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FOR 327-3
COURSE NUMBER

FISHERIES BIOLOGY/MANAGEMENT
COURSE NAME

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

COURSE OUTLINE

FISHERIES BIOLOGY/MANAGEMENT

COURSE TITLE:

CODE NO.: FOR 327-3 SEMESTER: V

PROGRAM: FISH AND WILDLIFE TECHNOLOGY

AUTHOR: VALERIE WALKER

DATE: JANUARY 1992 PREVIOUS OUTLINE DATED: JANUARY 1991

APPROVED: [Signature]
Dean

Feb 14 1992
Date

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

TOTAL CREDIT HOURS: 48

PREREQUISITE(S): NONE

I. PHILOSOPHY/GOALS:

A practical course dealing with anatomy, physiology, identification and biology of Ontario's sport and commercial fish. The principles, philosophy and application of fisheries management, including fish culture in Ontario will also be addressed.

II. STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student will:

1. Identify important sports and commercial fish of Ontario and discuss their biology.
2. Describe the basic anatomy and general physiology of a fish.
3. Describe the policies and objectives as well as the physical requirements for fish culture in Ontario.
4. List the goals, issues and management strategies identified under S.P.O.F.
5. Describe the regulatory and non-regulatory mechanisms used to control angler exploitation of fish stocks.
6. Discuss the use of the morpho-edaphic index to predict potential fish yields.
7. Outline the pros and cons of artificial fishing opportunities.
8. Discuss the objectives of the Community Fisheries Involvement Program and the procedure in planning and executing a C.F.I.P. project.
9. List and discuss the requirements of trout and outline basic trout stream rehabilitation techniques.
10. Discuss methods of fisheries assessment and the role of fisheries assessment units in Ontario.

COURSE NAME

COURSE NUMBER

III. TOPICS TO BE COVERED:

<u>Hours</u>	<u>Lecture Schedule</u>	<u>Hours</u>
4	UNIT 1 Introduction to Fishes <ul style="list-style-type: none">- modern fishes- fish classification- distinguishing characteristics of Families of fish	4
5	UNIT 2 Anatomy and Physiology <ul style="list-style-type: none">- integument- musculature- skeleton- circulatory system- respiration system- digestive system- nervous system- osmoregulation/excretion- endocrine system	5
6	UNIT 3 Ecology and Development <ul style="list-style-type: none">- form and movement- reproduction/strategies- embryology- growth	6

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

Lecture Schedule - Continued

Hours

5

UNIT 4 Fish Biology (Presentations)

- natural history of important game/commercial fish

8

UNIT 5 Aquaculture

- policies/objectives
Speaker: MNR
- fish handling
- egg collection/fertilization
Video: Rainbow Trout Egg Collection
- systems: cage culture
Video: Espanola Cage Culture
- closed systems
Video: Dorion Fish Hatchery
Video: Thessalon Hatchery
- feeding
- hatchery management
Field Trip: Platte River Hatchery
Field Trip: Tarentorus Fish Culture Station

8

UNIT 6 Fisheries Management

- policies, objectives
- management strategies in Ontario
- SCOL, PERCID, STOCKS, SLIS, SPOF
- Community Fisheries Involvement Programs (CFIP)
- Fisheries Assessment Units
- Fisheries Management Plans

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

LABORATORY METHODS: (INCLUDES ASSIGNMENTS, ATTENDANCE REQUIREMENTS ETC.)

Lab Schedule

Hours

- 2 **LAB 1.** Fish Classification
 - distinguishing characteristics
 of Families

- 2 **LAB 2.** Fish Dissection

- 2 **LAB 3.** Fish Identification Group #1

- 2 **LAB 4.** Fish Identification Group #2

- 2 **LAB 5.** Fish Identification Group #3

- 2 **LAB 6.** Fish Identification Group #4

- 1 **LAB 7.** Fish Identification TEST

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

IV. EVALUATION METHODS: (INCLUDES ASSIGNMENTS, ATTENDANCE REQUIREMENTS ETC.)

- A+ - 90% - 100%
- A - 80% - 89%
- B - 70% - 79%
- C - 60% - 69%
- R - less than 60%

MARKS

A. Term Tests	40
B. Laboratory Tests	15
C. Fish Biology Oral Presentation	10
D. Management Report	15
E. Small Fish Collection	15
F. Physiology Report	5
TOTAL	<u>100%</u>

A. Term Test

Term tests will be based on lectures, field trips, video and guest speaker presentations. Term tests will account for 40% of the course grade.

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

B. Laboratory Test

Several practical lab tests based on the identification of Ontario's freshwater fish will comprise 20% of the course grade.

A Grade of 85% is mandatory for each lab test on species identification.

Scientific names must accompany common names only for major game species of Ontario.

Students will also be tested on the use of identification keys.

C. Fish Biology Oral Presentation

Students are required to give a 10 minute oral presentation outlining the:

1. identification features
2. range
3. habitat/food preferences
4. life history (be sure to include age at sexual maturity)
5. importance

of a commercial/sports fish of significance in Ontario.

Each student will present a typed handout (with the categories outlined above) which summarizes in point form the highlights of the presentation.

The handout will be given to the instructor prior to the actual presentation so as to be copied for each member of the class.

The oral presentation is valued at 10% of the course grade.

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

ONTARIO FISH SPECIES FOR ORAL PRESENTATIONS

<u>Common Name(s)</u>	<u>Scientific Name</u>
1. Lake trout	<u>Salvelinus namaycush</u>
2. Brook trout	<u>Salvelinus fontinalis</u>
3. Rainbow trout	<u>Oncorhynchus mykiss</u>
4. Brown trout	<u>Salmo trutta</u>
5. Lake whitefish	<u>Coregonus clupeaformis</u>
6. Cisco	<u>Coregonus artedii</u>
7. Smallmouth bass	<u>Micropterus dolomieu</u>
8. Largemouth bass	<u>Micropterus salmoides</u>
9. Rock bass	<u>Ambloplites rupestris</u>
10. Pumpkinseed	<u>Lepomis gibbosus</u>
11. White bass	<u>Morone chrysops</u>
12. Brown bullhead	<u>Ictalurus nebulosus</u>
13. Channel catfish	<u>Ictalurus punctatus</u>
14. Northern Pike	<u>Esox lucius</u>
15. Muskellunge	<u>Esox masquinongy</u>
16. Carp	<u>Cyprinus carpio</u>
17. White sucker	<u>Catostomus commersonii</u>
18. Walleye	<u>Stizostedion vitreum</u>
19. Yellow perch	<u>Perca flavescens</u>
20. Rainbow smelt	<u>Osmerus mordax</u>
21. Coho salmon	<u>Oncorhynchus kisutch</u>
22. Chinook salmon	<u>Oncorhynchus tshawytscha</u>

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

D. FISH CULTURE REPORT

Details to be announced.

E. SMALL FISH COLLECTION

Students are required to make a collection of 12 minnows (F. Cyprinidae, F. Cottidae, F. Gasterosteidae, F. Umbridae, F. Cyprinodontidae and Darters) for submission.

Specimens should be fixed initially in formalin, soaked in water, transferred to an alcohol based preservative (eg. 70% ethyl alcohol) and stored in glass, screw capped vials.

For each specimen a collection record will be completed (supplied) identifying to species.

The minnow collection will comprise 15% of the course grade.

NOTE: Submission of all assignments is mandatory. Students with outstanding assignments will receive an "R" grade regardless of their accumulated grade for the course.

F. FISH PHYSIOLOGY REPORT

Students are required to submit a one page summary of some aspect of fish physiology. (Diagrams may be helpful.)

Reference material is available.

The physiology summary will comprise 5% of the course grade.

FOR 327-3

FISHERIES BIOLOGY/MANAGEMENT

COURSE NUMBER

COURSE NAME

D. FISH CULTURE REPORT

Details to be announced

E. SMALL FISH COLLECTION

SMALL FISH COLLECTION FORM

SPECIMEN NO. _____

COMMON NAME _____

GENUS _____

SPECIES _____

CAPTURE DATE _____

LOCATION _____

WATER DEPTH _____ (meters)

WATER TEMPERATURE _____ (°C)

SUBSTRATE _____

AQUATIC VEGETATION _____

COLLECTOR _____

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

V. REQUIRED STUDENT RESOURCES

TEXTBOOK(S):

Chiasson, Robert. 1980. Laboratory Anatomy of the Perch. Third Edition. Wm. C. Brown Co. Publishers., Dubuque, Iowa.

Nielsen, L.A. and D.L. Johnson (eds.). 1983. Fisheries Techniques. American Fisheries Society. Bethesda, Maryland.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada Bulletin 184.

Ministry of Natural Resources. Aquaculture in Ontario. Fisheries Branch, Toronto, Ontario.

VI. ADDITIONAL RESOURCE MATERIALS:

FISHERIES BIOLOGY REFERENCES

Adams, S. Marshall (ed.) 1990. Biological Indicators of stress in Fish. American Fisheries Society Symposium 8. AFS, Bethesda, Maryland.

Cailliet, G.M., M.S. Love and Q.W. Ebeling. 1985. Fishes, A Field Manual on Their Structure, Identification and Natural History. Wadsworth Publishing Co., Belmont, CA.

Calow, P. (ed.) 1985. Fish Energetics. New Perspectives. The Johns Hopkins University Press, Baltimore, MD.

Carlander, K.D. 1977. Handbook of Freshwater Fishery Biology, Vol. 2. Iowa State University Press. QL625.C373 V.2

Cooper, E.L. (ed.) 1987. Carp in North America. AFS, Bethesda, Maryland.

Craig, John F. 1987. The Biology of Perch and Related Fish. Timber Press, Portland, Oregon.

Goldman, C.R. 1983. Freshwater Crayfish. AVI Publishing Co. Inc. QL444.M33I57 1981.

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

FISHERIES BIOLOGY REFERENCES - CONTINUED

- Hoar, W.S. and D. J. Randall. 1983. Fish Physiology. Academic Press Inc., New York, N.Y.
- Johnson, J.E., 1987. Protected Fishes of the United States and Canada. American Fisheries Society. Bethesda, Maryland. QL 625.J63
- Johnson, L. and B. Burns (eds). 1984. Biology of Arctic Charr. Proceedings after International Symposium, 1981. University Manitoba Press. Winnipeg, Manitoba.
- Kendall, R.L. (ed.) 1978. Selected Coolwater Fishes of North America. American Fisheries Society, Bethesda, Maryland.
- Lagler, K.F., J.E. Bardach and R.R. Miller, 1962. Ichthyology. John Wiley and Sons Inc., New York.
- McKeown, B.A. 1984. Fish Migration. Timber Press. Portland, Oregon.
- Moyle, P.B. and J.J. Cech, Jr. 1982. Fishes: An Introduction to Ichthyology. Prentice-Hall Inc., New Jersey.
- Page, Lawrence M. 1983. Handbook of Darters. TFH Publications, Inc. Ltd. Neptune City, New Jersey.
- Pickering, A. (ed.). 1981. Stress and Fish. Academic Press, Inc., New York, N.Y. QL639.1.S74 1981.
- Potts, G.W. and R.J. Wooton. 1984. Fish Reproduction: Strategies and Tactics. Academic Press, Inc., New York, New York
- Raat, A. 1988. Synopsis of Biological Data on the Northern Pike, Esox lucius Linneaus. FAO Fisheries synopsis No. 30, Rev. 2. FAO.
- Scott, W.B. and E.J. Crossman, 1973. Freshwater Fishes of Canada. Bulletin 184. Fish Res. Board of Can., Ottawa.
- Scott, W.B. and Mildred Grace. 1988. Atlantic Fish of Canada. University of Toronto Press, Downsview, Ont., QL 626.5 A8 S36 1988
- Sedgwick, Stephen Drummond. 1982. The Salmon Handbook. Andre Deutsch Ltd. London.

FISHERIES BIOLOGY REFERENCES - CONTINUED

Sigler, William and J.W. Sigler. 1987. Fishes of the Great Lakes Basin: A Natural History. University of Nevada Press.

Sigler, W. F. and J. W. Sigler, 1990. Recreational Fisheries Management, Theory and Application. University of Nevada Press.

Thompson, P. 1980. The Game Fishes of New England and S.E. Canada. Down East Books. Camden, M.E.

Tytler, Peter and Calow Peter. 1985. Fish Energetics - New Perspectives. John Hopkins University Press. QL639.1.F554 1985.

Weatherly, A.H. and H.S. Gill. 1987. The Biology of Fish Growth. Academic Press Inc., New York, N.Y.

Welcomme, R. 1988. International Introductions of Inland Aquatic Species. FAO Fisheries Technical Paper No. 294. FAO.

FISHERIES MANAGEMENT REFERENCES

Anderson, L.G. (ed). 1986. The Economics of Fisheries Management (2nd ed). The Johns Hopkins University Press, Baltimore, MD.

Bennett, G.W. 1971. Management of Lakes and Ponds. 2nd edition. Van Nostrand Reinhold, Toronto.

Butler, M. et al. 1988. The Application of Remote Sensing Technology to Marine Fisheries: An Introductory Manual. FAO Fisheries Technical Paper #295. Unipub SH334.7.A66.

Everhart, W.H., A.W. Eipper and W.D. Youngs. 1981. Principles of Fisheries Science. Cornell University. Press, Ithaca, London.

Grant, W.E. 1986. Systems Analysis and Simulation in Wildlife and Fisheries Science. John Wiley and Sons, Rexdale, ON.

Gresswell, R.E. (ed.). 1988. Status and Management of Interior Stocks of Cutthroat Trout. A.F.S. Symposium S0892-2284 4. Bethesda, Maryland. QL 638 S2 S785

Lackey, R.T. and L.A. Nielson (eds). 1980. Fisheries Management. John Wiley and Sons. Toronto, Ontario.

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

FISHERIES MANAGEMENT REFERENCES - CONTINUED

McNeil, William J. (ed.). 1988. Salmon Production, Management and Allocation: Biological, Economic and Policy Issues. Proceedings of the World Salmonid Conference, Portland, Oregon in 1986. Oregon State University Press, Oregon.

Mills, Derek and David Piggins (eds). 1988. Atlantic Salmon: Planning for the Future. Proceedings of the Third International Atlantic Salmon Symposium, Biarritz, France in 1986. Timber Press. Portland, OR. SH 346.I57 1986

Mills, D. 1989. Ecology and Management of Atlantic Salmon. Chapman and Hall. QL 638 S2 M48 1989

Nielsen, Larry A. and David L. Johnson (eds). 1983. Fisheries Techniques. AFS, Bethesda, Maryland.

Royce, William F. 1984. Introduction to the Practice of Fishery Science. Academic Press, New York, N.Y.

Royce, William F. 1987. Fishery Development. Academic Press Inc., New York, N.Y. SH328.R74 1987.

Royce, William F. 1987. Fishery Development. Academic Press, New York, N.Y.

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.

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

AQUACULTURE/NUTRITION REFERENCES - CONTINUED

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.

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.

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

AQUACULTURE/NUTRITION REFERENCES - CONTINUED

- 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.

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.

FISHERIES BIOLOGY/MANAGEMENT

FISHERIES BIOLOGY/MANAGEMENT FOR 327-3

COURSE NAME

COURSE NUMBER

FISH DISEASE REFERENCES (cont'd)

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.

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

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

ENVIRONMENT/FISHERIES REFERENCES

Cairns, V.W., P.V. Hodson and J.O. Nriagu. 1984. Contaminant Effects of Fisheries. John Wiley and Sons, Inc., Rexdale, ON

Gore, J.A. (ed). 1985. The Restoration of Rivers and Streams: Theories and Experience. Butterworth Pub., Stoneham, MA.

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

Krumholz, L.A. (ed). 1981. The Warmwater Streams Symposium. AFS, Bethesda, Maryland.

Marshall, Adam S. 1990. Biological Indicators of Stress in Fish. A.F.S. Symposium No. 8. Bethesda, Maryland. 904712

Rand, G. and S. Petrocelli (eds). 1985. Fundamentals of Aquatic Toxicology. Hemisphere Publishing Corp. New York, N.Y.

Schmidtke, Norbert W. (ed). 1987. Toxic Contamination in Large Lakes. Lewis Pub. Inc., Chelsea, MI.

Shubert, L.E. (ed). 1984. Algae as Ecological Indicators. Academic Press, Inc., New York, N.Y.

FISHERIES BIOLOGY/MANAGEMENT

FOR 327-3

COURSE NAME

COURSE NUMBER

VIII. SPECIAL NOTES:

Students with special needs (e.g. 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.

ENVIRONMENT/FISHERIES REFERENCES

Carroll, V.W., P.V. Hobson and J.O. Wright. 1984. Contaminant Effects of Fisheries. John Wiley and Sons, Inc., Reston, VA.

Gore, J.A. (ed). 1985. The Restoration of Rivers and Streams: Theory and Experience. Butterworth Press, London, UK.

Hoch, Alan G. 1987. Water Pollution and Fish Physiology. CRC Press, Boca Raton, Fla.

Kirchhoff, J.A. (ed). 1981. The Waterway Stress Symposium. A.S. Bethesda, Maryland.

Marshall, Adam S. 1990. Biological Indicators of Stress in Fish. A.F.S. Symposium No. 8. Bethesda, Maryland. 304712

Rand, G. and S. Petrocelli (eds). 1985. Fundamentals of Aquatic Toxicology. Hemisphere Publishing Corp. New York, N.Y.

Schmidtke, Herbert W. (ed). 1987. Toxic Contamination in Large Lakes. Lewis Pub. Inc., Chelsea, MI.

Spurr, L.E. (ed). 1984. Algae as Ecological Indicators. Academic Press, Inc., New York, N.Y.