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Simple Rules That May Help Ranchers Select Replacement Heifers for Increased Pregnancy Rates and Reduce Dystocia

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Market Report	Yr Ago	4 Wks Ago	10/31/08
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	$91.57	$96.48	$91.24
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb..	117.21	110.53	103.94
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	112.57	108.77	98.76
Choice Boxed Beef, 600-750 lb. Carcass.	140.03	154.40	142.06
Western Corn Belt Base Hog Price Carcass, Negotiated.	50.91	68.19	54.92
Feeder Pigs, National Direct 50 lbs, FOB..	37.72	36.43	45.04
Pork Carcass Cutout, 185 lb. Carcass, 51-52% Lean.	57.48	73.44	63.49
Slaughter Lambs, Ch. & Pr., Heavy, Wooled, South Dakota, Direct..	91.25	94.62	*
National Carcass Lamb Cutout, FOB.	265.02	269.24	262.55
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu..	7.17	5.58	4.86
Corn, No. 2, Yellow Omaha, bu.	3.53	4.40	3.91
Soybeans, No. 1, Yellow Omaha, bu.	9.41	9.32	9.11
Grain Sorghum, No. 2, Yellow Dorchester, cwt..	6.50	6.23	5.30
Oats, No. 2, Heavy Minneapolis, MN , bu.	*	*	*
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	*	190.00	202.50
Alfalfa, Large Rounds, Good Platte Valley, ton..	97.50	77.50	77.50
Grass Hay, Large Rounds, Premium Nebraska, ton..	*	85.00	75.00
Dried Distillers Grains, 10% Moisture, Nebraska Average.	*	160.00	148.50
Wet Distillers Grains, 65-70% Moisture, Nebraska Average.	42.00	58.00	49.50
***No Market**			

Every year livestock producers replace cows they cull from their herds with young animals often selected from progeny of the cows they currently own. Since replacement rates for beef cattle in Nebraska tend to average between 16 to 20 percent annually, this is not a trivial undertaking. Much of the talk among producers tends to concentrate on muscling and other physically observable characteristics, and the genetic composition of animals to be selected as replacements. These criteria are important, but what must also be considered is the ability of the selected replacement animals to perform reproductively. Producers expect cost to be reduced by using heifers that become pregnant easily, re-breed, and have fewer problems calving, no dystocia. Cows that remain a productive part of the herd longer result in larger savings, since the value of culled animals is about half that of a productive one.

Data used to create a Maturity Index (MI) and relate it to pregnancy rates and dystocia, were taken from two previous experiments used to identify breeding readiness of grouped beef heifers, conducted at the University of Nebraska–Lincoln Gudmundsen Sandhills Laboratory (GSL). This work has been published in the 2002 and 2005 *Beef Cattle Reports*, pp. 4-7 and pp. 3-6, respectively. These studies included 500 heifers, but only those heifers that had a calf were included in this analysis (n=448).

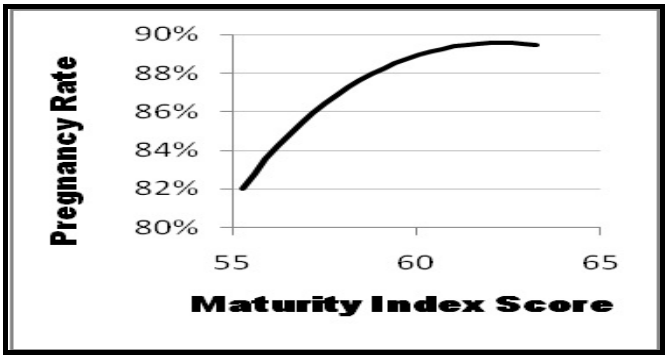
It has been found that replacement heifers perform differently according to maturity, as measured by the MI score which is predicted by: weight at breeding, birth weight, age at breeding, dam's weight and nutritional level between weaning and breeding (see Equation 1).

Equation 1:

$$MI = 30.508 + 0.032Wt_{Pb} - 0.146Wt_{Birth} + 0.078Age - 0.013Wt_{Dam} + 4.839T1 + 2.658T2 + 2.499T3$$

Heifers that were ranked with a higher MI score tend to have higher first pregnancy rates, lower dystocia rates and higher re-breeding rates. Given a range of MI scores between 55 to 62.6 the corresponding probability of first pregnancy estimated using a quadratic Probit Model, ranged from just over 81 percent to just under 90 percent, as shown by Chart 1.

Chart 1. Pregnancy Rates by MI Score



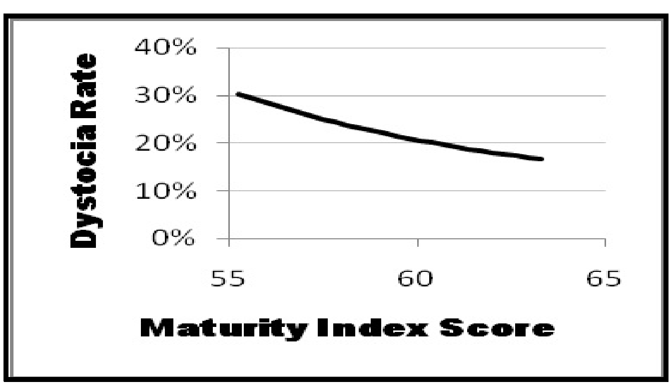
Probit regressions are commonly used to estimate qualitative information where the dependant variable is limited, ranging from zero to one inclusively. In this case a heifer either had a calf on her own, no dystocia, measured as a zero, or required help calving, dystocia, measured as a one. The Probit Model that best fit over the relevant range of the data is of the cubic form. Equation 2 shows the estimated coefficients of the cubic model used to estimate z, which is a part of a normal cumulative distribution function used to convert it to the appropriate probability. The relationship between MI and dystocia is mapped out in Chart 2.

Equation 2:

$$z = \underset{(<0.01)}{6.185} - \underset{(<0.01)}{0.104\,MI} - \underset{(<0.01)}{0.00145\,MI^2} + \underset{(0.02)}{0.0000207\,MI^3}$$

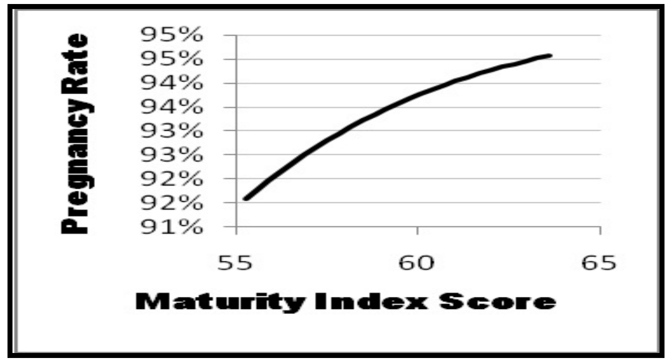
Where: z - Distance from zero in a normal distribution in terms of standard deviations
MI - Maturity Index score

Chart 2. Dystocia Rates Predicted by Maturity Index Score



As expected, the dystocia rate decreases as the MI score increases. Likewise, second pregnancy rates increase as dystocia rates decrease, making second pregnancy rates increase as the MI scores increase (see Chart 3).

Chart 3. Second Pregnancy Rates Predicted by MI



A complete economic analysis of these relationships is currently underway, where preliminary results indicate the economic optimal MI score is close to 60, where the biological optimum is higher at 62.75. The economic optimum varies in relation to cost and prices. The completed work is expected to be available late in the Spring of 2009 as a Research Bulletin.

However, even without the complete analysis, producers can extract useful information from the relationships contained in this abbreviated work. It is evident that choosing an optimal maturity is based on five key variables. Intuition tells us that the relationships between the five variables that make up the MI score provide critical keys in the heifer selection process.

As with all economic decisions, it is assumed that the gain in the benefit must exceed the cost of obtaining that gain. Therefore, without changing any physical or management inputs, and by simply selecting those heifers with higher MI scores, producers should see an increase in pregnancy rates and a decrease in dystocia. Given that there are no appreciable differences in cost, the heifers thus selected would provide a superior economic outcome.

For example, the relationships of the predictor variables to the MI score in Equation 1 indicate that when choosing between two heifers of similar weight, size and conformation, the older heifer with the smaller dam and larger relative birth weight would have the higher MI score. This higher MI score translates into a higher probability of breeding successes and a lower chance of experiencing calving difficulty, making the choice a simple one.

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