Bull-to-cow ratios: practical formulae for estimating the number of bulls suggested for successful pasture breeding of female cattle

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Abstract

The literature contains inconsistent recommendations for bull-to-cow ratios used for pasture breeding in restricted breeding seasons. Age of bulls and scrotal circumference are primary determinants when bulls are classified as satisfactory potential breeders according to the standards of the Society for Theriogenology. The Auburn formulae are, for single-sire units, based on the bull's age in months for young bulls, and on scrotal circumference in centimeters for adult bulls. The formula for multiple sire breeding groups also establishes a firm recommendation for larger breeding groups.

Keywords: breeding soundness, bull-to-cow ratio, natural service, pasture mating, scrotal circumference

Introduction

The published literature is inconsistent regarding suggestions for the number of bulls required for natural service of varying numbers of cows and/or heifers, or conversely, the number of female cattle assigned to a bull or bulls for pasture breeding. The most common circumstance finds producers with an established number of females in a breeding group or groups; therefore we prefer the designation "bull-to-cow ratio," as this ideates the relatively fixed number of females as the denominator. This phrase is also occasionally found in the literature[1,2] or electronic media.[3] Other potentially applicable phrases include "cow-to-bull" which is not widely used, or the colloquial "bull power," but its meaning is inconsistent. "Serving capacity" is widely referenced, especially in Australian literature regarding rams and bulls, but typically includes an assessment of breeding behavior[4,5] which is not a part of the bull breeding soundness examination commonly practiced in the United States.

Estimating an efficient bull-to-cow ratio seems to have been an inexact science, traditionally being 1:25-30 for mature bulls,[6] but ranging from 1:10 to 1:60.[7] Several trials and observational studies should be considered. *When bulls were selected for maturity and scrotal circumference*, acceptable reproductive performance has been observed in single-sire, non-synchronized breeding groups of up to 60 females[8,9] and synchronized breeding groups of up to 25 females.[10]

Age of bull(s) should be considered when establishing breeding ratios. Yearling bulls have traditionally been suggested to be limited to ratios of 1:10-20.[6] This is not without support in the literature. For example, single-sire breeding groups averaging 20 females (range: 14-29) had higher pregnancy rates when bred by two-year-old bulls than by yearling bulls.[1] However, 24 months is not necessarily the age of peak performance: two-year-old bulls exposed for 60 days to 50-cow, single-sire breeding groups achieved only 67-83% pregnancy rates, leading the authors to suggest that the typically recommended ratio of 1:25 could be expanded to 1:40 only for "high-serving-capacity" bulls.[2] We read with interest that approximating breeding group size for young bulls by equating it to their age in months is "A time honored rule-of-thumb …"[3] because it has been time-honored only since we developed the notion in the mid-1990's.

There is general agreement and reasonably good evidence that multiple-sire breeding groups are less efficient than single-sire units. Social dominance, which is correlated with age,[9] is alleged to play a part. This is supported by the finding that individual bulls in multiple-sire breeding systems sire disproportionate numbers of calves.[11,12] Breedings by more than one bull during each estrus may be inefficient and, interestingly, heifers in breeding groups of 1:20 were bred more times during each estrus by their single sire than were heifers in groups of 2:40 by the combined services of two bulls.[13]

We have noted some reluctance to accept minimum scrotal circumference standards established by the Society for Theriogenology,[14] especially in the face of differences in average scrotal circumference among breeds. However, we suggest this undermines the notion of a unified standard for pasture breeding. Interestingly, we have noted a decrease over time in the proportion of bulls deemed

unsatisfactory due to insufficient scrotal circumference during breeding soundness examinations.[15] We believe that this has been the effect of selection for this moderately to highly heritable trait. We also suggest that breed associations should require scrotal circumferences which exceed the minimum standard if they wish to market bulls for natural service, and that we should discriminate against the minimum scrotal circumference in favor of bulls that well exceed that measurement.

The Auburn formulae for bull-to-cow ratios

Regardless of the pattern of use for breeding, each bull must be determined to be a satisfactory potential breeder by the standards of the Society for Theriogenology for breeding soundness examination of the bull. Further consideration of scrotal circumference obtained during this examination is detailed, below.

Single sire breeding groups

The size of a single-sire breeding group is N (1:N bull:cow ratio), meaning that the bull may be exposed to *up to, approximately,* N females:

using a bull < 36 months of age, N = (is approximated by) the bull's age in months;
using a bull ≥ 36 months of age, N = the bull's scrotal circumference in centimeters.

Simply stated, the number of females per bull in single-sire units equals the bull's age in months up to 36 months of age and, beginning at 36 months of age, the number of females equals the bull's scrotal circumference.[16]

Multiple sire breeding groups

When it is not possible or reasonable to divide larger groups of females into single-sire breeding groups, some accommodation must be made for the inefficiency of multi-sire systems. Our mentor, Robert S. ("Bob") Hudson, proffered this advice: each bull added to the first in a multiple sire breeding group may be expected to dependably serve only one-half of his compliment of cows or heifers[16] (N, as calculated, above). Thus, for example, a breeding group of 100 females would require four adult bulls, if each had a scrotal circumference of approximately 40 centimeters: 40 females for the first bull and 20 for each of the additional three bulls, or:

$$B = 1 + [(T-N) / ½N]$$

where B = number of bulls required, T = total female cattle in the breeding group, and N is the fair compliment of females calculated for single-sire groups, based on the characteristics of the bulls. This calculation depends on reasonable uniformity in size, age and scrotal circumference amongst the candidate bulls.

Discussion

Our formulae result in exposure of somewhat fewer females to each bull than the maximum numbers assigned to some bulls in the literature, but in some cases, more than allowed by the tentative, "traditional" estimates. We defend our suggested limits to the pressure placed on bulls by pointing to the value of each calf resulting from the goals of a satisfactory potential breeding: greater than a 90-95% calf crop from a restricted breeding season of 60-90 days. Empirically, our recommendations have stood well against even greater pressure placed on bulls, for example, breeding seasons as short as 45 days.

We are unaware of the source of the on-line information regarding exposure of young bulls to the number of females approximated by the bull's age in months.[3] This is not referenced, but is presented as common knowledge, and the author is not indicated. This was surprising to us, because we distinctly recall originating the idea in shared discussion. This means of estimating the reproductive pressure placed on young bulls is, to our knowledge, otherwise absent in the literature. It is possible, of course,

that others divined but did not publish this notion and it became, indeed, common knowledge. We believe it perhaps more plausible that we, or our students who have been exposed to the idea for some 15-20 years, have extolled it to the degree that it has entered the public sphere.

Our use of scrotal circumference to allow exposure of more females to bulls with larger scrotal circumferences is the result of our desire to increase the allowed minimum for a satisfactory potential breeder. Continued pressure on this trait will increase the efficiency of cow/calf operations by allowing the use of fewer bulls. We foresee the possibility of reducing the age of conversion of the calculation from age-in-months to scrotal-circumference-in-centimeters based on improvements in this trait.

The requirement of uniformity of age and scrotal circumference among bulls when calculating bull requirements for multi-sire breeding groups may be problematic. We insist that such uniformity remains a best-practice when multiple sires are required, but understand that it is not always possible. If bulls with such disparate characteristics must be utilized together, the combined wisdom of experienced veterinarians and herdsmen should be applied to minimize conflicts which might interfere with breeding efficiency.

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