was considerable in the past have become the rarest canid as a result of habitat destruction (Giannatos *et al.*, 2005).

Destruction of habitats in Greece (Peloponnese) resulted in the reduction of the jackal population close to 10% of the population (Giannatos *et al.*, 2005). As a consequence of changes in habitat and human use, a significant decline in the distribution of jackals is registered in Greece (Giannatos *et al.*, 2005). As a result, conservation action plan was prepared in 2004, which has an overall goal of maintaining and restoring viable population of jackal as integral part of the ecosystems (Giannatos, 2004).

According to the IUCN (2004), list of threatened species, the status of golden jackal is “least concern”. There are no other known threats, except local policies of extirpation and poisoning and can be considered as a species requiring no immediate protection with caution and knowledge that populations throughout its range are likely to decline (Jhala and Moehlman, 2004).

Golden jackals are present in all protected areas of India except for those in the high elevation regions of the Himalayas. In East Africa, they protected in the Serengeti-Masai Mara-Ngorongoro complex, as well as numerous other conservation units. Thus, they have a wide coverage in terms protected populations (Moehlman, 1989). Little quantitative information is available on jackal densities, habitat use, and ranging patterns in relation to food availability. Information on dispersal, survival and mortality factors of adults, pups and dispersing individuals is needed. Jackal ecology needs to be studied in forested ecosystems of Southeast Asia where a different set of factors are likely to operate affecting food availability, ranging patterns and survival. Aspects of canid diseases in relation to population dynamics of jackals and transmission need to be better understood (Moehlman, 1986).

Conclusion

The golden jackal (*C. aureus*), is the most widely distributed of the three jackal species (*C. adustus*, *C. mesomelas*, *C. aureus*). It is the only jackal species that occurs outside the Sub-Saharan Africa. The golden jackal occurs in North and East Africa, South-eastern Europe, Middle East and South Asia up to Burma and Thailand. This implies that the golden jackal is a habitat generalist, similar to the coyote in North America. Golden jackals are opportunistic feeders, being both predators and scavengers. In East Africa, although they feed on invertebrates and a fruit, over 60% of their diet is composed of rodents, lizards, snakes, birds, hares and young of Thomson’s gazelle. In Africa, golden jackals have been observed to kill the cubs of black-backed jackals. Jackals will feed alongside spotted hyenas, though they will be chased if they approach too closely. Jackals often scavenge off the kills of larger predators like lion, tiger, leopard, spotted hyaena, dhole and grey wolf. Jackals have been observed following grey wolves on a hunt and scavenging off wolf kills without evoking any hostile reactions from wolves.

The Golden Jackal is a widespread species. It is fairly common throughout its range with high densities observed in areas with abundant food and cover. However, Population estimates for Africa are not available. Due to the low level of human – jackal conflicts, it seems that conservation measures for the species would be easier to enforce than with other sympatric canids. Golden jackal is threatened over its entire range except in protected areas like National Parks and Sanctuaries. In general, the status of golden jackal is a “least concern”. There are no other known threats, except local policies of extirpation and poisoning and can be considered as a species requiring no immediate protection with caution and knowledge that populations throughout its range are likely to decline.

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