



# Celebration of 100 Years of “Nutrient Requirement” Publications

Donald C. Beitz  
Iowa State University

# National Research Council

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- The NRC plays a major role in establishing nutrient requirements
- The NRC is a private, nonprofit organization established in 1916 to provide advice to the U.S. Federal Government on issues of science and industry
- The NRC is the working arm of the National Academy of Sciences



# History of the National Research Council

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- 1863 National Academy of Sciences  
Abraham Lincoln signed a charter that established the NAS to serve the nation by furthering science and technology
- 1916 National Research Council  
Woodrow Wilson asked NAS to provide government with broader scientific research services to assist in military preparedness of the country
- 1917 Animal Nutrition Subcommittee of Committee on Food and Nutrition
- 1919 Division of Biology and Agriculture formed
- 1919 Animal nutrition became part of Division of Biology and Agriculture
- 1928 Committee on Animal Nutrition established



# Agriculture Committee Transitions to Board on Agriculture and Natural Resources

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1917	Agriculture Committee
1918	Division of Agriculture, Forestry, Botany, and Fisheries
1919	Division of Biology and Agriculture
1944	Agriculture Board
1973	Board on Agriculture and Renewable Resources (BARR)
	Board on Agriculture (BA)
	Board on Agriculture and Natural Resources (BANR)



# Hierarchy of Committee on Animal Nutrition

- National Academy of Sciences (NAS)
  - National Academy of Engineering (NAE)
  - Institute of Medicine (IOM)
- } National Academy of Sciences, Engineering, and Medicine (NASEM)
- The National Academies
  - National Research Council (NRC)
  - Board on Agriculture and National Resources (BANR)
  - Committee on Animal Nutrition (CAN)
  - Subcommittee on Horse Nutrition



# National Research Council Horse Publication

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- 1949 – Recommended Nutrient Allowances for Horses
- 1966 – Nutrient Requirements for Horses
- 1973 – Nutrient Requirements for Horses, 3<sup>rd</sup> Revised Edition
- 1978 – Nutrient Requirements for Horses, 4<sup>th</sup> Revised Edition
- 1989 – Nutrient Requirements for Horses, 5<sup>th</sup> Revised Edition



# Early Goals of Committee on Animal Nutrition

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- Meet Hoover's goal of "A chicken in every pot"
- Provide leadership to agricultural committee by "defining animal nutrient needs and feed nutrient values to allow farmers improve cost-effectiveness of feeding regimes"
- Utilizes knowledge of essentiality of nutrients as they were determined
- Face challenges in animal agriculture because of Great Depression



# First Reports of Subcommittee on Animal Nutrition

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## 1921

- Cooperative Experiments upon Protein Requirements for the Growth of Cattle
- On Formulation of Methods of Experimentation in Animal Production
- The Determination of the Protein Requirements of Animals and of the Protein Values of Farm Feeds and Ration





# Early Publications of Committee on Animal Nutrition

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1942

1. The Fluorine Problem of Livestock Feeding
2. Iodine – Its Necessity and Stabilization
3. The Nutrition of Swine during the War Emergency
4. Nutrition and Reproduction of Farm Animals
5. Suggestions for Meeting the War-Time Poultry Feed Situation
6. War Emergency Plans for Raising Calves and Heifers



# Early Publications of Committee on Animal Nutrition

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1943

1. The Effect of Storage of Grains on Their Nutritive Value
2. Is Animal Protein an Essential Constituent of Swine and Poultry Rations
3. Suggestions for Meeting the Poultry Feed Situation during 1943
4. Use of Phosphorous-Containing Substitutes for Bone Meal in Livestock Feeding with Particular Reference to the Fluorine Hazard



# First Nutrient Requirement of Species Publications

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1944

- Recommended Nutrient Allowances for Poultry
- Recommended Nutrient Allowances for Swine

1945

- Recommended Nutrient Allowances for Beef Cattle
- Recommended Nutrient Allowances for Dairy Cattle
- Recommended Nutrient Allowances for Sheep

(1953: Changed to Nutrient Requirements for .....)



# First Species- Focused Report

RECOMMENDED  
NUTRIENT ALLOWANCES FOR  
DOMESTIC ANIMALS

NUMBER I  
RECOMMENDED NUTRIENT ALLOWANCES  
FOR POULTRY

*A Report of the*  
COMMITTEE ON ANIMAL NUTRITION

*Prepared by*  
SUB-COMMITTEE ON POULTRY NUTRITION

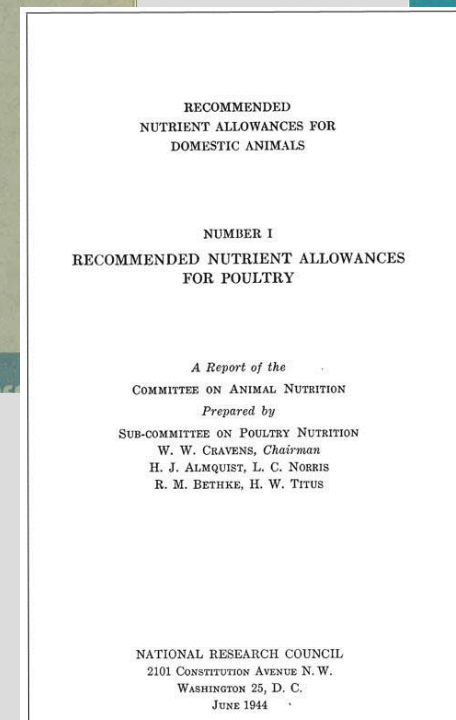
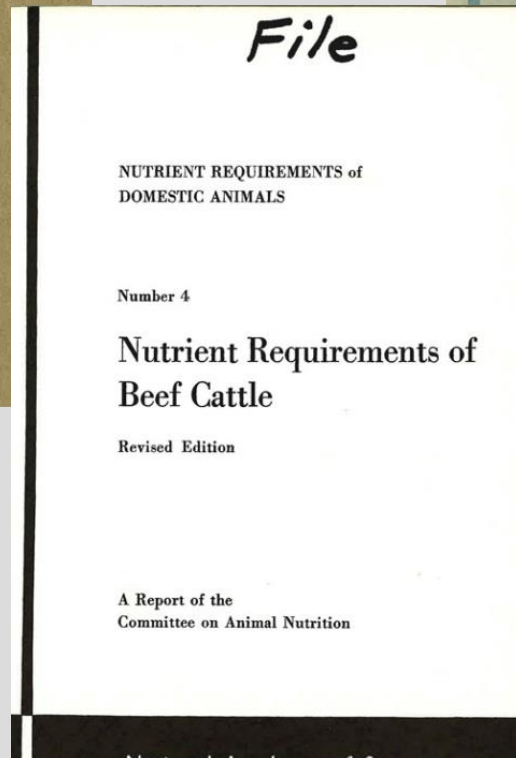
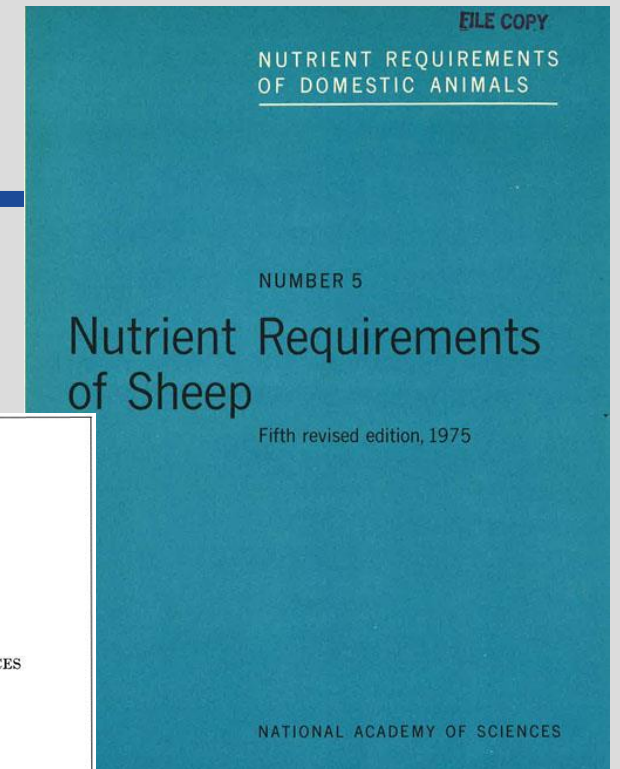
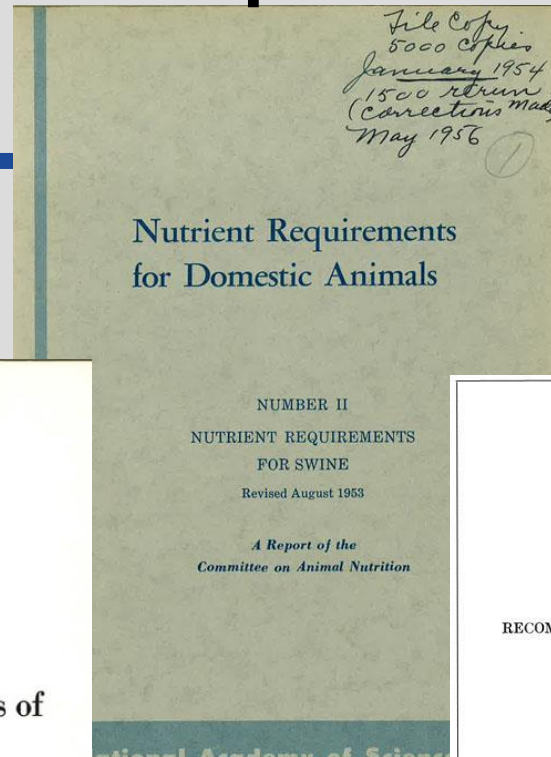
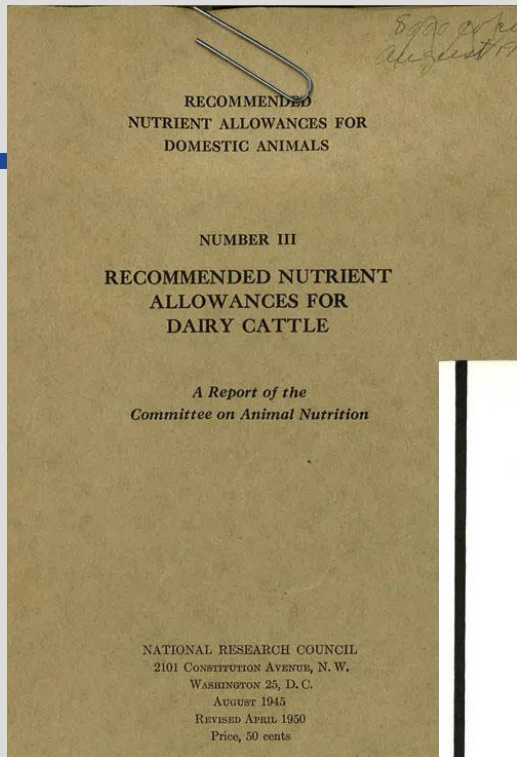
W. W. CRAVENS, *Chairman*  
H. J. ALMQUIST, L. C. NORRIS  
R. M. BETHKE, H. W. TITUS

NATIONAL RESEARCH COUNCIL  
2101 CONSTITUTION AVENUE N. W.  
WASHINGTON 25, D. C.  
JUNE 1944



The **National Animal  
Nutrition Program**

# First Five Species Reports



# Second Wave of Species Reports





# Selected Current Species Reports



# The Process of Developing a CAN Report

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1. Establish need for report (by CAN, stakeholders)
2. Develop charge to subcommittee (by NRC, CAN)
3. Search for candidates for subcommittee membership (by CAN)
4. Appoint subcommittee members (by chair of NRC)
5. Examine evidence and hold face-to-face meetings (by subcommittee)
6. Provide oversight of subcommittee (by CAN, NRC)
7. Report on findings, conclusions, and recommendations (based on fact and rigorous analysis of refereed data)
8. Review of report (by experts)
9. Publish, market, and distribute report (by National Academies Press)





# Content of Nutrient Requirement Publications

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1. Digestion, biochemistry, and physiology of nutrients
2. Welfare and environmental aspects of nutrients
3. Nutrient requirement tables
  - Stage of life, production, reproduction
4. Nutrient composition of feeds
5. Model evaluation and prediction equations
  - 1989 – Dairy (6<sup>th</sup>); 2001 (7<sup>th</sup>)
  - 1989 – Horses (5<sup>th</sup>)
  - 1996 – Beef Cattle (7<sup>th</sup>); 2016 (8<sup>th</sup>)
  - 1998 – Swine (10<sup>th</sup>); 2012 (11<sup>th</sup>)
  - 2007 – Horses (6<sup>th</sup>)



# Sponsors of CAN Publications

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- National Research Council
- National Academy Press
- Users of publications
- Federal organizations – e.g., USDA, ARS, FDA, NIH
- Private organizations – e.g., AFIA, CFIA
- Pharmaceutical and feed companies
- Foundations
- Animal commodity groups



# New Technologies Stimulated Need for Revised Publications

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- Discovery of essential nutrients
- Fat-to-lean ratios of carcasses
- Demand for saturated fat in human diet
- Demand for low-fat foods
- Use of metabolic modifiers
- New feed processing technologies on nutrient bioavailability
- Development of models of animal productivity



# Advances in Nutrient Requirements of Swine

Ed	Year	Nutrients	Nutrients with an Estimated Requirement
1	1994	11	TDN, CP, Ca, P, K, carotene, vitamins A and D, thiamin, niacin, pantothenic acid, riboflavin, and pyridoxine
2	1950	14	Added Lys, Trp, Met, Cl; Deleted K and vitamin A
3	1953	27	Added choline, vitamin B <sub>12</sub> , Cu, Fe, I, Mn, and the 7 other essential AA
4	1959	29	Added DE (calculated from TDN), vitamin A, Mg, and Zn
5	1964	30	Added Se
6	1968	30	Changed carotene to $\beta$ -carotene



# Advances in Nutrient Requirements of Swine

<b>Ed</b>	<b>Year</b>	<b>Nutrients</b>	<b>Nutrients with an Estimated Requirement</b>
7	1973	31	Added DE (not calculated from TDN), ME, and vitamin E
8	1979	35	Added K, vitamin K, biotin, and folacin
9	1988	36	Added available P and linoleic acid; Changed niacin to available niacin
10	1998	36	Added true and apparent ileal digestible AA and Cr recognized as a required nutrient; Changed AA and energy requirements estimated with mathematical equations (model)
11	2012	36	Added an updated computer model

(10 pages in 1944 to 189 pages in 1998; references from 69 to 1,524)



# Use of Reports of Committee of Animal Nutrition

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- Stimulate future scientific investigations
- Educate next generation of students for industry and academics
- Serve as central component of outreach programs to improve care of research, farm, and companion animals
- Stimulate discussions of:
  - Sustainable animal agriculture
  - Food safety and quality
  - Animal care and well-being
  - Environmental quality
  - International trade and development
- Provide a principal reference on animal nutrition for academia, animal industry, consultants, and producers



# Foreign Translation Versions of Nutrient Requirement Series

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Bulgarian 1998, Swine

Chinese 1994, Poultry; 2003, Nonhuman Primates; 2001, Dairy Cattle; 2006, Dogs and Cats; 2011, Fish and Shrimp; 2012, Dairy Cattle; 2016, Beef Cattle

Japanese 2001, Dairy Cattle

Korean 2007, Horses

Spanish 1966, Horses; 1968, Swine; 1970, Rabbits; 1968, Beef Cattle; 1975, Sheep; 1978, Dairy Cattle



# Latest Nutrient Requirement Publications

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2016 Beef Cattle

2012 Swine

2011 Fish and Shrimp

2007 Small Ruminants, Sheep, Goats, Cervids, and New World Camelids

2007 Horses

2006 Dogs and Cats (2<sup>nd</sup> being considered)

2001 Dairy Cattle (8<sup>th</sup> underway)

1995 Laboratory Animals

1994 Poultry (10<sup>th</sup> underway)

1982 Mink and Foxes

1978 Nonhuman Primates

1977 Rabbits





# Contributors to Poultry Update

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AB Vista  
Adisseo  
ADM  
Ajinomoto  
Cargill  
Dupont  
DSM  
Evonik  
Hy-Line  
Huvepharma  
Micronutrients  
Novus  
USDA-Ag Research Service

United Soybean Board  
PA Poultry Research  
Committee  
NRSP/NANP (Experiment  
Station Directors)  
National Academy of Sciences  
(internal from reports sales)  
IFEEDER  
Illinois Corn Marketing Assoc.  
(Cost of study \$480K)



# Recent Issue-Oriented Reports

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- Safety of Dietary Supplements for Horses, Dogs, and Cats (2008)
- Mineral Tolerance of Animals (2<sup>nd</sup> revised edition; 2005)
- Air Emissions from Animal Feeding Operations
- The Role of Chromium in Animal Nutrition (1997)
- Metabolic Modifiers: Effects on Nutrient Requirements of Food-Producing Animals (1994)
- Vitamin Tolerance of Animals (1987)
- Ruminant Nitrogen Usage (1985)
- Selenium in Nutrition (1983)
- Underutilized Resources as Animal Feedstuffs (1983)
- Nutritional Energetics of Domestic Animals (1981)
- Taurine Requirement of the Cat (1981)
- The Effect of Genetic Variance on Nutritional Requirements of Animals (1975)



# National Academy Press

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- Non-profit publishing entity of NASEM
- Publisher of CAN reports
- Income from sales kept by Press
- In 2004, business model change where some income used for future publications of Nutrient Requirement series



# Summary of U.S. Sales of Nutrient Requirement Publications

Title	Year Issued	Lifetime Sales
Mineral Tolerance of Animals, Second Revised Edition	2005	1,398
Nutrient Requirements of Dogs and Cats	2006	3,796
Nutrient Requirements of Beef Cattle: Eighth Revised Edition	2016	2,261
Nutrient Requirements of Swine: Eleventh Revised Edition	2012	2,424
Nutrient Requirements of Fish and Shrimp	2011	1,899
Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids	2007	2,919
Nutrient Requirements of Poultry: Ninth Revised Edition	1994	9,965
Nutrient Requirements of Dairy Cattle: Seventh Revised Edition	2001	12,396
Nutrient Requirements of Beef Cattle,: Seventh Revised Edition	1996	11,569
Nutrient Requirements of Swine: Tenthh Revised Edition	1998	8,340



# Chairs of Committee on Animal Nutrition

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P. E. Howe 1928-1940  
L. A. Maynard 1941-1944  
L. C. Norris 1945-1964  
W. M. Beeson 1965-1972  
T. J. Cunha 1973-1975  
R. R. Oltjen 1976-1978  
J. P. Fontenot 1979-1981

D. E. Ullrey 1982-1984  
J. G. Morris 1985-1987  
D. E. Johnson 1988-1991  
H. F. Hintz 1992-1995  
D. C. Beitz 1996-1998  
G. L. Cromwell 1998-2002

(139 total CAN members – 1928-1998; 10 to 15 scientists per CAN)



# Members of the Last Committee on Animal Nutrition

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Gary L. Cromwell (chair) -- Univ. of Kentucky	Swine
Rosalina Angelo -- Univ. of Maryland	Poultry
Jesse Goff -- USDA/NADC	Dairy
Ronald Hardy -- Univ. of Idaho	Fish
Kristen Johnson -- Washington State Univ.	Beef
Brian McBride -- Univ. of Guelph	Ruminant
Keith Rinehart -- Perdue Farms, Inc.	Poultry
L. Lee Southern -- Louisiana State Univ.	Swine
Donald R. Topliff -- West Texas A&M Univ.	Equine



# Transition of Committee on Animal Nutrition

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- BANR conducted review of status of CAN in 1998-2000
- Review committee recommended transfer of activities of CAN to BANR
- More animal scientists were added to BANR
- Final outcome: Activities of CAN has been assumed by BANR
- NANP established and complements BANR



# Role of NANP in Nutrient Requirement Series

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- Complement NRC/BANR roles
- Help with fundraising (e.g., Poultry)
- Suggest authors of publications
- Recommend reviewers
- Provide high quality feed composition data
- Develop and provide animal models





# Roles of Feed Composition Subcommittee

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- Bring together data and research resources in the area of feed composition
- Foster communication among those collecting feed composition information
- Facilitate efficiencies and consistencies in data collection and maintenance



# Roles of Modeling Subcommittee

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- Improve use of predictive technologies and tools to best utilize available platforms
- To work with researchers to effectively share, combine, manage, manipulate, and analyze models and modeling information



# Accomplishments and Current Activities of Feed Composition Subcommittee of NANP

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1. Developed database structure for feed composition repositories with input templates for beef, dairy, poultry, and swine
2. Work with Modeling Subcommittee to support needs regarding ingredient composition data as model inputs
3. Continue to collect feed composition information
4. Identify assays or methods that prove to have potential benefits to diet formulation
5. Help different NRC/NASEM committees to develop feed composition tables
6. Create a webpage displaying feed composition tables
7. Develop algorithms to classify feeds automatically based on differences in nutrient composition
8. Organize symposium and participate in conferences



# Accomplishments and Current Activities of Modeling Subcommittee of NANP

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1. Update NRC Dairy Cattle Model 2001
  - Two calculation errors were corrected
  - Installation program was recompiled to support 64-bit Windows installations
2. Update NRC Beef Cattle Model 2000
  - Created an installation program for model to operate on modern Windows-based computers
3. Work with researchers to develop and share modeling information
4. Develop a review of techniques used to evaluate models
5. Develop article with guidelines for reporting dietary information in publications
6. Evaluate software platforms that could be used across NRC models
7. Develop a database for observational data, for use in model development
8. Collect feedback from model users
9. Assess supply and requirement model subcomponents for use across species



# Concluding Statements

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1. Great foresight of Abraham Lincoln in promoting a national science program
2. Great contribution of CAN to the science, practice, and teaching of animal nutrition
3. Contributions made by hundreds of volunteer scientists as innovators, writers, reviewers, and users of CAN publications
4. Great example of public/private partnership in providing latest animal nutrition information to academic community, regulators, feed industry, producers, consultants, and other users
5. Publications regarded as the benchmark for animal nutrition

