Time of year influences social play in juvenile ground squirrels

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INTRODUCTION

- Animals must allocate available energy according to priorities that ensure survival and maximize long-term reproductive success.
- Play is a common behavior among juvenile mammals (Burghardt 2005) and can have important influences on their development (Beckoff and Byers 1998; Pellis et al. 2010). Play is expected to be a lower priority behavior (compared to foraging, growth, etc.), and is more likely to get dropped from the time budget during times of high stress (Baldwin and Baldwin 1974; Berger 1980; Barrett et al. 1992).
- We evaluated how the amount of energy young animals devote to play behavior changes over the course of their annual cycle as other energetic considerations change, using Belding's ground squirrels (*Urocitellus beldingi*) as a model system.
- Belding's ground squirrels live in habitats with a short annual growing season, and therefore have an annual cycle consisting of a brief active period in the summer followed by an extended, 8-9 month period of hibernation (Jenkens and Eshelman 1984).

METHODS

- From May to July 2016 and 2017, we studied a population of Belding's ground squirrels (*U. beldingi*) at Tioga Pass in the Sierra Nevada.
- We captured the juvenile squirrels at their first emergence from the natal burrow using live-traps baited with peanut butter.
- Once captured, each juvenile was weighed and given colored, metal ear tags and a unique mark with hair dye.

- Play behavior in *U. beldingi* occurs primarily during the first two weeks that the juveniles are above ground (Nunes et al. 1999b). Observation of the play bouts and the behavior of the juveniles were recorded during this period. Data, such as play duration, identity of play partners, and type of play, were recorded for each play bout.
- Near the end of the juvenile developmental period, 12-15 days following their first emergence from their natal burrows, juveniles were recaptured and weighed again.
- We compared the data for play rates and change in mass over the developmental period between 2016 and 2017
- We then combined the data for the two years into time blocks, categorizing juveniles based on dates of first emergence from the natal burrow; we compared differences in play rates and change in mass over the development period between early-emergence, intermediate-emergence, and late-emergence juveniles.

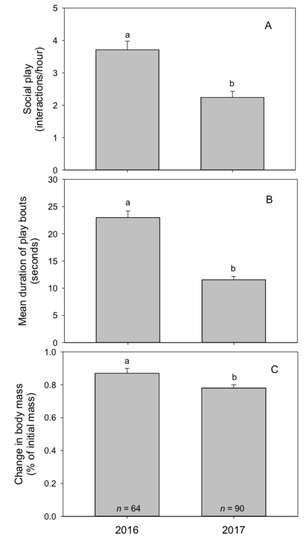


Figure 1. Between-year differences in A) rates of social play, B) duration of play bouts, and C) increases in body mass during the play interval among among juvenile *U. beldingi.*

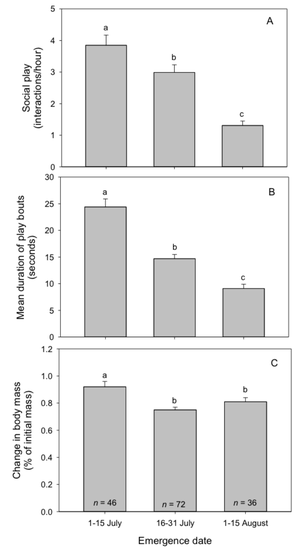


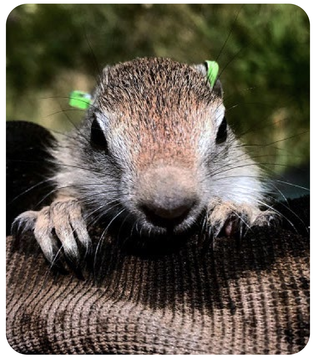
Figure 2. Differences in A) rates of social play, B) duration of social play bouts, and C) increases in body mass during the play interval among early-, intermediate-, and late-born juvenile *U. beldingi.*

RESULTS

- There was no overlap in dates of juveniles' first emergence from the natal burrow between the two years of the study. Juveniles first emerged between 5-18 July in 2016 and between 20 July-9 August in 2017.
- We compared the data for play rates and change in mass over the developmental period between 2016 and 2017:
  - Juveniles in 2016 engaged in higher rates of social play (Fig. 1A, independent *t*-test, $t_{152} = 4.98$, $P < 0.001$) and longer duration play bouts (Fig. 1B, independent *t*-test, $t_{152} = 8.12$, $P < 0.001$) than did juveniles in 2017.
  - Juveniles in 2016 also had greater increases in body mass across the play period (Fig. 1C, independent *t*-test, $t_{152} = 8.12$, $P < 0.001$) than did juveniles in 2017.
- We combined data from 2016 and 2017 to evaluate changes associated with date of emergence in the summer:
  - Emergence date was significantly associated with declining rates of social play (Fig. 2A, ANOVA, $F_{2,151} = 27.38$, $P < 0.001$) and duration of play bouts (Fig. 2B, ANOVA, $F_{2,151} = 37.46$, $P < 0.001$), with late-emergence juveniles engaging in the lowest rates of play and shortest duration play bouts.
  - Increases in body mass during the play period were greater among early-emergence compared to intermediate-emergence and late-emergence juveniles (Fig. 2C, ANOVA, $F_{2,151} = 8.61$, $P < 0.001$).

DISCUSSION

- We found that play behavior was lower among late-emergence juveniles. It was also observed in a previous study that emigration from the natal area among juvenile male *U. beldingi* was lower among late-emergence juveniles (Nunes et al. 1999a).
- Early-emergence juveniles had greater increases in body mass during the play interval compared to late-emergence juveniles. Activity in general, including feeding activity, may be greater among early-emergence juveniles.
- Variations in behavior and growth patterns associated with birth date may reflect some changes in metabolism and physiology associated with shifts in the annual cycle of *U. beldingi*.



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