# INTRODUCTION

# TO PART V

## METEOROLOGY AND THERMAL RELATIONSHIPS OF WILD RUMINANTS

The earth and its atmosphere is a physical entity in the near-vacuum of space. Meteorologists study the behavior of this earth-atmosphere system, and some ecologists study the energy balance of organisms within the biosphere, the part of this earth-athmosphere system where life occurs.

Considerable attention has been given to the effects of weather on wildlife, and a large number of field observations of animal behavior and activity patterns have been related to measurements of weather conditions. Although conclusions may be made from such analyses, there are some basic problems in relating animal behavior directly to weather data. Animals experience weather, which is another term for atmospheric physics, in ways that are different from that experienced by weather instruments. For example, the temperature-sensing capabilities of wild ruminants are different from those of thermometers. Also, animals experience the effects of wind and respond to it in ways that are different from cup anemometers or other wind measuring devices. Thus it is dangerous to draw conclusions about animal responses to weather directly from weather data, and the use of simple correlations between the two is discouraged.

Animals experience both thermal and mechanical effects of weather forces. The sensation of cold is a thermal effect of wind, and the distribution of scent a mechanical effect. Thermal and mechanical forces act on both plants and animals, and each organism has ranges of sensitivities and responses to these forces. Analyses of these responses are best completed by analyzing the basic physical and biological factors involved.

The first chapter in this part, CHAPTER 14, includes discussions of meteorological characteristics. The second, CHAPTER 15, includes discussions and data that describe thermal characteristics and basic heat transfer between organism and environment. CHAPTER 16 includes descriptions of two ways of evaluating basic heat transfer between animal and environment, and thermoregulatory responses. CHAPTER 17 includes discussions of weather, range, and animal profiles that are useful when evaluating energy balances over time. Such considerations lead to evaluations of population responses in PART VI.

The list of PERIODICALS on the next two pages will help introduce the reader to the publications available in meteorology. Complete lists of published papers on different aspects of meteorology are not given in each CHAPTER since the number of such references is very large. Papers describing the responses of wild ruminants to meteorologcal characteristics and thermal exchange are listed, however.

## PERIODICALS PERTAINING TO METEROLOGY

### UNITED STATES

Bulletin of the American Meteorological Society. Monthly. AMS, 45 Beacon St., Boston, MA 02108.

Geophysical Monograph Series. Irregular. American Geophysical Union. 1145 19th St., N.W., Wash., D.C. 20036.

Journal of Applied Meteorology. Bimonthly. AMS, 45 Beacon St., Boston, MA 02108.

Journal of the Atmospheric Sciences. Bimonthly. AMS, 45 Beacon St., Boston, MA 02108.

Journal of Geophysical Research. Semimonthly. Amer. Geophys. Union, 1145 19th St., N.W., Wash., D.C. 20036.

Mariners Weather Log. A bimonthly climatic review of ocean and lake areas. Weather Bureau, ESSA. Wash., D.C. 20402.

Meteorological and Geoastrophysical Abstracts. Monthly. AMS, 45 Beacon St., Boston, MA 02108.

Meteorological Monographs. Irregular. AMS.

Monthly Weather Review. Monthly. Weather Bureau, ESSA. Supt. of Documents, Government Printing Office, Wash., D.C. 20402.

Mount Washington Observatory Bulletin. Quarterly. Amer. Geophys. Union, Wash., D.C.

Reviews in Geophysics. Quarterly. Amer. Geophys. Union, Wash., D.C.

Transactions of the American Geophysical Union. Quarterly. Amer. Geophys. Union, Wash., D.C.

Weatherwise. Bimonthly. AMS, 45 Beacon St., Boston, MA 02108.

### CANADA

Atmosphere. Bulletin of Canadian Meteorology. Quarterly. Canadian Branch, RMS, Dept. of Meteorology, McGill Univ., Montreal., P.Q. Commenced March 1963.

CANADA continued on the next page

Canadian Geophysical Bulletin. Annual. National Research Council of Canada. Ottawa, Ont.

Canadian Weather Review. Monthly. Canadian Meteorological Service. Queen's Printer, Ottawa, Ont. 8 pages climatological data.

GREAT BRITAIN

The Marine Observer. Quarterly. British Met. Office. British Information Services, 845 Third Ave., New York, NY.

Meteorological Magazine. Monthly. British Met. Office. British Information Services, N. Y.

Quarterly Journal of the Royal Meteorological Society. RMS, 49 Cromwell Road, London SW 7, England.

Weather. Monthly. RMS, 49 Cromwell Road, London SW 7, England.

OTHERS (mainly English text)

Australian Meteorological Magazine. Quarterly. Canberra.

Bulletin of the World Meteorological Organization. Quarterly. WMO, Geneva, Switzerland.

Geophysical Magazine. Irregular. Central Met. Observatory. Tokyo, Japan.

Indian Journal of Meteorology and Geophysics. Quarterly. Indian Met. Dept. Manager of Publications, Delhi, India.

Journal of Hydrology. Quarterly. North-Holland Publishing Co., Box 103, Amsterdam, Netherlands. Commenced March 1963.

## GLOSSARY OF ANIMAL CODE NAMES

Wild ruminants are referred to in this CHAPTER by a 4-character abbreviation from the family, genus and genus-species. These are listed below under Abbreviation.

Scientific names of North American wild ruminants are those used in BIG GAME OF NORTH AMERICA, edited by J.C. Schmidt and D. L. Gilbert (1979: Stackpole Books, Harrisburg, PA 17105, 494 p.), and may be different from the scientific names given in the original literature.

The abbreviations used for North American wild ruminants are listed below.

CLASS: MAMMALIA

| ORDER: ARTIODACTYLA | Abbreviation |
|---|---|
| FAMILY: CERVIDAE | cerv |
| GENUS: Odocoileus (deer) | od-- |
| SPECIES: O. virginianus (white-tailed deer) | odvi |
| O. hemionus (mule deer) | odhe |
| GENUS: Cervus (Wapiti, elk) | ce-- |
| SPECIES: C. elaphus | ceel |
| GENUS: Alces (moose) | |
| SPECIES: A. alces | alal |
| GENUS: Rangifer (caribou) | |
| SPECIES: R. tarandus | rata |
| FAMILY: ANTILOCAPRIDAE | |
| GENUS: Antilocapra | |
| SPECIES: A. americana (pronghorn) | anam |
| FAMILY: BOVIDAE | bovi |
| GENUS: Bison (bison) | bi-- |
| SPECIES: B. bison | bibi |
| GENUS: Ovis (sheep) | ov-- |
| SPECIES: O. canadensis (bighorn sheep) | ovca |
| O. dalli (Dall's sheep) | ovda |
| GENUS: Ovibos | |
| SPECIES: O. moschatus (muskox) | obmo |
| GENUS: Oreamnos | |
| SPECIES: O. americanus (mountain goat) | oram |

The abbreviations used for European wild ruminants are listed below.

| CLASS: MAMMALIA | |
|---|---|
| ORDER: ARTIODACTYLA | Abbreviation |
| FAMILY: CERVIDAE | cerv |
| GENUS: *Capreolus* (roe deer) | ca-- |
| SPECIES: *C. capreolus* | caca |
| GENUS: *Dama* (fallow deer) | da-- |
| SPECIES: *D. dama* | dada |
| GENUS: *Cervus* (Wapiti, elk) | ce-- |
| SPECIES: *C. elaphus* (red deer) | ceel |
| GENUS: *Alces* (moose) | |
| SPECIES: *A. alces* | alal |
| GENUS: *Rangifer* (caribou) | |
| SPECIES: *R. tarandus* | rata |
| FAMILY: BOVIDAE | |
| GENUS: *Bison* (bison) | |
| SPECIES: *B. bonasus* | bibo |
| GENUS: *Capra* (ibex, wild goat) | cp-- |
| SPECIES: *C. aegagrus* (Persian ibex) | cpae |
| *C. siberica* (Siberian ibex) | cpsi |

OTHERS

Abbreviations for a few other species and groups of species may appear in the reference lists. These are listed below.

| | |
|---|---|
| *Axis axis* (axis deer) | axax |
| *Elaphurus davidianus* (Pere David's deer) | elda |
| *Cervus nippon* (Sika deer) | ceni |
| *Hydropotes inermis* (Chinese water deer) | hyin |
| *Muntiacus muntjac* (Indian muntjac) | mumu |
| *Moschus moschiferus* (musk deer) | momo |
| *Ovis nivicola* (snow sheep) | ovni |
| *Ovis musimon* (moufflon) | ovmu |
| *Ovis linnaeus* (Iranian sheep) | ovli |
| *Rupicapra rupicapra* (chamois) | ruru |
| big game | biga |
| domestic sheep | dosh |
| domestic cattle | doca |
| domestic goat | dogo |
| domestic ruminant | doru |
| herbivore | hrbv |
| mammals | mamm |
| three or more species of wild ruminants | many |
| ruminants | rumi |
| ungulates | ungu |
| vertebrates | vert |
| wildlife | wldl |
| wild ruminant | wiru |

## ORGANIZATION OF REFERENCE LISTS

Extensive reference lists, based on computer-assisted searches back to 1970 and manual searches of literature published prior to 1970, are included in each of the PARTS. The lists are organized in a functional way for use in the library rather than in the conventional alpabetized-by-author way, with the information necessary for locating the references in libraries given in abbreviated, one-line form. The reference books listed after each PART, CHAPTER, and TOPIC contain background information for the material covered, and may contain specific information for several of the UNITS and WORKSHEETS.

The headings for the lists of BOOKS are:

TYPE PUBL CITY PGES ANIM KEY WORDS---------- AUTHORS/EDITORS-- YEAR

The TYPE of book could have either an author (aubo) or an editor (edbo). Publishers (PUBL) and CITY of publication are given with four-letter mnemonic symbols defined in the GLOSSARY. The PAGE column gives the number of pages in the book; ANIM refers to the species discussed in the book (given as a four-letter abbreviation of genus and species), and KEY WORDS lists key words from the title. The AUTHORS/EDITORS' names and YEAR of publication are given in the last two columns. Thus all of the essential information for finding each book in the library is given on just one line.

Serial publications that pertain to each division are listed with a slightly different format. (Serials are identified by a five-character, generally mnemonic code called CODEN, published in 1977 BIOSIS, LIST OF SERIALS (BioSciences Information Service, 2100 Arch Street, Philadelphia, PA 19103).

The headings for the lists of SERIALS are:

CODEN VO-NU BEPA ENPA ANIM KEY WORDS---------- AUTHORS---------- YEAR

The volume and issue numbers (VO-NU) are given after the CODEN entry, followed by beginning page (BEPA), ending page (ENPA), species discussed (ANIM), key words from the title (KEY WORDS), AUTHORS, and YEAR.

Specific authors and dates of publication can be located quickly by scanning the two right-hand columns. If the author's name fits in the 17 characters, some character spaces are left blank. If there are two authors and all of the first author's name and part of the second author's name fits in the 17 character spaces, the second author's name is truncated at the right margin of the author column. If there are more authors that do not appear in the author column due to lack of space, a slash (/) is added inthe 17th space of the column.

References cited in the text material and in the WORKSHEETS are given under LITERATURE CITED in the traditional format (author, date, title of article, journal, volume, issue number, and page numbers).

A third category, OTHER PUBLICATIONS, may be included at the beginning of PARTS or in the CHAPTERS. This category contains references to publications that are not authored or edited books or serials listed by BioSciences Information Service. Examples are "Transactions of the Northeastern Deer Study Group Meetings" and "Biannual Pronghorn Antelope Workshop, Proceedings." Both of these contain many articles on deer and pronghorns, respectively, but are not included in the one-line abbreviated form. Such publications are listed by titles, which should make it possible to locate the publications in libraries.

## HOW TO USE THIS SYSTEM

The one-line format used to list references makes it possible to list several thousand references in a minimum amount of space. The logic of the one-line entries in the reference lists is based on the order of decision-making when finding literature. First, the references are grouped according to biological functions and relationships discussed in this book. Second, species of interest are selected. Third, journals containing references to be read are located in the library. Fourth, the publications are located in the journals. The use of this reference list format in the library will confirm the logic of this arrangement. Call numbers and stack levels should be added in the margins so references may be quickly located in a particular library.

CODEN entries are identified by the full title of the serial publication and its country, territory, or commonwealth of origin in the APPENDIX. CODEN entries in the serial lists are alphabetized. This results in some of the full titles being out of alphabetical order. Since the user of this book will usually work from CODEN to consult the list of full titles in the APPENDIX, this disorder will result in nothing more than occasional inconvenience. Most of the full titles will be near alphabetized, so the CODEN for a specific serial can be quickly found by scanning the appropriate part of the list.

Serials, including journals and report literature, constitute the major portion of the literature on wild ruminants. Scientists are urged to publish their findings in recognized journals so the results of their work are readily available.