Rangelands Resources, Oregon State University). OWIC has had a successful beginning. Through OWIC the potential exists to develop the multitude of benefits of riparian systems and associated watersheds through spirit of cooperation and mutual understanding.

If programs such as the Washoe/Modoc Experimental Stewardship Program and OWIC can be emulated elsewhere, litigation may become less prominent in formulating public land policy and constructive management might have a chance to occur.

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Economic Losses from Broom Snakeweed Poisoning in Cattle

Brent D. Carpenter, Don E. Ethridge, and Ronald E. Sosebee

Broom snakeweed *(Xanthocephalum sarothrae)* is an undesirable perennial half-shrub found on much of the rangeland in the western half of the United States and northern areas of Mexico. Broomweed infestations are cyclic and may result from climatic fluctuations rather than range overgrazing (Jameson 1970, Valentine 1974), although overgrazing expedites its density after it occurs and dense infestations become more permanent (less cyclical). Greatest plant numbers occur in the southern High-Plains and the Canadian-Pecos valleys of west Texas and eastern New Mexico (McDaniel and Sosebee 1988). The production and economic losses caused by snakeweed infestations stem from the adverse effects on two complementary processes. The forage yield is reduced on infested areas and livestock production efficiency is impaired when the plant is consumed.

The poisonous property of perennial snakeweeds was documented as early as 1936. Mathews (1936) found that snakeweed ingestion caused death in ruminants. After years of incrimination by ranchers, studies verified that snakeweed also causes abortion in ruminants. Retained placentas, pre-mature calves that are weak and underweight, and other reproductive disorders are often associated with poisoning (Dollahite and Anthony 1956, 1957; Dollahite and Allen 1959).

The dimension of the cattle poisoning problem in west Texas, along with other information, was estimated by McGinty and Welch (1987). For individual counties the cattle death loss ranged from 0 to 10% and the abortion rate ranged from 0 to 20%. The mean cattle loss for the 148-county area was 1% and the abortion rate averaged 2.9%.

Experimental evidence suggests that several factors contribute to the extent of poisoning in a cow herd. Toxicity problems usually occur during the winter and early spring when low forage availability forces animals to consume relatively large amounts of the plant. Coinciding with this time period is the stage of leaf formation, the most toxic stage of the snakeweed life cycle (Kingsbury 1964). Dollahite and Anthony (1957) also reported that

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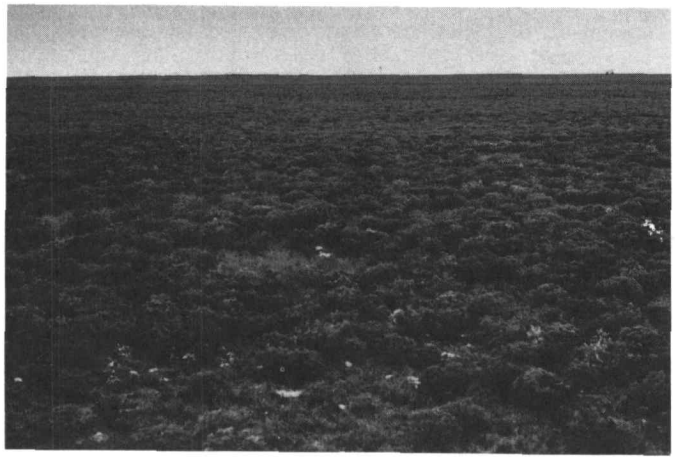

Snakeweed infestation.

although snakeweed grows more abundantly on loam soils, snakeweed growing on sandy soils appears to be more toxic.

The impact of snakeweed on livestock production is related to the level of snakeweed present in the diet; i.e., the quantity of snakeweed in proportion to the available forage. While it has been verified that snakeweed consumption can substantially reduce cow herd efficiency and output, the extent of the damage, particularly as it varies with level of infestation, has not been determined. The purpose of this study was to quantify the expected loss in cow-calf productivity and revenue which occurs with varying levels of broom snakeweed.

Estimation Procedures

In the absence of controlled experimentation, the most reliable information available is the collective knowledge acquired from observations of the effects of snakeweed poisoning. A survey questionnaire was developed to pool information on production losses as it relates to the level of snakeweed. The continuum of possible infestation levels was categorized into three defined classes: light (less than 5% canopy cover or 5 plants/yd^2); moderate (5 to 20% cover or 5 to 20 plants/yd^2); and heavy (greater than 20% cover or 20 plants/yd^2).

The survey group consisted of poisonous plant experts in west Texas, New Mexico, Arizona, and Utah who have observed the effects of snakeweed poisoning or who are in direct contact with ranchers that practice grazing infested pastures. By profession, the respondents included range management specialists, poisonous plant researchers, and veterinarians.

The questionnaire was designed to accomplish three objectives: (1) identify the specific production variables in which snakeweed poisoning reduces cow-calf efficiency, (2) estimate the magnitude of the impact for each variable as a function of the level of infestation, and (3) determine if any residual effects exist after poisoning symptoms are observed.

The survey was interpreted by calculating the range, mean and standard deviation of the responses for each variable and infestation level. If no adverse effects had been observed by an individual, a zero value was averaged into the calculations. If a range was given for a particular estimate, the mid-point was used for determining the mean. One-tailed Student's *t*-tests of significance were conducted to determine if the estimates were statistically different from the appropriate budgeting values of 0 or 1, at the 0.95 probability level.

For the economic analysis, several factors were considered to quantify the loss in revenue for each snakeweed situation. Dollar values were calculated for a cow producing unit (CPU), defined as a mature cow plus 5% of a bull (1 bull/20 cows), and 14% of a raised replacement heifer.

The total revenue from a cow-calf operation depends on the sale prices of cull cows and weaned calves. Expected prices were derived by averaging the most recent 10 years (1979–1988) of cattle prices from Amarillo Auction Sales, not adjusted for inflation (U.S. Dept. of Agriculture 1979–1988). The following prices per cwt were used in the calculations: $41.98 for cull cows, $66.34 for 425 lb. heifer calves, and $77.76 for 450 lb. steer calves.

Revenue is also contingent on weaning weights, death rates for cows and calves, and the replacement rate. Base values for these variables were established from the Texas Agricultural Extension Service budgets. Production parameters for the three infestation conditions were adjusted as indicated in the survey estimates. For example, with a heavy snakeweed stand, the calf crop, which is an additive function of the conception and abortion rates, is reduced to approximately 59%. Assuming a typical 12% replacement rate, and equally distributed calf crop with a 0.5% calf death loss for each gender, and a 4.7% cow death rate; the saleable output from 100 CPUs is 7.3 cull cows, 17.4 heifers and 29.4 steer calves at reduced weaning weights. The loss in revenue with any given infestation level is simply the difference from the total revenue received with no snakeweed.

Survey Results

Seventy-one percent of the 31 questionnaires were returned. Eight of these respondents did not provide any specific estimates, citing that they did not feel qualified to give reliable answers. The remainder (45%) were able to give estimates for at least one of the production variables.

The survey results indicated that four production variables—abortion rate, conception rate, birth weight, and weaning weight— are significantly affected with at least a moderate infestation (Table 1). However, there was not a consensus among the respondents for the magnitude of the impacts. In general, the standard deviations are high relative to the mean responses. The responses verify that there is a degree of uncertainty associated with the current knowledge on the effects of poisoning.

From the responses it can be concluded that production losses from snakeweed poisoning are not significant with only a light infestation. Although there is less forage available on a unit of land, the cow herd appears to perform just as efficiently with a light infestation as it does

Table 1. Results of snakeweed poisoning survey.

Production variable	Units	Mean	Standard Deviation	No. of Responses[1]
no infestation				
Abortion Rate	%	0.6*	1.0	10
Cow Death Rate	%	1.3**	1.4	9
Calf Death Rate	%	0.9**	1.3	9
light infestation				
Abortion Rate	%	2.5*	6.2	10
Conception Rate	% chg	0.6*	1.1	7
Birth Weight	% chg	3.8*	7.0	6
Weaning Weight	% chg	2.6*	3.8	7
Cow Death Rate	%	1.5**	1.7	9
Calf Death Rate	%	1.2**	1.4	9
moderate infestation				
Abortion Rate	%	9.7	12.9	10
Conception Rate	% chg	3.6	3.2	7
Birth Weight	% chg	7.5	6.3	6
Weaning Weight	% chg	11.1	8.4	7
Cow Death Rate	%	2.6**	3.4	9
Calf Death Rate	%	2.2**	4.7	9
heavy infestation				
Abortion Rate	%	16.6	14.1	11
Conception Rate	% chg	9.3	8.7	8
Birth Weight	% chg	17.8	11.8	8
Weaning Weight	% chg	20.6	9.3	8
Cow Death Rate	%	4.7	5.6	11
Calf Death Rate	%	3.7**	4.7	9

* Not significantly different from 0.
**Not significantly different from 1.
[1]Total number of usable responses was 14. No respondent answered every question.

with no snakeweed present. The presence of snakeweed does not appear to affect the death rate of nursing calves at any level. The death rate of cows is significantly affected when they are grazing a heavily infested area. Perhaps a more subtle loss than abortions or death is the reduction in weaning weights with a moderate or heavy infestation.

No carry-over effects of poisoning were identified in the survey. The recovery from a snakeweed induced abortion was observed to be complete and rapid once the source of the problem is eliminated. These findings imply that economic losses are directly related to the current level of snakeweed.

The results of the survey are generally consistent with previously known information regarding the occurrence of poisoning under traditional management practices. That is, the heaviest infestations are accompanied with the most severe losses. However, the production loss for specific variables, and therefore the forfeiture of a portion of the potential economic return, is somewhat greater than prior estimates (McGinty and Welch 1987, Torell et al. 1988).

The economic impact of snakeweed poisoning is substantial, and increases with the level of infestation. Table 2 shows the total returns and foregone revenue for a typical cow-calf herd, without regard to the economic impact of diminished forage production or an increase in veterinary and related costs. These values are expected annual losses which occur in every year that snakeweed is present at the defined level.

Table 2. Total returns and foregone revenue due to snakeweed poisoning.

Level of Infestation	Total Return $ per CPU	Revenue Loss $ per CPU
None	277.73	— — —
Light	277.73	0
Moderate	217.21	60.52
Heavy	151.61	126.12

Conclusions

Based on the collective judgement of professional range specialists, broom snakeweed poisoning has a substantial economic impact on animal efficiency when snakeweed infestations are moderate and heavy, but no impact on animal efficiency and revenue per animal unit when infestations are light. Compared to the total revenue with no snakeweed, as defined in this analysis, the revenue per cow producing unit received from snakeweed infested pastures is 22% less with a moderate infestation and 45 percent less with a heavy infestation. It should be noted that these estimates do not include the economic losses from decreased forage production.

The results also indicate that assessments concerning the effects of poisoning have a high variability. More definitive research with controlled experiments is needed to quantify production losses related to the concentration of snakeweed.

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