

SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ON

COURSE OUTLINE

COURSE TITLE: AQUACULTURE

CODE NO.: FOR341-3 SEMESTER: VI

PROGRAM: INTEGRATED RESOURCE MANAGEMENT TECHNOLOGY

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DATE: JANUARY 1996 PREVIOUS OUTLINE DATED: NEW

APPROVED:

M. Cook
DEAN

January 5, 1996
DATE

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TOTAL CREDITS 48

PREREQUISITE(S): NONE

I. PHILOSOPHY/GOALS:

This is a practical course with the principal emphasis placed on the culture of coldwater 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 traditional classroom environment is partially replaced by a work practicum at a local hatchery. Students provide a verbal and written report on a specific aspect of the operation of this hatchery.

II. STUDENT PERFORMANCE OBJECTIVES (OUTCOMES):

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

1. Beneficially apply his/her aquaculture knowledge in the location and design of private aquaculture facilities.
2. Apply his/her aquaculture knowledge in recommending improvements in existing aquaculture facilities.
3. Apply his/her knowledge in the correct operation of coldwater aquaculture facilities.
4. Handle and spawn broodstock, and handle, incubate and transport eggs of salmonid species without excessive mortality.
5. Describe the stages of egg development and implications for handling and care.
6. Describe the types of incubators and their advantages/disadvantages in rearing coldwater species.
7. Recognize signs and symptoms of common fish diseases/parasites in coldwater hatcheries and prescribe treatment/elimination of the offending organism(s).
8. Employ appropriate equipment, timing and handling methods in the movement of hatchery fish to be stocked. Employ appropriate shipping methods for fresh and live table fish produced from hatcheries and other rearing facilities.
9. Describe methods used in the incubation and rearing of warmwater and baitfish for distribution to various markets.

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III. TOPICS TO BE COVERED:

Approximate Time
Frames

1. Hatchery Requirements

Water Quality - temperature, dissolved
gases, suspended and dissolved solids,
turbidity

Water Supply and Treatment - incoming water
and reuse

9 hours

Treatment of Effluent Water and Sludge

Hatchery Design

Buildings, egg incubation facilities,
types and selection of rearing
facilities

Cage Culture

2. Hatchery Operation

Production Methods

Length - weight relationship

Growth & Water Temperature

Carrying Capacity

Inventory Methods

Grading, Handling and Harvesting

Rearing Unit Management

Record Keeping

6 hours

3. Broodstock, Spawning and Egg Handling

Acquisition and care of broodstock
Improvement of Broodstock (selective
breeding)

9 hours

Spawning of broodstock/wildstock

- artificial spawning/insemination

- control of spawning time in
broodstock

Egg Incubation and Handling

- stages in egg development

- factors affecting egg development

- egg enumeration and sorting

- egg disinfection

- egg transportation

- incubator types

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III. TOPICS TO BE COVERED: (continued)

Approximate Time
Frames

4. Nutrition and Feeding

Factors Influencing Nutritional
Requirements

Nutritional Requirements

9 hours

- protein
- carbohydrate
- lipids
- energy
- vitamins
- minerals
- fiber and other non-nutrients
- influences on fish quality and
flavour
- toxicants in feeds

Feed Sources

- types of feed
- manufacturers

Feed Handling and Storage

Feeding

- feed guides
- initial feeding and frequency
- feed sizes
- feeding methods

5. Fish Health Management

Diseases

- characteristics and causative
organisms
- signs and recognition
- stress and its relationship to
disease
- treatment of diseases
 - methods of treatment
 - chemicals and their uses
- equipment and hatchery
decontamination
- preparation and shipment of diseased
specimens for analysis

6 hours

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III. TOPICS TO BE COVERED: (continued)

Approximate Time
Frames

6. Transportation and Stocking of Hatchery Stock

3 hours

- types of transportation equipment
- water quality requirements
- handling, loading and stocking
- stress and use of anesthetics
- timing of stocking

7. Production of Warm Water Fishes

- smallmouth/largemouth bass
- collection and incubation of eggs
- rearing of fry
- sand culture of fingerlings
- catfish culture
- walleye culture
- baitfish production methods

3 hours

IV. LEARNING ACTIVITIES/REQUIRED RESOURCES

All Units:

Traditional lecture/discussion in a classroom setting for each topic will be supplemented with slides and field trips to local hatcheries for on site viewing. All students will obtain on site experience by putting in 40 hours of work at a hatchery/rearing facility in the region.

All students will take one aspect of the facility at which they have worked, prepare a technical report on the subject and do a brief classroom presentation to fellow students.

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TECHNICAL REPORT

A technical report of approximately ten pages (typewritten - double spacing) is required on one of the topics listed below. Each student will select a different topic and apply this to one of the two local hatcheries - the municipal hatchery downtown or the Provincial Tarentorus Hatchery off of Landslide Road. Thus two students may select the same topic but each will discuss it in relation to a different hatchery.

The format for technical reports required for co-op reports will be used as the marking criteria for this assignment.

Each report will include the following:

- occurrence/practice/problems/applicability to the local hatchery selected
- local attempts to correct the problem(s) or to use the recommended methods/formula
- your assessment of their success or lack of success
- your recommendations on how the hatchery involved should change their present practices related to your topic.
- a one page summary of the report contents and findings for distribution to classmates

Topic Listing

Quality of Incoming Water (except temperature)
Water Temperature
Effluent Treatment
Hatchery Record Keeping
Production Methods (capacities, growth, variation in size etc.)
Broodstock Care and Maintenance
Egg Sources and Collection Methods
Egg Incubation and Handling (to swim-up stage)
Nutrition and Feed Supply
Fish Disease(s)
Fish Parasite(s)
Transportation and Stocking Methodology

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V. EVALUATION METHODS:

1. Work Performance Evaluation (by hatchery representative)	20%
2. Technical Report	20%
3. In class Presentation of Topic	10%
4. Term Tests (2) Based on lectures, field trips, presentations, etc.	50%
	<u>100%</u>

All students must successfully complete each of the first three activities for a passing grade.

Grading	A+ - 86 - 100%
	A - 75 - 85%
	B - 68 - 75%
	C - 60 - 68%
	R - less than 60%

VI. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the instructor.

VII. REQUIRED STUDENT RESOURCES

Castledine, A.S. 1988. Aquaculture in Ontario. Revised 1988. Toronto, Ministry of Natural Resources, Ministry of Agriculture and Food and Ministry of Environment. 80 pp.

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VIII. ADDITIONAL RESOURCES

AQUACULTURE/NUTRITION REFERENCES

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

Bonn, E.W. et al. 1976. Guidelines for Striped Bass Culture. AFS Publishing Co., Bethesda, MA. SH351.B3G85

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

Brown, E. Evan. 1980. Crustacean and Mollusk Aquaculture in the United States. 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.

Goldman, Charles R. 1983. Freshwater Crayfish V. AVI Publishing Co., Inc. Westport, CT.

Hall, G.E. (ed) 1986. Managing Muskies. Papers from the International Muskie Symposium at LaCrosse, Wisconsin, April 4-6, 1984. AFS Publishing Co., Bethesda, MA.

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

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.

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VIII. ADDITIONAL RESOURCES (continued)

AQUACULTURE/NUTRITION REFERENCES
(continued)

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.

Stickney, R.R. 1979. Principles of Warmwater Aquaculture. John Wiley and Sons, Inc., Rexdale, ON.

Stickney, Robert R. 1986. Culture of Nonsalmonid Freshwater Fishes. CRC Press, Inc., Boca Raton, FLA.

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.

Tucker, C.S. (ed). 1985. Channel Catfish Culture. Elsevier Science Publishing Co., New York, N.Y. SH167.C35C48 1985.

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VIII. ADDITIONAL RESOURCES (continued)

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, Academic 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.

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VIII. ADDITIONAL RESOURCES (continued)

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.

VIII. ADDITIONAL RESOURCES (continued)

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.

IX. SPECIAL NOTES

Students with special needs (eg. physical limitations, visual impairments, hearing impairments, learning disabilities) are encouraged to discuss required accommodations confidentially with the instructor.

Your instructor reserves the right to modify the course as he/she deems necessary to meet the needs of students.