



**I. COURSE DESCRIPTION:**

This course concentrates on the methods and equipment used in the culture of cold-water fish such as trout and salmon. Hatchery requirements including water quality and quantity, egg sources, collection and incubation, and early and late rearing facilities are studied. Hatchery operation and record keeping, fish nutrition and feeding, management for fish health and brood stock management are also discussed. The classroom environment is supplemented with videos and on site visits to area hatcheries. Students will prepare a technical report on a specific problem associated with hatchery fish production, stocking or survival.

**II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:**

Upon successful completion of this course, the CICE student, with the assistance of an Educational Assistant will demonstrate a basic ability to:

**1. Beneficially apply his/her aquaculture knowledge in the location and design of aquaculture facilities.****Potential Elements of the Performance:**

- Have a basic understanding of the importance of aquaculture and the species raised in Canada and Ontario
- describe water quality requirements for cold water hatchery location
- recognize treatment methods for problems with incoming water supply and for water supply reuse
- describe requirements and methods for treatment of hatchery effluent
- describe the general layout of hatchery buildings
- describe layout of egg incubation facilities and type and layout of rearing facilities
- describe the use of cages to rear cold water fish

*This learning outcome will constitute 15% of the course's grade.*

**2. Apply his/her knowledge in the correct operation of coldwater Aquaculture facilities.****Potential Elements of the Performance:**

- recognize the significance of the length-weight relationship
- diagram the relationship between growth and water temperature
- discuss the concept of carrying capacity in rearing facilities
- explain methods of doing inventories of eggs and fish
- explain proper methods of grading fish, handling and harvesting
- describe the necessary procedures in management of the rearing unit including cleaning and disinfection.
- explain general record-keeping procedures and the need for them.

*This learning outcome will constitute 15% of the course's grade*

**3. Discuss the various aspects of brood stock management.****Potential Elements of the Performance:**

- recognize the acquisition and care of broodstock
- recognize methods of selective breeding of broodstock
- recognize procedures used for artificial spawning/insemination
- recognize methods of controlling spawning time in broodstock

*This learning outcome will constitute 10% of the course's grade.*

**4. Describe the stages of egg development and implications for handling and care.****Potential Elements of the Performance:**

- name the stages in egg development
- explain factors which affect egg development
- recognize egg enumeration and sorting methods
- recognize methods of egg disinfection
- recognize the transportation of eggs
- recognize the advantages of major types of incubators

*This learning outcome will constitute 10% of the course's grade.*

**5. Describe the important nutritional requirements of fish, feed sources types and feeding protocol.****Potential Elements of the Performance:**

- recognize factors influencing nutritional requirements of fish
- state the important nutritional requirements of fish
- recognize feed sources
- recognize proper feed handling and storage
- describe proper feeding protocol

*This learning outcome will constitute 20% of the course's grade*

**6. Recognize signs and symptoms of common fish diseases/parasites in cold water hatcheries and determine the prescription for control.****Potential Elements of the Performance:**

- have a basic understanding of the major disease organisms of hatchery fish associated symptoms and treatment with each.
- explain the relationship between stress with disease
- explain methods of equipment and hatchery decontamination
- recognize the preparation and treatment of diseased specimens for analysis

*This learning outcome will constitute 20% of the course's grade.*

**7. Employ appropriate equipment, timing and handling methods in the transportation of hatchery fish to be stocked.**

**Potential Elements of the Performance:**

- recognize types of transportation equipment
- explain water quality requirements
- recognize the proper loading, handling and stocking of fish
- recognize the use of anesthetics to control stress
- recognize the proper timing of stocking procedures

*This learning outcome will constitute 10% of the course's grade.*

**III. TOPICS:**

1. Importance and species raised and location, design and layout of cold water aquaculture facilities.
2. Operation of aquaculture facilities.
3. Broodstock development, care and spawning.
4. Egg development and care.
5. Nutrition and feeding of fish
6. Parasites/diseases and their symptoms and treatment
7. Handling and movement of hatchery fish

**V. REQUIRED RESOURCES/TEXTS/MATERIALS:**

**Castledine, A.J. 1987. Aquaculture in Ontario. Toronto, Queen's Printer for Ontario. 80 pp.**

Traditional lecture/discussion in a classroom setting for each topic will be supplemented with slides and videos. Reference texts are available on reserve in the library. Two or three field trips to view aquaculture facilities in the region will be provided.

Students will do short technical reports on each of the tours and will do one page summaries of each video presentation.

## V. EVALUATION PROCESS/GRADING SYSTEM

<b>Unit Tests (3)</b> <b>(based on lectures, field trips, videos)</b>	<b>60%</b>
<b>Field Trip Reports</b> <b>(must attend to submit report)</b>	<b>15%</b>
<b>Summaries of videos</b>	<b>10%</b>
<b>Tour Summaries*</b>	<b>(15%)</b>
	<b>100%</b>

Assignments and report values will be reduced at a rate of 10% per day for late submissions for a period of 5 days after the due date. After 5 days lab assignment/report value will be zero.

All assignments must be submitted regardless of lateness to pass the course. Field trips and/or tests missed without documented health or personal reasons will be valued at zero.

The following semester grades will be assigned to students in postsecondary courses:

<u>Grade</u>	<u>Definition</u>	<u>Grade Point Equivalent</u>
A+	90 - 100%	4.00
A	80 - 89%	3.75
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 - 59%	1.00
F (Fail)	59% and below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field /clinical placement or non-graded subject area.	
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.	
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course without academic penalty.	

**VI. SPECIAL NOTES:**Special Needs:

If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your instructor and/or the Special Needs office. Visit Room E1101 or call Extension 703 so that support services can be arranged for you.

Retention of course outlines:

It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Plagiarism:

Students should refer to the definition of “academic dishonesty” in *Student Rights and Responsibilities*. Students who engage in “academic dishonesty” will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course/program, as may be decided by the professor/dean. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Course outline amendments:

The Professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

**VII. PRIOR LEARNING ASSESSMENT:**

Students who wish to apply for advanced credit in the course should consult the professor. Credit for prior learning will be given upon successful completion of a challenge exam or portfolio.

**VIII. DIRECT CREDIT TRANSFERS:**

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean's secretary. Students will be required to provide a transcript and course outline related to the course in question.

**AQUACULTURE/NUTRITION REFERENCES**

Beveridge, Malcolm, C.M. 1987. Cage Aquaculture. Fishing News Books Ltd. New York, N.Y. SH151.B48

Brown, E. Evan. 1980. Fish Farming Handbook. AVI Publishing Co., Inc. Westport, CT.

Castledine, A. J. 1984. Handbook of Fish Culture. Ontario Ministries of Agriculture & Food, Environment and Natural Resources, (Toronto). n.p.

Cowey, C., A. Mackie and J. Bell (eds). 1985. Nutrition and Feeding in Fish. Academic Press, Inc., New York, N.Y. SH156.N88 1985.

Davis, H.S. 1973. Culture and Diseases of Game Fishes. University of California Press, Berkeley, CA.

Halver, John E. 1988. Fish Nutrition (2nd ed). Academic Press, Inc., New York, N.Y. Co. Inc.

Harrell, R.M. 1990. Culture and Propagation of Striped Bass and its Hybrids. A.F.S. Bethesda, Maryland.

Huner, J.V. and E.E. Brown 1985. Crustacean & Mollusk Aquaculture in the United States. AVI Publishing Co. Inc. SH365.A3C78 1985.

Klontz, G. no date. A Manual for Trout and Salmon Production. Nelson & Sons, Murray (UT). n.p.

Lannan, J.E. 1986. Principles and Practices of Pond Aquaculture. AVI Publishing Co., Inc. Westport, CT.

Leitritz, Earl and Robert C. Lewis. 1980. Trout and Salmon Culture (Hatchery Methods). ANR Publications, Oakland (CA).

March, B.e. and M.G. Walsh. 1987. Salmonid Culture, Fundamentals and Practice for British Columbia. Univ. of British Columbia, Vancouver. 283 pp.

McLarney, William, O. 1984. The Freshwater Aquaculture Book: A Handbook for Small Scale Fish Culture in North America. Hartley and Makrs, Inc.

Meade, J.W. 1989. Aquaculture Management. Van Nostrand Reinhold. SH135 M43 1989.

Muir, J.F. and R.J. Roberts (eds). 1985. Recent Advances in Aquaculture. Vol. 2. Westview Press, Boulder, CO.

**Piper, Robert G. et al. 1982. Fish Hatchery Management. United States Dept. of the Interior. Fish and Wildlife Service, Washington, DC.**

Robbins, W. H. and H. R. MacCrimmon. The Blackbass in America and Overseas. Biomangement and Research Ent., Sault Ste. Marie, 196 p.

Sedgwick, Stephen Drummond. 1973. Trout Farming Handbook. Seeley Service, London.

Spotte, S. 1979. Fish and Invertebrate Culture (2nd ed). John Wiley and Sons, Inc., Rexdale, ON.

Stroud, R.H. (ed). 1986. Fish Culture in Fisheries Management. AFS, Bethesda, Maryland.

Swift, Donald R. 1985. Aquaculture Training Manual, Fishing News Books Ltd., Surrey, England

Thorpe, J.E. 1980. Salmon Ranching. Academic Press, Inc. New York, New York.

Willoughby, S. 1999. Manual of Salmonid Farming. Fishing News Books, Blackwell. Oxford. 329 pp.

## **FISH DISEASE REFERENCES**

### **GENERAL**

AMOS, K.H. (ed). 1985. Procedures for the Detection and Identification of Certain Fish Pathogens. 3rd edition. AFS, Bethesda, Maryland.

BRUNO, D.W. and T.T. POPPE. 1996. A colour Atlas of Salmonid Diseases. Academic Press, London & New York 194. pp.

ELLIS, ANTHONY E. 1985. Fish and Shellfish Pathology. Academic Press. Harcourt and Brace Jovanovich, Don Mills, Ont.

LASEE, B.A. (editor) 1995. Introduction to Fish Health Management, Revised Edition. USDA Fish & Wildlife Service, Washington. 139 pp.

MAWDESLEY THOMAS, L.E., ed. 1972. Diseases of Fish. No. 30. Symposia of the Zoological Society of London, Academic Press, London and New York.

MCDANIEL, D. (editor) 1979. Procedures for the Detection and Identification of Certain Fish Pathogens (revised). Amer. Fish. Society, (Washington). 118 pp.

NOGA, E.J. 2000. Fish Disease, Diagnosis and Treatment, Iowa State Univ. Press, Ames. 367 pp.

POST, G. 1983. Textbook of Fish Health. TFH Publication, Inc. Ltd., Neptune city. N.J.

RIBELIN, W.E., and G. MIGAKI, eds. 1975. Pathology of Fishes. University of Wisconsin Press, Madison, WI. pp. 1004.

ROBERTS, R.J., ed., 1978. Fish Pathology. Bailliere Tindall, London. pp. 1978.

ROBERTS, R.J. and C.J. SHEPHERD, 1974. Handbook of Trout and Salmon Diseases. Fishing News (Books) Ltd., Surrey, England. pp. 168

WARREN, J.C. 1978. Diseases of hatchery fish. United States Fish and Wildlife Service. Twin Cities, Minnesota. pp. 94

WOOD, J.W. 1968. Diseases of Pacific Salmon, their Prevention and Treatment. Hatchery Division, Department of Fisheries, State of Washington, Olympia, WA. pp. 82.

**BACTERIAL AND FUNGAL** (see also GENERAL references above)

BULLOCK, G.L., D.A. CONROY, S.F. SNIEZSKO 1971. Bacterial diseases of fishes. In Snieszko S.K. and H.R. Axelrod, eds. Book 2A of Diseases of Fishes. T.F.H. Publications, Inc., Neptune City, N.J. pp. 151.

**VIRAL** (see also GENERAL references above).

SNIESZKO, S.F., R.F. NIGRELLI, K. WOLF. 1965. Viral Disease of Poikilothermic Vertebrates. New York Academy of Sciences. Annals of the New York Academy of Sciences, New York, N.J. pp. 680.

WOLF, K. 1966. The Fish Viruses. Advances in Virus Research. Vol. 12, Academic Press. New York, N.J. pp. 36-101.

WOLF, K. 1988. Fish Viruses and Fish Viral Diseases. Cornell University Press.

**PARASITIC** (see also GENERAL references above).

BOUSFIELD, E.L. 1987. Amphipod Parasites of Fish of Canada. Canadian Bulletin of Fisheries and Aquatic Sciences #217, Fisheries and Oceans, Ottawa.

HOFFMAN, G.L., 1967. Parasites of North American Freshwater Fishes, University of California Press, Berkeley, CA pp. 486.

HOFFMAN, G.L. AND F.P. MEYER. 1974. Parasites of Freshwater Fishes. T.F.H. Publications, Inc., Neptune City, N.J. pp. 224.

KABATA, Z. 1970. Crustacea As Enemies of Fishes. In S.F. Snieszko and H.R. Axelrod, eds. Book 1 of Diseases of Fishes. T.F.H. Publications, Inc., Neptune City, N.J. pp. 171.

**NUTRITIONAL**

ASHLEY, L.M. 1972. Nutritional Pathology. In Halver, J.W., ed. fish Nutrition. Academic Press, New York N.Y. pp. 439-537.

HALVER, J.E. 1976. Nutritional Deficiency Diseases In Salmonids. Fish Pathology 10: 165-180.

## **ENVIRONMENTAL AND EFFECTS OF ENVIRONMENT ON INFECTIOUS DISEASES**

(see also GENERAL references above).

STECHEY, D. and Y. TRUDELL. 1990. Aquaculture Wastewater Treatment: Wastewater Characterization and Development of Appropriate Treatment Technologies for the Ontario Trout Industry. Environment Ontario, Toronto. 108 pp.

FRYER, J.L. AND K.S. PILCHER. 1974 Effects of Temperature on Diseases of Salmonid Fishes. U.S. Environmental Protection Agency. Washington, D.C. pp. 115.

HABITAT ADVISORY BOARD OF THE GREAT LAKES FISHERY COMMISSION AND THE GREAT LAKES WATER QUALITY BOARD OF THE INTERNATIONAL JOINT COMMISSION. 1999. Addressing Concerns for Water Quality Impacts from Large-scale Great Lakes Aquaculture. International Joint Comm. and Great Lakes Fishery Comm. Windsor & Ann Arbor. 78 pp.

UMA ENGINEERING LTD. 1988. Waste Water treatment in Aquaculture Facilities. Ministry of Environment, Ontario, Toronto. 61 pp. + Appendices.

WEDEMEYER, G.A., F.P. MEYER, L. SMITH. 1976. Environmental Stress and Fish Diseases. In S.F. Snieszko and H.R. Axelrod, eds. Book 5 of Diseases of Fishes. T.F.H. Publications, Inc., Neptune City, N.J. pp. 192

ZWEIG, R.D., J.D. MORTON and M.M. STEWART. 1999. Source Water Quality for Aquaculture, a Guide for Assessment. The World Bank, Washington. 62 pp.

## **AQUACULTURE BUSINESS**

PALFREMAN, A. 1999. Fish Business Management, Strategy –Marketing – Development. Fishing News Books, Blackwell, Oxford. 294 pp.

NOTE: Most of the above references are found in the library - in the stacks, in reference or on reserve at the front under your instructor's name and the course number. Other faculty may also have some office copies if required.

**CICE Modifications:****Preparation and Participation**

1. An Integrative Educational Assistant will attend class with the student(s) to assist with inclusion in the class and to take notes.
2. Students will receive support in and outside of the classroom (i.e. tutoring, assistance with homework and assignments, preparation for exams, tests and quizzes.)
3. Study notes will be geared to test content and style which will match with modified learning outcomes.
4. Although the Integrative Educational Assistant may not attend all classes with the student(s), support will always be available. When the Integrative Educational Assistant does attend classes he/she will remain as inconspicuous as possible.

**A. Tests may be modified in the following ways:**

1. Tests, which require essay answers, may be modified to short answers.
2. Short answer questions may be changed to multiple choice or the question may be simplified so the answer will reflect a basic understanding.
3. Tests, which use fill in the blank format, may be modified to include a few choices for each question, or a list of choices for all questions. This will allow the student to match or use visual clues.
4. Tests in the T/F or multiple choice format may be modified by rewording or clarifying statements into layman's or simplified terms. Multiple choice questions may have a reduced number of choices.

**B. Tests will be written in CICE office with assistance from an Integrative Educational Assistant.*****The Integrative Educational Assistant may:***

1. Read the test question to the student.
2. Paraphrase the test question without revealing any key words or definitions.
3. Transcribe the student's verbal answer.
4. Test length may be reduced and time allowed to complete test may be increased.

**C. Assignments may be modified in the following ways:**

1. Assignments may be modified by reducing the amount of information required while maintaining general concepts.
2. Some assignments may be eliminated depending on the number of assignments required in the particular course.

***The Integrative Educational Assistant may:***

1. Use a question/answer format instead of essay/research format
2. Propose a reduction in the number of references required for an assignment
3. Assist with groups to ensure that student comprehends his/her role within the group
4. Require an extension on due dates due to the fact that some students may require additional time to process information
5. Formally summarize articles and assigned readings to isolate main points for the student
6. Use questioning techniques and paraphrasing to assist in student comprehension of an assignment

**D. Evaluation:**

Is reflective of modified learning outcomes.