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Development of juvenile goitered gazelle social behavior during the hiding period

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ABSTRACT

In many ungulate species, social organization of adults is based on a linear dominance hierarchy, which in turn often positively correlates with age, body mass, and horn/antler size. In contrast to the social behavior of adults and specific mother-offspring interactions, the process of ungulate socialization in juveniles through contacts with other conspecifics is poorly understood, especially for hider species during their initial hiding period. Therefore, we investigated this process in goitered gazelle (*Gazella subgutturosa*), which is a typical hiding species, and analyzed all contacts between fawns and other conspecifics, omitting mother-young interactions, which are different by nature from other contacts and demands separate consideration. We found that apart from mothers, fawns interacted most often with nonmaternal adult females, less with other fawns and least with adult males and sub-adults. The frequency of the fawns' contacts with conspecifics other than their mother increased during May and early-June, reaching a maximum in late-June, when fawns had the most mobility and independence from their mothers. This frequency decreased in July, when fawns spent more time with their mothers and when they mostly followed the mother's behavior. The interactions of adult males and sub-adults of both sexes with fawns were the most aggressive in character, involving frequent displays of butting and chasing. Aggressive interactions were fewer between adult females and fawns, while fawn-fawn interactions had least aggressive displays. The main cause of interactions between fawns and other conspecifics were attempts of these young gazelles to suckle from other adults and sub-adults, especially frequently from nonmaternal females. Only fawn-fawn contacts were not linked to suckling and seemed to relate mostly to the development of social behavior and dominance hierarchies.

1. Introduction

Social life serves many purposes, including group cohesion, better protection from predators, more efficient foraging, easier access to sexual partners, and more successful defense of neonates (Jarman, 1974; Fraser and Broom, 1997; Estevez et al., 2007). Communication plays a key role in the development and maintenance of social behaviors and social bonds (Miranda-de la Lama and Mattiello, 2010). One of the most important functions of communication within a group is sending signals through agonistic-submissive encounters intended to establish or maintain a dominance hierarchy, which can significantly affect individual access to vital resources, such as food, water, shelter, and space, as well as impact reproductive success (Clutton-Brock et al., 1986; Côté, 2000). Furthermore, creating a predictable social environment, in which each individual has its own social rank or place in the social structure, may reduce the energy costs and risk of injury associated with fighting (Clutton-Brock et al., 1979; Hand, 1986). Social rank in adult individuals is positively correlated with individual traits such as age, body mass and antler/horn size (Côté, 2000; Holand et al., 2004; Taillon and Côté, 2006).

The aggressive behavior and dominance hierarchies of adult males are described in detail for many ungulate species (Schaller, 1983; Walther, 1984); hierarchical relationships between females are less investigated (Kumpula et al., 1992; Côté, 2000; Bebié and McElligott, 2006; Stockley and Campbell, 2013); while development of social behaviors in young wild ungulates and especially appearance and establishment of dominance hierarchies through offspring-conspecifics interactions are poorly understood (Sarno et al., 2006; Dušek et al., 2007). Typically right after birth, young do not exhibit aggressive behavior, and their relationships with their mothers and their twins (if

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twinning occurs) usually are quite amicable. However, they can be attacked by adult animals if they try to approach other mothers or mature males (Hafez et al., 1969). Goitered gazelle and blesbok antelope (*Damaliscus dorcas*) offspring, for example, approach other conspecifics other than their mothers and try to suckle from them after birth, when they are unable to distinguish their own mothers from other conspecifics (Walther, 1969; Blank, 1985).

Apart from mother-young interactions, which are the most important for offspring survival, contacts with other conspecifics and learning of social behaviors can further benefit young (Lent, 1974; Ruckstuhl and Ingold, 1999). Individual social rank in bovids starts to form prior to weaning, as well as during aggressive interactions with conspecifics of various ages and sexes (Hall, 1983; Veiberg et al., 2004). Social rank can be established as early as six weeks of age as was found for pronghorn (Autenrieth and Fichter, 1975), and the development of the hierarchical structure may continue well into the second year, as shown in mountain goats (*Oreamnos americanus* – Gendreau et al., 2005), bighorn sheep (*Ovis canadensis* – Festa-Bianchet, 1991) and red deer (*Cervus elaphus* – Thouless and Guinness, 1986).

Though inter-relationships established between offspring and other individuals are very important for understanding social life in gregarious ungulates and have life-long consequences, social behavior development in wild species is poorly understood (Garay et al., 1995). In this study, we investigated the behavior of adults and sub-adults toward offspring of goitered gazelles (*Gazella subgutturosa*) during the hiding period, omitting the mother-young interactions from our analysis, which are different by nature from other contacts and demand separate consideration (Blank, 2017; Blank et al., 2015; Blank and Yang, 2015). The goitered gazelle is a medium-sized ungulate, which originally was widely spread over Middle and Central Asia, Iran, Afghanistan, and Turkey; at present time, these gazelles have disappeared in many areas and their natural habitat has shrunk considerably (Kingswood and Blank, 1996). Adult females give birth in mid-May and most pregnancies produce twins, while the youngest and oldest females usually produce a single offspring (Kingswood and Blank, 1996). A mother with hiding fawns stays alone for several weeks after giving birth, and then joins with 1–2 other mothers with young into small groups. Males, during this time, remain single or stay in small-sized male groups (Blank et al., 2012). Throughout their first weeks of life, young goitered gazelles stay alone without their mothers for most of the day (Blank, 1985), with females only returning to nurse their offspring. As their young grow, females stay with their offspring for longer periods of time until they reach the age of two months in mid-July, when they start to follow their mothers constantly, thus ending the hiding period (Blank, 1985). In this paper, we investigate the development of social behavior during the hiding period (mid-May–mid-July), when fawns interact with older conspecifics (other than their mothers), which helps to prepare the offspring for later social integration (Autenrieth and Fichter, 1975).

It seems to be a widespread rule in ungulate behavior that the animals interact with conspecifics of their own sex, age, and social class most often, less frequently with animals of lower or higher rank, and infrequently or not at all with animals from more distant ranks (Walther, 1984; Côté, 2000). We therefore propose our first hypothesis that the frequency of interactions with other conspecifics would be age- and rank-dependent. We predicted that goitered gazelle fawns, apart from their mothers, would have most contacts with other fawns, less frequently with sub-adults, and least with adult gazelles.

As mentioned previously, the general activity of goitered gazelle fawns increases with age (Blank, 1985). In domestic goats and bighorn sheep (*Ovis canadensis*), young tend to associate and form bonds with other offspring of the same age and spend less time with their mothers than with other young (Berger, 1979; Lickliter, 1987). Therefore, our second hypothesis is that the frequency of social contacts of goitered gazelle fawns with conspecifics would continuously grow as the fawns aged. We predicted that fawns would have more social contacts with other fawns, and that they would stay in the company of other fawns for grazing and resting more often, compared to observed cases of gazelle fawn-adult associations.

Walther et al. (1983) found that encounters among juvenile animals differed from all the others (juvenile-adult and juvenile-sub-adult interactions) in that agonistic behaviors are infrequent or even lacking. We assume this also could be true for interactions between adult and sub-adult gazelles versus fawns and thus proposed our third hypothesis that adult and sub-adult gazelles would behave more aggressively toward fawns than fawns would with each other.

Typically, during their first weeks of life, offspring do not demonstrate aggressiveness; however, they can be attacked by adult animals if they try to approach them (Hafez et al., 1969). In goitered gazelles, fawns often approach alien adults trying to suckle, and generally only rarely stay in the company of adults for grazing and resting (Blank, 1992). We thus proposed our fourth hypothesis that most interactions between fawns and adult conspecifics would be because of suckling attempts.

2. Materials and methods

We observed the interactions of goitered gazelle fawns with conspecifics in their natural environment of the Altyn-Emel National Park, which covered 4.600 km^2 (Ili Hollow, southeastern Kazakhstan) during a 6-year period from 1981 to 1986, when the total population number fluctuated between 1500 and 5000 gazelles. The study area is represented by a gravel desert, which is scarred with a thick net of dry river beds, karst craters and depressions, and intermingled with clusters of small hills and plateaus. Vegetation is scattered and presented mostly by desert shrubs and dwarf-shrubs, which were more abundant along dry river beds. For our research, we used the continuous focal animal observation method (Altmann, 1974). All behaviors for one focal individual were recorded by one observer during the entire observation period and were recorded in the order in which they occurred and each time they occurred (all occurrence method). In most cases, gazelles were observed from distances of 50 to 100 m using binoculars (magnification $8^{\times}$) or a spotting scope (magnification $30^{\times}$–$60^{\times}$). Observation posts were usually established on elevations and in different parts of our study area to reduce pseudo-replication. The ages of fawns were known, since most females in the population gave birth within a period of several days starting in mid-May, which limited the movements of mothers and young during May–June (Blank, 1985). This allowed us to concentrate on 2–3 randomly selected single adult females with hiding young (usually the closest) for alternate observations from the same vantage point. This was done for as long as possible (up to 9 h), recording all activities. The total numbers of observed females, fawns,

Table 1
Number of adult and subadult females, adult and subadult males, and fawns, that were observed during four successive 15-day intervals during May–July of 1981–1986.

Intervals	Adult females	Fawns	Subadult females	Adult males	Subadult males
Late-May (15–31 May)	153	274	28	57	16
Early-June (1–15 June)	161	180	19	98	31
Late-June (16–30 June)	205	176	13	147	36
Early-July (1–15 July)	481	465	22	204	66