SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE:	AQUACULTURE		
CODE NO. :	NRT209	**SEMESTER:**	IV
PROGRAM:	FISH & WILDLIFE TECHNICIAN		
AUTHOR:	H. ROBBINS		
DATE:	JAN. 2000	**PREVIOUS OUTLINE DATED:**	NEW
APPROVED:			
	DEAN		**DATE**
TOTAL CREDITS:	3		
PREREQUISITE(S):	NONE		
LENGTH OF COURSE:	15 WEEKS	**TOTAL CREDIT HOURS:**	45

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 student will demonstrate the ability to:

1. Beneficially apply his/her aquaculture knowledge in the location and design of aquaculture facilities.

   Potential Elements of the Performance:
   - Describe water quality requirements for cold water hatchery location
   - Describe 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:
   - Describe 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. Handle and spawn broodstock, and handle, incubate and transport eggs of salmonid species without excessive mortality.

   Potential Elements of the Performance:
   - Describe the acquisition and care of broodstock
   - Describe methods of selective breeding of broodstock
   - Describe procedures used for artificial spawning/insemination
   - Describe 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
   - Describe the stages in egg development
   - Explain factors which affect egg development
   - Describe egg enumeration and sorting methods
   - Describe methods of egg disinfection
   - Describe the transportation of eggs
   - Describe 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
   - Describe factors influencing nutritional requirements of fish
   - State the important nutritional requirements of fish
   - Describe feed sources
   - Describe 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 prescribe treatment/elimination of the offending organism(s).

   Potential Elements of the Performance
   - Describe the major disease organisms of hatchery fish associated symptoms and treatment with each.
   - Explain the relationship of stress with disease

- Explain methods of equipment and hatchery decontamination
- Describe 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 movement of hatchery fish to be stocked.

Potential Elements of the Performance

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

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

III. TOPICS:

1. 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.

ADDITIONAL RESOURCES

AQUACULTURE/NUTRITION REFERENCES

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

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

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.

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.

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.

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.

FISH DISEASE REFERENCES

GENERAL

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

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

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

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, Universit 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).

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.

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

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.

V. GRADING AND EVALUATION

1. Technical Reports on field trips to aquaculture facilities — 15%
2. Summaries of videos — 10%
3. Term Tests (3) — 75%
   Based on lectures, field trips, videos.

The following semester grades will be assigned to students in post-secondary courses:

Grade	Definition	Grade Point Equivalent
A+	90 - 100%	4.00
A	80 - 89%	3.75
B	70 - 79%	3.00
C	60 - 69%	2.00
R (Repeat)	59% or below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field placement or non-graded subject areas.	
U	Unsatisfactory achievement in field placement or non-graded subject areas.	
X	A temporary grade. This is used in limited situations with extenuating circumstances giving a student additional time to complete the requirements for a course (see *Policies & Procedures Manual – Deferred Grades and Make-up*).	

NR	Grade not reported to Registrar's office. This is used to facilitate transcript preparation when, for extenuating circumstances, it has been impossible for the faculty member to report grades.

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 E1204 or call Extension 493, 717, or 491 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 post-secondary 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, as may be decided by the professor. 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.

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 instructor. Credit for prior learning will be given upon successful completion of the following:

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.