

Position No. NC-3986  
Research Wildlife Biologist, GM-486-14

Position description and accomplishments 1976-1993 of USFS Research Scientist Lynn Rogers for use by the U.S. Forest Service Research Evaluation Panel, 1993.

#### FACTOR I--RESEARCH ASSIGNMENT

- A. Research Organization: The incumbent is a Research Wildlife Biologist in Research Work Unit FS-NC-4202, "Integrated Approaches to Wildlife and Fish Management," North Central Forest Experiment Station, St. Paul, Minnesota. The unit's mission is to develop, improve, and evaluate integrated resource management alternatives affecting wildlife and fish habitat in the North Central States. The three problem areas assigned to the RWU are: (1) there is a need to develop accurate information that can be used to reliably predict wildlife responses to integrated resource management practices at the ecosystem, landscape, community, population, and species level and to understand the ecological mechanisms involved, (2) there is a need to understand habitat use by endangered, threatened, and sensitive species sufficiently well to identify threshold levels of habitat factors critical to the continued support of viable populations of those species, and (3) there is a need to develop accurate information that can be used to reliably predict the response of fisheries to the effects of integrated resource management practices on riparian and aquatic habitats and to understand the mechanisms involved.
- B. Personal Research Assignment: The incumbent plans and conducts research within Problem 1. The research objective is to determine ecological mechanisms that influence wildlife responses to integrated resource management practices at the ecosystem, landscape, community, population, and species level. Specific approaches are to (1) develop, test, and refine a black bear Habitat Suitability Index model, (2) determine interrelationships between habitat and regional populations of selected species or groups of species and determine their patterns of abundance and habitat selection in local landscapes, and (3) develop and test management strategies to integrate wildlife habitat objectives into resource management procedures. Each of these assignments involves a series of studies to determine habitat selection factors, foraging strategies, growth and productivity of individuals, physiological condition, and the relation of these factors to habitat quality. Some of these studies are extremely broad and complex and require a series of sub-studies to complete. Modeling foraging strategies, for example, requires identifying and describing relevant functions, obtaining field data for coefficients, and validating models with field observations. The incumbent conducts most studies independently, but serves as leader for interdisciplinary studies with investigators at universities, medical research centers, the Smithsonian Institute, and U.S. Fish and Wildlife Service (Endangered Species Office, Patuxent, and National Ecology Research Center, Ft. Collins). Some of the research problems are recognized as exceptionally difficult and unyielding to research analysis. For example, information needed to reliably determine responses of wide-ranging species to man-caused changes in northern forest landscapes is essentially lacking despite considerable study, and past studies of black bears, although extensive, have provided surprisingly little information useful to habitat managers. However, new research methods developed by the incumbent are providing a new level of resolution regarding habitat requirements of bears, and prototype GIS models developed by the incumbent are providing new avenues for integrating wildlife habitat data into forest management plans. Current research is providing (1) predictive, descriptive, and mathematical models of the behavior, habitat use, and energetics of study species, (2) integration of Ecological Land Classification System (ECS) data with wildlife habitat use data

using Geographic Information Systems (GIS) technology, (3) habitat management prescriptions, and (4) tests to determine the effects of those prescriptions on populations. The significance of progress in these studies is that (1) they provide managers with information directly useful in forest management and (2) the methods developed in these studies to handle complex data sets for large geographic areas can be used to integrate habitat information for other species into forest management decision processes. Some of the species studied are of special significance in that they are prey of the threatened timber wolf. Habitat models for those species will enable land managers to better ensure viable wolf populations in the Great Lakes Region and will be useful in assessing programs to restore the wolf to parts of its former range. Technology transfer efforts for managers include developing models, conducting seminars for particular management groups, and publishing scientific papers. Technology transfer for researchers include conducting seminars, participating in workshops, developing computer analysis software, and publishing scientific papers. Technology transfer to the public includes teaching teachers and students in 3-5 weekend seminars each year, publishing informative posters for classroom use, publishing How To's for recreationists, writing semipopular articles on black bear behavior and ecology, and working with the media to give the public a more realistic image of the black bear.

C. Team Leadership: None

D. Team Membership: None

E. Related Function: The incumbent represents the Station in an interagency group called North Central Caribou Corporation (NCCC) which the incumbent advises concerning the feasibility of reintroducing caribou to Minnesota. The incumbent oversees and participates in a cooperative study with the NCCC and University of Minnesota's Natural Resources Research Institute to evaluate northeastern Minnesota as caribou habitat using Landsat imagery, ERDAS GIS technology, and Shannon Diversity Indices. The method being developed should also be useful for evaluating habitat for other wide-ranging animals.

The incumbent represents the Station as a member of the IUCN Species Survival Commission Bear Specialist Group.

The incumbent represents the Station as an advisor to the International Wolf Center.

The incumbent advises industrial, state, and federal land managers, and others on wildlife habitat problems. He is often contacted for advice in his area of specialization by other scientists and is frequently asked to review manuscripts. These related functions require about 15 percent of the incumbent's time.

F. Supervisory and Administrative Responsibilities: The incumbent is a supervisor. The incumbent sets performance standards, evaluates performance, discusses problems and progress with employees, resolves minor grievances, identifies training needs, insures that training opportunities are provided, and approves leave. Incumbent plans work, establishes work schedules and priorities, and assigns and reviews work. Recommends employee status changes, such as promotions, and advises employees of matters related to less than adequate performance. Keeps employees informed of management policies and goals.

The incumbent actively supports the civil rights program in the unit and the Station and communicates this support to subordinates. Cooperates in developing and carrying out affirmative action efforts in the unit and those actions described in the Service-wide

Affirmative Action Plan that have a bearing on the unit. Demonstrates and conveys to subordinates an understanding of and sensitivity to issues relating to civil rights within the unit.

Incumbent is the on-site administrator of Kawishiwi Field Laboratory, a group of 10 buildings located 11 miles southeast of Ely, Minnesota, in Superior National Forest.

#### FACTOR II--SUPERVISION RECEIVED

The incumbent works under the general supervision of the Project Leader but is located separately at the Kawishiwi Field Laboratory near Ely, MN. He participates with the Project Leader in the analysis of one or more of the problems assigned to the Unit for solution. Within the framework of approved Problem Analyses, the incumbent selects high priority studies and develops plans and methodology to bring the studies to completion. The incumbent is recognized as an international authority on black bears and, as such, works with only nominal and consultative supervision. Supervision is characterized by (1) a degree of confidence in and reliance on the researcher's productivity, competence, and judgment that there is an unusual level of support of his recommendations and his most novel and as yet seemingly fruitless investigations; (2) responsibility such that interpretations, recommendation and conclusions having major impact on matters of great urgency and significance are furnished other agencies and the professional community without reference to or knowledge of higher authority in the agency, and (3) the supervisory relationship fully reflects recognition of the incumbent as a top technical authority in his field in the agency and as a distinguished and brilliant scientist. Within the framework of management objectives, priorities, and pressures for results, the researcher locates and explores the most fruitful areas of research in relation to the agency's program and needs and the state of science involved, takes responsibility for formulating research plans and hypotheses and carrying them through to completion, and takes full technical responsibility for interpreting findings, including interpreting their applicability to activities and interests of the agency, and their broader applicability to basic scientific methodology. Station policy requires that study plans and manuscripts be technically and administratively reviewed and approved by the Supervisor. However, the incumbent's technical judgment and conclusions are considered authoritative. They are, of course, subject to further test and ultimate validation or modification by the scientific community.

The incumbent maintains personal contact with other researchers in his area of specialization and conducts information exchanges with them directly on a one-to-one basis. He is the Unit's expert on ungulate and carnivore ecology and as such is called on to speak and act for the Unit in this capacity. He is internationally recognized as an expert on black bear research, habitat, and behavior and occasionally is asked to advise, or speak for, various federal or state agencies or universities.

#### FACTOR III--GUIDELINES AND ORIGINALITY

The incumbent works under the general policies and administrative regulations of the Forest Service, but with no written guides or controls as to the technical aspects of his research. The position requires an incumbent with a knowledge of the literature, principles, and methods of mammalian research, especially the study of large carnivores and ungulates. The research entails integration of knowledge concerning animals, forests, and land management. The incumbent must understand the basic processes of energy and nutrient flow through food chains and must be able to relate these processes to the management of environments of free-ranging organisms. The literature on black bears, moose, deer, caribou, and some of the other study species is extensive

but was developed using methods which are inadequate to elucidate ecological relationships in sufficient detail to enable reliable recommendations for habitat management. Geographic Information Systems, Landsat imagery, Ecological Land Classification Systems, Global Positioning Systems, Field Data Recorders (and new software), knock-down radio-collars, and radio-collars that store activity data until it is recalled remotely with radio signals are all relatively new and are proving useful in the incumbent's studies and in interdisciplinary studies led by the incumbent. The integrated use of these tools is even newer and is essentially without guidelines.

Many areas of the research require a high degree of originality and creativity to define problems which are very elusive and/or highly complex, to develop productive hypotheses for testing, to develop new research methods, and to relate the significance of results to other research findings. The work is characterized by the application of such unusual productivity, creativity, and depth of insight into the fundamental nature of phenomena and their relationships as to produce a substantial variety of new methods and techniques, of new approaches to formerly intractable problems, of identification of new problems to be attacked, and of important new concepts and discoveries that extend existing theory and methodology. The incumbent opens up new areas for exploration, and the findings have widespread applicability to other fields of science and technology such that there is likely to be a major stimulus to scientific and technological effort and achievement in the field of endeavor. The incumbent pioneered many of the techniques now commonly used in bear research, and he wrote the two most widely cited references in bear literature. His pioneering work with completely free-ranging animals (deer and bears) has set a new standard in North American large mammal research.

Previous studies and methods have provided insufficient information for landscape ecology planning with respect to wildlife. Although some information is available on habitat use for most species, little information is available on habitat requirements and population responses to various silvicultural practices. Problems are compounded by the need to consider multiple species. New research approaches are needed to identify critical elements of habitats, test new hypotheses, and to relate the new results to previous findings. The new approaches developed by the incumbent are stimulating new scientific and technological effort and new habitat models useful to management.

## FACTOR IV--QUALIFICATIONS AND SCIENTIFIC CONTRIBUTIONS

### A. Personal Data

1. Name: Lynn L. Rogers
2. Educational Background:
  - a. College degrees
    1. A.S., Grand Rapids (Mich.) Junior College, 1959, Biology
    2. B.S. (high honor), Michigan State University, 1968, Wildlife Management
    3. M.S., University of Minnesota, 1970, Ecology and Behavioral Biology (Statistics Minor)
    4. Ph.D., University of Minnesota, 1977, Wildlife Ecology

b. Additional academic study

1. Creative problem solving, 8 hours, Tom Kuby and Associates, 1978
2. Technical writing, 8 hours, Shipley Associates, 1981

3. Date of Last Promotion: July 17, 1988

4. Professional Experience:

- a. September 1968-December 1972, Research Assistant, Bell Museum of Natural History, University of Minnesota, Minneapolis
- b. January 1973-August 1976, Director, Wildlife Research Institute, Minneapolis, Minnesota
- c. August 1976-July 1979, Research Wildlife Biologist, GS-11, North Central Forest Experiment Station, St. Paul, MN
- d. July 1979-March 1982, Research Wildlife Biologist, GS-12, North Central Forest Experiment Station, St. Paul, MN
- e. March 1982-July 1988, Research Wildlife Biologist, GS-13, North Central Forest Experiment Station, St. Paul, MN
- f. July 1988-present, Research Wildlife Biologist, GS-14, North Central Forest Experiment Station, St. Paul, MN

B. Professional Activities and Recognition

1. Honors and Awards:

- a. Anna M. Jackson Award, 1974. American Society of Mammalogists. For oral paper entitled "The social system of female black bears."
- b. Quality Research Award, 1988. North Central Forest Experiment Station. For Wildlife Monograph No. 97 (Publication no. 54).
- c. USDA Certificate of Appreciation from F. Dale Robertson, 990, for help in producing The Nature Conservancy/Forest Service brochure "Conserving our heritage: America's biodiversity."

2. Presentations:

a. Invited papers before scientific societies:

1. Lake Superior Biological Conference, Michigan Institute of Technology, Houghton, Michigan. October 1971. "Habits of black bears in northern Minnesota."
2. Minnesota Zoological Society, St. Paul, Minnesota, January 30, 1974, "Black bear behavior and relations with man in Minnesota."
3. Sigurd Olson Institute, Johnson Lecture Series, Northland College, Ashland, Wisconsin, October 4, 1974, "Black bears of the Lake Superior Region" (publ. no. 7).
4. Minnesota Academy of Science, St. Cloud State College, St. Cloud, Minnesota, October 1975, "The status and behavior of the black bear in Minnesota."

5. American Association of Zoological Parks and Aquaria, Annual meeting, Omaha, Nebraska, May 1975, "Habits of black bears and suggestions for research on captive animals."
6. Wildlife Management Institute, Symposium: "The use of population characteristics to improve management of wildlife populations," Washington, D.C., March 1976, "Effects of mast and berry crop failures on the survival, growth, and reproductive success of black bears in northeastern Minnesota" (publ. no. 13).
7. International Bear Association, 4th International Conference, Kalispell, Montana, February 20-24, 1977, "Conference summary" (Publ. no. 15).
8. Minnesota Medical Association, Annual meeting, Duluth, Minnesota, May 11, 1978, "Medical aspects of black bear studies in northern Minnesota."
9. American Association for Laboratory Animal Science, Annual meeting, Minneapolis, Minnesota, October 27, 1978, "Habits and habitats of black bears in northeastern Minnesota."
10. Colorado State University, Symposium: "The structure and evolution of carnivore social systems," Ft. Collins, Colorado, June 10, 1980, "Social behavior among kin and non-kin in a solitary omnivore: the black bear."
11. American Society of Zoologists, Symposium: "Patterns of dispersal among mammals and their effects on the genetic structure of population," Denver, Colorado, December 29-30, 1984, "Factors influencing dispersal in black bears" (publ. nos. 61, 62).
12. State University of New York, Syracuse, New York, February 21, 1985, "Black bear habits and habitat."
13. National Geographic Society, Washington, D.C., February 22, 1985, "An overview of black bear research in Minnesota."
14. National Wildlife Rehabilitators Association, Annual conference, Featured speaker, St. Paul, Minnesota, March 22, 1985, "Aiding the wild survival of orphaned black bear cubs" (publ. nos. 45, 47).
15. University of Illinois, College of Medicine, Champaign, Illinois, June 7, 1985, "The black bear as a model in studies of human medicine."
16. State University of New York, Syracuse, Symposium: "Wildlife and man in the Adirondacks: past, present, and future," Lake George, New York, September 5, 1985, "Effects of an expanding human population on black bears."
17. Minnesota Society of American Foresters, St. Paul, Minnesota, November 12, 1986, "Black bears: their habitat, problems, and relations with man."
18. Science Museum of Minnesota, St. Paul, Minnesota, February 10, 1987. "Bears and people."

19. Society of American Foresters, The Wildlife Society, American Fisheries Society, Society for Range Management, Soil Conservation Society of America, Science Day lecture. Washington, D.C. May 20, 1987. "Black bears, habitat, and people"
20. Society of American Foresters, Annual Meeting, Minneapolis, Minnesota, October 20, 1987, "Black bear and forest management in the Lake States."
21. Science Museum of Minnesota, St. Paul, Minnesota, February 16, 1990, "The black bear in imagination and reality."
22. Science Museum of Minnesota, St. Paul, Minnesota, October 9, 1990, "Coexisting with Minnesota's black bears."
23. Mayo Clinic, Rochester, Minnesota, January 15, 1991, "Black bear ecology and physiology: implications for human medicine."
24. Harvard University, Cambridge, Massachusetts, March 9, 1991, "Views of a changing planet: the black bear in a changing environment." (publ. no. 86).
25. Harvard University, Cambridge, Massachusetts, March 7, 1992, "Black bears in the modern American landscape: Is coexistence possible?"
26. 11th Eastern Black Bear Workshop, Waterville Valley, New Hampshire, April 1-3, 1992. "Bear-human conflicts in modern America."

b. Offered papers before professional societies.

1. American Institute of Biological Sciences, Annual meeting, St. Paul, Minnesota, 1972, "Movement patterns and social organization of black bears in northeastern Minnesota" (publ. no. 3).
2. American Society of Mammalogists, State University of New York, Binghamton, New York, June 1974, "Social organization of female black bears in northern Minnesota." (Anna M. Jackson award paper).
3. American Society of Mammalogists, University of Montana, Missoula, Montana, June 1975, "The use of dental annuli as an index to reproductive success" (publ. no. 8).

c. Presentations at technical conferences, workshops, etc.: (\* = invited, all other offered)

- \*1. Minnesota Department of Natural Resources Annual Game Workshop, Itasca State Park, Minnesota, May 27, 1971, "Ecology of the black bear in northern Minnesota."
- \*2. Eleventh Annual Northwoods Nights Lecture Series, Ely, Minnesota, July 28, 1971, "Black bears of the Superior National Forest."
- \*3. University of Minnesota, Department of Zoology, Noon seminar series, Minneapolis, Minnesota, January 19, 1973, "Social behavior and movements of black bears in northern Minnesota."

- \*4. National Rifle Association, Annual meeting, Washington, D.C., March 31, 1973, "Techniques for studying black bears."
- \*5. University of Wisconsin, Superior, Wisconsin, May, 1973, "The use of telemetry in the study of elusive forest carnivores."
- 6. Third International Bear Conference, Binghamton, New York, June 1974, "Social organization of black bears."
- \*7. Mayo Brothers Clinic, Sigma Xi Lecture Series, Rochester, Minnesota, December 5, 1974, "The black bear in Minnesota."
- \*8. Gustavus Adolphus College, St. Peter, Minnesota, January 27, 1975, "Methods and results of black bear studies in Minnesota."
- \*9. University of British Columbia, Symposium: "Natural regulation of wildlife," Vancouver, British Columbia, March 10, 1975, "Nutritional limitation of black bear numbers" (publ. no. 37).
- \*10. Minnesota Department of Natural Resources game School, Isabella, Minnesota, May 28, 1975, "Status and population dynamics of black bears in northeastern Minnesota."
- \*11. Fifteenth Annual Northwoods Nights Lecture Series, Ely, Minnesota, August 13, 1975, "Black bears of the Superior National Forest."
- \*12. International Bear Association, Black bear workshop, Kalispell, Montana, February 17-19, 1977, "Status of the black bear in Minnesota."
- 13. Fourth International Bear Conference, Kalispell, Montana, February 20-23, 1977, "Color changes in black bears" (publ. no. 18).
- 14. Fourth Eastern Black Bear Workshop, University of Maine, Orono, Maine, May 1978, "Toward standardization of interpretations of dental annuli of black bears."
- \*15. U.S. Forest Service, Superior National Forest, Wildlife habitat management workshop, Isabella, Minnesota, May 10, 1978, "Habitat management for black bears in the Superior National Forest."
- \*16. Smithsonian Institute, Washington, D.C., December 21, 1978, "Evolutionary aspects of behavior of white-tailed deer and black bears."
- 17. Fifteenth annual North American Moose Conference and Workshop, Anchorage, Alaska, March 12-16, 1979, "Sleep reduction, activity cycles, and foraging strategies of moose and deer as adaptations to detect predators."
- 18. Fifth International Bear Conference, Madison, Wisconsin, February 11-13, 1980. "Effects of food supply, predation, cannibalism, parasites, and other health problems on black bear numbers in Minnesota" (publ. no. 37).



19. Great Lakes Deer Group Meeting and Workshop, Palisades, Minnesota, September 22-25, 1980, "North Central Forest Experiment Station's deer habitat research: methods and tentative results."
- \*20. Society of American Foresters, Field meeting, Ely, Minnesota, October 15, 1980. Presented a half-day seminar on deer and bear habitat research and findings in the Superior National Forest."
21. 42nd Midwest Wildlife Conference, St. Paul, Minnesota, December 8, 1980, "The use of tame, free-ranging deer in studies of food habits" (publ. no. 24).
- \*22. Sixth Eastern Black Bear Workshop. Marquette, Michigan, March 9-10, 1982. Panel Chairman. "Use of sex ratio and age structure data in population analyses."
- \*23. Seventh Eastern Black Bear Workshop, Homosassa Springs, Florida, March 26, 1984, "A year of physiological data from a young female black bear."
- \*24. Seventh Eastern Black Bear Workshop, Homosassa Springs, Florida, March 26, 1984, "Homing by black bears and other large mammals." (publ. no. 41).
- \*25. Superior National Forest General Management Review Team, Ely, Minnesota, June 10, 1984, "Management use of wildlife research results."
- \*26. Association for Environmental and Outdoor Education, Annual conference, Isabella, Minnesota, October 21, 1984, Keynote address, "Needs for public education: the black bear."
- \*27. North Central Forest Experiment Station, Noon seminar, November 12, 1986, "Black bears: their problems, needs, and relations with man."
- \*28. North Central Forest Experiment Station, Wildlife habitat relationships workshop, Lakes States national forests, January 29, 1987, "Black bear habitat research."
- \*29. James Ford Bell Museum of Natural History, Wildlife Conference, Minneapolis, Minnesota, February 7, 1987, "Black bear and white-tailed deer research."
30. 49th Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin, December 8, 1987, "Researcher-conditioned black bears provide detailed habitat use data."
- \*31. Ninth Eastern Black Bear Workshop, Huntsville, Ontario, Canada, April 4-7, 1988, "Black bear habitat use and behavior."
- \*32. Apostle Islands National Lakeshore, Bayfield, Wisconsin, June 6, 1988, "The black bear and its habitat in the Lakes States."
- \*33. North Central Forest Experiment Station, St. Paul, Minnesota, October 1988, Quality Research Award Lecture: "Black bear-forest relationships."
34. Eighth International Bear Conference, "A future for bears," Victoria, British Columbia, February 20-25, 1989, "How to obtain behavioral and ecological information from free-ranging, researcher-habituated black bears." (publ. no. 83).

35. Eighth International Bear Conference, "A future for bears," Victoria, British Columbia, February 21, 1989, 4-hour evening workshop on study techniques and bear ecology (publ. no. 83).
- \*36. Managing America's Enduring Wilderness Resource, Minneapolis, Minnesota, September 11-17, 1989, "Managing natural populations of wildlife in wilderness." (publ. nos. 79, 80).
37. Midwest Fish and Wildlife Conference, Madison, Wisconsin, December 2-5, 1989, "How to obtain behavioral and ecological information from free-ranging, researcher-habituated black bears." (publ. no. 83).
38. Midwest Fish and Wildlife Conference, Minneapolis, Minnesota, December 2-5, 1990, "Fawn predation by black bears." (publ. no. 84).
- \*39. 4th Western Black Bear Workshop, Yosemite National Park, California, April 2-5, 1991, "The role of habitat quality in the natural regulation of black bear populations."
- \*40. The Oak Resource in the Upper Midwest, Winona, Minnesota, June 3-5, 1991, "Black bears and the oak resource in northeastern Minnesota." (publ. no. 87).
- \*41. Minnesota Animal Control Association, Spring conference, Duluth, Minnesota, March 27, 1991, "Black bears and man."
- \*42. Old Growth Conference, Finland, Minnesota, April 19-21, 1991, "Wildlife values of old white pines in northeastern Minnesota."
43. Ninth International Bear Conference, Missoula, Montana, February 24-28, 1992, "Black bear predation on white-tailed deer fawns."

### 3. Society and Committee Participation.

#### a. Membership in professional societies.

1. The Wildlife Society
2. Society of American Foresters
3. American Society of Mammalogists
4. International Society for Behavioral Ecology

#### b. Offices held in professional societies. None

#### c. Committee assignments.

1. Superior National Forest Advisory Committee, USDA Forest Service, 1973.
2. Black bear habitat suitability index model committee, Interagency committee (U.S. Forest Service, U.S. Fish and Wildlife Service, Michigan Department of Natural Resources), May 1986.

3. Moose habitat suitability index model committee, North Central Forest Experiment Station representative on an interagency committee to write a habitat suitability index model for moose in the Great Lakes Region. 1987.
  4. Awards Committee, Minnesota Chapter, The Wildlife Society, 1985-1989.
  5. Caribou reintroduction committee, North Central Caribou Corporation, 1989 to present.
- d. Professional registration.
1. American Men and Women of Science
4. Participation in Technical Conferences and Workshops.
- a. Fourth International Conference on Bear Research and Management, Kalispell, Montana, 1977, Conference summarizer.
  - b. Black Bear Workshop, Kalispell, Montana, 1977, member of 2 committees of 4 people each who wrote chapters on habitat and techniques for "The black bear in modern North America," published by Boone and Crockett Club in 1979.
  - c. Sixth Eastern Black Bear Workshop, Marquette, Michigan, March 9-10, 1982. Panel chairman.
  - d. Seventh Eastern Black Bear Workshop, Homosassa Springs, Florida, 1984, Panel chairman.
  - e. 49th Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin. December 8, 1987. Wildlife Session Moderator.
5. Consultations .
- a. Wisconsin Department of Justice. February 4 to March 10, 1988. The incumbent provided information on black bear population dynamics, behavior, habitat, and denning habits to Wisconsin Assistant Attorney General Lisa Levin to aid her in preparing a case concerning the need to manage Wisconsin's black bear population and habitat.
  - b. U.S. Forest Service, Region 1, Coeur d'Alene, Idaho. December 15, 1988. The incumbent participated via conference telephone in a meeting chaired by James Caslick, Animal Damage Management Coordinator, to find ways to reduce bear damage to thinned timber stands in the Pacific Northwest.
  - c. France Office National de la Chasse. April 20, 1987. In response to a letter from French biologist Jean Jacques Camarra regarding problems of survival of the Pyrenean bear, the incumbent provided information on bear biology as it may pertain to that species.

- d. Scientific journals. The incumbent reviews several papers per year from the following scientific journals: Journal of Mammalogy, Journal of Wildlife Management, Wildlife Society Bulletin, Canadian Journal of Zoology, Canadian Field-Naturalist, Journal of Wildlife Diseases, Northwest Science, Wildlife Monographs, American Midland Naturalist, Conservation Biology, Canadian Journal of Forest Research, and Biological Conservation.
- e. Grant proposals. The incumbent reviews grant proposals for National Science Foundation, National Fish and Wildlife Foundation, National Geographic Society, Center for Field Research, USDI National Park Service, Association of Canadian Universities for Northern Studies, Canadian Northern Studies Trust, and American-Scandinavian Foundation.
- f. Publishers. 1981-1991. At the request of publishing companies, the incumbent has served as technical editor on the bear sections of the following books which include most of the authoritative books on bears published in the last 10 years.

<i>Author</i>	<i>Title</i>	<i>Publisher</i>	<i>Year</i>
Pettifer, J.	"Nature Watch"	Michael Joseph, Ltd. (England)	1981
McGuire, R.	"Black Bears"	Bowhunting Prod.	1983
Strung, Norm	"The Art of Hunting"	Cy DeCosse Publ. Co.	1984
Staff writers	"Baby Bears"	Nat'l Geogr. Soc.	1985
Herrero, S.	"Bear Attacks"	Winchester Press	1985
Bauer, Erwin	"Bear in their World"	Outdoor Life Books	1985
Laycock, Geo.	"The Wild Bears"	Outdoor Life Books	1986
Cramond, M.	"Of Bears and Man"	Univ. of Okla. Press	1986
Pringle, L.	"Bearman"	Chas. Scribner's	1989
Fair, J.	"The Great American Bear"	Northword Press	1990
Fair, J.	"Bears for Kids"	Northword Press	1991

Much of the background material for modern popular books on black bears comes from the incumbent's work, which also is the basis for black bear sections in textbooks such as Sociobiology by E. O. Wilson (Harvard University Press, 1975:502-504) and Life by R. Lewis (Wm. C. Brown, Publ., 1992:114, 681).

- g. Superior National Forest, January 12-31, 1989. Birch Lake Opportunity Area Management Plan. Incumbent worked with the District Biologist and District Ranger to improve black bear habitat on the Birch Lake Opportunity Area using information from publications 60 and 67.
- h. Michigan Department of Natural Resources, Division of Enforcement, January 23, 1991. At the expense and request of the Michigan DNR's Division of Enforcement, the incumbent conducted a 5-hour seminar for the conservation officers of Michigan's Upper Peninsula. Subjects covered included bear habits, meaning of bear displays, repelling problem bears, trapping bears, aging techniques, movements of live-trapped bears after release, bear population dynamics, and bear habitat use. Newspaper, magazine, and TV reporters also in attendance summarized the seminar for the public.

- i. Miscellaneous consultations. The incumbent responds to continuing requests for information on bear and deer research techniques, bear behavior, methods for evaluating deer and bear habitat, and methods for protecting field personnel and campers from bears. These requests come from State Departments of Natural Resources, U.S. Forest Service, universities, and others in the United States, Canada, Mexico, Colombia, France, Japan, China, Italy, Norway, Poland, Nepal, and Russia

## 6. Special Assignments.

- a. 1976. U.S. Fish and Wildlife Service. Incumbent was coauthor in a study to evaluate the status and habitat of the pine marten (*Martes americana*) in northeastern Minnesota to determine whether or not this species should be listed as endangered in Minnesota. The recommendation not to list this species was followed, and marten numbers have increased (publ. no. 14).
- b. May 1-5, 1977. Tennessee Wildlife Resources Agency and University of Tennessee. At the request and expense of the above, the incumbent was assigned to evaluate Tennessee's black bear population status, habitat, and management practices and recommend management and research programs. All recommendations were followed.
- c. August 18-22, 1986. U.S. Fish and Wildlife Service and Michigan Department of Natural Resources. Lansing, Michigan. Incumbent, with A. W. Allen, developed a Black Bear Habitat Suitability Index Model for the Great Lakes Region. (publ. no. 60).
- d. January 4-7, 1987. Vermont Department of Fish and Wildlife (VDFW). Rutland, VT. Incumbent was assigned to advise the VDFW concerning effects of proposed ski developments on black bear habitat, to testify for the VDFW to the Vermont Environmental Board, and to advise the VDFW concerning possible mitigation of habitat impacts by development. In 1991, the Vermont Environmental Board issued a decision to stop the development.
- e. September 16-30, 1987. Minnesota Department of Natural Resources and Superior National Forest. Following two black bear attacks on humans in the BWCAW, the incumbent was assigned to advise the DNR on the size of area that should be closed to camping, strategies for finding the attack bear, tests to determine whether the right bear was killed, and tests to determine why the attacks occurred. The incumbent spoke to the media for the DNR and the Superior National Forest and wrote two reports which were published to allay public fears, quash rumors, and suggest how future maulings might be prevented (publ. nos. 69, 70).
- f. January 16-May 1, 1992. State and Private Forestry. National Task Force member "Smokey Bear, The Living Symbol."

## 7. University Involvement.

- a. University of Minnesota-Duluth. Field advisor for Master of Science student Sheila Arimond who completed a thesis entitled "Fruit production in black bear habitat in northeastern Minnesota" in 1979.

- b. Friends World College, Huntington, New York. Field advisor for Bachelor of Science student Mary Shedd whose senior thesis entitled "Summer food habits of white-tailed deer in the Superior National Forest" was completed in 1981.
- c. University of Wisconsin, Stevens Point. Adjunct professor, 1990-present. With Dr. Ray Anderson, planning joint black bear/landscape ecology research project in the Chequamegon National Forest.
- d. Northern Michigan University, Marquette. Adjunct professor, 1992. Field advisor to M.S. student Terry DeBruyn.
- e. University of Minnesota, Department of Ecology and Behavioral Biology, Minneapolis, Minnesota. Adjunct professor, 1992. Field advisor to M.S. student Brian Kontio.
- f. Vermilion Community College instructor. Conducts 3-5 weekend seminars/year for teachers, scientists, and others from around the country as part of the Vermilion Community College Extension Program.

### C. Scientific Accomplishment and Related Technology Transfer.

#### 1. Before Last Promotion.

- a. Pine marten population status and distribution in relation to habitat. The incumbent, with David Mech of USFWS, documented the demise and comeback of pine martens (*Martes americana*) in Minnesota to provide a basis for determining whether or not they should be declared endangered. Mech and the incumbent recommended that pine martens not be listed as endangered. The recommendation was accepted. The population increased (publ. no. 14).
- b. Deer food habits. All available literature on food habits of deer in the boreal and near-boreal forest of the Upper Great Lakes Region was reviewed and summarized by month to help managers identify important deer foods through the year. Major short-comings and biases in previous methods and results were identified.
- c. New technique for determining deer food habits and habitat use. A new technique for studying food habits and habitat use of deer was developed using 8 free-ranging, researcher-habituated, radio-collared deer. The 8 deer proved similar to wild radio-collared deer in all testable aspects of behavior including home range size, avoidance of timber wolves, gross habitat use, overwinter survival, social integration with other deer in winter yards, ability to produce and raise young. They differed in that they allowed researchers to accompany them around-the-clock several times each season during 1977-1980 to record habitat selection, food species selection and availability by cover type, reactions to environmental stimuli, and amount of time spent at each activity in each habitat. Results added the detail and understanding missing from remote telemetry studies. Findings include the first data on amounts of food eaten in each season, the nutritional values of plant parts selected, and more complete information on food selection and habitat selection than was previously possible. The deer findings provide the necessary information for modeling deer-vegetation interactions. The data are currently being integrated with Ecological Land Classification System Data from the Ottawa National Forest, using Geographic Information System procedures, to develop a prototype model for integrating wildlife data into forest management systems (publ. nos. 24, 30, and 33).

- d. Changes and inheritance of coat color in black bears. The distribution of coat color phases across the black bear range provides insights into the evolution of coat color and factors that may influence it. Coat color also is used for field identification of black bears. This was a study of evolutionary and environmental factors that may influence coat color in bears and a documentation of coat color changes with age and season (publ. no. 18).
- e. Evaluation of succinylcholine chloride as an immobilizing drug. Succinylcholine chloride was long used as the drug of choice for dart gun immobilization of many species including black bears. In this study, side effects on the heart were discovered. The paper recommends against use of this drug. (publ. no. 10).
- f. Evaluation of promazine hydrochloride as an immobilizing drug. Promazine hydrochloride is commonly used in animal immobilization. In this study, fatal clostridial myonecrosis was found as a result of this drug. The problem was reported and procedures were recommended for preventing further occurrences (publ. no 21).
- g. Wolf-bear interactions. In this cooperative study with USFWS, both wolves and bears were radio-collared in the same area. Interactions between wolves and bears, including predation by a pack of 9 wolves on a family of black bears, were documented. It was shown that neither species is a serious threat to the other in good habitat, contrary to earlier reports from studies conducted in fragmented habitat (publ. no. 26).
- h. Identification of grizzly and black bear droppings. A problem in determining critical grizzly bear habitat is misidentification of grizzly and black bear droppings where the two species are sympatric. In this cooperative study with Canadian biologists, known droppings from each species from locations where the two species are not sympatric were compared to aid identification (publ. no. 29).
- i. Effects of canopy cover on wild fruit production. In this study with graduate student Sheila Arimond, canopy cover showed an inverse relationship with production of blueberry, cherry, raspberry, and juneberry fruits. Highest fruit production was in a burned area. Lowest was in herbicided areas. Results are contained in an unpublished master's thesis and are being used by forest managers (Part IV, B,7,a).
- j. Deer-wolf relations. In this cooperative study with USFWS and University of Minnesota, deer densities were found to be significantly higher in buffer zones between wolf territories than inside wolf territories them. Following a deer decline, some wolf pack territories were nearly devoid of deer. Buffer zones apparently are centers from which deer populations expand to repopulate wolf territories when deer numbers increase (publ. no. 19).

- k. Cementum annuli reveal age and reproductive success in black bears. The incumbent was the first to extract teeth from live bears to determine age and reproductive success. The first upper premolar is rudimentary in the black bear and is sometimes missing naturally. When the tooth is present, cementum annuli in the tooth reveal age. Spacing of the annuli reveals reproductive success (due to diversion of calcium to milk during lactation). The incumbent has developed the largest collection of stained, sectioned teeth from black bears of known age and known reproductive history, and this reference collection is used by researchers around the country. Photomicrographs are now available for greater ease of use. Accurate age determination facilitates studies of population dynamics in relation to habitat quality. First premolars are now routinely extracted in bear research studies (publ. nos. 7, 8, 11, and 17).
- l. Effects of habitat quality on black bears. This broad ecological study provided the first documentation that habitat quality affects essentially all aspects of black bear life including survival, growth, reproductive rate, movements, and social behavior. Since the last panel, the incumbent received North Central's Quality Research Award (1988) for publ. no. 54., which has become the most frequently cited publication in bear literature. (publ. nos. 13, 37, and 54).
- m. Habitat Suitability Index for black bears. With Art Allen of the USFWS National Ecology Research Center (303-226-9312), in cooperation with Michigan Department of Natural Resources, the incumbent developed a habitat suitability index for evaluating black bear habitat in the Great Lakes Region. The index includes a new method for evaluating human influence on wild populations. The index is widely used by managers to identify opportunity areas in the Great Lakes Region and has served as a model for development of subsequent indices outside the region (publ. no. 60).
- n. Hibernation physiology of black bears. The incumbent, in cooperation with various medical research centers, is continuing studies of the physiology of black bear hibernation. Studies using labeled nitrogen revealed that hibernating black bears recycle their nitrogen. Studies using deuterium revealed seasonal changes in body composition. Studies using Swan-Ganz catheters revealed seasonal changes in circulation and heart function. Results have provided a better understanding of mammalian physiology, including hibernation physiology. Healthy, hibernating black bears show conditions similar to those found in certain human maladies. The improved understanding of those conditions that was obtained through black bear studies has enabled more enlightened study of ailing humans and improvements in human medicine. Information from this study was incorporated into the college biology textbook "Life" by R. Lewis et al. (1992), W. C. Brown Publ. Co. (publ. nos. 2, 4, 12, 22, 31, 32, 34, 35, 38, 43, 48, 50, 56, 58, 81).
- o. Homing abilities of black bears. This series of studies provided the first statistically sound evidence of true navigation ability in a large terrestrial mammal and provided managers with information on the effectiveness of translocating nuisance bears to reduce problems. Previous literature on mammalian homing was anecdotal despite the importance of this subject to wildlife management and to the reintroduction of animals to new areas. Since last promotion, study has continued and results were summarized for managers and the public, and the information was incorporated into the college biology textbook "Life" by R. Lewis et al. (1992), W. C. Brown Publ. Co. (publ. nos. 40, 41, 42, 44, 46, 51, 65, 89).



- p. Bear repellent. This study provided hikers and campers with an improved method for defending their food. The incumbent conducted the first tests of tear gas and capsaicin on free-ranging black and polar bears. Tear gas proved ineffective. Capsaicin, the active ingredient of cayenne peppers, proved highly effective and is harmless to bears. Since last promotion, this repellent has come into routine use by forest workers and is being carried increasingly by recreationists. This deterrent is increasingly used as an alternative to shooting campground bears (publ. no. 39).
- q. New dispersal hypothesis. Findings that black bear males, but not females, disperse voluntarily regardless of food supply led to a new dispersal hypothesis based on kinship theory and beyond the old inbreeding hypothesis. A proper understanding of dispersal and its causes is essential to determinations of minimum habitat requirements. Managers will need this information when they attempt to maintain corridors and habitat tracts in increasingly fragmented forests (publ. nos. 61, 62).
- r. Effects of black bears on habitat. Fruit seeds that pass through bear digestive tracts are at least as likely to germinate as uneaten seeds. The black bear is one of the more important species aiding fruit seed dispersal because they eat large volumes, travel widely, and can handle large-seeded fruits such as plums (publ. no. 18, 36)
- s. Circannual metabolic rhythm in deer and behavioral regulation of body temperature. Rectal temperatures of free-ranging white-tailed deer showed a circannual rhythm that was metabolically based. Behavior and habitat selection caused variations in body temperatures within this rhythm. Body temperature regulation in summer and winter was a major factor in habitat selection near the northern edge of the species' range (publ. no. 52).
- t. Censusing white-tailed deer. The pellet group census method has long assumed a defecation rate of 13 pellet groups per day with no seasonal variation. That assumption was based on old studies of penned deer and has led to great overestimates of deer populations. Studies using free-ranging deer showed great and predictable seasonal variation in defecation rate and an average defecation rate of 34/day through the fall-to-spring census period. This study prompted several states to reevaluate their deer census results and to initiate studies which have now confirmed the results of this study (publ. no. 53).

## 2. Since Last Promotion.

- a. Oak management. Radio-collared black bears foraged 30-201 km outside their territories and revealed mature oak stands that comprise <0.002 percent of the Superior National Forest. Bears that found abundant acorns had higher growth and reproductive rates than did other individuals. These findings by the incumbent led Biologist Edward Lindquist (218-720-5483) to exempt oak in the Superior National Forest from all cutting except regeneration cutting. However, the best oak stands were outside the Superior National Forest. To protect those stands, The Minnesota Chapter of The Nature Conservancy and the Natural Heritage Section of the Minnesota Department of Natural Resources combined their efforts in 1990 and 1991 to raise \$250,000 and buy a square mile of the best oak habitat remaining. The 1991 Minnesota State Legislature added this land to adjacent Tettegouche State Park. The incumbent continues to advise the Park in management of the acquisition, which is one of the best wildlife viewing areas in northeastern Minnesota (publ. no. 87).

- b. Improved method for obtaining habitat use data for black bears. A method for habituating black bears to researchers to the extent that even mothers with cubs accept researchers and allow close observation of food selection, amounts consumed, habitat use, activity patterns, sleep patterns (REM and nonREM sleep), predation, social interactions, communication, territorial behavior, care of young, etc., was developed. Gross behavior patterns of the habituated bears are similar to those previously documented for other bears by remote telemetry, but the new method provides details that are enabling advances in studies of bioenergetics, predator/prey relations, and social and kinship theory. Previously unobtainable information on microhabitat use is revealing the importance of forest components and is helping forest managers understand the importance of the various forest cover types, Ecological Land Types, and Land Type Associations. The method involves use of Global Positioning Systems, field computers, personal computers, new computer software, and two-way radios. The method is being adopted by bear researchers in Michigan (Terry DeBruyn (906-226-8203), Labrador (Al Veitch, 709-896-2732), Banff National Park (Rick Kunelius, 403-762-3852), and Nepal (David Smith). The computer program that permits recording and summarization of voluminous activity and environmental data is also being tested in studies of children (Dr. Kathryn G. Karsh, Ed.D., Research Associate, Educational Research and Services Center, Inc., 425 Fisk Avenue, DeKalb, Illinois 60115). Field results from the black bears are directly useful to managers and are of high public interest. The method and a few of the early results have been published (publ. nos. 63, 67, 68, 73, 74, 75, 77, 78, 83, and 93).
- c. White pine management. Radio-collared black bears revealed that white pines have bark that is especially easy for inexperienced cubs to climb without falling and that mature white pines were highly preferred as refuge trees by mothers with cubs. Although white pine trees >5 inches DBH comprised <0.04 percent of the trees available, mothers with cubs selected the bases of mature white pines (16-37 inches DBH) for 90% of their beds in spring and for 88% of their overnight beds through summer and fall. Females without cubs also selected white pines disproportionately to their availability (29% of beds) but not to the extent mothers with cubs did. Eagles and ospreys each selected mature white pines for 80-81% of their nests. There is a question as to whether white pines in northeastern Minnesota are a renewable resource due to white pine blister rust. As a result of these findings and others assembled by the incumbent, the Superior National Forest supervisor (218-720-5321) and District Rangers such as Angela Cook (218-365-6185) now protect most white pines and the U.S. Forest Service is considering a moratorium on cutting the remaining white pines in northeastern Minnesota. (publ. no. 88).
- d. Lowland and wetland management. Observations of habituated black bears in spring revealed that lowland and wetland areas were more important feeding areas than had been suspected. Bluejoint grass (*Calamagrostis canadensis*), wild calla (*Calla palustris*), and other succulent aquatic plants were the important foods. Lowland or wetland areas <2.5 acres were previously ignored in mapping forest stands but some districts now note them as areas of special importance (publ. nos. 67 and 68).

- e. Reactions of black bears to human menstrual odors. Attacks by grizzly bears on two menstruating women led to government warnings against women entering bear country while menstruating. Studies by the incumbent showed that black bears are not interested in menstrual odors and that such warnings are unnecessary in black bear country. These findings were disseminated to USFS recreation specialists in the Washington Office, who directed, in turn, that USFS brochures be edited to reflect the new information. In Alaska, where USFS regulations prohibited menstruating women from entering bear habitat, the regulation was deleted (publ. no. 90).
- f. Coexistence with black bears. One of the greatest problems facing black bears is the increasing fragmentation of the forest as baby boomers build vacation homes and retirement homes in bear country. Many of these home are in areas that formerly served as buffers around designated Wilderness Areas. Others are in formerly marginal habitat that is becoming residential. The solution to this problem of encroachment and fragmentation will involve 1) managers recognizing the problem and taking steps to maintain minimum habitat requirements and corridors, 2) development of new methods for aversively conditioning bears, 3) new ways of making garbage unavailable to bears, and 4) above all, more tolerant human attitudes. Within wilderness recreation areas, there also are needs for new practices and attitudes. The incumbent is making progress in all these areas, frequently using the media to create a more realistic image of the black bear. As part of this, black bear reactions to various human behaviors were studied to determine how people might prevent property damage and attacks and how they might best defend against attacks. Bear vocalizations and body language were studied to better predict bear behavior during encounters. A "How To" on these subjects proved to be the most popular publication ever distributed by North Central Forest Experiment Station, with over 100,000 distributed (publ. no. 64). Other publications dealt with wilderness management (publ. nos. 79, 80) or were natural history publications designed to give managers or the public a better understanding of black bears (69, 70, 72, 77, 81, 82, 85, 86, 93, 98).
- g. Integrating wildlife habitat data into management practice. This was a study to determine what bears eat, what cover types produce those foods, and what forest managers can do to produce those cover types and foods. To learn black bear food habits across the Great Lakes Region, 177 field workers from Minnesota, Wisconsin, and Michigan Departments of Natural Resources, from all 7 national forests in those states, and from Menominee Indian Reservation and Voyageurs National Park combined to collect 1,134 black bear scats and send them to the incumbent for analysis. Forest ecologists Dr. James Jordan of Ottawa National Forest (906-932-1330) and Dr. John Kotar of University of Wisconsin (608-262-3296) provided information on the Ecological Land Types and cover types that produce those foods and which management practices are likely to produce those cover types. Drs. George Host and Lucinda Johnson of Natural Resources Research Institute (218-720-4294) provided Geographic Information Systems (GIS) expertise to integrate the food habits data with Ecologic al Land Classification System (ECS) data on the Ottawa National Forest to develop a prototype model for integrating wildlife data with ECS data to evaluate habitat quality over a large area. This is the kind of integration needed for managing habitat for multiple species as wildlife values assume greater importance in forest management (publ. nos. 92, 94).

- h. Bioenergetics of hibernating bears. Forest management creates and destroys denning habitat. Is the created habitat as good as the destroyed? This study investigated the heat loss components for a black bear in a slash pile den, created by forest management, and a traditional burrow den. Heat loss was no greater in the slash den. The energetics of hibernating bears was described (publ. no. 66).
- i. Blood parameters as indicators of habitat quality. The black bear itself may be the best integrator of the factors that determine habitat quality. This study was done in cooperation with Art Allen (303-226-9312) of USFWS National Ecology Research Center and with Dr. Glen DelGiudice of Veterans Affairs Hospital, Metabolic Research Laboratory (now at 218-327-4432). Hematology values from 20 years of study were analyzed to determine which blood parameters are the best indicators of habitat quality and to determine underlying seasonal changes in hematological values (publ. no. 91).
- j. Black bear predation on fawns. Black bears have long been known to eat newborn deer. This study answered questions concerning how many were killed and how many were scavenged, how significant fawns were in bear diets, what impact this predation has on deer populations, and the extent to which black bears compete with threatened timber wolves. Black bears killed up to 7 fawns per year and scavenged up to 3, taking 11-26 percent of the available fawns (publ. nos. 84, 99).
- k. Rapid estimation of deer browse biomass. To aid forest managers and researchers in estimating the amount of deer browse available, a set of equations was developed whereby stem or shrub height, which are easily measured or estimated in the field, can be used to estimate the biomass of browse within reach of deer. The information also reveals when further forest growth will create more or less deer browse, letting managers know when habitat improvement projects are needed. These equations aid in assessing habitat quality and modeling deer-habitat interactions (publ. no. XX).
- l. Caribou pre-reintroduction studies: More on integrating wildlife habitat data into management practice. Part of the planning for reintroduction of caribou to northeastern Minnesota involves evaluating the region as caribou habitat in order to select a reintroduction site. Methods developed for this evaluation should be helpful in evaluating and managing regions for other wide-ranging wildlife species. This study uses Landsat imagery with an ERDAS GIS image processing program to create classified images from the color/pattern signatures on the satellite images. After accuracy assessment using 50 samples for each image class, the region is evaluated for caribou by passing a 50 square kilometer window (a common caribou range size) over the map and calculating summary statistics, including the Shannon Diversity Index, for each window position. Of special interest for caribou reintroduction is a good mix of open conifer bog (containing abundant lichen cover), dense conifer jack pine and black spruce for thermal cover, open shrub cover for browse, and an abundance of shoreline and islands for escape and birthing. The area can be evaluated for other wide-ranging species by changing the window size and changing the target cover types. GIS data bases developed in the bear study area, within the caribou evaluation area, greatly facilitated testing of the system. Finally, successional transition probabilities for boreal forests in the region will be used to adjust acreages of the different habitat elements for each of five decades into the future to provide an estimate of the sustainability of suitable habitat for each window. The method is operational. A report and a publication are due out within a year.

D. Team Leadership:

E. Team Membership:

F. Reporting of Research Results:

1. Publications.

A = Abstract	R = Peer Reviewed
HT = "How To" Brochure	S = USFS Scientific Publication
O = Other	TT = Technology Transfer Publication

1. Rogers, L. L. 1970. Black bear of Minnesota. *Naturalist* 21(4):42-47.
2. Maxwell, R., J. Thorkelson, and L. L. Rogers. 1972. The energetics of wintering bears (*Ursus americanus*) in northeastern Minnesota. *Bull. Ecol. Soc. Amer.* 53(2):21. (Abstract) (Maxwell and Thorkelson conceived the abstract and wrote it. Rogers supplied ecological data, helped obtain energetics data, and edited the abstract.)
3. Rogers, L. L. 1972. Movement patterns and social organization of black bears in northeastern Minnesota. *Bull. Ecol. Soc. Amer.* 53(2)21. (Abstract)
- R 4. Rogers, L. L. 1974. Shedding of foot pads by black bears during denning. *J. Mamm.* 55(3):672-674.
- O 5. Rogers, L. L. 1974. On the trail of a big black bear. *National Rifle Assoc. Hunting Annual.* 1974:20-21, 167-169.
- R 6. Rogers, L. L. 1975. Parasites of black bears (*Ursus americanus* Pallas) of the Lake Superior Region. *J. Wildl. Diseases* 11:189-192.
- O 7. Rogers, L. L. 1975. Black bears of the Lake Superior Region. *North Land* 3(1):1-6.
- A 8. Rogers, L. L. 1975. The use of dental annuli as an index to reproductive success. p. 62 In: Abstracts of technical papers presented at the 55th annual meeting of the American Society of Mammalogists. Univ. Montana, Missoula. 121 pp. (Abstract)
- R 9. Rogers, L. L., and S. M. Rogers. 1976. Parasites of bears: a review. *Bear Research and Manage.* 3:411-430. (L. Rogers developed the idea, reviewed the literature, and wrote the paper. S. Rogers did 10% of the literature search.)
- R 10. Rogers, L. L., C. M. Stowe, and A. W. Erickson, 1976. Succinylcholine chloride immobilization of black bear. *Bear Research and Manage.* 3:431-436. (Coauthors provided financial support and advice. Rogers did the rest.)
- R 11. Rogers, L. L., D. W. Kuehn, A. W. Erickson, E. M. Harger, L. J. Verme, and J. J. Ozoga. 1976. Characteristics and management of black bears that feed in garbage dumps, campgrounds, or residential areas. *Bear Research and Management* 3:169-175. (Rogers developed the idea, collected the data, did half the lab work, and wrote the first and final drafts.)

- R 12. McMillin, J. M., U. S. Seal, L. L. Rogers, and A. W. Erickson. 1976. Annual testosterone rhythm in the black bear (*Ursus americanus*). *Biology of Reproduction* 15:163-167. (Rogers did the field work, contributed ecological background data, and edited the paper.)
- O 13. Rogers, L. L. 1976. Effects of mast and berry crop failures on survival, growth, and reproductive success of black bears in northeastern Minnesota. *Trans. North Amer. Wildl. and Natural Resour. Conf.* 41:431-438.
- S 14. Mech, L. D., and L. L. Rogers. 1977. Status, distribution, and movements of martens in northeastern Minnesota. *USDA Forest Service Research Paper NC-143*. 7 pp. (Mech and Rogers each did half the work and half the writing.)
- R 15. Rogers, L. L. 1977. Fourth International Conference on Bear Research and Management, a review. *Wildl. Soc. Bull.* 5(4):196:197.
- O 16. Rogers, L. L. 1977. The ubiquitous American black bear. Pages 28-33. In: Wm. H. Nesbitt and S. S. Parker (eds.) *North American Big Game*. Boone and Crockett Club and National Rifle association of America. Washington, D.C. 367 pp.
- O 17. Rogers, L. L. 1979. Interpretation of cementum annuli in first premolars of bear. *Proc. 4th Eastern Black Bear Workshop*: 102-112.
- R 18. Applegate, R., L. L. Rogers, D. Casteel, and J. Novack. 1979. Germination of cow parsnip seeds from grizzly bear feces. *J. Mamm.* 60:655. (Applegate conceived the idea and collected the data. Casteel and Novack did the lab work. Rogers did the literature search and wrote the paper.)
- R 19. Rogers, L. L., L. D. Mech, D. K. Dawson, M. Korb, and J. Peek. 1980. Deer distribution in relation to wolf pack territory edges. *J. Wildl. Manage.* 44(1):253-258. (Rogers analyzed Peek's data and wrote half the paper.)
- R 20. Rogers, L. L. 1980. Inheritance of coat color and changes in pelage coloration in black bears in northeastern Minnesota. *J. Mamm.* 61(2):324-327.
- R 21. Barnes, D., and L. L. Rogers. 1980. Clostridial myonecrosis associated with drug administration. *J. Wildl. Diseases* 16(3):315-317. (Rogers collected the data and wrote the 2nd and final drafts.)
- O 22. Folk, G. E., P. S. Cooper, L. L. Rogers, C. V. Gisolfi, and V. J. Morinello. 1980. Studies on hibernation-inducing factor. Report No. 22 from the Laboratory of Environmental Physiology, The University of Iowa, Iowa City, Iowa. 30 pp. (Rogers collected blood samples and did 10% of the lab work.)
- O 23. Kramer, G., and L. L. Rogers. 1980. Bear-ly visible. *National Geographic World Magazine* No. 64 (December 1980):4-9. (Rogers did the field research and edited the manuscript.)
- A 24. Rogers, L. L. 1980. The use of tame, free-ranging deer in studies of food habits. Abstracts of papers presented at the 42nd Midwest Fish and Wildlife Conference, St. Paul, Minnesota. Dec. 7-10, 1980. (Abstract)
- O 25. Buech, R. R., L. L. Rogers, and L. D. Mech. 1980. People and wildlife--bringing them together. *Naturalist* 31(4):12-20. (Rogers wrote 20% of the paper.)

- R 26. Rogers, L. L., and L. D. Mech. 1981. Interactions of wolves and black bears in northeastern Minnesota. *J. Mamm.* 62(2):434-436. (Rogers contributed 75% of the data and writing.)
- S 27. Ohmann, L. F., D. F. Grigal, and L. L. Rogers. 1981. Estimating plant biomass for undergrowth species of northeastern Minnesota. U.S. Dep. Agric., For. Serv., GTR NC-61. 10 pp. (Rogers developed Ohmann's idea, did the field work, and edited the manuscript.) (Peer reviewed)
- S 28. Rogers, L. L., J. J. Mooty, and D. K. Dawson. 1981. Foods of white-tailed deer in the Upper Great Lakes Region: A review. U.S. Dep. Agric., For. Serv., GTR NC-65. 24 pp. (Rogers conceived the paper, did 80% of the literature search, and wrote the first and final drafts.) (Peer reviewed)
- R 29. Hamer, D., S. Herrero, and L. L. Rogers. 1981. Differentiating black and grizzly bear feces. *Wildl. Soc. Bull.* 9(3):210-212. (Rogers contributed the black bear data.)
- O 29. Rogers, L. L. 1981. Walking with deer. pp. 29-34. In: W. H. Nesbitt and P. L. Wright (eds.). *Records of North American Big Game*. Boone and Crockett Club, Publisher. Alexandria, VA.
- O 31. Rogers, L. L. 1981. A bear in its lair. *Natural History* 90(10):64-70.
- O 32. Rogers, L. L. 1981. Die Gefahr Verschlafen (Sleeping through hard times). *Weltwoche* 49(52):34.
- A 33. Rogers, L. L. 1982. Wolf, deer decline prompts intensive deer study in northeastern Minnesota. *Restoration and Management Notes* 1(2):22. (Abstract)
- A 34. Wolfe, R. R., R. A. Nelson, T. P. Stein, L. L. Rogers, and M. H. Wolfe. 1982. Urea nitrogen reutilization in hibernating bears. *Federation Proceedings* 41:1623. (Abstract) (Rogers did the field work.)
- A 35. Wolfe, R. R., R. A. Nelson, M. H. Wolfe, and L. L. Rogers. 1982. Nitrogen cycling in hibernating bears. *Proc. Amer. Soc. Mass Spectrometry* 30:426. (Abstract) (Rogers did the field work.)
- R 36. Rogers, L. L., and R. Applegate. 1983. Dispersal of fruit seeds by black bears. *J. Mamm.* 64(2):310-311. (Rogers conceived the paper, collected the field samples, analyzed the data, and wrote the first and final drafts.)
- O 37. Rogers, L. L. 1983. Effects of food supply, predation, cannibalism, parasites, and other health problems on black bear populations. pp. 194-211. In: F. Bunnell, D. S. Eastman, and J. M. Peek (eds.). *Symposium in Natural Regulation of Wildlife Populations. Forest, Wildlife, and Range Experiment Station Proceedings 14*. Univ. of Idaho, Moscow. 225 pp. (Peer reviewed)
- O 38. Rogers, L. L. 1984. Sieben monate auf der Barenhaut (Seven months of laziness). *Das Tier* 1/84:4-9.
- R 39. Rogers, L. L. 1984. Reactions of free-ranging black bears to capsaicin spray repellent. *Wildl. Soc. Bull.* 12(1):59-61.
- O 40. Rogers, L. L. 1984. Recent advances in studies of homing mechanisms. *Proc. East. Workshop Black Bear Manage. Res.* 7:75-76.

- O 41. Rogers, L. L. 1984. Homing by black bears and other large mammals. Proc. East. Workshop Black Bear Manage. Res. 7:76-77.
- O 42. Rogers, L. L. 1984. Black bear homing panel summary. Proc. East. Workshop Black Bear Manage. Res. 7:78.
- R 43. Moen, A. N., and L. L. Rogers. 1985. Radiant surface temperatures and hair depths of a black bear, *Ursus americanus*. Canadian Field-Naturalist 99(1):47-50. (Rogers assisted in field work and edited the manuscript.)
- R 44. Rogers, L. L. 1986. Effects of translocation distance on frequency of returns by black bears. Wildl. Soc. Bull. 14(1):76-80.
- R 45. Rogers, L. L. 1986. Long-term survival of adopted black bear cubs in suboptimal habitat. Wildl. Soc. Bull. 14(1):81-83.
- R 46. Rogers, L. L. 1986. Homing by black bears in Minnesota. Canadian Field-Naturalist 100(3):350-353
- R 47. Rogers, L. L. 1986. Aiding the wild survival of orphaned bear cubs. Wildlife Rehabilitation 4:104-111.
- A 48. Ensrud, E. R., R. A. Nelson, G. Alt, T. Beck, G. Matula, and L. Rogers. 1986. Seasonal variation in the ratio of serum urea to creatinine (U/C) in black bears. The Physiologist 29(4):116 (Abstract). (Rogers contributed 20% of the blood samples.)
- O 49. Rogers, L. L. 1986. Habits of black bears in Minnesota. Minnesota Forests 1986 (Fall):8-9.
- O 50. Rogers, L. L., and A. Taylor. 1986. Why black bears are masters of winter survival. (Woods Wise column published in Minnesota Out of Doors, Woodland Management, Minnesota Forests, National Woodlands, Illinois Wildlife, Pennsylvania Forests, Missouri Wildlife, Michigan Out of Doors, Hoosier Conservation, Forestry Forum, and Northbound Magazine) (Rogers did the field work and wrote 75% of the manuscript.)
- R 51. Rogers, L. L. 1987. Navigation by adult black bears. J. Mammal. 68(1):185-188.
- R 52. Rogers, L. L., A. N. Moen, and M. L. Shedd. 1987. Rectal temperatures of 2 free-ranging white-tailed deer fawns. J. Wildl. Manage. 51(1):59-62. (Rogers conceived the paper, directed the study, analyzed the data, and wrote the first and final drafts.)
- R 53. Rogers, L. L. 1987. Seasonal changes in defecation rates of free-ranging white-tailed deer. J. Wildl. Manage. 51(2):328-331.
- R 54. Rogers, L. L. 1987. Effects of food supply and kinship on social behavior, movements, and population dynamics of black bears in northeastern Minnesota. Wildlife Monograph 97. 72 pp.
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2. Rogers, L. L., and V. D. O'Connor. 1991. BEARWATCH: Animal data analysis system. Version 5.0. Computer program manual. (Manuscript in peer review process. Intended for Station paper and a published review in the Wildlife Society Bulletin)
3. Rogers, L. L. Importance of white pine to black bears in northeastern Minnesota. (Manuscript in peer review process. Intended for Journal of Wildlife Management.)
4. Kotar, J., and L. L. Rogers. Relationships among bear food production, vegetation type, and forest management in northern Wisconsin. (First draft completed).
5. Fair, J., L. L. Rogers, and M. L. Wilton. Predatory habits of the black bear: a review. (First draft completed).
6. Rogers, L. L. Black bear predation on white-tailed deer fawns. (Draft nearly completed).
7. Lindquist, E., and L. L. Rogers. Eagle and osprey use of white pines.

8. Rogers, L. L. et al. Food habits of black bears of the Great Lakes Region.
9. Rogers, L. L. Use and avoidance of forest roads by black bears in northeastern Minnesota.
10. Use of nipple measurements to assess reproductive status of black bears.
11. Black bear foot pad widths as an indicator of age and sex in censuses using track indices.
12. L. L. Rogers. The importance of down and dead woody material to black bears.
13. L. L. Rogers. How to monitor black bear habitat quality.
14. L. L. Rogers. Use of cementum annuli to assess age and reproductive history of black bears.
15. L. L. Rogers. Weight-carrying capacity of gray jays.
16. L. L. Rogers. Why do black bear males disperse voluntarily?
17. L. L. Rogers, and M. L. Shedd. The importance of mushrooms in the fall diets of white-tailed deer.
18. L. L. Rogers. Seasonal changes in ingestion and defecation rates of black bears in northeastern Minnesota.
19. Authors not decided. Evaluating habitat for wide-ranging species using Landsat imagery.

## 2. Demonstrations, Workshops, and Symposia.

- a. On April 22, 1990, the incumbent led biologists from Canada, China, Holland, Italy, Mexico, Norway, Poland, Portugal, Saudi Arabia, Spain, Sweden, and United States to habituated bears in the Superior National Forest and demonstrated habituation techniques, radio-tracking, interpretation of bear vocalizations and body language, and data collection techniques. The incumbent demonstrated use of the BEAR and BEARWATCH computer programs and distributed diskettes and manuals to interested researchers.
- b. Michigan Department of Natural Resources, Division of Enforcement, January 23, 1991. At the expense and request of the Michigan DNR's Division of Enforcement, the incumbent conducted a 5-hour seminar for the conservation officers of the Michigan's Upper Peninsula. Subjects covered included bear habits, meaning of bear displays, repelling problem bears, trapping bears, aging techniques, movements of live-trapped bears after release, bear population dynamics, and bear habitat use. Newspaper, magazine, and TV reporters also in attendance summarized the seminar for the public.
- c. On July 5, 1991, the incumbent led press reporters from Australia, Colombia, Italy, Romania, Senegal, Switzerland, United States, Uruguay, and Yugoslavia (International Press Association) to habituated bears in the Superior National Forest and demonstrated habituation techniques, radio-tracking, interpretation of bear vocalizations and body language, and data collection techniques. The incumbent demonstrated use of the BEAR and BEARWATCH computer programs. The purpose was to increase awareness of bears, including endangered species of bears, in the reporters own countries and give the reporters a more realistic image of bears than the excessively fearsome one often portrayed.

- d. Each year the incumbent conducts 3-5 weekend seminars (Friday 5 PM to Sunday noon) for teachers, scientists, and interested others from around the country. Topics covered in lectures and field demonstrations include bear, wolf, and ungulate ecology, local vegetation patterns and their relation to glacial and geological patterns, research techniques, bear and wolf behavior and communication methods (postures, vocalizations, and scent marks), hibernation physiology, and problems of wide-ranging species in modern America.

### 3. Computer Software Accomplishments.

- a. BEAR and BEARWATCH. These companion computer programs aid collection and summarization of ecological data using a field computer and a personal computer. The software and xerox copies of the manuals have been distributed to researchers from North Central Forest Experiment Station's, Kawishiwi Field Lab, since June 1989. The programs have been continually updated and refined, and the manuals and programs are now undergoing peer review for formal publication.

### 4. Video Tapes, Slide Tape Programs, Films, and Poster Presentations.

- a. Mutual of Omaha's Wild Kingdom. "The sleeping bears of Kawishiwi" 30 minute program. Aired December 1980 and 7 reruns. Incumbent suggested program content, directed field operations, wrote 40 percent of the script, and narrated 40% of the program.
- b. Nature Watch. 30 minutes on USFS bear and deer research ATV (Anglia TV, United Kingdom). May 23, 1981 and reruns. Incumbent suggested program content, directed research-related field operations (80% of program), and did 30 percent of the narration.
- c. 3-2-1 Contact, PBS TV. 12 minutes on USFS bear research. Spring 1985 and reruns annually through 1991. This program dealt with human medicine aspects of the study and was done jointly with Dr. Ralph Nelson, Director of Research, Carle Foundation Hospital, University of Illinois. Incumbent directed field operations and did 30 percent of the narration.
- d. Newton's Apple, PBS TV. Three pieces (6, 7, and 8 minutes, respectively) giving updates on USFS bear research: 1. Spring 1985 and annual reruns through 1987. 2. October 30, 1988 and annual reruns through 1990. 3. Fall 1991 and a rerun in 1992. Incumbent suggested program content, directed field operations, filmed 10 percent of one of the programs, edited the scripts, and did 25-35 percent of the narrations.
- e. National Geographic Explorer. "Bear Talk." 15 minute segment on USFS bear research, aired April 10, 1988, and several reruns/year through 1991. Used as a wilderness orientation film for recreationists and USFS workers at Visitor Centers and District Ranger Stations at numerous locations around the country. Incumbent directed most field operations, filmed 12 percent of the program, edited the script, and narrated 30 percent of the program.
- f. Nova. "World of the Black Bear." PBS TV. 1 hour. Fall 1990 and reruns. (Incumbent was a scientific advisor with Dr. Charles Jonkel).

- g. Nature. "Black bear of the North." PBS TV (WNET-TV). 1 hour on USFS bear research. March 24, 1991. Incumbent suggested much of the program content, directed 25 percent of the field operations, and spent 3 days in New York writing script and taping narration. This program required over 3 months of filming, and the incumbent was absent during most of the filming.
- h. Education video produced by the U.S. Forest Service, Friends of the BWCAW, and the BWCAW Outfitter's Association for required viewing by all users of the Boundary Waters Canoe Area Wilderness. Incumbent helped develop the script and helped film the bear segment intended to help wilderness visitors understand the black bear and how to respond to encounters. Filming was completed in September 1991, and the video is now in post-production.
- i. Radio updates on North Central Forest Experiment Station's bear research. Monthly 7-10 minute updates (telephone interviews) on Minnesota Public Radio at 8:10 AM the first Thursday of every month, April 1990 through January 1992 and ongoing. Two updates on PBS' All Things Considered (March 1981 and May 1990). WCCO (CBS, Minneapolis) 1 hour talk show (February 15, 1990). KUOM radio, 40 minute talk show (March 7, 1990). Mutual Radio Network "Science Update" produced by American Association for the Advancement of Science for "America in the Morning", (3 minutes, April 1991).
- n. Poster "Black Bear" Minnesota Department of Natural Resources Wilderness Safari Series, January 1991. This informative poster was published by the Minnesota DNR's Division of Parks and Recreation in cooperation with North Central Forest Experiment Station to promote a more realistic image of the black bear among recreationists and to describe North Central's bear research which is conducted cooperatively with the Minnesota DNR. First printing 10,000. Incumbent provided 80 percent of the research information, edited the text, and provided half the photos.
- o. Poster "A Black Bear's Woodland Menu." Designed in cooperation with the Bell Museum of Natural History, this North Central Forest Experiment Station poster illustrates the incumbent's findings on food habits and is distributed to schools and the public. First printing 10,000. January 1992.
- p. Poster presentation "What is important to black bears in the Lakes States?" Presented at the Aspen Symposium, Duluth, Minnesota, July 25-27, 1989 (publ. no. 75).
- q. Poster presentations "Deer research" and "Black bear research." Bell Museum of Natural History, University of Minnesota, February 7, 1987. Seminar "First in the nation: a review of Minnesota's nontraditional wildlife programs for education, research, and management."
- r. Poster presentation "Managing natural populations of black bears in wilderness." Managing America's Enduring Wilderness Resource (Conference), Minneapolis, Minnesota, September 11-17, 1989.

#### G. Other Significant Information.

Between January 1987 and October 1990, incumbent spent a substantial amount of time in a major litigation: Vermont Department of Fish and Wildlife vs. Killington Ltd. At issue was ski development of a habitat corridor that connects the northern and southern portions of the Green Mountains National Forest. The Vermont DFW and a citizen's organization, Friends of Parker's

Gore, requested that the incumbent serve as an expert witness in this litigation along with Dr. Michael Pelton, Dr. Kenneth Elowe, and Dr. Charles Willey. Incumbent gave several hours of testimony and spent the equivalent of several weeks assisting attorneys and biologists in determining the impact of ski development on the bear habitat corridor and evaluating mitigation possibilities until the Vermont Environmental Board issued a decision in 1991 to ban ski development in the corridor under Vermont Act 250.

Between January 1987 and February 1990, incumbent spent a substantial amount of time incorporating his research findings into a Science Museum of Minnesota Exhibit "Bears in Imagination and Reality." As scientific advisor, the incumbent suggested concepts to be illustrated, provided specimens for mounting and reference photos for body positions, provided authentic background materials such as bear trees, ant logs, hornet nests, den nest material, research equipment, and photos of bear habitat, wrote the scripts for all black bear displays and video productions, provided 98% of the video for the video productions (2 5-minute videos on bear food, habitat use, and behavior), provided audio tapes of bear sounds, and provided photos illustrating aspects of bear behavior not covered in the dioramas. The exhibit opened at the Science Museum of Minnesota on February 17, 1990 and began traveling in January 1991. Over the next several years, it will show at 24 museums and miscellaneous sites such as National Geographic Society headquarters and Yellowstone National Park. This million dollar exhibit is the largest, most comprehensive bear exhibit to date and will educate over a million people according to Science Museum of Minnesota estimates.

Between September 1988 and October 1991, incumbent spent a substantial amount of time assisting The Nature Conservancy and the Minnesota Department of Natural Resources Natural Heritage Program in acquiring and protecting a unique, mile-long stand of oak that draws bears from more than 22 miles away. Incumbent identified the stand as critical and unique bear habitat, alerted the Minnesota Chapter of The Nature Conservancy and the Minnesota DNR Natural Heritage Program, provided documentation of its value to black bears and other wildlife in northeastern Minnesota, and assisted fund-raisers attempting to acquire and protect the property. The Nature Conservancy acquired the property and a square mile of surrounding property called Palisade Valley. The 1991 Minnesota State Legislature added the property to Tetegouche State Park, protecting the property in perpetuity.