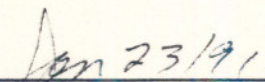


SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY  
SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: ENVIRONMENTAL ANALYSIS (OUTLINE & LAB MANUAL)  
CODE NO.: FOR 364-6 SEMESTER: V  
PROGRAM: FISH AND WILDLIFE TECHNOLOGY  
AUTHOR: VALERIE WALKER  
DATE: JANUARY 1991 PREVIOUS OUTLINE DATED: JANUARY 1990

APPROVED:   
DEAN

 23/91.  
DATE

ENVIRONMENTAL ANALYSIS - OUTLINE & LAB MANUAL FOR 364-6

I. PHILOSOPHY/GOALS:

This lab-based course provides the measurement and analysis of various parameters within the environment as well as a discussion of their significance. Topics include instrument operation, calibration and standardization and proper laboratory techniques. Labs will examine primary production, oxygen consumption in aquatic systems, response of organisms to a toxicant (bioassay) and the buffering capacity of lakes as related to acid precipitation. Outdoor Labs will examine temperature and oxygen stratification of lakes in winter, the effect of ice on lake productivity and snow density and snow type and its impact on wildlife. In addition, organic molecules of importance as related to the nutritional requirements of wildlife, will be studied with a practical application to bomb calorimetry.

II. STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student will be able to:

1. Discuss the physical, biological and ecological relationships in lentic versus lotic environments.
2. Describe those factors affecting oxygen consumption and production in aquatic systems.
3. Define pollution and discuss the categories of contamination.
4. Outline the procedure for setting up a bioassay and discuss the determination of LC50's, ET50's and toxicity curves.
5. Demonstrate the use and standardization of pH and oxygen meters.
6. Conduct an accurate titration for total inflection point alkalinity and dissolved oxygen.
7. Demonstrate the use of a snow gauge and correct documentation of results.
8. Discuss the physics of snow and its impact on wildlife.
9. List and discuss the essential nutrients required in wildlife nutrition and determine the caloric value of food items through bomb calorimetry.

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III. TOPICS TO BE COVERED:

WEEK

- 1            Introduction
- evaluation
  - course outline
  - lab safety
  - lab equipment
- 1            **Lab 1            Densities of Liquids and Solids**
- 1-3         Unit I:         Freshwater Systems
- lotic and lentic environments
  - food chains and food transfer effects
  - recycling
  - seasonal production cycles
  - factors affecting primary productivity
  - stability of ecosystems
- 2            **Lab 2            Primary Production in Standing Water**
- 4            Unit II:         Oxygen Consumption in Aquatic Animals
- factors affecting oxygen consumption
  - oxygen as a limiting factor
- 4            **Lab 3            Temperature & Oxygen Consumption in Aquatic Animals**
- 5            **TERM TEST #1**
- 5,6         Unit III:         Aquatic Pollutants
- definition of pollution
  - categories of contamination
  - acidification (SPEAKER)
  - toxicity terminology
  - environmental factors affecting toxicity
  - biomagnification
  - bioassays
  - (Videos - H<sub>2</sub> Overview, Early Warning)

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III. TOPICS TO BE COVERED: CONTINUED

- 7        Lab 4        Total Inflection Point Alkalinity
- 8        Lab 5        Bioassay
- 8        - (Speaker: Sea Lamprey)
- 9        TERM TEST #2
- 9,10    Unit IV - Winter Surveys
- inverse stratification of lakes
  - ice formation and its effect on light, production, oxygen
  - snow compaction, chillometer
  - physics of snow
- 10       Lab 6        Winter Lake Survey/Snow Study
- 11,12   Unit V:        Organic Molecules in Wildlife Nutrition
- required nutrients:
    - water
    - protein
    - carbohydrates
    - lipids
  - energy metabolism
  - macrominerals
  - micro (trace) minerals
- 12       Lab 7 (a)    Bomb Calorimetry - Sample Preparation
- 13       LAB 7 (b)    Bomb Calorimetry - Bombing
- 14       TERM TEST #3

N.B.    SCHEDULE SUBJECT TO CHANGE

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IV. EVALUATION METHOD:

- A - 80%
- B - 70%
- C - 60%
- R - less than 60%

|                |             |
|----------------|-------------|
| Lab Reports    | - 50%       |
| Term Tests (3) | - 50%       |
|                | <u>100%</u> |

Due to the practical nature of this course and the emphasis on laboratory technique and data interpretation, there will be no opportunity for a "rewrite".

Students with a final grade of less than 60% will receive an "R" grade. All labs must be submitted for a passing grade.

Lab attendance is **compulsory**. Students missing labs without documented reason run the risk of repeating the course.

V. REQUIRED STUDENT RESOURCES:

TEXTBOOK(S):

No textbook required for purchase. Lab manual is available at Campus Bookstore.

EQUIPMENT:

- lab coat
- safety glasses

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VI. ADDITIONAL RESOURCE MATERIAL AVAILABLE IN THE COLLEGE LIBRARY:

Alabaster, J.S. and R. Lloyd. 1982 Water Criteria for Freshwater Fish (2nd Edition). Butterworth's Inc., Yarmouth MA.

\*American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 1975, Standard Methods for the Examination of Water and Wastewater. 14th ed. Am. Publ. Health Assoc., Washington, D.C.

\*American Society for Testing and Materials. 1977. Bacterial Indicators - Health Hazards Associated with Water. ASTM, Phil.

\*American Society for Testing and Material. 1977. Aquatic Toxicology and Hazard Evaluation. ASTM, Philadelphia.

\*Andrews, W. A. 1972. A Guide to the Study of Environmental Pollution. Prentice-Hall, Inc. Scarborough, Ontario.

Ashworth, W. 1989. The Late, Great Lakes: An Environmental History. Collins Publ., Stockton, California. QH 545.A1 A57 1989

Black, John A. 1977. Water Pollution Technology. Reston Publishing Company, Inc. Virginia.

Brewer, Richard. 1979. Principles of Ecology. Saunders, Philadelphia

Brown, Lester Russell. 1988. State of the Word: A Worldwatch Institution Report on Progress Toward a Sustainable Society. W. W. Norton, New York

Burns, Noel M. 1985. Erie: The Lake that Survived. Rowman & Allanheld Pub., Totowa, N.J.

\*Cairns, John Jr. 1982. Biological Monitoring in Water Pollution. Pergamon.

Cairns, V.W., Hodson, Peter V. and Nriagu, J.O. 1984. Contaminant Effects on Fisheries. John Wiley & Sons, New York.

Chant, D. A. 1970. Pollution Probe. New Press, Toronto.

Colborn, Theo and Davidson. 1990. Great Lakes, Great Legacy? Conservation Foundation and Institute for Research on Public Policy in Canada. Halifax, N.S. TD 181.G73 G73 1990

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VI. ADDITIONAL RESOURCE MATERIAL - 2

Delwiche, C.C. 1981. Denitrification, Nitrification and Atmospheric Nitrous Oxide. Wiley, New York

Edmondson, W. T. (1969). Eutrophication in North America. In - Eutrophication - Causes, Consequences, Correctives. pp. 124-49. National Academy of Sciences, Washington.

Environmental Protection Agency. 198\_. Water Quality Criteria. E.P.A. R3-73-033. Washington, D.C.

\*Environmental Studies Board. 1983. Committee on Atmospheric Transport and Chemical Transformation in Acid Precipitation. Acid Deposition: Atmospheric Processes in Eastern North America. National Academy Press, Washington, D.C.

Freeman, A.M., Robert Haveman and Allen Kneese. 1984. The Economics of Environmental Policy. R.E. Krieger Publishing Co., Inc., Florida

\*Goldman, Charles R. and A. J. Horne. 1983. Limnology. McGraw-Hill, Toronto.

\*Gordon, Malcolm S. 1982. Animal Physiology: Principles and Adaptations (4th edition). MacMillan Publishing Co., Inc. New York.

Gore, James A. 1985. The Restoration of Rivers and Streams: Theories and Experience. Butterworth Publishing Co., Boston

Hammer, Mark J., 1986. Water and Wastewater Technology. John Wiley and Son Inc., New York.

Heath, Alan G. 1987. Water Pollution and Fish Physiology. CRC Press Inc., Boca Raton, Florida. SH174.H43 1987

\*Hoar, W. S. 1983. General and Comparative Physiology (3rd Edition). Prentice-Hall, Inc., New Jersey.

Hoar, W. S., and D.J. Randall, (eds.). 1979. Fish Physiology. Vol.7: Locomotion Academic Press, Inc., London.

\*Hoar, W.S., D.J. Randall and J.R. Brett (eds). 1979. Fish Physiology. Vol.8: Bioenergetics and Growth. Academic Press, Inc., London.

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ADDITIONAL RESOURCE MATERIAL - 3

Hocutt, Charles H. and Jay R. Stauffer Jr. (eds). 1980. Biological Monitoring of Fish. Lexington Books, Lexington, Mass.

Huntley, R.V. and R.Z. Rivers (eds). 1986. Proceedings of the Acid Rain Evaluation Seminar. Dept. of Fisheries and Oceans, Ottawa.

\*Hynes, H. B. N. 1970. The Ecology of Running Waters. University Toronto Press, Toronto.

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Isom, Billy G., S.D. Dennis, J.M. Bates. 1986. Impact of Acid Rain and Deposition on Aquatic Biological System. ASTM, Philadelphia.

Johnson, Raymond E. 1982. Acid Rain/Fisheries: Proceedings of an International Symposium on Acidic Precipitation and Fishery Impacts in Northeastern North America, Cornell University, Ithaca, New York, August 2-5, 1981. American Fisheries Assoc., Bethesda, Md.

Kimball, John W. 1978. Biology. 4th Ed. Addison-Wesley, Don Mills, Toronto.

\*Krenkel, P.A. and Parker, F.L. 1973. Nation Symposium on Thermal Pollution Proceedings: Biological Aspects of Thermal Pollution.

\*Larkin, P.A. 1974. Freshwater Pollution Canadian Style. McGill-Queen's University Press, Montreal.

\*Laws, Edward A. 1981. Aquatic Pollution - An Introductory Text. John Wiley and Sons, Toronto.

Mason, C. F. 1981. Biology of Freshwater Pollution. Longman.

McKane, L. and Kandel J., 1985. Micro-Biology Essentials and Applications. McGraw-Hill Book Co., Toronto.

\*McNeely, R. N., V. P. Neimanis and L. Dwyer. 1979. Water Quality Sourcebook Guide to Water Quality Parameters. Environment Canada, Inland Waters Directorate, Water Quality Branch, Ottawa.

Morgan, James and Werner Stum. 1981. Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibrium in Natural Waters. Wiley, New York



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ADDITIONAL RESOURCE MATERIAL - 4

Murty, A.S. 1986. Toxicity of Pesticides to Fish. CRC Press. Boca Raton, FLA.

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Palmer, C. Mervin. 1980. Algae and Water Pollution. Castle House Publications, Ltd., England.

Pavoni, J.L., 1977. Handbook of Water Quality Management Planning. Van Nostrand Reinhold Co., Litton Educational Publishing Inc., New York.

Pickering, A.D. 1981. Stress and Fish. Academic Press, San Diego, California. QL639.1 S74 1981

Rand, Gary M and Sam, R. 1985. Fundamentals of Aquatic Toxicology; Methods and Applications. Hemisphere Publications, Washington.

\*Reid, George K. 1961. Ecology of Inland Waters and Estuaries. Van Nostrand Reinhold Co., Toronto.

\*Ruttner, F. 1963. Fundamentals of Limnology. University of Toronto Press, Toronto.

Salle, A.J., 1967, Fundamental Principles of Bacteriology. 6th edition, McGraw-Hill Book Co., Toronto.

Shubert, Elliot L. 1984. Algae as Ecological Indicators. Academic Press, San Diego, California. QK 565.A46 1984

\*Smith, R. L. 1974. Ecology and Field Biology. Harper and Row Publishers, New York.

\*Sprague, J. B. 1973. The ABC's of pollution bioassay using fish. Biological Methods for the Assessment of Water Quality, ASTM STP 528, American Society for Testing and Materials, 1973, pp. 6-30. (Reprint available)

Suffet, Irwin H. 1977. Fate of Pollutants in the Air and Water Environments. Wiley, New York.

Tinsley, Ian J. 1979. Chemical Concepts in Pollution Behaviour. Wiley Interscience, New York.

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ADDITIONAL RESOURCE MATERIAL - 5

Tu, Anthony T. (ed). 1982. Survey of Contemporary Toxicology, Vol. 2. Wiley, New York.

Vallentyne, J. R. 1974. The Algae Bowl. Lakes and Man. Canada Department of the Environment, Fish and Marine Service, Misc. Spec. Pub. No. 22: 186 pp.

Viessman, W.Jr. and M.J. Hammer. 1985 Water Supply and Pollution Control. Harper and Row, Publishers, New York.

Wagner R. H., 1971. Environment and Man. Norton, New York.

Warren, C. E. 1971. Biology and Water Pollution Control. Saunders, Philadelphia.

Wetzel, Robert G. 1983. Limnology (2nd Edition). Saunders. College Publishing, Toronto.

Wetzel, R. G., and G. E. Likens, 1979. Limnological Analyses. Saunders, Philadelphia.

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\*Worf, D. L. 1980. Biological Monitoring for Environmental Effects. Lexington Books, San Diego, CA

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Bagenal, T.B. (ed). 1974. The Aging of Fish. Proceedings of an International Symposium (University of Reading, England, 1973), Unwin Brothers Ltd., Surrey, England

Nielsen, Larry A. and David L. Johnson (eds). 1983. Fisheries Techniques. American Fisheries Society. Southern Printing Co., Inc., Blacksburg, Virginia

Summerfelt, Robert C. and Gordon E. Hall (eds). 1987. Age and Growth of Fish. Iowa State University Press. Ames, Iowa

Weatherley, A.H. and H.S. Gill. 1987. The Biology of Fish Growth. Academic Press. Toronto, Ontario

\*ON RESERVE AT THE COLLEGE LIBRARY