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Pen confinement of yearling ewes with cows or heifers for 14 days to produce bonded sheep

E.L. Fredrickson[a,*], D.M. Anderson[a], R.E. Estell[a], K.M. Havstad[a], W.L. Shupe[a], M.D. Remmenga[b]

[a]*U.S. Department of Agriculture, Agriculture Research Service, Jornada Experimental Range, Box 30003, MSC 3JER, NMSU, Las Cruces, NM 88003-8003, USA*

[b]*University Statistics Center, New Mexico State University, Las Cruces, NM 88003-8001, USA*

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Abstract

Mixed species stocking is commonly a more ecologically sound and efficient use of forage resources than single species stocking, especially in pastures having complex assemblages of forage species. However, in many environments livestock predation on especially smaller ruminants adds an extra challenge to mixed species stocking. When mixed sheep and cattle remain consistently as a cohesive group (flerd), predation risks are lessened, while fencing and herding costs are reduced. To establish a cohesive group (bond), a 30-day bonding period in which young sheep and cattle pairs are penned together is currently recommended. The purpose of this research was to test if a bond could be produced in <30 days (14 days) using pen confinement; thus reducing feed, labor, and overhead costs. Additionally, we tested whether cow age affects cohesiveness of bonded pairs immediately following 14 days of pen confinement. Sixteen mature cows (7–8 years of age) and sixteen 9-month-old heifers were randomly paired with one of 32 yearling ewe lambs. Eight cow/ewe (PC) and eight heifer/ewe (PH) pairs were maintained individually in 2 m × 6 m pens for 14 days. The other eight-cow/ewe (NC) and heifer/ewe (NH) pairs were separated by species with each species maintained on separate pastures for the 14-day period. After 14 days, pairs were released in observation paddocks and separation distance between treatment pairs was measured during a 30-min open field test. Other behaviors were also noted and recorded during the field test. Separation distance did not differ ($P = 0.973$) between the PC and PH treatments; however, separation distance for NC versus NH ($P < 0.004$), NC versus PC ($P < 0.001$), and NH versus PH ($P < 0.002$) all differed. Mean separation distance (meters) and standard errors were 40 ± 3.9, 3 ± 0.3, 76 ± 5.3, and 4 ± 1.4 for NH, PH, NC, and PC treatments, respectively. Overall, the animals that were penned spent more time grazing and less time walking than animals not previously penned for 14 days. Penned animals also vocalized less than non-penned animals during the open field test. The bond sheep formed to the bovines was not affected by cow age. These data suggest that inter-specific bond formation using pen confinement can be accomplished within 14 days, representing a 53% savings in time and associated costs when compared to pen confinement lasting 30 days.

Keywords: Bonding; Multispecies stocking; Sheep; Beef cattle; Mixed species stocking

1. Introduction

Few grasslands co-evolved with a single large herbivore. In spite of this, modern animal husbandry practices in the United States rarely use mixed species

* Corresponding author. Tel.: +1-505-646-1301; fax: +1-505-646-5889.
E-mail address: efredric@nmsu.edu (E.L. Fredrickson).

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stocking to capitalize on animal diversity when stocking native rangelands. Lack of animal species diversity in modern grazing practices may in part be responsible for the vegetation transition of arid and semi-arid grasslands to desert scrub conditions.

Reviews by Nolan and Connolly (1977) and Walker (1994) indicate that output per unit area and typically profits per unit area are greater for mixed compared with mono-specific stocking. Walker (1994) further states that multispecies stocking is a more environmentally sound practice than mono-specific stocking. Mixed species stocking can be accomplished by combining two or more species simultaneously or following one species by another when stocking the same unit of land (Byington, 1985). Cross-specific bonding of two or more species, so they remain together has been termed a flerd (flock + herd; Anderson et al., 1988). Research by Nakamatsu (1989) suggests that flerds use the forage resource more uniformly than either species grazing independently. Bonding sheep to cattle provides greater protection of sheep from predators (Hulet et al., 1987, 1989). Additionally, the need for expensive sheep fencing can be eliminated or reduced in pastures with fences designed for cattle (Anderson et al., 1994). Fences can also be designed that allow free movement of most wildlife species, while controlling distribution of cattle and bonded sheep. Anderson et al. (1994) further concluded that sheep are easier to locate when bonded to cattle, especially when grazing shrub-dominated rangelands.

Regardless of the potential benefits, there is producer resistance to mixed species stocking. In part due to social factors (Vallentine, 1990), plus the need for increased management skills and in some instances increased facility costs (Meyer and Harvey, 1985). Frequently, resistance is due to predation loss of small ruminants (Merrill, 1985). In the case of pen confinement to create an inter-specific bond, the costs associated with labor, facilities, and feed are likely deterrents. Anderson et al. (1987a) demonstrated that an adequate bond could be achieved using 8–9-month-old heifers in a period as short as 30 days. If a cross specific bond can be achieved in a shorter time then a substantial reduction in cost should be realized. For this reason, we designed a study to test the hypothesis that a cross-specific bond could be achieved in 14 days. The bonds previously reported appear to be unidirectional with the sheep forming a bond to beef cows, not individual cows, while beef cattle simply tolerate the presence of one or more sheep (Anderson, 1998). However, based on previous research (Anderson et al., 1987a), we hypothesized that a cross-specific bond would form without regard to age of the bovine. If true, then more options would be available for implementation of bonding strategies.

Previous studies using pen bonding (Anderson et al., 1987a, 1992, 1996; Hulet et al., 1987, 1989, 1991) have used young sheep. These studies involving 45–90-day-old sheep were designed to take advantage of critical learning periods (Scott, 1962) in modifying animal behavior. Research on flerd formation to date indicates that the age window during which bonds can be formed range between 45 days and 24 months. It is unclear if these critical learning periods are required by both species in the development of intra-specific pair bonds.

2. Material and methods

Thirty-six Polypay and Polypay × Rambouillet yearling ewes were randomly selected from the USDA — Agricultural Research Service's Jornada Experimental Range's (JER; located 37 km northeast of Las Cruces, NM, USA) range flock. The yearling ewes were not previously exposed to cattle before initiation of the study. Sixteen Hereford × Angus heifer calves 9 months of age previously naïve to sheep but gentle in the presence of humans were selected from a group of replacement heifers managed under free-ranging conditions. Sixteen Hereford × Angus cows (7–8 years of age) not naïve to sheep were chosen based on their gentleness in the presence of humans. It should be noted that bonds appear unidirectional with sheep bonding to beef cows, and in a general nature rather than to specific individuals (Anderson, 1998). These animals were randomly placed in one of four treatments involving cows (C), heifers (H), penned (P) and non-penned (N) animals. Eight-cow/yearling ewe (PC) and eight heifer/ewe (PH) pairs were penned for 14 days. Another eight cow/ewe (NC) and heifer/ewe (NH) pairs were separated by species and maintained in separate paddocks in visual isolation from one another for 14 days.

Each pair assigned to pen confinement was randomly assigned to one of sixteen outdoor pens

measuring 2 m × 6 m. Pens were adjacent to each other but were constructed with solid plywood sides to ensure visual isolation among adjacent pens. Water and trace mineral salt was provided ad libitum in each pen and paddock. Alfalfa hay was fed ad libitum each morning in each of the 16 pens. Position of each animal in the pen was recorded before feeding and periodically during daylight hours.

Bonding of the ewe to the bovine was determined using an open field test immediately following the 14-day pen confinement period. We have learned that once a bond is formed, as evidenced by degree of spatial association, that a bond will persist if management promotes the continued association between species (Anderson, 1998). Affinity was determined by measuring the distance maintained between members of each pair during a 30-min-period. To ensure that each pair was tested after 14-days of pen confinement, we placed half of the pairs in their respective treatments on 1 December and the other half on 2 December, allowing 2 days to conduct the open-field tests. The open field test was conducted in a 202 m × 196 m brush free paddock 8 km from the pen confinement area. Pairs were transported to and from the test area using a stock trailer. Root plowing 6 years earlier in the test paddock had removed shrubs that may have impaired movement or visual perception of the animals. Dormant grasses were available throughout the paddock. The paddocks surrounding the open-field test were free of other sheep and cattle. Likewise, disturbances were limited to two observers that were only partially visible. Once the pair entered the paddock distance between the two animals was estimated every minute using a technique previously described by Walser and Williams (1986) and modified by Hulet et al. (1992). Data were collected by a trained observer located 9 m above the ground in a hydraulically operated lift located directly outside the southwest corner of the paddock. Separation distance was defined as the distance between the cow's front feet and the lamb's front feet using a measuring tape held at arm's length. For distances of separation exceeding measurable distance, the number of body lengths were visually estimated. In addition to separation distance between animals, the following behaviors also were recorded for each 1 min interval: lying, standing, walking, drinking, grooming, or other.

Data were then analyzed using GLM procedures of SAS (SAS, 1989). Mean separation was accomplished using pair-wise contrasts (equivalent to LSD's). Separation distances were analyzed using analysis of variance (ANOVA) for repeated measures, testing treatment effects using animal within treatment variability as the error term and using the Huynh–Feldt P-value adjustment for within animal effects (i.e. time and time by treatment interaction; Huynh and Feldt, 1970). Animal activity was analyzed separately for cows and sheep using a one-way ANOVA of percentage of time engaged in the activity.

3. Results

Separation between pairs during the open-field test is depicted in Fig. 1. The overall model for separation distance was highly significant ($P < 0.0001$) with no time by treatment interactions ($P = 0.077$). Separation distance between PC and PH did not differ ($P = 0.973$); however, separation distance for NC versus NH ($P < 0.004$), NC versus PC ($P < 0.001$), and NH versus PH ($P < 0.002$) all differed. Mean separation distance and standard errors were 40 ± 3.9, 3 ± 0.3, 76 ± 5.3, and 4 ± 1.4 m for NH, PH, NC, and PC treatments, respectively.

During the 14-day pen confinement phase, separation between pairs decreased with time. Initially pairs remained separated at opposite ends of the pen except when fed and after humans had moved away from the pens. Even though the cows used in this study were familiar with sheep, their failure to associate with the sheep supports the hypothesis that sheep bond while cattle become tolerant to the presence of the sheep. By the third day, approximately half of the pairs were in close proximity regardless of the time of day or the position of the observer. By fifth day, more than 80% of the pairs remained in close proximity (<1 m) to each other during observations. With the exception of one pair that lagged about 2 days behind the others, the remaining pairs were observed to be within a meter of one another by sixth day and during the remainder of the 14-day period.

Penned pairs spent more time grazing and less time walking during the field test compared to animals which previously had not been penned for 14 days (Fig. 2). The penned ewes ($P = 0.0002$) and cattle

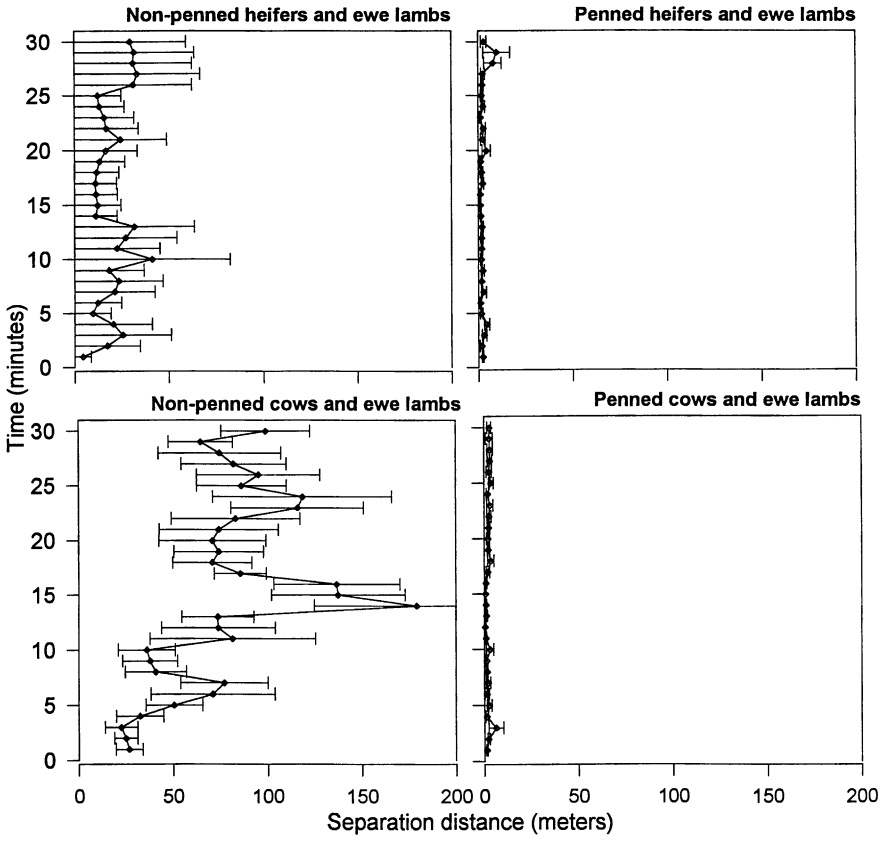

Fig. 1. Mean separation distances (m) and standard errors (S.E.) of penned (14 days) yearling ewe/cow and yearling ewe/heifer pairs compared to non-penned yearling ewe/cow and yearling ewe/heifer pairs during a 30-min open-field test.

($P = 0.002$) walked less than non-penned sheep or cattle. Ewes ($P = 0.0001$) and cattle ($P = 0.041$) that were previously penned grazed more than their non-penned counterparts. Non-penned sheep that had previously been maintained as a group in the NC treatment were observed to run more than sheep in the other treatments ($P = 0.0005$; Fig. 2). This behavior suggests stress, especially that associated with separation from peers as previously reported by Lynch et al. (1992). While NH and PH treatments did not differ ($P > 0.05$), NH sheep ran frequently while PC sheep were never observed running during the open-field testing. Cattle in the CH treatment ran more (1.25 min; $P = 0.030$) than did the sheep yet cattle movement between the PH and CH groups did not differ ($P > 0.05$). It should be noted that not all animals within a treatment were observed running, and the few animals that did run, did so for short periods.

Drinking and grooming behaviors were never observed during the 30-min tests. Behaviors categorized as other (Fig. 2) were infrequently observed and were limited to rubbing the head or other body parts against the fence. The percent of observations in which the animals were observed to be standing (Fig. 1) without engaging in any noticeable activity, did not differ ($P > 0.05$) among treatments.

These data support previous observations from similar research (Anderson, 1998) that penned animals when evaluated in an open-field test appeared calmer and less agitated than previously non-penned animals. Vocalization data further support previous observations (Fig. 3). During 22% of the total treatment observations, heifers in the NH treatment were

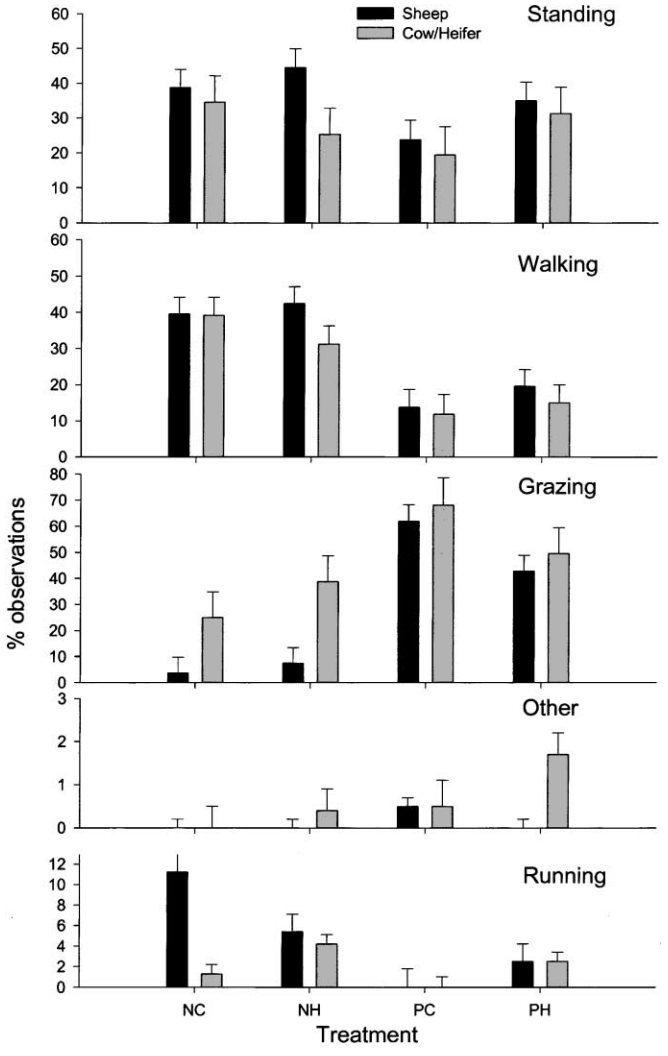

Fig. 2. Mean livestock grazing behaviors of penned (14 days) yearling ewe/cow (PC), yearling ewe/heifer (PH) pairs and non-penned yearling ewe/cow (NC) and yearling ewe/heifer (NH) pairs during a 30-min open-field test.

vocalizing, while sheep in the NH treatment vocalized during 30% of the observations. Vocalization percent of the NC treatment was 12 and 27% for cows and sheep, respectively. The penned groups vocalized noticeably less. Heifers and ewes that had not been previously penned together for 14 days (PH) vocalized for 7 and 0% of observations, respectively, whereas, cows and ewe lambs in the PC treatment vocalized for only 2 and 0% of the total observations, respectively.

4. Discussion

Anderson et al. (1987a) achieved a bond that was cohesive throughout an eight consecutive hour open-field test using 8–9-month-old heifers and 45, 62, and 90-day-old lambs, following 30 days of inter-specific pen confinement. The bond (inter-specific separation distance) was not strengthened when animals were confined for an additional 30 days, suggesting that a 30-day-period of pen confinement was adequate.

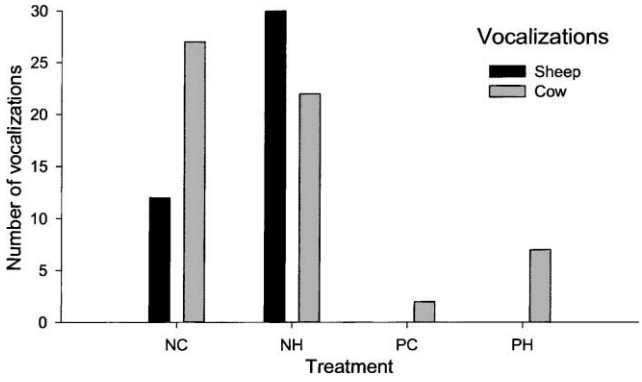

Fig. 3. Mean percent vocalization of penned (14 days) yearling ewe/cow (PC) and yearling ewe/heifer (PH) pairs and non-penned yearling ewe/cow (NC) and yearling ewe/heifer (NH) pairs during a 30-min open-field test.

However, based on additional research (Anderson, 1998), these workers suggest that for a cohesive bond not to disintegrate over time, under range conditions, periods of socialization >30 days may be required to ensure endurance of the bond. Previous research suggests inter-specific separation distances were less for younger sheep (45 and 62 days of age) than older lambs (90-days of age).

Anderson et al. (1987b) reported 75-day-old lambs formed a cohesive bond with heifers after only 20 days of pen confinement but the bond was strengthened with an additional 35 days of confinement. Strengthening was most noticeable after 55 days in the group of lambs in which the heifers demonstrated physical antagonistic behaviors toward lambs. This suggests the time required to develop a cohesive bond is lengthened if bovines are abusive to the ovines during pen confinement.

From the current study, we believe the time required for inter-specific penning to produce an inter-specific bond may be reduced if conditions for bonding are optimally maintained throughout the pen confinement period. Furthermore, these data support previous bonding research (Anderson, 1998) suggesting that sheep bond to cattle regardless of whether a heifer or mature cow is used to initiate the inter-specific association. Prior experience indicates a cohesive flerd can be maintained once the initial bond is formed and allowed to ''mature'' under free-ranging conditions. Furthermore, the bond is species rather than individual animal specific (Anderson, 1998). Realistic minimum inter-specific distances within a flerd may increase over time; yet, a cohesive flerd is maintained if the animals ''mature'' to free-ranging conditions (Anderson et al., 1996) when defined by a minimum inter-specific distance (Anderson et al., 1987a). Though the period of observation was short (30 min) relative to previous studies (8 h), the fact that a separation distance consistent with that has been defined for a bond was demonstrated in the penned but not in the control animals is noteworthy. Additional research will be required to focus on the steps necessary to maintain the bond and develop into a ''mature'' and enduring flerd configuration under extensive free-ranging conditions. The required length of the bonding period may vary due to breed differences, environmental constraints, and handling practices and should be addressed in subsequent research.

Compared to the prior recommendation of a 30–60-day-period of pen confinement, a 14-day interval would reduce time and associated costs by 53–77%. Feed costs are further reduced if heifers rather than mature cows are used. Incorporating pen confinement into ongoing management routines such as early weaning of calves or lambs could further reduce costs.

Livestock professionals that use dogs and herding to maintain optimal animal distribution on rangelands report that flerd-like behaviors can be achieved and maintained without penning (Murray Creighton, personal communication). In this case, dogs are used to bunch sheep and cattle in a group, and the process is repeated when this inter-specific group begins to disassociate until a flerd configuration is achieved. This method has been advocated for producing flerds (Anderson, 1998) and would effectively reduce or eliminate costs associated with pen confinement.

One of the advantages of a short 14-day penning period to socialize the two species is that subsequent attempts to develop a flerd configuration by herding will be easier since resistance to attempts to force the two species together will be lessened. A short penning period should also reduce the stress associated with atypical behaviors such as cross-specific bonding, resulting in more efficient use of herding. In the future, it is likely that an array of pro-active, behavioral based methods will be available to livestock professionals. The method chosen will depend on the goals of the operator, nature of the operation, skills of the livestock professional, and the tools available.

5. Conclusions

Previous recommendations are that sheep and cattle be penned together for a period between 30 and 60 days to achieve a desired inter-specific bond. This study suggests the same results can be obtained in 53–77% less time and can be accomplished using heifers or cows. This approach for creating a bonded animal that can be developed into a flerd may be viable for some mixed-species management operations.

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