# APPLICATION OF PHYSIOLOGIC VALUES TO BIGHORN SHEEP MANAGEMENT

by

Albert W. Franzmann, Idaho Cooperative Wildlife Research Unit, University of Idaho

## ABSTRACT

The indicator species concept was used to demonstrate the application of physiologic values to bighorn sheep management. Utilizing blood urea nitrogen, packed cell volume, albumin-globulin ratio, and hemoglobin values from groups of bighorn sheep with low quality diet and good quality diet the statistical differences in means between the groups was discussed. The use of blood urea nitrogen (BUN) values to reflect protein availability to the bighorn on a particular range is proposed, and the need to pursue the indicator species concept approach to solving management and ecological problems is stressed.

## INTRODUCTION

The application of physiologic values to bighorn sheep management entails the understanding of the indicator species concept (Franzmann 1970). This concept refers to a species' ability to reflect its environmental quality, or lack thereof. Since the animal is a product of its' environment (Platt et al. 1964), we should utilize the animal to gain insight into its' environment.

Direct studies of the environment have received the majority of research effort in the past and will play a continuing important role, but application of the indicator species concept to better understanding the complex interrelationships has advantages in certain situations. For example, when sampling standing forage on a range to determine the quality of forage for grazing herbivores one is confronted with major variables such as feeding behavior, forage quality variability within site and plant, and digestive capabilities and interactions. These variables can be eliminated by sampling blood from the grazing herbivore to determine the end result of grazing and/or browzing.

The bighorn sheep is an ideal species through which this concept can be demonstrated because it is a climax species (Leopold 1966) and has specific requirements to fulfill its life cycle. Physiologic values from bighorn sheep were used in this paper to demonstrate this concept and were obtained from 219 bighorns sampled from October 1969 to February 1971.

I wish to thank Drs. K. E. Hungerford, M. E. Hornocker, and R. J. Knight from the University of Idaho for their assistance and guidance and Daryl Hebert, University of British Columbia; Dr. E. T. Thorne, Wyoming Game and Fish Department; and Dr. J. R. Gorham, Director,

Endoparasite Vector Pioneering Research Laboratory, Agriculture Research Service, Pullman, Washington for their assistance and cooperation in this study.

Agencies and organizations which cooperated in sampling bighorn sheep and from which many persons too numerous to mention were involved were: Banff National Park, British Columbia Fish and Game Branch, Canadian Wildlife Service, Idaho Fish and Game Department, Montana Fish and Game Department, Okanagan Game Farm, Utah Division of Fish and Game, Washington Department of Game, Washington State University School of Veterinary Medicine and Wyoming Game and Fish Commission.

Direct financial assistance for this cooperative study was from the Idaho Cooperative Wildlife Research Unit, the Idaho Fish and Game Department, a National Defense and Education Act Fellowship, a National Wildlife Federation Fellowship and the University of Idaho College of Forestry, Wildlife, and Range Science.

## METHODS

Blood samples taken from the juglar vein of 219 bighorn sheep were analyzed for 22 different values. The values utilized for this paper were: blood urea nitrogen (BUN), packed cell volume (PCV), albumin-globulin ratio (A/G), and Hemoglobin (Hb).

BUN values were obtained utilizing the urease type, Berthelot reaction (Biodynamics, Indianapolis, Ind.). The PCV percentage was obtained by centrifuging blood filled Pre-Cal Microhematocrit Tubes (Clay-Adams, N.Y., N.Y.) at 7400 R.P.M. for 5 minutes in a MP Readacrit Centrifuge (Clay-Adams, N.Y., N.Y.). A/G ratios were obtained from electrophoretic patterns produced from the blood serum at the Endoparasite Vector Pioneering Research Laboratory, Agriculture Research Service, Pullman, Washington. Hemoglobin values were obtained utilizing cyan-methemoglobin reaction (Biodynamics, Indianapolis, Ind.).

Poor quality diet (less than 5% protein) was received by 39 captive bighorns (Franzmann and Hebert 1971) and good quality diet (more than 15% protein) was received by 84 captive bighorns which were fed high quality alfalfa hay with a protein supplement. The protein content of the diet of the wild bighorn sheep sampled was unknown, but they all were sampled from winter populations where management measures were being practiced to prevent overuse of winter range.

## RESULTS AND DISCUSSION

The differences in the mean values for BUN, PCV, and A/G between poor and good diet groups were highly significant and for Hb were significant using Student's $t$ test for analysis (Table 1).

Table 1 - Physiologic value differences in bighorn sheep with diet.

| Values | [a]Poor Quality Diet (39 Captive Sheep) | [b]Good Quality Diet (84 Captive Sheep) | Unknown Diet (96 Wild Sheep) |
|---|---|---|---|
| Blood Urea Nitrogen mg/100 ml | 14.9** | 36.9** | 22.5 |
| Packed Cell Volume % | 43.4** | 49.2** | 45.9 |
| Albumin-Globulin Ratio | 1.37** | 0.95** | 1.07 |
| Hemoglobin gm/100 ml | 16.8* | 18.0* | 18.7 |

a. Less than 5% protein
b. More than 15% protein
* Significant $t_{.05}$
** Significant $t_{.01}$

The differences give us a basis from which we can potentially utilize these values to evaluate the range condition of a population of bighorn sheep.

The most significant difference between means was for BUN and this was the most useful of the 4 values in reflecting protein intake. Increase in BUN is related to protein intake (Coles 1967, Preston et al. 1965).

PCV is a reflection of the percentage of erythrocytes in blood and is a valuable technic in the clinical laboratory (Coles 1967). This value does not reflect protein intake per se, but it does reflect general condition. Where highly significant differences in PCV means occur between low and good quality diets, we must consider it a potentially useful tool in applying the indicator species concept.

A/G mean differences between the poor and good diets is a result of a higher proportion of albumin in the blood serum. This has many implications, but the possibility that it reflects an increase in a type of protein may have useful applications.

Hemoglobin, which is a measure of the oxygen carrying capacity of the blood, also reflects a character of quality to the blood. Its value in interpreting results is limited as the analysis of hemoglobin remains one of the most unsatisfactory measurements in clinical use (Coles 1967).

## CONCLUSION

In summary, we have examined four physiologic values which had statistically significant differences in means between a group of bighorn

sheep on low quality diet and a group on good quality diet. The point to emphasize is that this is an example of applying the indicator species concept to bighorn sheep. The quality of forage intake through the bighorn was evaluated and thereby conditions of the sheeps enviroment were considered.

To conclude that all these values are related to protein intake would be invalid, because we do not know at present what levels of these values are significant or what other variables may have a major influence on the results. We can conclude that BUN (which reflects protein intake and which had highly significant mean differences between low and good protein intake) can be used to apply the indicator species concept through the bighorn sheep to reflect its' protein utilization on a particular range.

The wild sheep physiologic values (Table 1) indicate that their forage conditions were at a level between the poor (less than 5% protein) and good (more than 15% protein) groups.

## LITERATURE CITED

Coles, E. H. 1967. Veterinary Clinical Pathology. W. B. Saunders Co., Philadelphia 455 pp.

Franzmann, A. W. 1970. Ecology and the veterinarian. J.A.V.M.A. 157 (11): 1926-1927.

Franzmann, A. W. and D. M. Hebert 1971. Rectal temperature variation in bighorn sheep. J. Wildl. Mgmt. (in press).

Leopold, A. S. 1966. Adaptability of animals to habitat change. Pp 66-75. IN F. F. Darling and J. P. Milton (Editors), Future Environments of North America. Natural History Press, Garden City, N.Y. 767 pp.

Platt, R. B., W. D. Billings, D. M. Gates, C. E. Olmsted, R. E. Shanks, and J. R. Tester 1964. The importance of environment to life. Bioscience 14 (7):25-29.

Preston, R. L., D. D. Schnackenberg, and W. H. Pfander 1965. Protein utilization in ruminants. I. Blood urea nitrogen as affected by protein intake. J. Nutr. 86(2):281-288.

## DISCUSSION

QUESTION BY STEVE HAWKS, BLM, IDAHO: How adaptable, economically and physically, are these techniques in the field?

REPLY BY FRANZMANN: That was one of the criteria used to select the values I used. The data you saw was collected with a field testing kit

with the work done right on the site. The values which require difficult laboratory procedure were not utilized because they have no value in application.

QUESTION BY JIM BAILEY, CSU: I agree wholeheartedly that we need to look at the animal more than we have to evaluate its relationship to its environment. Your evaluation of these parameters is based on three sets of animals. How else might you have evaluated whether or not you indeed have a parameter which is correlated with nutrition or physical condition? For instance, did you try to correlate parameters in your sample of wild sheep?

REPLY BY FRANZMANN: Yes. At least an analysis of variance was done for all 18 different sources of variation. On the basis of this, the first group was eliminated because it was not significant. Then we maintained significance at that level.

REPLY BY BAILEY: Correlated with what?

REPLY BY FRANZMANN: Correlated with the physiological body. The sources for variation for that - condition, sex, age, subspecies.

REPLY BY BAILEY: How did you evaluate the physical condition of the animal against these parameters? Just the three sets of animals?

REPLY BY FRANZMANN: Robinson's ten-point system of classification.

REPLY BY BAILEY: Your blood urea nitrogen values, it seems to me, could be related to more than just protein content of the diet such as I think soluble carbohydrates in the diet, might affect it and protein catabolism during weight loss might increase this. So, there are a lot of other variables besides protein in the diet that would affect that.

REPLY BY FRANZMANN: We have two curves actually that affect blood urea nitrogen. One would be based on the intake alone and then one on the animal's putting blood urea nitrogen back into the blood through the degrading process. Those things can influence it but when you have differences of 14 to 33 mg percent protein intake, you certainly have a usable value. If you are going to hold it down to a milligram or two percent you never would find anything you can use.

REPLY BY BAILEY: I don't know whether these things can be affected to this magnitude by these other factors.

REPLY BY FRANZMANN: That is why I say it is really not that important.

REPLY BY BAILEY: We have one set of data out of Colorado collected by Bob Keiss that shows high blood urea nitrogen values of animals that were dying of starvation - in some cases with available supplemented feed.

REPLY BY FRANZMANN: There is a point where the animal's tissue completely breaks down.