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Influences of immunocontraception on intraband social behavior in free-ranging feral horses, *Equus caballus*

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Contraception is often considered for population control of wildlife that is otherwise protected from more traditional management strategies, though little is known about the behavioral consequences of contraception in wild populations of socially complex animals. Feral horses, *Equus caballus*, in the western United States are ideal candidates for contraceptive management due to broad scale federal protection, reported herd growth rates of 15-25% per year, and finite public land allocated for them. We investigated influences of the immunocontraceptive porcine zona pellucida (PZP) on social behavior within bands of feral horses in three discrete populations for 4 years. Each band consisted of a single stallion and a harem of adult females (e^c2 years old) and their foals, as well as associated yearling males and females. Four mutually exclusive behaviors (herding, reproductive, harem tending, and agonism) were analyzed to investigate the difference between behaviors initiated by band stallions toward control mares and contracepted mares within the bands. Additionally, spatial relationships between each stallion and each harem female were analyzed to assess possible passive interactions.

A candidate set of 22 hierarchical mixed effects models, using the discrete populations as a random effect on various fixed effects, was analyzed by restricted maximum likelihood estimation. The most supported models were selected by corrected Akaike's Information Criteria (AICc). Analyses were done on 3 female age cohorts based on distinct fecundity rates: 2 to 5 year olds, 6 to 14 year olds, and e^c 15 year olds. Stallions herded control mares in the 6 to 14 year cohort more than contracepted mares ($n=128$, $P=0.037$) with treatment being the most supported effect, but foal presence (dependent foal) also contributed significantly to the model.

Contracepted mares received more reproductive behaviors than control mares in the 6 to 14 year cohort ($n = 151$, $P=0.020$). No differences were detected in herding or reproductive behaviors in the least fecund groups, the 2 to 5 year olds and e^c 15 year olds. The only independent variable in the most supported model for reproductive behavior was treatment, and the covariates of foal presence, band residence (resident or transient female), band size, and body condition did not contribute. There were no differences in any age cohort for harem tending or agonism. Spatially, stallions maintained closer relationships with 2 to 5 year old contracepted females than with the same age control females ($n=136$, $P < 0.001$) while the group was feeding (at its most dispersed structure), but there were no differences while the band was resting or in locomotion. There were no spatial differences detected in the other age cohorts.

Given the polyestrous nature and high fecundity of feral horses, the observed difference in reproductive behaviors between treatment groups was not surprising; however, the difference detected in herding rates was an unexpected behavioral modification. This change in herding behavior suggests that further investigation is needed to determine if PZP immunocontraception has an underlying influence on mare social rank, band structure, and band stability, as well as the scope and long-term importance of these behavioral dynamics.