Time spent suckling is affected by different social organization in three zebra species

J. Pluháček¹,², M. Olléová³, L. Bartoš¹ & J. Bartošová¹

¹ Department of Ethology, Institute of Animal Science, Praha – Uhříněves, Czech Republic
² Ostrava Zoo, Ostrava, Czech Republic
³ Faculty of Tropical AgriSciences, Czech University of Life Sciences, Prague, Czech Republic

Keywords
Equus; suckling behaviour; zebra; social system; zoo.

Abstract
Suckling bout duration and frequency were used in the past as an indicator of milk intake. However, later studies found no significant relationship between suckling bout duration and frequency and milk or energy intake. On the other hand recent studies are in line with the suggestion that suckling bout duration and frequency may express intensity of maternal care. The three extant zebra species differ in their ecology and social system. Mountain Equus zebra and Grévy’s zebra E. grevyi live in an arid environment, whereas plains zebras E. quagga are found in savannah. Mountain and plains zebra mares form stable herds associated with high aggression and low aggression, respectively. Female Grévy’s zebras form loose associations with the lowest level of aggression. The aim of this study was to re-evaluate the suggestion that suckling bout duration and frequency are affected by social system. We observed suckling behaviour of 30 foals (16 plains zebras, 8 Grévy’s zebras and 6 mountain zebras) at the Dvůr Králové Zoo, Czech Republic. We found that suckling bout duration was longest in mountain zebras, followed by plains and Grévy’s zebras. Similar results were found for suckling frequency. These results coincide with the rate of aggression among mares; foals spent more time by suckling in species, where more aggression among adults occurred. Thus, the results of our study support the suggestion that suckling bout duration reflects social needs of the foal rather than milk intake requirements.

Introduction
In past studies on mammalian maternal investment, time spent suckling was often used as a predictor of the milk transferred to the infant (Duncan, Harvey & Wells, 1984; Berger, 1986; Green, 1986, 1990; Lee & Moss, 1986; Trillmich, 1990; Dalezsczyk, 2004). However, a meta-analysis of studies in mammals that have correlated measures of time spent suckling with milk intake estimates based on weight gain revealed a weak positive relationship and significant heterogeneity between studies (Cameron, 1998). In feral horses Equus caballus (Cameron et al., 1999), fallow deer Dama dama (Birgersson & Ekvall, 1994), domestic mice Mus domesticus (Mendel & Paul, 1989) domestic cats Felis catus (Mendel & Paul, 1989) and domestic cattle Bos taurus (Álvarez-Rodríguez et al., 2010), no significant relationship between suckling bout duration and/or suckling frequency and milk or energy intake was found. Suckling bout duration and frequency should not be used as an index of energy intake (Cameron et al., 1999); however, they can be used as an indication of conflict between the mare and foal over energy intake (Mendel & Paul, 1989; Byers & Bekoff, 1990; Cameron, Linklater & Stafford, 2003; Therrien et al., 2007).

The three extant zebra species differ in their behavioural ecology and social system. In the wild, Mountain E. zebra and Grévy’s zebras, E. grevyi, live in an arid environment, whereas plains zebras, E. quagga, inhabit more mesic savannah (Klingel, 1975; Estes, 1991). Mountain and plains zebra mares form stable herds involving a social hierarchy (Klingel, 1972; Penzhorn, 1979) associated with high aggression in the former and low aggression in the latter (Joubert, 1972b; Penzhorn, 1984; Lloyd & Rasa, 1989; Fischhoff et al., 2010). Aggression by adult mares towards unrelated foals has often been recorded in mountain zebra (Penzhorn, 1984; Lloyd & Rasa, 1989), but is very rare in plains zebra (Pluháček, Bartošová & Bartoš, 2010c). Female Grévy’s zebras form only loose associations without any hierarchy (Klingel, 1974; Rubenstein, 1989; Sundaresan et al., 2007) and exhibit a lower level of aggression than the two other zebra species (Klingel, 1974; Penzhorn, 1984; Andersen, 1992; Pluháček, Bartoš & Čulík, 2006). Therefore, zebras form an optimal model for investigating the relationship between social organization and maternal behaviour.

Although an evolutionary approach has been suggested to understand the dynamics of parent–offspring relationships in mammals (Bateson, 1994), only few studies have compared...
the suckling behaviour in different species (e.g. Trillmich, 1990; Laviguer & Barrette, 1992; Maestripieri, 1994a; McGuire, Vermeulen & Bemis, 2011). The only interspecific comparison of equid suckling behaviour was published from wild Grévy’s and plains zebra (Becker & Ginsberg, 1990), comparing also data from the literature on feral horses (Tyler, 1972; Crowell-Davis, 1985). Becker & Ginsberg (1990) concluded that Grévy’s zebra foals spent the least amount of time suckling and had the longest intervals between suckling bouts compared with other equids. They proposed that the shorter time spent by suckling found in Grévy’s zebra compared with other equids would be an adaptation to arid environment (Becker & Ginsberg, 1990). Recently, we re-evaluate their suggestions using rejection and termination of suckling bouts (as indicators of conflict over energy intake) in three captive zebra species kept in the same facility (thus under same living conditions; Pluháček et al., 2012).

On the other hand, we revealed higher incidence of allonursing in Grévy’s zebra than in plains and mountain zebra, where allonursing was associated with adoption (Ollérová, Pluháček & King, 2012). We suggested that higher tolerance towards non-filial offspring, including the occurrence of allosuckling in Grévy’s zebras, could be affected by different social systems of zebra species as reported in several species of ungulates, rodents and primates (McGuire & Novak, 1984; Maestripieri, 1994a; Ekvall, 1998; Das, Redbo & Wiktorsson, 2000; Landete-Castillejos et al., 2000; McGuire et al., 2011).

Previous studies on suckling behaviour of various equid species (E. caballus, E. hemionus, E. quagga, E. zebra) reported that suckling bout duration and frequency could be affected highly by the age and the sex of the foal, the animal terminating the bout, parity of the mare and mother’s pregnancy (Joubert, 1972b; Tyler, 1972; Rogalski, 1973; Rashek, 1976; Duncan et al., 1984; Crowell-Davis, 1985; Becker & Ginsberg, 1990; Smith-Funk & Crowell-Davis, 1992; Pluháček, Bartoš & Bartošová, 2010a; Bartošová et al., 2011). Thus, we included these factors in our analyses, too.

Because suckling bout duration and frequency should not reflect energy intake, but the amount of maternal care in current offspring (Mendl & Paul, 1989; Cassinello, 2001; Therrien et al., 2007; Pluháček et al., 2010a; Bartošová et al., 2011), we presume that they would be affected more by variability in social life of different species than by environmental adaptation. Therefore, we predicted that the time spent by suckling would increase with increasing intolerance towards foals in different zebra species, that is, foals of mountain zebras should spend the longest time by suckling, followed by foals of plains zebras and by foals of Grévy’s zebras.

**Materials and methods**

**Animals**

We observed 30 foals (16 plains zebras, 8 Grévy’s zebras and 6 mountain zebras) in five different herds (three of them being plains zebras) at the Dvůr Králové Zoo, Czech Republic (for details see Pluháček et al., 2012; Table 1).

In the summer, all herds were in an enclosure (800–2800 m²) for 24 h a day. From October to April, the zebras were stabled at night (stables were 62–194 m² per herd). Plains and Grévy’s zebras were stabled in groups, whereas mountain zebra mares were stabled individually, but not separated from their foals. Therefore they were not observed in stables. Although a lactation study like this would be more realistic if it was done in the wild, it would be extremely difficult to carry out. Therefore even with potential constraints in interpretation, it represents a valuable piece of information.

Plains zebras were observed from January 1999 to January 2000, and from September 2001 to March 2002. All three species were observed from September 2008 to July 2010. Each observation session lasted for 180 min (started either from 08:00 or 14:00 h). For details of observation schedule see Pluháček et al. (2010a,b; 2012). In total, the three herds of plains zebras were observed for 549, 489 and 198 h; the herd of Grévy’s zebras for 270 h; and the herd of mountain zebras for 120 h.

We used the same definitions of suckling bout, sucking attempt and interruption of suckling bouts as described in previous studies on equids (Becker & Ginsberg, 1990; Cameron et al., 1999; for details about data collection, see Pluháček et al., 2010a,b,c, 2012). Suckling bouts involving foals other than the mother (allosuckling) were excluded from analyses.

The frequency of suckling was counted as a number of successful suckling bouts per individual foal per one session (180 min). In total, we recorded 2193, 1705 and 842 successful suckling bouts and 455, 521 and 204 sessions per individual foals for respective species (plains zebras, Grévy’s zebras and mountain zebras).

**Statistics**

All data were analysed using the SAS System version 9.2 (SAS Institute, Inc., Cary, NC, USA). Factors influencing the suckling bout duration and frequency were tested using a multivariate general linear mixed model (PROC MIXED, SAS Institute, Inc.). Fixed factors (independent variables) tested in each of the models were the foal’s age and sex, the number of dominant mares (at the date of suckling bout), the herd nested within the season (1999/2000, 2001/2002, 2008/2010), the mother’s age, the mother’s parity, the number of other suckling foals within the herd, the number of other animals in the herd, the number of previous births of the mother, the number of offspring successfully reared by the mother, the place where the suckling bout occurred (stable, yard or enclosure; in analyses of suckling bout duration only), and the feeding state of the mother (‘yes’, ‘no’, ‘interrupted due to nursing’; in analyses of suckling bout duration only), and their first-order interaction terms.

In all models, repeated measures on the same individuals across the period of observation were handled with the individual foal entering the model as a subject in the repeated statement. The within-group means were appropriately adjusted for the other effects in the model (least-squares
means statement). The differences between the means were tested by *t*-test; with multiple comparisons we used the Tukey–Kramer adjustment.

### Results

#### Suckling bout duration

Average suckling bout duration lasted for 57.32 ± 25.02 s (n = 1689 bouts) in Grévy’s zebra, 60.24 ± 19.64 s (n = 2012 bouts) in plains zebra and 71.95 ± 27.64 s (n = 835 bouts) in mountain zebras. The longest suckling bout lasted for 4 min and 16 s in Grévy’s zebras, 4 min and 35 s in plains zebras, and 3 min and 14 s in mountain zebras.

The duration of suckling bouts decreased with increasing age of the foal ([*F* = 173.00; degrees of freedom (d.f.) = 1, 4497; *P* < 0.001]). Duration was affected by the animal that terminated the bout (*F* = 178.19; d.f. = 2, 4497; *P* < 0.001), by the interaction between species and the animal that terminated the bout (*F* = 22.09; d.f. = 4, 4497; *P* < 0.001), and by the feeding status of the mare at the beginning of the suckling bout (*F* = 31.46; d.f. = 2, 4497; *P* < 0.001).

In all three zebra species, suckling bouts terminated by the foal were longer than those terminated by the mare (plains zebras: *t* = 7.97, d.f. = 4497, *P* < 0.001; Grévy’s zebras: *t* = 6.88, d.f. = 4497, *P* < 0.001; mountain zebras: *t* = 14.83, d.f. = 4497, *P* < 0.001) or by a herdmate (plains zebras: *t* = 5.81, d.f. = 4497, *P* < 0.001; Grévy’s zebras: *t* = 2.59, d.f. = 4497, *P* = 0.01; mountain zebras: *t* = 6.28, d.f. = 4497, *P* < 0.001; Fig. 1). The suckling bouts were shorter when terminated by a herdmate than when terminated by the mare in plains zebras only (*t* = 3.49, d.f. = 4497, *P* < 0.01). When the mother interrupted feeding because of nursing, then the suckling bouts duration lasted longer than when the mother did not feed (*t* = 3.65, d.f. = 4497, *P* < 0.01) or when she was feeding during the whole bout (*t* = 7.86, d.f. = 4497, *P* < 0.001). The suckling bout duration was longer when she was not feeding than when she was feeding while nursing (*t* = 6.28, d.f. = 4497, *P* < 0.001). No other factor was significant.

For the next step, we ran three separate analyses for suckling bout duration in bouts terminated by the foal, by the mare and by a herdmate. When terminated by a herdmate, the suckling bout duration did not differ among species ([*F* = 0.60; d.f. = 2, 53; not significant (NS)]; when terminated by the mare, suckling bout duration did differ among species (*F* =

### Table 1 Detailed individual data of observed foals of three zebra species

<table>
<thead>
<tr>
<th>Foal</th>
<th>Mother</th>
<th>Species</th>
<th>Sex</th>
<th>Herd identity and season</th>
<th>Age of foal at start of observation (in days)</th>
<th>Age of foal at end of observation (in days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pergy</td>
<td>Piki</td>
<td>Equus quagga</td>
<td>F</td>
<td>1/1999</td>
<td>36</td>
<td>113</td>
</tr>
<tr>
<td>Pelopones</td>
<td>Pinta</td>
<td>E. quagga</td>
<td>M</td>
<td>1/1999</td>
<td>0</td>
<td>330</td>
</tr>
<tr>
<td>Paris</td>
<td>Palmyra</td>
<td>E. quagga</td>
<td>M</td>
<td>1/2001</td>
<td>96</td>
<td>278</td>
</tr>
<tr>
<td>Ptolemaios</td>
<td>Piki</td>
<td>E. quagga</td>
<td>M</td>
<td>1/2001</td>
<td>94</td>
<td>276</td>
</tr>
<tr>
<td>Paula</td>
<td>Palmyra</td>
<td>E. quagga</td>
<td>F</td>
<td>1/2008</td>
<td>4</td>
<td>432</td>
</tr>
<tr>
<td>Rubi</td>
<td>Karma</td>
<td>E. quagga</td>
<td>F</td>
<td>1/2008</td>
<td>2</td>
<td>261</td>
</tr>
<tr>
<td>Irwin</td>
<td>Irkasa</td>
<td>E. quagga</td>
<td>M</td>
<td>1/2008</td>
<td>4</td>
<td>298</td>
</tr>
<tr>
<td>Linda</td>
<td>Karolina</td>
<td>E. quagga</td>
<td>F</td>
<td>1/2008</td>
<td>4</td>
<td>173</td>
</tr>
<tr>
<td>Masud</td>
<td>Meri</td>
<td>E. quagga</td>
<td>M</td>
<td>2/1999</td>
<td>3</td>
<td>143</td>
</tr>
<tr>
<td>Delos</td>
<td>Duky</td>
<td>E. quagga</td>
<td>M</td>
<td>2/1999</td>
<td>0</td>
<td>84</td>
</tr>
<tr>
<td>Akin</td>
<td>Alžběta</td>
<td>E. quagga</td>
<td>M</td>
<td>2/2008</td>
<td>100</td>
<td>394</td>
</tr>
<tr>
<td>Padme</td>
<td>Penta</td>
<td>E. quagga</td>
<td>F</td>
<td>2/2008</td>
<td>26</td>
<td>320</td>
</tr>
<tr>
<td>Kid</td>
<td>Kity</td>
<td>E. quagga</td>
<td>M</td>
<td>3/1999</td>
<td>1</td>
<td>245</td>
</tr>
<tr>
<td>Beata</td>
<td>Boma</td>
<td>E. quagga</td>
<td>F</td>
<td>3/1999</td>
<td>4</td>
<td>75</td>
</tr>
<tr>
<td>Accra</td>
<td>Angelika</td>
<td>E. quagga</td>
<td>F</td>
<td>3/2001</td>
<td>3</td>
<td>101</td>
</tr>
<tr>
<td>Kikwit</td>
<td>Katrin</td>
<td>E. quagga</td>
<td>M</td>
<td>3/2001</td>
<td>3</td>
<td>101</td>
</tr>
<tr>
<td>Aika</td>
<td>Arica</td>
<td>E. grevyi</td>
<td>F</td>
<td>4/2008</td>
<td>3</td>
<td>333</td>
</tr>
<tr>
<td>Alf</td>
<td>Ambra</td>
<td>E. grevyi</td>
<td>M</td>
<td>4/2008</td>
<td>5</td>
<td>377</td>
</tr>
<tr>
<td>Belinda</td>
<td>Tabia</td>
<td>E. grevyi</td>
<td>F</td>
<td>4/2008</td>
<td>8</td>
<td>394</td>
</tr>
<tr>
<td>Guru</td>
<td>Gizela</td>
<td>E. grevyi</td>
<td>M</td>
<td>4/2008</td>
<td>1</td>
<td>352</td>
</tr>
<tr>
<td>Hedvika</td>
<td>Gobi</td>
<td>E. grevyi</td>
<td>F</td>
<td>4/2008</td>
<td>9</td>
<td>395</td>
</tr>
<tr>
<td>Kevin</td>
<td>Šárka2</td>
<td>E. grevyi</td>
<td>M</td>
<td>4/2008</td>
<td>5</td>
<td>174</td>
</tr>
<tr>
<td>Lukrinta</td>
<td>Řeřed</td>
<td>E. grevyi</td>
<td>F</td>
<td>4/2008</td>
<td>5</td>
<td>369</td>
</tr>
<tr>
<td>Naomi</td>
<td>Nora</td>
<td>E. grevyi</td>
<td>F</td>
<td>4/2008</td>
<td>2</td>
<td>374</td>
</tr>
<tr>
<td>Belisa</td>
<td>Bonita</td>
<td>E. zebra</td>
<td>F</td>
<td>5/2008</td>
<td>24</td>
<td>396</td>
</tr>
<tr>
<td>Brenda</td>
<td>Beata</td>
<td>E. zebra</td>
<td>F</td>
<td>5/2008</td>
<td>10</td>
<td>382</td>
</tr>
<tr>
<td>Lenka</td>
<td>Lada</td>
<td>E. zebra</td>
<td>F</td>
<td>5/2008</td>
<td>25</td>
<td>397</td>
</tr>
<tr>
<td>Lola</td>
<td>Linda</td>
<td>E. zebra</td>
<td>F</td>
<td>5/2008</td>
<td>30</td>
<td>366</td>
</tr>
<tr>
<td>Maja</td>
<td>Manka</td>
<td>E. zebra</td>
<td>F</td>
<td>5/2008</td>
<td>0</td>
<td>358</td>
</tr>
<tr>
<td>Hasan</td>
<td>Halina</td>
<td>E. zebra</td>
<td>M</td>
<td>5/2008</td>
<td>4</td>
<td>362</td>
</tr>
</tbody>
</table>
3.26; d.f. = 2, 1162; \( P = 0.033 \)): suckling bout duration was shorter in Grévy’s zebras than in plains zebras (\( t = 2.65; \) d.f. = 1162; \( P < 0.011 \); Fig. 1). The suckling bout duration terminated by a mountain zebra mare did not differ from that of the other species (Fig. 1). When terminated by a foal, again the suckling bout duration differed among species (\( F = 19.04; \) d.f. = 541; \( P < 0.001 \)). The suckling bout duration was longer in mountain zebras than in plains (\( t = 4.87, \) d.f. = 3239, \( P < 0.001 \)) or Grévy’s zebras (\( t = 6.03, \) d.f. = 3239, \( P < 0.001 \)), and it was longer in plains zebras than in Grévy’s zebras (\( t = 1.95, \) d.f. = 3239, \( P = 0.049 \); Fig. 1).

### Suckling bout frequency and total time spent by suckling

Average suckling frequency per 180 min was 3.29 ± 2.14 (\( n = 521 \) individual sessions), 4.68 ± 2.42 (\( n = 455 \)) and 3.92 ± 2.25 (\( n = 204 \)) in Grévy’s, plains and mountain zebras, respectively. The maximum suckling bout frequency per 180 min (one observation session) in three species was 17 times in Grévy’s zebras, 22 times in plains zebras and 13 times in mountain zebras. The lowest suckling bout frequency was once per 180 min (all three species). Suckling bout frequency has been affected by the age of the foal (\( F = 582.83; \) d.f. = 1, 1147; \( P < 0.001 \)), by the species (\( F = 7.99; \) d.f. = 2, 1147; \( P < 0.001 \)) and by the interaction between the age of the foal and the species (\( F = 12.51; \) d.f. = 1, 1147; \( P < 0.001 \); Fig. 2). The highest suckling bout frequency has been observed in plains zebras followed by that of mountain zebras (\( t = 4.80, \) d.f. = 1147, \( P < 0.001 \)), whereas we did not find any difference between plains zebras (202.04 ± 20.19 s per session) and two other species (NS; Fig. 3).

### Rate of agonistic interactions

In total we recorded 2312 agonistic interactions among adult mares. The rate of agonistic interactions per individual during 1 h of observation was highest in mountain zebras (0.90),

![Figure 1](image1.png) **Figure 1** The suckling bout duration in three zebra species according to the animal terminating the bout and the identity of species (mean ± standard error). Only significant differences among species are shown.

![Figure 2](image2.png) **Figure 2** The frequency of suckling bouts within the 180-min observation session according to the age of foal and the species.

![Figure 3](image3.png) **Figure 3** The total time spent by suckling within the 180-min observation session according to the species.

lower in plains zebras (0.52) and lowest in Grévy’s zebras (0.09; χ² = 25.81, d.f. = 2, P < 0.001).

Discussion

We found that suckling bout duration was the longest and most frequent in mountain zebra, followed by plains and Grévy’s zebra. Thus, suckling bout duration in captive animals does not necessarily reflect evolutionary adaptation to an arid environment. Although suckling bout duration and frequency is not a good indicator of milk transfer (Cameron, 1998; Cameron et al., 1999), it can be useful to assess the amount of maternal care in current offspring (Mendl & Paul, 1989; Cassinello, 2001; Therrien et al., 2007; Pluháček et al., 2010a) and specifically the needs of the offspring (e.g. suckling frequency in Therrien et al., 2007). Our results suggested that suckling bout duration increased with intraspecific aggression rate among adult females of the species (i.e. longest duration recorded in mountain zebras, followed by plains zebras and Grévy’s zebras). A similar effect of relationships among adults, including aggression among female adults on maternal style, was recorded in interspecific comparisons of several macaque species (Kaufman & Rosenblum, 1969; Thierry, 1985; Maestripieri, 1994a,b). This has been given as a possible explanation for high-suckling frequency in studies on white-tailed deer Odocoileus virginianus and fallow deer (Laviguerie & Barrette, 1992; Therrien et al., 2007). In primates suckling duration is correlated with stress reduction (Gomendio, 1990; Clutton-Brock, 1991; Redondo, Gomendio & Medina, 1992), and in cattle with socialization with the dam (Das et al., 2000). Therefore, suckling bout duration and the time spent suckling can reflect the social needs of the foal, whereas termination and rejection seems to be affected by ecological adaptation. Because our results came from captive animals living in limited space, the high aggression rate among mares could strengthen the social demands of the foal to the mother, in mountain zebras in particular. The artificial setting may also have affected the results likely by two factors: smaller space than in the wild and high-quality diet of predictable delivery.

Our results dealing with suckling bout duration and frequency are a little different from those of Becker & Ginsberg (1990). In both studies the lowest suckling frequency and time spent suckling was observed in Grévy’s zebras. However, contrasting with the results of Becker & Ginsberg (1990) we recorded longer suckling bout duration in plains than in Grévy’s zebras. In our earlier study on captive plains zebras, we found that suckling bout duration was highly affected by the animal terminating the bout and by the pregnancy status of the nursing mare (Pluháček et al., 2010a); in this study we excluded pregnant mares and did separate analyses depending on the animal terminating the bout. These factors could have affected the results of Becker & Ginsberg (1990). Nevertheless, we cannot omit the effect of captivity as an explanation for the difference in suckling bout duration between our and their studies.

This study including all three zebra species confirmed our previous results on plains zebras (Pluháček et al., 2010a) showing the importance of the animal terminating the bout on the duration of the bout. In all three species the suckling bout duration was shorter when terminated by the mother than when terminated by the foal. Similar results were observed in other ungulates as, for example, red deer Cervus elaphus (Bartošová, Ceacero & Bartoš, 2012) or babirusa Babyrousa babyrussa (MacLaughlin et al., 2000). Because we did not find any substantial interspecific differences among suckling bout duration terminated by mother, we suppose that the level of parent-offspring conflict (Trivers, 1974) did not differ highly among different zebra species. On the other hand the interspecific differences were most pronounced in bouts terminated by the foal. It shows that the foals of different species differed in their intention for how long to suckle. As suckling bout duration should not reflect milk intake (Cameron, 1998; Cameron et al., 1999), and because the foals in our study suckled longer when not terminated by the mother in species with higher rate of agonistic interactions among mares, our results support the suggestion that suckling bout duration reflect psychological needs of the young.

In line with most studies on ungulates (Gauthier & Barrette, 1985; Byers & Moodie, 1990; Green, 1990; Lent, 1991; Birgersson & Ekvall, 1994; Alley, Fordham & Minot, 1995; Špinka & Algiers, 1995; Das et al., 2000; Daleczszyk, 2004), we found that suckling bout duration and frequency decreased with increasing age of the foal in all three observed zebra species. However, in several ungulate species (cattle, impala Aepyceros melampus, Sumatran rhinoceros Dicerorhinus sumatrensis), suckling bout duration is not affected by the age of the young (Lewandrowski & Hurnik, 1983; Mooring & Rubin, 1991; Plair, Reinhart & Roth, 2012) or even increased with an increasing age of the young (eland Taurotragus oryx; Underwood, 1979; common hippopotamus Hippopotamus amphibius; Pluháček & Bartošová, 2011). Therefore, we suggest that suckling bout duration seems to be better indicator of offspring needs than suckling frequency.

This study offers the first detailed report of suckling bout duration and frequency in mountain zebra. Mountain zebras in the present study had the longest suckling bout duration when considering bouts terminated by foal of the three zebra species. This coincides with reports from the wild suggesting that ‘the total suckling time usually varies from 90 s to 2 min’ (Joubert, 1972a,b; Penzhorn, 1984), which are among the highest values reported for equids (Waring, 2003). On the other hand, we did not record any interruption 10 s before the end of the bout as reported from the wild (Joubert, 1972a,b; Penzhorn, 1984). The higher suckling frequency of mountain zebra recorded in our study compared with other studies on the same species (Joubert, 1972b; Penzhorn, 1984) could be explained by captive conditions including water availability.

In conclusion, our results showing that suckling bout duration seems to reflect aggression rate among mares of the different zebra species are in line with the hypothesis that suckling bout duration indicates the social needs of the foal rather than milk intake requirements.
Acknowledgements

The authors gratefully acknowledge the assistance of the staff of Zoological Garden at Dvůr Králové, in particular Luděk Čulík, Markéta Čulíková, Aleš Kopecký, Jiří Soumar, Miroslava Kubeľková, Miroslava Doležalová, Pavel Moucha, Barbara Rakova, Jiří Hrubý and Dana Holečková. We are indebted to Alois Pluháček for technical help. The paper was much improved by comments from Jana Pluháčková, Martina Komárová, Radka Šárová, Marek Špinka and Radim Kotrba. We highly appreciated the help of Sarah R. B. King who improved the English. This work was supported by grant no. 523/08/P313 from the Czech Science Foundation and by the Ministry of Agriculture of the Czech Republic (MZCe002701404).

References


