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Pelvic Measurement of Heifers: A Case Study in Hawaii

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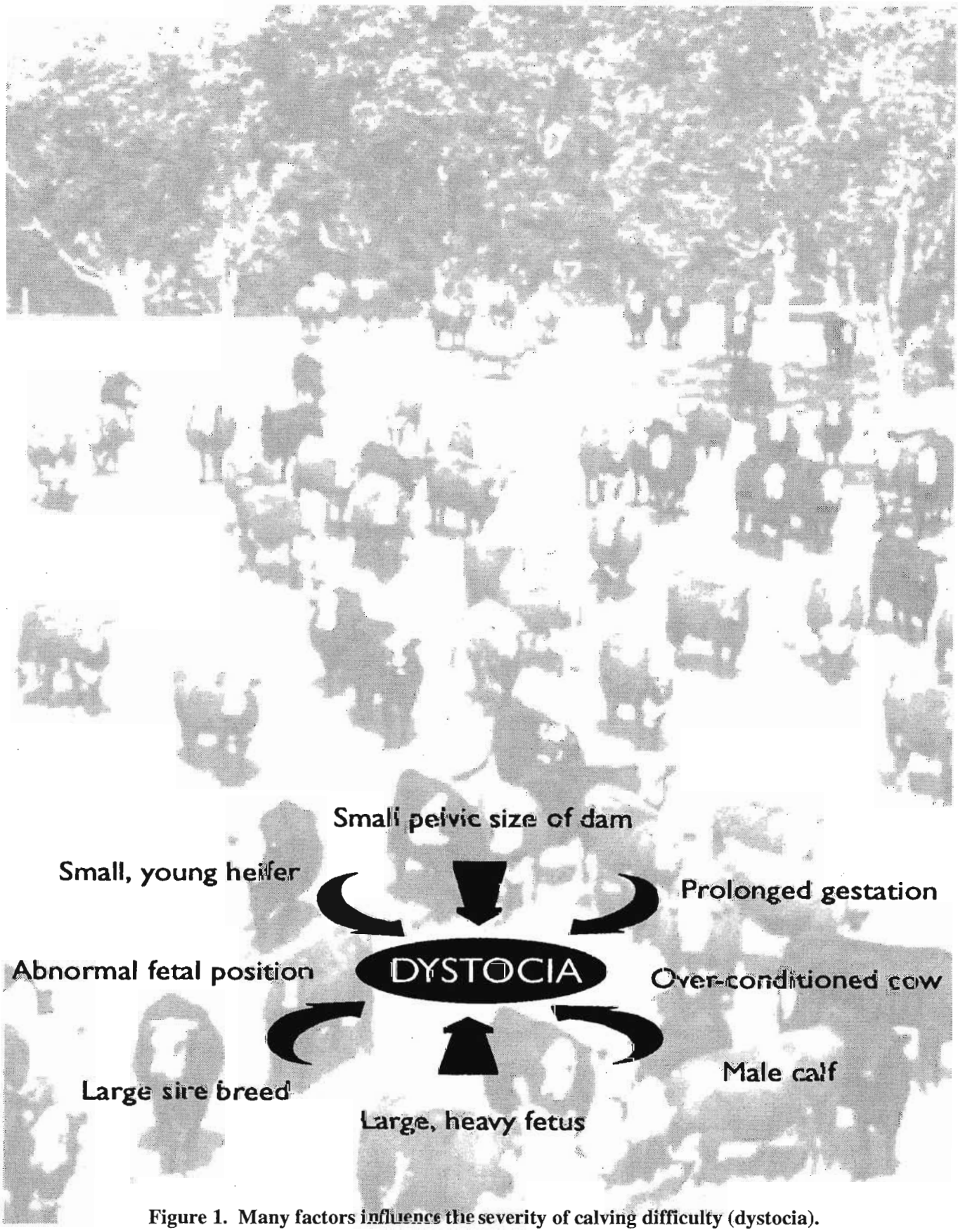

Figure 1. Many factors influence the severity of calving difficulty (dystocia).

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Abstract

Pelvic measurement (PM) can be used as a management tool in reducing the incidence and severity of calving difficulty (dystocia) in beef cattle operations. A large majority of calving difficulties occurs in first-parity heifers. By identifying and quantifying heifers' pelvic areas, ranchers can make informed culling decisions affecting the future productivity and economic success of the cow herd. We evaluated the impact of PM-based heifer culling decisions on the percent of calving losses at parturition. In total, 2244 long yearling heifers were measured using a Rice pelvimeter. Pelvic areas ranged from 133 to 255 cm^2; heifers with pelvic area less than 187.5 cm^2 were culled. Calving losses in the herd prior to PM were 7.18 $\pm$ 1.06, whereas losses after PM were 4.08 $\pm$ 0.28. Calving losses were significantly lower ($P<0.05$) when critical minimum pelvic area measurements were used as culling criteria, compared to the visual culling criteria used prior to PM. In summary, the use of PM can significantly reduce the incidence of dystocia in a commercial heifer herd when combined with a sound herd health and nutrition program for heifers and the use of "calving-ease" (low birth weight) bulls.

Key words: dystocia, pelvic measurement, beef cattle, heifer

Introduction

How does your replacement heifer start making money for you? When she produces a live calf on the ground at two to two-and-a-half years of age. This can be accomplished through a sound heifer management program and by establishing a production goal of one calf per cow per year.

Heifer development and reproduction in the tropics is a major challenge to livestock operators because of low forage quality and environmental stresses caused by high temperature and humidity. Compared to temperate forages, tropical forages contain less protein and more structural carbohydrates, such as neutral detergent fiber, cellulose, and lignin. Consequently, replacement heifer development and growth are not optimal in tropical and subtropical environments. The goal of the rancher is to keep replacement heifers on a high plane of nutrition to stimulate steady growth and the onset of puberty and, ideally, produce a calf at two years of age.

Management of the heifer herd is the critical key to profitable and sustained productivity of the ranch operation. Decisions should be based on objective rather than subjective selection methods. The rancher can use measurable productivity indexes to make more informed decisions to maximize heifer selection efficiency. Pelvic measurement (PM) provides an objective tool to aid the rancher in replacement heifer selection.

Pelvic area measurement of yearling heifers has been adopted recently in Hawaii as a management tool for reducing the incidence and severity of calving difficulty (dystocia) in commercial herds. Figure 1 shows that there are many factors influencing dystocia. The use of PM is a practical method that can be easily adopted by the rancher and make a positive impact on the problem of calving difficulty. By quantifying and categorizing a heifer's pelvic area, ranchers can make more informed culling decisions than are possible with subjective culling by the "trained eye." Subjective selections based on frame size, femininity, external hip height and width, and body condition are often unreliable, and therefore costly.

The Rice pelvimeter shown in Figure 2 (Lane Manufacturing, Denver, CO) is the device commonly used by local veterinarians. The caliper-type instrument is inserted in the rectum and manipulated to measure the minimum dorsal opening (height) and maximum lateral opening (width) of the pelvis, as illustrated in Figure 3.

Why measure heifers ?

A large majority of calving difficulties occur in "first-calf heifers," which are the future of the herd. By using pelvic measurements, a rancher can effectively eliminate heifers with smaller pelvises and select heifers with larger pelvic areas for retention in the ranch breeding program. Combining this strategy with a good nutrition program and the use of "calving-ease" (low birth weight) bulls, a rancher can greatly reduce dystocia and achieve some "peace of mind" during calving time. Research shows that the yearling stage is the most reliable time to measure the pelvic area of heifers (Simons et al.).

Why measure bulls ?

Selection for large pelvic size in bulls should increase the trait in their progeny (Johnson and Deutscher 1986, Siemens et al. 1991). The heritability estimate (h^2) of this trait is reported at 0.6 (60 percent heritable) (Beef Improvement Federation 1990). For example, consider two bulls of similar age and weight but with a 30-cm^2 difference in pelvic area (Bull A = 210 cm^2, Bull B = 180 cm^2). Taking the 30-cm^2 difference, or advantage, of Bull A, with a heritability factor of 0.6 and one half (0.5) of the influence being passed on by the bull, the predicted advantage for daughters of Bull A is a 9-cm^2 larger pelvic area, compared to the daughters of Bull B ([30 cm^2 x 0.6] x 0.5 = 9 cm^2).

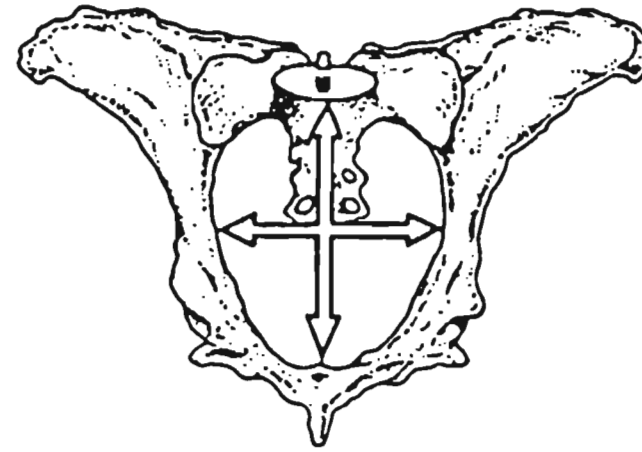

Figure 3. Diagram of a pelvis showing location of height and width measurements (Beef Improvement Federation 1990).

Case study at Kahuku Ranch

Based on positive results at the University of Arizona (E. Schwennesen, personal communication, 1988) the management of Kahuku Ranch in the Ka'u district of the island of Hawaii decided to incorporate pelvic measurements (PM) in their replacement heifer herd selection program. We evaluated the impact of using pelvic measurements as a screening tool for heifers on

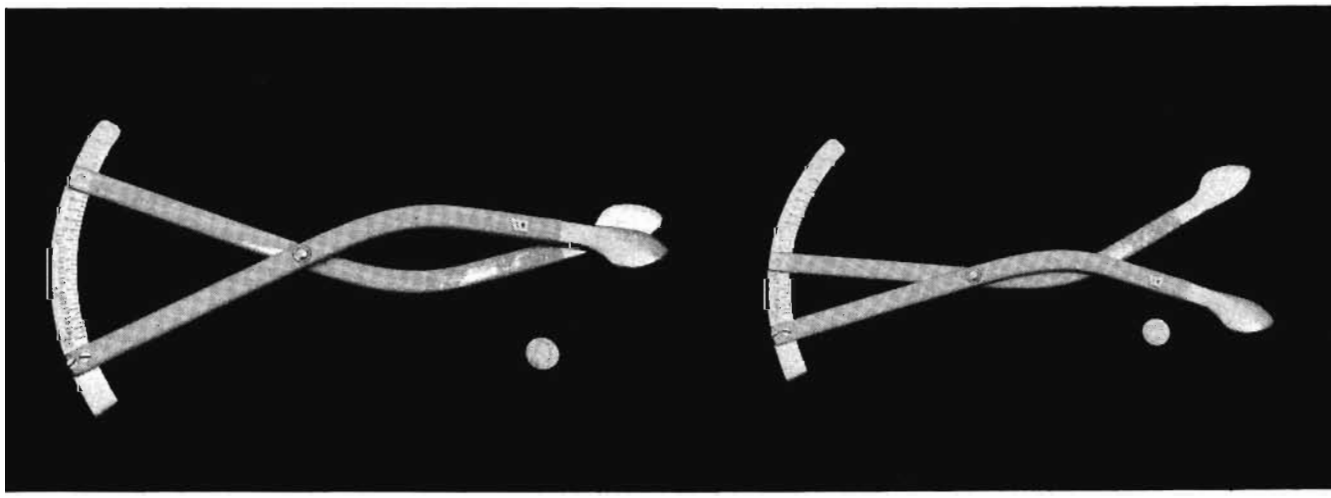

Figure 2. The Rice pelvimeter is a simple, inexpensive tool which is relatively easy to use. The blunt tips measure the internal pelvic opening. The measurement is read on the external calibrated scale, in centimeters. The pelvimeter is shown in closed position (left) and open to approximately 15 cm (right). A 25-cent coin indicates the size of the instrument.

Table 1. Ten-year summary of the percentage of calves lost from the replacement heifer herd, and comparison of the percent calving losses before and after adoption of pelvic measurements (PM).

Treatment	Year	No. of heifers[a]	Heifers culled %	Threshold[b] cm^2 (lb)	Mean pelvic area cm^2	Calving loss %	Mean calving loss per treatment[c] %
No PM	1983	278	-	-	-	9.0	7.18 ±1.06
	1984	309	-	-	-	4.2	
	1985	279	-	-	-	4.7	
	1986	201	-	-	-	10.9	
	1987	317	-	-	-	6.3	
PM	1988[d]	433	6.7	187.5 (75)	210.9	8.0	4.08 ± 0.28
	1989	452	19.25	190.0 (76)	201.5	4.5	
	1990	538	13.38	187.5 (75)	200.6	4.5	
	1991	519	16.96	187.5 (75)	205.5	4.0	
	1992	302	15.89	165.0 (66)	181.6	3.3	

[a]Total number of heifers evaluated prior to breeding.

[b]Threshold = minimum calculated pelvic area accepted by the rancher; heifers below this level would be culled.

[c]Mean ± standard error; treatment means for calf loss differ significantly at $P < 0.05$.

[d]Year in which pelvic measurement practice was incorporated in heifer management plan.

the incidence of severe dystocia as measured by calf losses at parturition.

PM data were collected from Spring 1988 through 1992 by a trained veterinarian using a Rice pelvimeter. Replacement heifers entering the commercial herd were measured during the heifer screening and selection period. Heifers ranged from 15 to 18 months of age when measured. A threshold level, which estimates the cow's ability to deliver a calf no larger than the calculated calf birth weight, was established for the herd. The threshold level varied from 165 to 190 cm^2 over the five-year study. Preliminary work established that at a 75-pound calf threshold level, 5 to 20 percent of the heifers would be culled. The threshold value was mutually agreed upon between the ranch manager and the veterinarian. Heifers with pelvises less than the threshold limit were culled.

Severe drought conditions in 1991 resulted in poor feed, which depressed growth of the replacement heifers. A management decision was then made to lower the threshold level in an effort to retain more heifers for breeding. If the previous threshold level had prevailed, an additional 122 heifers (or a total of 56.3 percent) of the replacement heifers would have been culled on the basis of PM. Thus, PM is a herd management tool that can be adjusted to meet individual herd targets and requirements.

Heifers were culled based upon a formula developed at Colorado State University and Kansas State University. The pelvic area divided by the heifer-age adjustment factor estimates the minimum deliverable calf birth weight. For example, the standard age adjustment factor is 2.0 for a 12-month-old heifer (Heifer Y) and 2.5 for an 18-month-old heifer (Heifer Z). Given similar pelvic measurements for both heifers, 14.5 cm height and 12.0 cm width, the resulting pelvic area is 174 cm^2. Also given is an established threshold level of a 75-pound calf. The formula estimates the maximum deliverable calf birth weight based on the measured pelvic area and heifer age adjustment factor. The estimated value is 87 pounds for Heifer Y (174 $cm^2/2$) and 69.6 pounds for Heifer Z (174 $cm^2/2.5$). Thus, Heifer Y at 12 months of age exceeds the pre-set threshold limit and would be retained in the herd, whereas the 18-month-old Heifer Z would be culled.

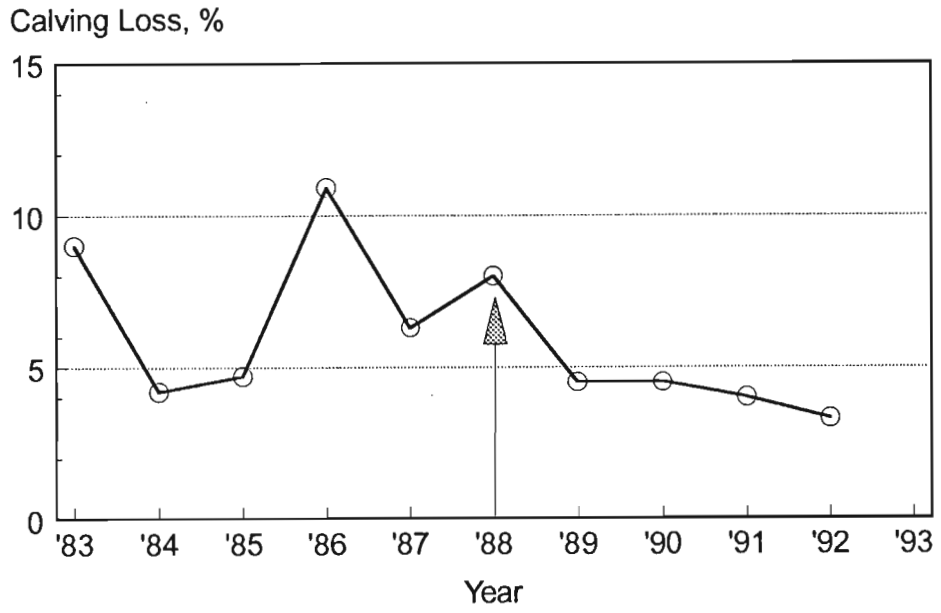

Figure 4. Percentage of calves lost from 1983 to 1992 at Kahuku Ranch. Pelvic measurement practice was adopted in 1988.

The breeding program consisted of a three-breed rotation. The use of "calving ease" bulls was begun before the study period and continues to the present time. The data were analyzed by an independent *t* test comparison (SAS 1985) of the differences between means of the calving loss percentages before and after the adoption of PM.

Results and discussion

A total of 2244 crossbred replacement yearling heifers was measured over a five-year period from 1988 to 1992. Pelvic area measurements ranged from 133 cm^2 to 255 cm^2. Table 1 summarizes the herd data over the past ten years and compares the calving losses before and after the use of PM.

Prior to the adoption of PM, calving losses varied widely, ranging from 4.2 percent to 10.9 percent and averaging 7.18 percent over a six-year period from 1983 to 1988. After implementation of PM, calving losses have stabilized, ranging from 3.3 to 4.5 percent and averaging 4.08 percent from 1989 to 1992. The difference in percent calving losses between the two groups is statistically significant ($P < 0.05$). There were no major changes in the philosophy of breeding herd management during the 10-year period.

The historic distribution of calving losses before and after adoption of PM is presented in Figure 4. The figure shows erratic calving losses prior to the incorporation of PM, followed by declining losses since the adoption of PM in 1988.

The distribution of heifer pelvic areas from 1988 to 1992 shown in Figure 5 emphasizes the variability and range of pelvic area measurements found in the heifer herd. Heifers on the lower end of the range may be cause for concern at calving time. PM can identify those dystocia-prone candidates for culling from the breeding group and effectively improve the reproductive performance and efficiency of the herd. PM continues as part of the Kahuku Ranch heifer management program on the island of Hawaii and has been adopted for other herds in the state.

Management considerations

The typical commercial cow-calf herd operates in range conditions, where heifers must fend for themselves at calving. Considerations for implementing the use of pelvic measurement should include your ranch's goals for the replacement heifer herd and the historic and current calving losses of the herd. A trained veterinarian can evaluate approximately 100 to 120 heifers per hour, or one heifer every 30 to 40 seconds. It is a relatively fast procedure, which should take about a minute per

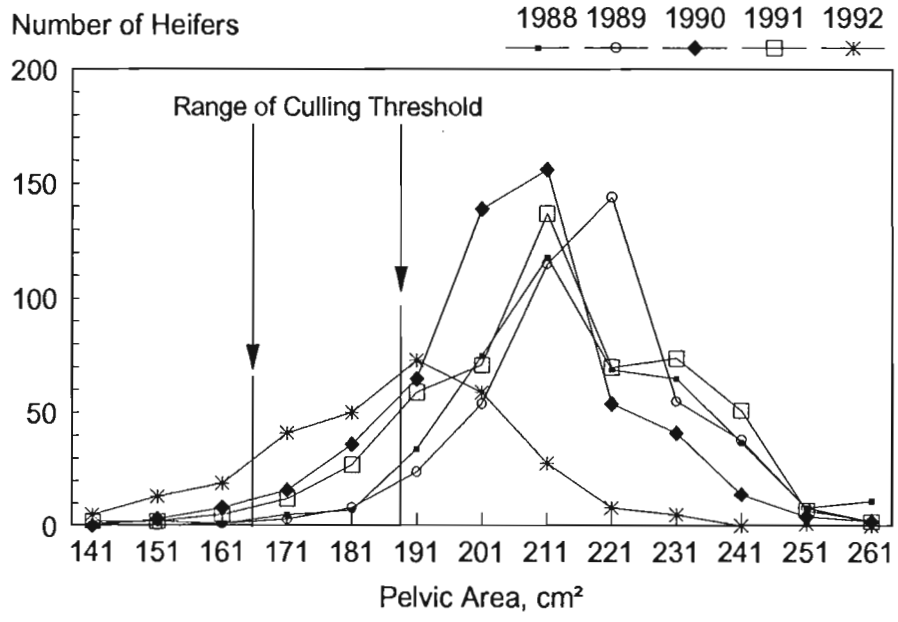

Figure 5. Pelvic area distribution in heifers from 1988 to 1992 at Kahuku Ranch.

head when done by ranch personnel. A suggested method to test for accuracy of your measurements is to slip a few measured heifers back into the string without informing the person doing the measuring.

The direct economic benefits of including pelvic measurements in the total ranch program are reflected in the reduction of calf and heifer losses. Also, the value of the culled heifer, including her total development cost (a 15- to 18-month investment), is recovered as a higher valued feeder or grass-finished product through the ranch marketing program. A partial budget of a 100-heifer herd scenario, shown in Table 2, summarizes the economic impact of the use of pelvic measurement.

The threshold level for culling would vary with each herd, depending upon management and environmental conditions. Nutrition plays a large role in heifer development. Assess your feed status and the condition of the heifers when establishing your culling threshold level. Work with your veterinarian in establishing your threshold level, in order to maintain a normal heifer replacement rate of between 10 and 15 percent.

Genetic strategies for improving calving ease include the use of across-breed comparisons to take advantage of the wide differences in birth weights that exist between breeds. For example, the Angus breed, with average birth weight for bull calves of 70 pounds, would be better for calving ease compared to the Simmental breed, with average birth weight of 91 pounds. Use birth weight Expected Progeny Differences (EPD) as the best direct indicator of calving ease within a chosen breed. Finally, for the replacement heifer herd, select calving-ease bulls that have low birth weight EPD, high maternal EPD, and moderate growth (Leachman 1993).

Other strategies to integrate in herd management include a sound herd health program, a good record-keeping system, adequate nutrition, an optional implanting program, and a routine reproductive examination by a trained herdsman or your veterinarian. Finally, give extra time and attention to first-calf heifers at calving.

In summary, pelvic measurement is one management tool a rancher can use to refine the ranch's replacement heifer development program. PM is a good tool for identifying and culling heifers with small pelvises to reduce dystocia in the herd. PM should be combined with other strategies that contribute to reduced dystocia.

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Table 2. Partial budget scenario comparing the economic impact of incorporating the use of pelvic measurements (PM) on a replacement heifer program.

Item	No PM	PM
Study data		
Number of heifers	1384	2244
Heifers culled (%)	-	14.4
Calving loss (%)	7.18	4.08
100-head replacement heifer herd scenario		
Expenses		
Veterinary cost for PM (0 vs. 100, @ $2/head)	0	200
Hidden management-related costs		
Value of calves lost (7 vs. 4, @ $225/cow/year)	1575	900
Value of heifers lost (4% vs. 2%, @ $450/head)	1800	900
Heifer dystocia costs (4% vs. 2%, @ $75/head)	300	150
Replacement heifer development cost (4 vs. 16, @ $15/mo for 18 mo)	1080	4320
Expenses, subtotal	***4755***	***6470***
Additional revenue		
Calves (3 @ $250)	0	750
Culled heifers (14 marketed @ $450)	0	6300
Additional revenue, subtotal	***0***	***7050***
Marginal differences [revenue – expenses]	(4755)	580
Savings	***0***	***4175***

Assumed dollar values are conservative; they can be replaced with values derived from your own operation or with current market prices.

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