MOOSE CONFERENCE WORKSHOP, MAY 20, 1993

THEME: METHODS OF POPULATION ESTIMATION AND MONITORING

Chair: H.R. Timmermann

The workshop consisted of 6 sessions as follows:

SESSION A - AERIAL SURVEYS

- see paper "Use of aerial survey for estimating and monitoring moose populations - a review" by H.R. Timmermann (this volume).

SESSION B - PHYSIOLOGICAL INDICES

- see paper - "Use of physical and physiological indices for monitoring moose population status - a review" by A. W. Franzmann and W. Ballard (this volume).

SESSION C - MODELLING

- see paper "Constructing simple population models for moose management" by C.C. Schwartz (this volume).

SESSION D - VEHICLE COLLISIONS

- see paper "Using road kills as an index to moose population change". by A. Hicks (this volume).

SESSION E - HUNTER EFFORT AND OBSERVATIONS

- see paper - "Hunter effort and observations - the potential for monitoring trends of moose populations - a review" by V. Crichton (this volume).

SESSION F - INFRARED THERMAL IMAGERY

Presentation by Kent A. Gustafson, New Hampshire Fish and Game Department, 2 Hazen Drive, Concord, NH 03301.

The following material is intended to serve as a brief overview of the use of infrared thermal imagery in censusing ungulates. The hope is to stimulate interest in the method while providing some insight into its benefits and limitations. Like most techniques in wildlife research and management, infrared thermal imagery will not be applicable or desirable in all situations but may provide a valuable tool when more widely used techniques such as visual aerial surveys are not practical.

Infrared imagery involves the detection of "hot spots" against a cooler environmental background followed by the recognition of these "hot spots" as the desired target (ie. moose, elk etc.). This problem has obvious similarities to visual aerial surveys. In order to be detected, a target animal must emit enough energy (heat) in the appropriate wavelengths to be distinguished from the background. As with visual surveys this implies that the target cannot be hidden or obscured by overstory vegetation or other obstructions (Gasaway *et al.* 1986, Croon *et al.* 1968).

In order to be recognized, the target must have characteristics which distinguish it from other "hot spots" which might be detected. In visual surveys, this is simply dependent on the observer's ability to recognize the target when they see one. In the infrared realm it depends on the size, shape and radiant surface temperature of the target. These three factors combine to form what is commonly referred to as the thermal signature of the target. While the size and shape of the target may be relatively constant, the radiant surface temperature depends on a number of variables. Briefly, these include such factors as target emissivity (how well the target radiates heat). For example, healthy moose in winter pelage will radiate less heat than a hairless moose suffering from winter tick infestation (Graves *et al.* 1972). In addition, wind will lower the radiant surface temperature while direct sunlight will increase it. These factors should all be considered when developing the target's thermal signature at the time of the survey (Croon *et al.* 1968, Graves *et al.* 1972).

The technology necessary to apply infrared thermal imagery to ungulate censusing first became available in the 1960's. The early technology had limited sensitivity and resolution which made detection of targets a significant concern (Graves *et al.* 1972). In addition, the early studies relied on "skilled interpreters" to visually inspect the infrared images to recognize the desired targets (Croon *et al.* 1968). Other problems included cost and a general lack of theory and practical knowledge of aerial surveys in general. Gasaway *et al.* (1986) has addressed the latter problem while information theory has been applied to the problem of target detection and recognition (Wyatt *et al.* 1980). In addition, widespread use of computers has allowed the application of digital processing and enhancement of infrared images to aid in detection and recognition of targets. These techniques employ such methods as Baye's theorem and maximum likelihood estimators to detect and recognize targets against the background noise within certain probabilities of error.

A new generation of technology is currently available which greatly improves the sensitivity and resolution of infrared imagery and may solve many of the early problems with the technique. Currently an infrared survey flight results in a video tape containing the images recorded during the flight. These images can be digitally analyzed and/or viewed by "skilled interpreters" to detect and recognize targets.

There has also recently been considerable progress made in the area of unmanned aerial vehicles (UAV's). These UAV's have the ability to carry the infrared scanning equipment while using the Global Positioning System (GPS) to accurately navigate any desired flight path and accurately geo-reference targets on the tape. In areas such as New Hampshire in which traditional visual survey flights have proven difficult due to rugged terrain and poor weather among other things, infrared surveys using UAV's may prove an effective survey tool.

The New Hampshire Fish and Game Department is beginning work with the University of New Hampshire to investigate the use of infrared surveys for moose. The potential advantages of the current infrared technology and UAV's include: 1) detection and recognition of targets may equal or exceed the capability of tradition aerial surveys, 2) because the UAV can be flown day or night, the time of year and time of day for the survey can be selected for periods of highest animal activity and species detectability, 3) infrared surveys may prove valuable for collecting information on a variety of species and perhaps other useful information (such as habitat) simultaneously, and 4) UAV's minimize the risk to agency personnel and will hopefully be more efficient than manned aerial survey flights.

Whether infrared imaging will turn out to be an effective and efficient method for surveying ungulate populations remains to be seen. In all probability, future studies will reveal its effectiveness in certain situations. The technology for conducting infrared surveys and the practical knowledge of aerial survey data collection and analysis are improving rapidly, keep an eye on the literature to keep abreast of current and future developments. Appendix I lists additional references which may be of interest to those looking for more information.

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APPENDIX I

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