



STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

Number 25

January 2000

Manual of Fisheries Survey Methods II: with Periodic Updates



A light gray outline map of the state of Michigan. The western half of the Lower Peninsula and both peninsulas of the Upper Peninsula are filled with a medium gray color. A small, dark gray diamond-shaped callout points to the name of the editor on the northern part of the Upper Peninsula.

James C. Schneider, Editor

**MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION**

**Fisheries Special Report 25
January 2000**

**MANUAL OF FISHERIES SURVEY METHODS II:
WITH PERIODIC UPDATES**

James C. Schneider, Editor

The Michigan Department of Natural Resources (MDNR), provides equal opportunities for employment and access to Michigan's natural resources. Both State and Federal laws prohibit discrimination on the basis of race, color, national origin, religion, disability, age, sex, height, weight or marital status under the Civil Rights Acts of 1964, as amended, (1976 MI P.A. 453 and 1976 MI P.A. 220, Title V of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act). If you believe that you have been discriminated against in any program, activity or facility, or if you desire additional information, please write the MDNR Office of Legal Services, P.O. Box 30028, Lansing, MI 48909; or the Michigan Department of Civil Rights, State of Michigan, Plaza Building, 1200 6th Ave., Detroit, MI 48226 or the Office of Human Resources, U. S. Fish and Wildlife Service, Office for Diversity and Civil Rights Programs, 4040 North Fairfax Drive, Arlington, VA. 22203.

For information or assistance on this publication, contact the Michigan Department of Natural Resources, Fisheries Division, Box 30446, Lansing, MI 48909, or call 517-373-1280.

This publication is available in alternative formats.



*Printed under authority of Michigan Department of Natural Resources
Total number of copies printed 53 — Total cost \$1,112.50 — Cost per copy \$20.99*

Foreword

The Manual of Fisheries Survey Methods was prepared in 1981 to provide a philosophical framework for sampling Michigan waters and reaffirm and standardize procedures that had drifted through the years. Forms were revised, as needed, to record the most important elements of information. The target audience was field biologists and technicians of the Fisheries Division. Generally, the emphasis was on why and how to sample, rather than exactly how to sample. That left considerable discretion in the hands of the surveyor about, for example, which species to target and how large a sample was needed to solve a specific management problem. It also left open the option to ignore fishes considered to be relatively unimportant to sport fishing.

This has been a “living” document. Sections of the original, especially appendices on growth and length-weight relationships, were updated on an irregular basis and distributed to the small list of manual holders. Some revisions did not reach their audience. By 1998, it was apparent that more sections needed updating, some ideas should to be added and others deleted, and the reasons for surveying should be broadened. Thus, this first major revision was born. It too, will never be completely finished. Some of the above problems will be reduced by maintaining an official version of the Manual of Fisheries Survey Methods II on our Intranet Web Site where it can be more easily updated and distributed. All sections of the document were updated and edited. The names of the original authors (some of which have retired) were retained on the new version unless changes were substantial.

In 1981, as now, certain types of information were essential and could be meaningfully summarized on forms. Paper forms are gradually being replaced by computerized forms linked to databases. However, the concept of forms as packets of related information remains viable and is still the organizing theme of this revision. The new computerized “Fish Collection System” has eliminated some paperwork and guarantees accurate computation of many statistics used routinely. Forms that have been essentially replaced by the computerized system are FISH COLLECTION (R-8058), SURVEY PLANNING (R-8060), and FISH GROWTH (R-8070). Variations of these forms are in electronic format and can be downloaded. Computer software can also create tables used for Status of the Fisheries Reports. These reports summarize catch by species and size, and growth and age composition information.

“Users Guide for the Fish Collection System, April 8, 1997, DNR Fisheries Division” describes the current capabilities of the computer system and exactly how to use it. Consider it a companion document to this survey manual. It is available as a MS-Word document on file servers at most DNR offices under the file name: FISCOL.DOC.

Some forms have been little used since 1981. Examples are LAKE SURVEY SUMMARY (R8063), STREAM SURVEY SUMMARY (R8064), and LAKE PHYSICAL DESCRIPTION (R8057). They are still included in the revision because they contain important elements of information and should be used when appropriate. If nothing else, they can guide the assembly of databases that are in the process of development.

For additional practical discussion of fish survey methods, see “*Fisheries Techniques*” (2nd edition), edited by B. R. Murphy and D. W. Willis and published by the American Fisheries Society in 1996.

Special thanks go to Alan D. Sutton and Ken Muha for preparing the electronic version of Manual of Fisheries Survey Methods II and to James Breck for editorial assistance.

James C. Schneider, editor
January 2000

Foreword

Suggested citation:

Schneider, James C. (ed.) 2000. Manual of fisheries survey methods II: with periodic updates. Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION TO SURVEY MANUAL.....	1
1.1 Perspective.....	1
1.2 Survey planning	1
1.3 Objectives and description of survey modules.....	1
1.3.1 Drainage and basin descriptions	1
1.3.2 Limnology.....	2
1.3.3 Plants and Invertebrates.....	2
1.3.4 Fish Surveys	2
1.3.5 Fishery Assessment	3
1.4 Forms and Information Systems	3
CHAPTER 2: MODULES FOR LAKE AND STREAM SURVEYS.....	1
2.1 Drainage and basin descriptions	1
2.1.1 Lakes	1
2.1.2 Streams.....	1
2.1.2.1 Zones	2
2.1.2.2 Stations	2
2.1.2.3 Length	2
2.1.2.4 Width.....	3
2.1.2.5 Depth	3
2.1.2.6 Cross section profiles.....	3
2.1.2.7 Static water volume.....	3
2.1.2.8 Discharge.....	3
2.1.2.9 Velocity	8
2.1.2.10 Annual stream discharge	8
2.1.2.11 Stream stage.....	8
2.1.2.12 Gradient	8
2.1.2.13 Bed type.....	8
2.1.2.14 Spawning areas	8
2.1.2.15 Cover	8
2.2 Limnology.....	9
2.2.1 Lakes	9
2.2.2 Streams.....	9
2.2.2.1 Temperature	9
2.2.2.2 Water chemistry.....	9
2.2.3 Limnological methods	9
2.2.3.1 Temperature	9
2.2.3.2 Dissolved oxygen.....	10
2.2.3.3 Alkalinity.....	11
2.2.3.4 Secchi disk transparency.....	11
2.2.3.5 Color	12
2.2.3.6 pH.....	12
2.3 Plants and invertebrates	12
2.3.1 Lakes	12
2.3.1.1 Macrophytes	12
2.3.1.2 Phytoplankton	12
2.3.1.3 Fish food	12
2.3.2 Streams.....	14
2.3.2.1 Vegetation	14

2.3.2.2 <i>Fish food</i>	14
2.4 Fish Surveys	14
2.4.1 Discussion	14
2.4.1.1 <i>Catch summary</i>	15
2.4.1.2 <i>Length-frequency and Length-biomass</i>	15
2.4.1.3 <i>Age and growth</i>	16
2.4.1.4 <i>Length-weight regression</i>	16
2.4.1.5 <i>Population estimates</i>	17
2.4.2 Procedures	17
2.4.2.1 <i>Planning</i>	17
2.4.2.2 <i>Forms and records</i>	17
2.4.2.3 <i>Fish identification</i>	18
2.4.2.4 <i>Measuring fish</i>	18
2.4.2.5 <i>Selection of sample sites</i>	18
2.4.2.6 <i>Index stations</i>	19
2.4.2.7 <i>Selection of gear and season</i>	19
2.4.2.8 <i>Duration and effort</i>	24
2.4.2.9 <i>Catch per effort (CPE)</i>	24
2.4.2.10 <i>Fish recruitment surveys</i>	26
2.4.2.11 <i>Length-weight relationship</i>	26
2.4.2.12 <i>Length-frequency</i>	27
2.4.2.13 <i>Length biomass and total biomass</i>	27
2.4.2.14 <i>Average length and weight</i>	28
2.4.2.15 <i>Age and growth</i>	28
2.4.2.16 <i>Population estimates</i>	29
2.4.2.17 <i>Age-frequency and survival</i>	35
2.4.2.18 <i>Production</i>	35
2.4.2.19 <i>Natural history observations</i>	35
2.4.2.20 <i>Nuisance control</i>	35
2.5 Fishery Assessment.....	36
2.6 References	36
 CHAPTER 3: FISHING GEAR	 1
3.1 Trap nets.....	1
3.2 Fyke nets	1
3.3 Inland experimental gill nets	5
3.4 Modified Great Lakes gill nets.....	5
3.5 Seines	5
3.6 Toxicant sampling	5
3.7 Electrofishing.....	6
3.8 Trawl	7
3.9 Visual observations.....	7
3.10 References	7
 CHAPTER 4: FORMS – USES AND POINTS OF CLARIFICATION	 1
SURVEY PLANNING (R-8060).....	1
LIMNOLOGY (R-8056).....	1
LAKE PHYSICAL DESCRIPTION (R-8057).....	2
LAKE AREA AND VOLUME ANALYSIS (R-8069).....	2

FISH COLLECTION (R-8058) and FISH COLLECTION (CONT) (R-8058-1).....	2
LENGTH-WEIGHT FIELD DATA (R-8059).....	4
LENGTH-WEIGHT REGRESSION (R-8059-1).....	4
FISH GROWTH (R-8070)	4
POPULATION ESTIMATES (R-8073).....	4
NOTES AND REFERENCES (R-8077)	5
LAKE SURVEY SUMMARY (R-8063).....	5
STREAM SURVEY SUMMARY (R-8064)	5
MANAGEMENT RECORD (R-8076)	5
HERPS OBSERVATIONS (R-8001).....	5
CHAPTER 5: SURVEY REPORTS	1
5.1 Style.....	1
5.2 Content of River Rotenone Survey Reports.....	1
5.3 Content of Status of the Fishery Resource Reports	2
5.4 References.....	3
CHAPTER 6: SAMPLE SIZE FOR BIOLOGICAL STUDIES.....	1
6.1 Precision	1
6.2 Power	4
6.3 Length-weight bias	7
6.4 References.....	12
CHAPTER 7: STREAM FISH POPULATION ESTIMATES BY MARK-AND-RECAPTURE AND DEPLETION METHODS	1
7.1 Mark-and-recapture estimates.....	1
7.1.1 Chapman - Petersen methods	1
7.2 Depletion estimates	3
7.2.1 Two-pass depletion methods	4
7.2.2 Multiple-pass depletion methods	5
7.3 References.....	13
CHAPTER 8: LAKE FISH POPULATION ESTIMATES BY MARK-AND-RECAPTURE METHODS.....	1
8.1 General procedures	1
8.2 Variations	2
8.2.1 Chapman variation of Petersen formulas for bi-census.....	3
8.2.2 Schumacher-Eschmeyer formulas for multiple census	3
8.2.3 Alternative methods	5
8.2.4 Bias	5
8.3 References.....	9

CHAPTER 9: AGE AND GROWTH METHODS AND STATE AVERAGES	1
9.1 Procedures	2
9.1.1 Recording data on scale envelopes	2
9.1.2 Taking the scale sample.....	2
9.1.3 Making age determinations	3
9.1.4 Back calculation	4
9.2 Michigan average growth summaries	5
9.3 Growth index.....	6
9.4 References	13
CHAPTER 10: MAPPING LAKES WITH ECHO SOUNDERS	1
10.1 Equipment	1
10.2 Mapping procedure	2
10.2.1 Sounder operation instructions	3
10.3 Preparation of the work chart and tracing.....	3
CHAPTER 11: INSTRUCTIONS FOR WINTER LAKE MAPPING.....	1
11.1 Equipment	1
11.1.1 Check list of lake mapping equipment and supplies	1
11.2 Mapping Procedure	2
11.2.1 Access to lakes	2
11.2.2 Lake outline	2
11.2.3 Soundings.....	2
11.2.4 Substrate	3
11.2.5 Shore features	3
11.2.6 Legend.....	5
11.2.7 Bench marks	5
11.3 Completing the map	6
11.3.1 Depth contours	6
11.3.2 Bottom soils	6
11.3.3 Miscellaneous data.....	7
CHAPTER 12: THREE METHODS FOR COMPUTING THE VOLUME OF A LAKE.....	1
12.1 Method No. 1	1
12.2 Method No. 2	1
12.3 Method No. 3	1
12.4 Procedures	1
12.5 Comparison of the three methods	3
CHAPTER 13: THE COEFFICIENT OF CONDITION OF FISH.....	1
References	2

CHAPTER 14: CONDUCTING ROVING AND ACCESS SITE ANGLER SURVEYS.....	1
14.1 Description	1
14.2 Methods	2
14.2.1 Sampling Schedule	2
14.2.2 Survey Clerk	2
14.2.3 Counts.....	2
14.2.4 Interviews.....	3
14.3 Implementation.....	4
14.4 References.....	5
CHAPTER 15: WEIGHTED AVERAGE LENGTH AND WEIGHTED AGE COMPOSITION.....	1
CHAPTER 16: ENDANGERED AND THREATENED FISHES IN MICHIGAN	1
16.1 Endangered fishes	1
16.2 Threatened fishes	1
16.3 Extirpated fishes	2
CHAPTER 17: LENGTH-WEIGHT RELATIONSHIPS	1
References.....	15
CHAPTER 18: SAMPLING ZOOPLANKTON IN LAKES.....	1
18.1 Equipment.....	1
18.2 Sample sites	1
18.3 Taking samples	3
18.4 Lab procedures	3
18.5 Computations and applications	4
18.6 References.....	4
CHAPTER 19: MEASUREMENT OF STREAM VELOCITY AND DISCHARGE	1
19.1 Methods for Current Measurement	2
19.1.1 Embody Float Method.....	2
19.1.2 Current Meters (Price-Gurley)	2
19.1.3 Cone and Rubber Bag Method	3
19.2 References.....	5
CHAPTER 20: MICHIGAN STREAM CLASSIFICATION: 1967 SYSTEM	1
20.1 Part I—Stream type and quality	1
20.1.1 Non-anadromous	1
20.1.2 Designation of existing runs of anadromous trout and salmon, Director's designated trout streams	2

20.1.3 Discussion	2
20.1.4 Mapping.....	3
20.2 Part II–Stream size.....	4
20.2.1 Stream size categories	4
20.2.2 Fluctuating stream subclass	4
20.2.3 Part II–Mapping (Stream size).....	4
20.3 Part III–Stream zone development.....	5
20.3.1 Classes.....	5
20.3.2 Mapping (Development)	5
20.4 General instructions and discussion—all parts	6
20.5 Procedure	6
 CHAPTER 21: INTERPRETING FISH POPULATION AND COMMUNITY INDICES1	
21.1 Population indices.....	1
21.1.1 Size and age structure	1
21.1.2 Abundance	3
21.2 Community indices	4
21.2.1 Coldwater Lakes.....	4
21.2.2 Coolwater Lakes.....	4
21.2.3 Warmwater Lakes	4
21.2.4 Average warmwater and coolwater lake communities.....	5
21.2.5 Standing Crops.....	6
21.2.6 Angling yield	6
21.2.7 Angling statistics.....	7
21.3 References	25
 CHAPTER 22: GUIDELINES FOR SAMPLING WARMWATER RIVERS WITH ROtenone 1	
22.1 Sampling methods	1
22.2 Data collection	3
22.3 Report format.....	3
22.4 References	3
 CHAPTER 23: GUIDELINES FOR EVALUATING WALLEYE AND MUSKIE RECRUITMENT 1	
23.1 Walleye	1
23.1.1 Walleye sampling	1
23.1.2 Walleye evaluation	2
23.2 Muskie.....	2
23.2.1 Muskie sampling.....	2
23.2.2 Muskie evaluation.....	2
23.3 References	3

CHAPTER 24: AQUATIC NUISANCE SPECIES CONTROL POLICY FOR FISHERIES DIVISION FIELD SURVEYS	1
24.1 Small equipment such as scap nets, measure boards, buckets, rain gear, waders, anchors	1
24.2 Large equipment such as trap nets, gill nets, fyke nets, and holding crates.....	1
24.3 Boats and trailers.....	2
24.4 Rearing ponds.....	2
24.4.1 Uncontaminated ponds:.....	2
24.4.2 Contaminated ponds:.....	2
24.5 Fish transport units	2
CHAPTER 25A: GLEAS PROCEDURE #51 SURVEY PROTOCOLS FOR WADABLE RIVERS.....	1
I. INTRODUCTION	1
II. PRINCIPLES OF FISH, MACROINVERTEBRATE AND HABITAT SURVEYS	2
III. GENERAL SAMPLING CONSIDERATIONS	2
IV. SITE SELECTION	3
V. QUALITATIVE FISH SAMPLING PROCEDURES AND DATA ANALYSIS TECHNIQUES....	4
A. Fish Sampling Procedures.....	4
B. Data to be Recorded.....	4
C. Data Analysis Techniques	5
<i>Metric Description</i>	5
VI. QUALITATIVE BENTHIC MACROINVERTEBRATE SAMPLING PROCEDURES AND DATA ANALYSIS TECHNIQUES	7
A. Benthic Macroinvertebrate Sampling Procedures	7
B. Data to be Recorded.....	8
C. Data Analysis Techniques	8
<i>Metric Description</i>	8
VII. HABITAT SURVEY PROCEDURE AND DATA ANALYSIS TECHNIQUES	10
A. Habitat Evaluation.....	10
<i>Metric Description</i>	11
VIII. OVERALL APPLICATION AND INTEGRATION	14
A. Relationship of Habitat Quality and Biological Condition.....	14
B. Application.....	14
IX. QUALITY ASSURANCE/QUALITY CONTROL	14
A. Training	15
B. Standard Procedures	15
C. Documentation.....	15
D. Habitat Assessment.....	15
E. Benthic Collections	15
F. Fish Collections.....	15
X. REFERENCES	16

CHAPTER 25B: GLEAS PROCEDURE 51 METRIC SCORING AND INTERPRETATION	1
GENERAL CONCEPT	1
SCORING.....	1
FISH METRICS.....	2
MACROINVERTEBRATE METRICS	2
INTERPRETATION OF SCORES	2
REFERENCES.....	3
CHAPTER 26: STREAM STATUS AND TRENDS PROGRAM SAMPLING PROTOCOLS.....	1
26.1 Overview of sampling plan.....	2
26.1.1 Random site sampling (stratified random sampling design).....	2
26.1.2 Fixed site sampling	2
26.2 Data collection and recording.....	3
26.2.1 General protocols.....	3
26.2.2 Random site protocols	4
26.2.3 Fixed site protocols	5
26.2.4 Habitat sampling protocols.....	7
26.3 Data management in the Fish Collection System.....	9
26.3.1 Survey folder “Details” tab	9
26.3.2 Survey folder “Efforts” tab	10
26.3.3 Fish Collection System improvements.....	10
26.4 Literature cited	15
Appendix A	17
Appendix B	37