Applied Animal Behaviour Science, 22 (1989) 261–267
Elsevier Science Publishers B.V., Amsterdam — Printed in The Netherlands

Bonding of Goats to Sheep and Cattle for Protection from Predators*

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(Accepted for publication 17 October 1988)

ABSTRACT

Hulet, C.V., Anderson, D.M., Smith, J.N., Shupe, W.L., Taylor, C.A., Jr. and Murray, L.W., 1989. Bonding of goats to sheep and cattle for protection from predators. *Appl. Anim. Behav. Sci.*, 22: 261–267.

Fourteen 5-month-old mohair goats previously confined with heifers for 60 days were randomized into two groups. Group 1 was confined with two heifers for an additional 14 days. Group 2 was confined with eight previously cattle-bonded sheep and a heifer for 14 days. A third group of six non-bonded sheep and seven goats, and three heifers with calves served as a control. The three groups were randomized among three brushy range pastures averaging 190 ha and rotated whenever a goat or sheep was found dead or missing. Control goats, control lambs and Group 1 goats were observed to move independently of the cattle. Group 2 goats consistently stayed with the bonded sheep and cattle. Sheep and goats which did not stay with cattle were killed by predators starting 5 days after going to pasture. Within 10 days all goats, one lamb from the control group and six of the seven goats from Group 1 were dead, wounded or missing. Only the smallest goat in Group 2 was lost. This group was rotated among the three pastures for an additional 21 days with no further loss.

INTRODUCTION

Multispecies grazing increases the efficient utilization of range forage (Bennett et al., 1970). Cattle prefer grass, sheep prefer herbaceous broadleaf plants and goats tend to prefer shrubs. Proper management of multispecies grazing

*Cooperative investigations of the Agricultural Research Service, U.S. Department of Agriculture, New Mexico Agricultural Experiment Station and the Texas Agricultural Research Station. Journal Article 1409, Agricultural Experiment Station, New Mexico State University, Las Cruces, NM, U.S.A.

0168-1591/89/$03.50

not only improves utilization of the range but can improve range quality by reducing the quantity of undesirable shrubs and forbs for cattle. However, in spite of the obvious advantages, multispecies grazing generally has not been practiced on ranges of the western United States due primarily to coyote predation of sheep and goats.

Anderson et al. (1987) bonded sheep to cattle by keeping young lambs in close confinement with cattle for 60 days. This bond has endured for 2 years in sheep kept constantly in the same pasture with cattle. The constant close association of sheep with cattle provided protection from coyote predation for over a year in an area densely populated by coyotes which routinely killed unprotected sheep (Hulet et al., 1987). Observations disclosed that the protection was a result of the sheep running in among the cattle when threatened by predators (Anderson et al., 1988). In the second year, some losses were experienced in lambs born to bonded ewes during lambing on arid native range pastures. However, this lamb loss appeared to be no greater than that experienced in a range flock accompanied by Akbash guard dogs. It was observed that ewes tended to separate from the flock during lambing and that ewes with young lambs tended to spread out over a much wider area than the ewe flock before lambing. It appeared that young lambs in the dispersed flock, especially in rough brushy country, became more vulnerable to predation even when either accompanied by guard dogs or when bonded to cattle. This problem has led to the practice of lambing the flock in drylot, weaning the lambs early and returning the ewes to the range.

Following the successful bonding of weaned lambs to heifers and their survival in a coyote habitat (Anderson et al., 1987; Hulet et al., 1987), there was interest in adding goats to the multispecies herd to utilize range forage more efficiently. The objectives of this study were to evaluate the bonding of kid goats to cattle and to cattle-bonded lambs with reference to the kids' affinity to the combined flock–herd (flerd), and to evaluate the extent of protection from predation afforded by bonding while livestock graze arid desert range.

MATERIALS AND METHODS

Treatments are summarized in Table 1. Two groups of seven 5-month-old mohair kid goats, previously confined for 60 days in small pens with three weanling heifers, and a third group of six mohair kid goats, raised in isolation from sheep and cattle (unbonded control), in Sonora, Texas were transported to the Jornada Experimental Range near Las Cruces, New Mexico in late September 1987. Upon arrival at the ranch headquarters, the 14 kid goats previously confined with heifers were maintained with three Brangus heifers, and the six unbonded control kids were kept isolated from other livestock for a quarantine period of 14 days. Next, seven of the cattle-exposed kids were placed in the same pen with eight bonded sheep (two yearling wethers and six lambs)

TABLE 1

Treatment and loss summary

Study treatment	Earlier treatments	Field trial numbers			Total range-pasture observation period (days)
		Goats	Sheep	Cattle	
Multispecies control (MSC)	No association among species	6(6)[1]	6(1)	3	15
Two-species (TS) group	(a) Goats confined with cattle for 60 days (Texas) (b) Goats confined with cattle for 14 days (quarantine) (c) Goats confined with cattle for additional 14 days	7(6)	0	3	15
Multispecies (MS) group	(a) Goats with cattle (Texas) and sheep with cattle (NM) confined in separate groups for 60 days (b) Goats confined with cattle for 14 days (quarantine) (c) Sheep maintained with cattle (d) Goats and sheep confined in one group with cattle for 14 days	7(1)	8	8	36

[1]Numbers in parentheses indicate numbers missing, killed or wounded during observation period.

and one Brangus heifer [multispecies (MS) group]. The other seven cattle-raised kids were placed in another pen with two heifers [two-species (TS) group]. The six kid goats raised in isolation from sheep and cattle were again placed in a small pen isolated visually from both sheep and cattle [MS control (MSC)]. After 14 days of this treatment, the three groups were hauled to corrals in the afternoon which were adjacent to range pastures and held overnight in their respective groups. The next day, Brangus cattle were added to the bonded groups to make up ratios of two sheep or goats per heifer and/or cow with calf. The goats were individually identified. In addition, six lambs reared in isolation from both goats and cattle (MSC) were placed with six control kid goats and three cows and one calf.

At 0800 h during the third day, the three experimental groups were released from corrals to three separate pastures which had no common border. The location of the various species of livestock in relation to other species in each experimental group (distance between perimeters of the smallest circles en-

closing each species) were recorded at 15-min intervals over a 4-h period. The diameters of the circle enclosing each species were also estimated. We also recorded each time one species was observed deliberately following another species. Bonding was arbitrarily defined by Anderson et al. (1987) as the maintenance of interspecific distances of $\leqslant 322$ m during a pasture test of 6 h. The degree of bonding was considered to be strong if the distance was $\leqslant 161$ m. In this study, in order to compare the intraspecific affinity and the interspecific affinity or closeness of association more critically, the data were summarized by classifying the estimated diameters of each species group into one of two categories: diameter $\leqslant 15$ m or > 15 m for intraspecific affinity and diameter $\leqslant 30$ m and > 30 m for interspecific affinity. The maximum distance that animals could be separated in the pastures was > 1.5 km. The frequency classes were statistically analyzed using χ^2 tests of homogeneity.

On the second day, following the preliminary 4-h observation for cohesiveness, the three experimental groups were again randomly placed in three separate large range pastures (85–300 ha). The groups were rotated among pastures at weekly intervals or whenever a sheep or goat was lost to predation. Location of the different animal species in relation to each other within pastures and surviving numbers of the different species were observed each morning and evening. Whenever a goat or sheep was missing, a search was made to locate the missing animal and determine the cause of death. The MSC and TS groups were removed from the study when five or more lambs or goats were lost from each group. The MS group remained exposed to predation for an additional 21 days (7 days in each pasture) after the other groups had been removed to further test the degree of protection afforded to bonded sheep and goats.

RESULTS

During the initial short-term observation the bonded goats in the TS group and in the MS group were observed within 30 m of the cattle 100% of the time, whereas the goats in the MSC group were observed within 30 m of the cattle only 37.5% of the time ($\chi^2 = 27.9$, $P < 0.001$). The bonded sheep (MS group) were observed within 30 m of the cattle 100% of the time and the control sheep (MSC) were within this distance only 31.2% of the time ($\chi^2 = 18.3$, $P < 0.001$). The MSC goats and sheep were at times separated in excess of 1.5 km. The bonded sheep and goats always followed the cattle, but the cattle did not follow the sheep or goats.

When the three treatment groups were put to pasture on a long-term continuous test, the goats in the MS group continued to stay close to cattle, but the goats in the TS group, like those of the MSC group, did not stay close to the cattle (Table 2, $\chi^2 = 37.3$, $P < 0.001$). The sheep in the MS group (Table 2) were also within 30 m of the cattle 100% of the time and within 30 m of the

TABLE 2

Effects of pen confinement and species composition on frequency of association of goats and sheep with cattle under free-ranging conditions

Treatment group	Species observed for separation distance	Distance frequencies for separation classes	
		⩽30 m	⩾30 m
MSC[1]	Goats to cattle	11.1	88.9
MSC	Sheep to cattle	5.9	94.1
MSC	Goats to sheep	58.8	41.2
TS[2]	Goats to cattle	15.8	84.2
MS[3]	Goats to cattle	100.0	0.0
MS	Sheep to cattle	100.0	0.0
MS	Goats to sheep	100.0	0.0

[1]MSC = multispecies control.
[2]TS = two species pen-confined.
[3]MS = multispecies pen-confined.

goats 100% of the time. Thus, it appears that the affinity or social bonding of the goats to cattle was weak and only endured when reinforced by the more enduring bonding of the sheep to cattle. The more frequent association of the goats with sheep in the MSC group (Table 2) illustrates that goats may attach more naturally to sheep than to cattle. The treatments did not affect the diameter of the goat groups ($\chi^2 = 0.82$, df = 2, $P = 0.67$). However, the sheep were observed to be in diameter groups of ⩽ 15 m more often when not bonded (MSC) than when bonded to cattle ($\chi^2 = 4.2$, $P < 0.05$). This appears to be due to the fact that cattle have a more dispersed grazing behavior than sheep and the bonded sheep become a part of this more dispersed group resulting in a greater intraspecies distance of separation for the sheep.

The first loss (a goat) occurred in the TS group (goats and cattle) 5 days after the start of observations. The second loss was in the MSC group after 8 days. Within 10 more days, all goats (100%) and one lamb (17%) from the MSC group were either missing or found dead with evidence indicative of coyote predation (Table 1). The first phase of the study was terminated when 100% of the goats had been lost in the MSC group and 86% of the goats had been lost or wounded in the TS group. Only one goat in the TS group was unharmed. Only the smallest female was missing in the MS group (14%) on Day 12 of the study.

The MS group of eight sheep, six surviving goats and eight cows with two calves consistently stayed together during the next 21-day observation period (7 days in each pasture) after the other two groups had been removed from the study area. No further loss occurred.

DISCUSSION

Goats previously confined with heifers and tested with heifers on the range stayed with the heifers during short-term tests and appeared to be bonded. However, the goats did not stay with the cattle in the long-term observation. The reason that the bond of goats with cattle did not endure is not understood. It appears from this study and other observations, that goats have a more natural affinity for sheep than for cattle. This may explain why the goats combined with sheep and cattle stayed with the group, whereas those combined with cattle only would not stay with them except for short periods.

Kid goats in this study appeared to be more vulnerable to predation than lambs. A border collie herding dog was exposed once to each MS group during the initial 4-h bonding test period in order to observe their response to a predation threat. Whenever the flerd moved away from the threatening dog, the lambs easily stayed with the cattle. However, kid goats were quickly left behind and laid down. This behavior could account for the loss of the small kid in the MS group.

The results reinforce the observations of Hulet et al. (1987), clearly demonstrating that bonding can provide a predation shield for smaller coyote-vulnerable species, if they stay with the cattle. The natural instinct of sheep and goats to bunch together when threatened is probably essential for survival. Cattle move together in a loose herd allowing space for the sheep and goats to move among them. The threatening presence of the cattle is apparently adequate to intimidate coyotes (Anderson et al., 1988).

Only five of the 13 dead or missing goats were found, probably due to the size and brushy nature of the pastures. Those that were found had been so completely consumed (only skull, back bone, legs and pelt remained) that it was not possible to confirm that coyotes killed them. However, the one surviving wounded goat had been attacked on the throat in the manner characteristic of coyotes. It is believed that most if not all of the losses over this 10-day period were due to coyote predation. The immediate termination of all losses when the two groups were removed is circumstantial evidence that the losses were due to predation.

The loss of sheep and goats during the course of this study was unfortunate. This research was aimed at protecting sheep and goats from predation. Predation cannot be clearly established unless the effects of the natural environment on survival are known and documented. Coyotes are a natural component of the range habitat and repeatedly cause sheep and goat losses.

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