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A case of adoption and allonursing in captive plains zebra (*Equus burchellii*)

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ABSTRACT

Although allonursing (allowing non-filial offspring to suckle) can be a costly behaviour, it has been reported for many mammals including ungulate species. However, such behaviour is very rare in equids. This is the first report on adoption and allonursing in captive plains zebra (*Equus burchellii*), recorded in the Dvůr Králové Zoo, Czech Republic. We observed a case of adoption of an orphaned foal by a lactating mare, who then regularly nursed two foals (filial and non-filial). The allonursing mare rejected more suckling attempts, terminated suckling bouts more often, and had a shorter suckling bout duration than other mares. When nursing both foals at the same time, the suckling bout lasted for less time than when nursing a single foal, regardless of whether it was filial or non-filial. The allonursing mare apparently did not discriminate between the filial and non-filial foal.

1. Introduction

Allonursing (nursing of non-offspring) is the most extreme form of communal parenting (Gittleman and Thompson, 1988) as lactation itself is the most costly part of parental investment (Clutton-Brock, 1991; Packer et al., 1992).

Allonursing has been reported in many mammalian taxa (Packer et al., 1992; Roulin, 2002). Nevertheless it is more common in polytocous species than in monotocous (Packer et al., 1992). Among ungulates, allonursing has been reported many times in artiodactyls (red deer *Cervus elaphus* – Bartoš et al., 2001; Landete-Castillejos et al., 2000; cattle *Bos taurus* – Víchová and Bartoš, 2005; Saharan arrui *Ammotragus lervia* – Cassinello, 1999; guanaco *Lama guanicoe* – Zapata et al., 2009a,b, 2010; common hippopotamus *Hippopotamus amphibius* – Pluháček and Bartošová, in press), but rarely in perissodactyls. Only three such cases of allonursing were reported in detail (Cameron et al., 1999; Lloyd and Harper, 1980; Penzhorn, 1984), two of which were adoptions recorded in wild Cape mountain zebra (*Equus zebra zebra*). In one case a two-month old female foal left her natal herd and joined a lactating mare, from which she suckled together with the mare's own foal (Penzhorn, 1984). In the other, a foal was nursed by two mares, its mother and an another mare who abandoned her own foal (Lloyd and Harper, 1980). A case of co-operative nursing of a foal by its mother and grandmother was observed in feral horses (*Equus caballus*) after the death of the second offspring (Cameron et al., 1999).

These cases are exceptional. No other study on maternal behaviour in horses or plains zebras (*Equus burchellii*) or any other equid have recorded any case of allonursing despite extended periods of observation (Crowell-Davis, 1985; Feist and McCullough, 1976; Pluháček et al., 2010a,b; Tyler, 1972). Although suggested in the past (Wackernagel, 1965), our study is the first to directly observe and report adoption and allonursing behaviour in captive plains zebra in detail. We focused on differences between nursing and allonursing behaviour occurring in a group of mares with foals.

2. Materials and methods

2.1. Study animals

We observed a herd of plains zebra belonging to the subspecies *Equus burchellii boehmi* at the Dvůr Králové Zoo, Czech Republic, in November and December 2004. The herd consisted of one adult male, four adult females, one subadult female and five foals (two females and three males). All of the adult females were pregnant. Two foals (both male) were orphaned during the observation period. One of the orphaned foals (Galileo) was orphaned at nine days old, and was subsequently regularly nursed by one of the mares (Duky), who also nursed her own foal (a female, Denisa). The other foal was orphaned at the age of four and half months, and depended solely on solid food.

We used the same observational methods as described in our previous studies (Pluháček et al., 2006, 2007, 2010a,b): an observation session started at 8 a.m. or at 2 p.m. and lasted 180 min. In

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Table 1
Detailed individual data of observed captive plains zebra foals.

Foal	Sex	Nursing female	Number of foals suckling from one mare	Season (year)	Age of foal (days)	Number of suckling bouts	Number of suckling attempts
Amina	F	Alžběta	1	2004	133–175	85	43
Dario	M	Desaja	1	2004	109–151	107	75
Denisa	F	Duky	2	2004	107–149	100	129
Galileo[a]	M	Duky	2	2004	119–161	113	104
Delos	M	Duky	1	1999	105–161	62	30

[a] The mother of Galileo was Gajda. She died when he was 9 days old.

total, we observed nursing and allonursing behaviour in the herd over 9 days (18 observation sessions). All observational data were collected by the same observer (JP) using a tape recorder.

2.2. Statistics

To determine differences in allonursing and nursing behaviour, we combined the data collected on the observed group with data on the nursing behaviour of the allonursing mare obtained in 1999 when she was rearing a previous foal (her ninth; Table 1).

All data were analysed using the SAS System, Version 9.2. Factors influencing the rejection and termination of suckling bouts by the mother were tested using the logistic regression model (LR, GENMOD procedure) and those affecting suckling bout duration and frequency were tested using a multivariate general linear model (GLM, PROC MIXED, SAS). Tested factors (independent variables) were the identity of the foal and the foal's age and sex. Due to the small number of observed animals, we focused on differences among individual foals as applied in other study (Cameron et al., 1999) rather than testing effect of a 'foal's suckling type' (allosuckler/offspring of an allonursing female/non-allosuckler). The differences between the means of categorical factor levels in GLM were tested by *t*-tests with the Tukey–Kramer adjustment of *p*-values for multiple comparisons. Tests for specified hypotheses concerning the model parameters for explanatory variables in LR were constructed via the ESTIMATE statement.

In the next step we compared differences in suckling bout duration and termination by the mare when she was nursing one or two foals at a time. We compared bouts involving simultaneous suckling of Galileo and Denisa with those involving Galileo or only Denisa and with those for all other foals and their mothers.

3. Results

The case of adoption occurred in 2004 in a captive herd of plains zebra (*Equus burchellii boehmi*). A 21-year old multiparous female (Gajda) gave birth to a male foal (Galileo) on the 6th July. Nine days later she died. In the following two days the keepers saw the foal suckling from other mares in the herd. On the third day after the death of Gajda, another female (Duky; also 21 years old) gave birth to a female foal (Denisa) and adopted Galileo, who began suckling regularly from her. Duky successfully reared both foals.

During 2004 in the entire herd, we recorded 405 successful suckling bouts and 252 unsuccessful suckling attempts rejected by the mare, of which 113 successful suckling bouts and 95 unsuccessful suckling attempts were performed by the allosuckling foal. The allonursing female nursed both foals simultaneously 74 times (54% of observations; Fig. 1), her offspring alone 26 times (19%), and the adopted foal alone 37 times (27%). The orphaned foal succeeded in suckling twice from another mare, on both occasions simultaneously with her own foal.

The allonursing mare rejected more suckling attempts (47%; $n = 403$ solicitations) more often than other mares (26%; $n = 341$ solicitations; LR, PROC GENMOD: $\chi^2 = 40.79$; $df = 4$; $p < 0.0001$; Fig. 2a). On the other hand, the frequency of the successful suckling bouts was not affected by allonursing.

Fig. 1. Nursing and allonursing at the same time in captive plains zebra at Dvůr Králové Zoo (allonursed foal "Galileo" is on the left).

Both foals nursed by the allonursing female had a shorter suckling bout duration than other foals (GLM, PROC MIXED: $F = 19.29$; $df = 4, 457$; $p < 0.0001$; Fig. 2b); there was no difference in duration of suckling bouts between the filial and non-filial foal. Suckling bout duration when both foals suckled at the same time was shorter than when only one suckled, when considering either the foals nursed by the allonursing female only or other mare-foal pairs (GLM: $F = 12.62$; $df = 1, 455$; $p < 0.001$; Fig. 3).

The allonursing mare terminated more suckling bouts (84%; $n = 205$) than other mares (35%; $n = 250$), regardless of the foal's identity (LR, PROC GENMOD: $\chi^2 = 142.10$; $df = 4$; $p < 0.0001$; Fig. 2c). Termination of a suckling bout by the mother was not affected by the number of foals nursing at a time in one bout.

4. Discussion

Our study is the first report of allonursing in plains zebra. We did not find any difference in rejection, frequency, duration or termination of suckling between the non-filial (adopted) and filial foal of the allonursing female. The possibility of misdirected parental care (Georges et al., 1999; Maniscalco et al., 2007; Roulin, 2002) is an unlikely explanation of the adoption observed here. The allonursing mare adopted the orphan outside the window time of the sensitive period for establishing mother-young bonding. In line with all other reports on allonursing in equids (Cameron et al., 1999; Lloyd and Harper, 1980; Penzhorn, 1984), we can also reject the possibility of milk-theft reported in several other species (Landete-Castillejos et al., 2000; Murphey et al., 1995; Zapata et al., 2009b) as the allonursed foal did not apparently need to develop any special tactic to get milk from the female.

We do not know the level of kin relatedness between the allonursing mare and the adopted foal, as she and the mare that