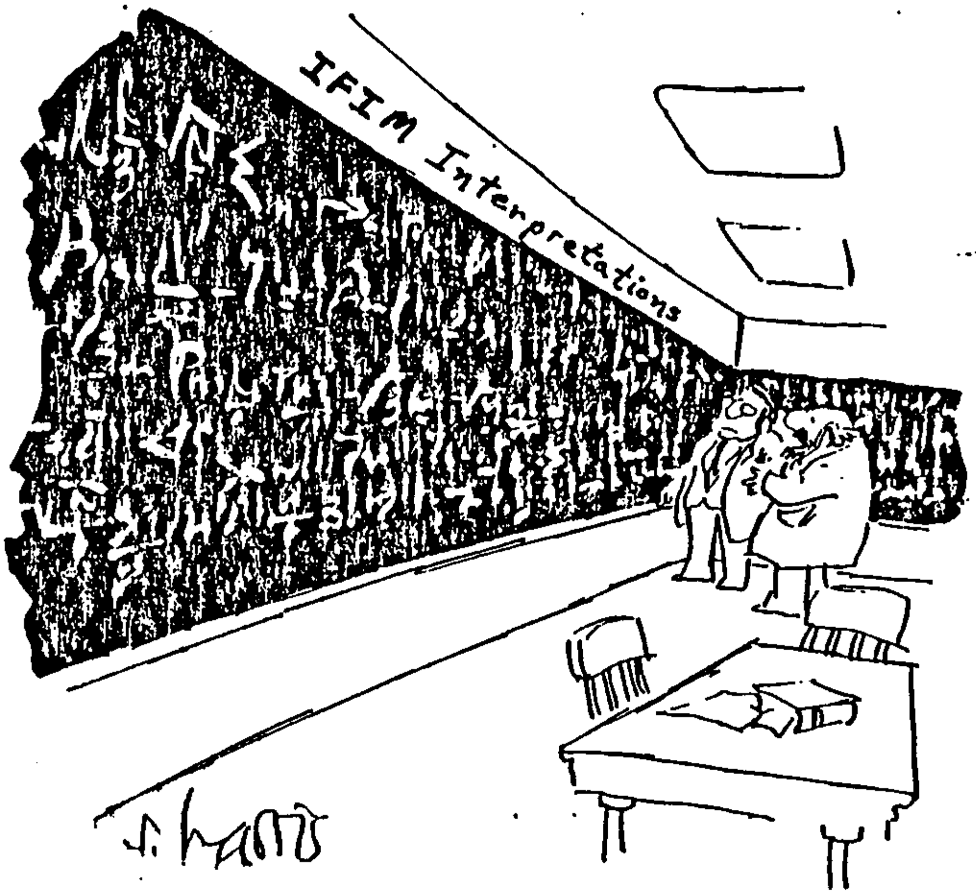
IF 201

PROBLEM ANALYSIS AND NEGOTIATING SOLUTIONS USING IFIM



"But this is just a simplistic way of looking at the problem."

DECEMBER 7-11, 1992
AUBURN UNIVERSITY

CONTENTS

	Page
Agenda	2
Objectives	3
Course Evaluation	5
I. PREPARATION FOR NEGOTIATION	9
LAB 1	17
II. INTRODUCTION TO TIME SERIES ANALYSIS	29
III. HABITAT TIME SERIES	43
LAB 2	55
IV. ANALYSIS OF RAPID FLOW FLUCTUATIONS	71
LAB 3	83
V. RESERVOIR OPERATIONS	99
LAB 4	117
VI. INTRODUCTION TO NETWORKING/PULSE ATTENUATION	137
VII. ELEMENTS OF NEGOTIATION	153
LAB 5	161
VIII. QUALITY ASSURANCE IN IFIM STUDIES	173
LAB 6	175
IX. ANSWERS TO DISCUSSION QUESTIONS	187
LAB 1	189
LAB 2	199
LAB 3	207
LAB 6	211
X. IFIM NETWORKING TUTORIAL	227

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8:00-9:00	Registration Introductions	**HABITAT TIME SERIES ANALYSIS** Lab 2 briefing	**RESERVOIR OPERATIONS** Lab 4 briefing	Lab 5 briefing Lab 5 prep Break	Lab 6
9:00-10:00	Course objectives Orientation Break (9:45)	Lab 2	Lab 4	Lab 5 (phase 1)	Lab 6 Break
10:00-11:00	**PREPARATION FOR NEGOTIATION** Lab 1 briefing	Lab 2	Lab 4	Lab 5 (phase 1) Break Lab 5 (phase 2)	Lab 6 debriefing
~~11:00-11:45~~	Lab 1	Lab 2	Lab 4	Lab 5 (phase 2)	Lab 6 debriefing Course evaluations
11:45-1:15	Lunch	Lunch	Lunch	Lunch	Adjourn
1:15-2:00	Lab 1	Lab 2 debriefing	Lab 4 debriefing	Lab 5 (phase 3)	
~~2:00-3:00~~	Lab 1 debriefing **ALTERNATIVES ANALYSIS: AN OVERVIEW**	**ANALYSIS OF RAPID FLOW FLUCTIATIONS: INTRO TO HABEF** Lab 3 briefing	**INTRODUCTION TO NETWORKING** **PULSE ATTENUATION IN HYDROPEAKING STUDIES**	Lab 5 (phase 4) Break	
3:00-4:00	Break **INTRODUCTION TO TIME SERIES ANALYSIS**	Lab 3	Break **ELEMENTS OF NEGOTIATION**	Lab 5 Debriefing	
4:00-5:00	**INTRODUCTION TO TIME SERIES ANALYSIS**	Lab 3	**DEALING WITH DINOSAURS**	**INTRODUCTION TO QUALITY ASSURANCE IN IFIM STUDIES**	

OUR OBJECTIVES

TO IMPROVE YOUR ABILITY TO:

- FORMULATE, GENERATE, AND EVALUATE ALTERNATIVES IN THE MANAGEMENT OF WATER WITH SPECIAL EMPHASIS ON HYDROPEAKING APPLICATIONS.
- CONDUCT QUALITY ASSURANCE REVIEWS OF DATA AND SIMULATIONS USED IN IFIM APPLICATIONS.
- PREPARE YOUR DATA AND YOURSELF FOR NEGOTIATION OR OTHER DECISION MAKING PROCESSES.

TO MEET YOUR EXPECTATIONS. WHAT ARE THEY?

IF 201

~~May 11-15~~ Dec 7-11, 1992

~~Fort Collins, CO~~ Auburn, Ala.

Course Evaluation

Name ____

Address ____

____

____

____

1. Where did you first learn about this course?

_____ U.S. Fish and Wildlife Service Training Catalog.

_____ Instream Flow Chronicle (CSU).

_____ Previous IFIM training course.

_____ Supervisor.

_____ Colleague.

2. Had you taken IF 200 prior to taking IF 201?

_____ Yes

_____ No

3. If No, did you feel that you were at a disadvantage in IF 201 for not having taken IF 200?

_____ Major disadvantage.

_____ Somewhat of a disadvantage.

_____ No disadvantage.

_____ Better off for not having taken it.

4. Based on your prior knowledge of IF 201, what did you expect to get out of the course when you enrolled? (To be answered on Day 1 of the course).

____

____

____

____

____

5. Was the prepared subject matter of this course relevant to your expectations?

_____ Exceeded my expectations.

_____ Met all my expectations.

_____ Met most of my expectations.

_____ Met few of my expectations.

_____ Met none of my expectations.

6. How well did the instructors of this course meet your expectations?

_____ Exceeded my expectations.

_____ Met all my expectations.

_____ Met most of my expectations.

_____ Met few of my expectations.

_____ Met none of my expectations.

7. How relevant to your job is the objective, "To improve your ability to formulate, generate, and evaluate alternatives in the management of water with special emphasis on hydropeaking applications?"

_____ Very important.

_____ Somewhat important.

_____ Not important.

If not important, please state the objective you would have preferred as a substitute.

____

8. How well did the training you received in IF 201 meet this objective?

_____ Exceeded my expectations.

_____ Met all my expectations.

_____ Met most of my expectations.

_____ Met few of my expectations.

_____ Met none of my expectations.

9. How relevant to your job is the objective, "To improve your ability to conduct quality assumrance reviews of data and simulations used in IFIM applications?"

_____ Very important.

_____ Somewhat important.

_____ Not important.

If not important, please state the objective you would have preferred as a substitute.

____

10. How relevant to your job is the objective, "To improve your ability to prepare your data and yourself for negotiation or other decision making precesses?"

_____ Very important.

_____ Somewhat important.

_____ Not important.

If not important, please state the objective you would have preferred as a substitute.

____

11. What subject areas, materials, or problem types should be added to the IF 201 curriculum?

____

____

____

____

12. What subject areas, materials, or problem types should be deleted from the IF 201 curriculum?

____

____

____

____

13. Would you have preferred to complete this training at your own duty station on your own time rather than attending a formal training course?

_____ Yes

_____ No

If no, why not? ______________________________

____

____

14. What improvements to the existing training materials would be needed if you were to complete IF 201 training at your own duty station rather than attending a formal training course?

I.

PREPARATION FOR NEGOTIATION

THE INSTITUTIONAL ANALYSIS COMPONENT OF IFIM

LECTURE OUTLINE:

I. WHY EVALUATE THE INSTITUTIONAL SETTING?

A. Help to diagnose the kind of problem you face.

B. Help determine what kind of information you will need to deal with others.

II. WHAT IS INSTITUTIONAL ANALYSIS?

A. Description of the organizations involved in a decision-making, including:

1. A listing of the organizations and their likely representatives.

2. An understanding of the authorities and policies that guide these organizations.

3. An understanding of the roles that these organizations usually play in decision-making.

4. An understanding of the abilities these organizations have to influence decisions.

B. Analysis of the negotiation strategies likely to be employed in the decision-making process.

III. TO PERFORM AN INSTITUTIONAL ANALYSIS, THE IFIM USES THE LEGAL-INSTITUTIONAL ANALYSIS MODEL (LIAM). THE LIAM CONSISTS OF THREE PARTS:

A. Listing of organizations and their authorities.

B. Determination of the role and power of each organization.

C. Analysis of likely information needs and negotiation strategies for each organization.

IV. OUTPUT FROM THE LIAM IS DISPLAYED IN THREE PRODUCTS:

A. A role map describing the likely role of each organization.

1. These roles are a combination of four types:
(a) Broker
(b) Arbitrator
(c) Advocate
(d) Guardian

2. The roles are arrayed along one of two continua:
    (a) Goal preference: Advocate-Guardian
    (b) Process preference: Broker-Arbitrator

3. The relative position of each of the players on this role-map allows a preliminary understanding of the likely strategies to be employed in decision-making.

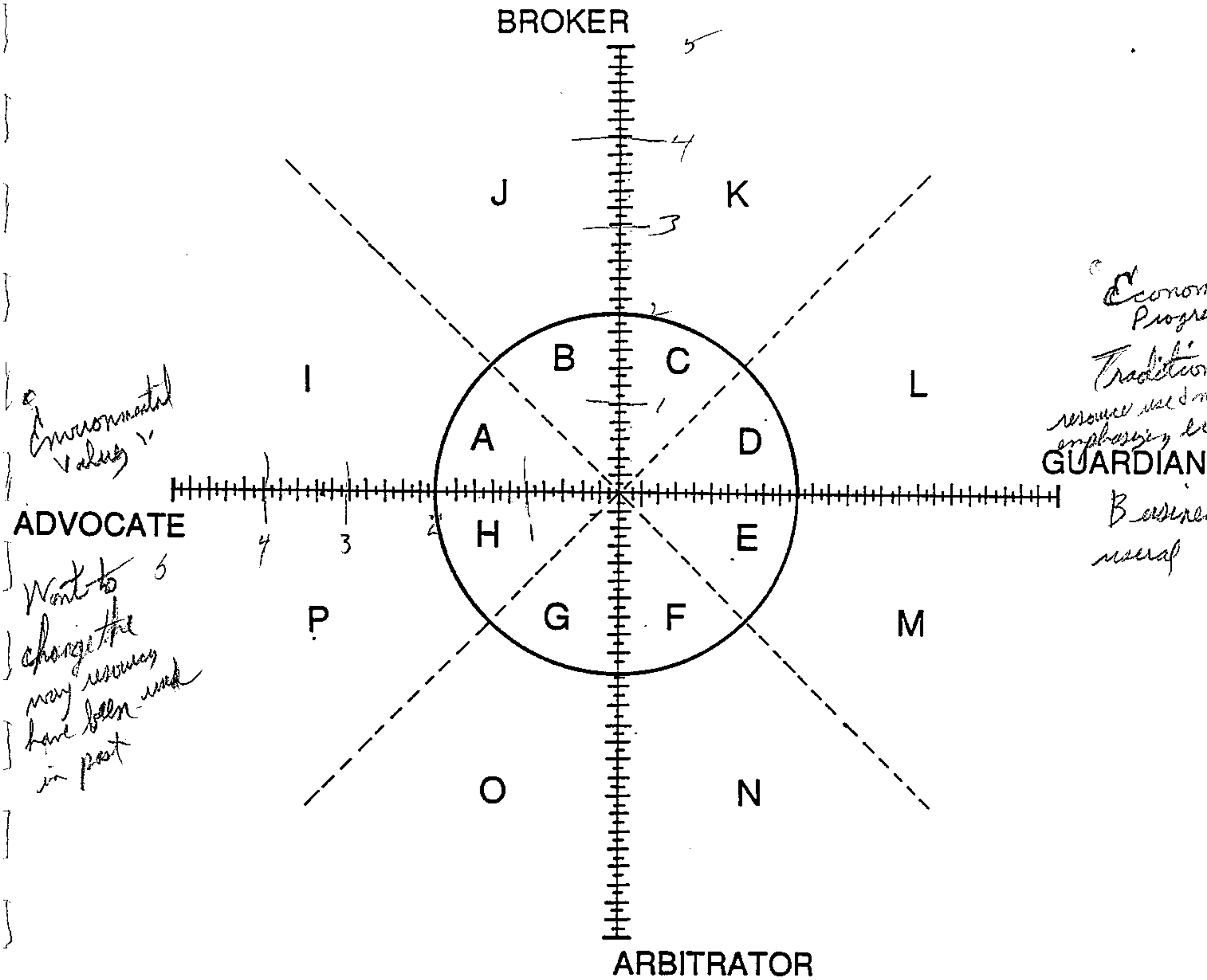
B. A role and power analysis for each organization. This is produced as a summary statement for each organization.

C. An in-depth needs analysis for each organization.

weakness equity to info. needs

Present economic arguments

Distributative arena
divide the pie (make it bigger)



Environmental Values

Want to change the way resources have been used in past

Economic Progress & Traditional resource use & mgt. emphasizing economic values

Business as usual

Regulatory Arena
or
Courts
little or no compromise
simply an rational decision

Present factual arguments
related to regulatory & laws

Dec 7-11 IF 201
~~May 11-15~~, 1992
Fort Collins, CO

Lecture Evaluation

(circle appropriate lecture #)

Lecture # I II III IV V VI VII VIII IX

1. Was the subject of the lecture relevant to the stated objectives of the course?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the material covered in the lecture necessary to achieve one of the stated objectives of the course?

_____ Absolutely necessary for understanding concepts.

_____ Helpful, but not necessary.

_____ Would have been less confusing without the lecture.

3. Did the materials in the workbook follow the materials presented in the lecture?

_____ Workbook was easy to follow.

_____ Workbook was somewhat out of order with presentation.

_____ Workbook contained extraneous materials not covered in lecture.

_____ Lecture covered extraneous material not contained in workbook.

_____ Lecture and workbook were totally out of synch.

4. Were lecture notes in the workbook helpful in following the lecture?

_____ Very helpful.

_____ Somewhat helpful.

_____ Would have been helpful if instructor had followed them.

_____ Lecture notes not provided.

5. Were audio-visual materials audible and/or visible?

_____ Yes

_____ No

If no, which need improvement and how can they be improved?

____

____

____

6. Did AV materials support the lecture materials?

_____ Yes

_____ No

If no, should the AV materials be replaced or eliminated?

_____ Replace (with)____

____

_____ Ditch them.

7. If this course were to be packaged as a correspondence course, what would be the best medium through which to present the materials covered in the lecture?

_____ None. The lecture is unnecessary.

_____ None. Interaction with a live instructor is essential.

_____ Good lecture outline plus video-taped lecture.

_____ Convert lecture notes to prose (i.e., text of covered materials).

_____ Text plus video-taped lecture.

_____ Other. ____

____

____

____

____

Deal 180 Melanie

LAB 1

PREPARING FOR NEGOTIATIONS
INTRODUCTION TO LEGAL/INSTITUTIONAL ANALYSIS

OBJECTIVES

TO DEVELOP SKILLS IN:

1. THE APPLICATION OF THE LEGAL/INSTITUTIONAL ANALYSIS MODEL (LIAM).

2. USE OF LIAM RESULTS TO PREPARE FOR NEGOTIATION OF INSTREAM FLOW ALTERNATIVES.

BACKGROUND

Wyman Dam is located on the Kennebec River approximately 10 miles upstream from Bingham, Maine. This 3,000 acre reservoir has a capacity of 206,000 acre feet when filled and is operated by the Central Maine Power Company (CMP). Over the past ten years, the average gross income to CMP for electricity generated at this facility has been estimated to be approximately $6.5 million. Although CMP conducts business in a manner that is characteristic of a moderately-sized corporate utility, the company has made an effort to promote an image of environmental-consciousness in its advertising and public outreach programs. The Wyman Project has operated as a hydropeaking facility since 1934, and is currently scheduled for re-licensing by the Federal Energy Regulatory Commission (FERC) in 1994. During normal project operation, CMP has agreed to limit lake level fluctuations during the summer to a maximum drawdown of two feet or less. This constraint has been honored through a "gentlemen's agreement" negotiated previously with private landowners who own summer homes and recreational facilities around the lake. During the winter and spring, most of these second homes are unoccupied and the lake is normally drawn down four to eight feet in order to allow capture of snowmelt runoff and alleviate flooding downstream.

The principal intervenors in this case are the U.S. Fish and Wildlife Service (FWS) and the Maine Department of Inland Fisheries (MDIF). Both agencies must be consulted by CMP in the pre-license application phase of the FERC process. The CMP does not have to follow the agencies' recommendation. However, if the CMP does not conduct the studies recommended by the agencies, FERC is unlikely to license the project. Public meetings are a part of the process.

Trout Unlimited has shown a keen interest in the rainbow trout and eastern brook trout fishery provided by the Kennebec, and is a strong supporter of the FWS' Atlantic Salmon Restoration Program. Increasing salmon stocks under the existing hydrologic regime may not be feasible, however, as there is a strong feeling among professional biologists (as well as considerable anecdotal evidence) that project operation is detrimental to existing populations of rainbow trout and brook trout. FWS, MDIF, and TU have agreed to evaluate habitat for rainbow trout and brook trout as the primary target species in the instream flow study. To some extent these species may have been chosen under the assumption that whatever improves trout habitat will also improve salmon habitat. Restoration of salmon may be the real, but hidden, objective of these agencies.

Observing the upcoming re-licensing with interest and some anxiety are the landowners who have property surrounding Wyman Lake. They will have a chance to comment on the studies to be conducted as well as recommended license conditions developed by CMP. Over the past 60 years, the landowners have enjoyed a relatively stable lake level, provided by CMP through the aforementioned agreement. Virtually all private land surrounding the lake has been developed with single family summer homes and a few retirement homes have also been built. Every home has its own dock or boathouse, designed to be usable only within a narrow window of lake levels. There are also several public access facilities operated by Maine State Parks and Forests. These small enclaves consist primarily of picnic grounds, public docks, and boat ramps. At low water levels, the docks would be unusable to public boaters but the boat ramps would be usable at lake levels of 10 feet below full capacity. Although CMP is not legally obligated to maintain a constant lake level, the landowners and lake recreationists make better political allies than enemies. Most are fairly wealthy and politically well-connected, particularly in the state of Maine. The private landowners have formed a Homeowner's Association. A lawyer for the Association has offered an opinion that the Association would have standing to file suit against CMP and the state if the lake levels were to fluctuate below 483 feet MSL (2 feet below full capacity).

YOUR ASSIGNMENT

The Legal Institutional Analysis Model (LIAM) was designed to help natural resource professionals perform an analysis of upcoming negotiations regarding instream flow. The purpose of the LIAM is to 1) determine which roles agencies are likely to play in an interagency negotiation--such as the FERC license consultation--2) outline the strengths and weaknesses of each organization, and 3) allow negotiators to perform a "needs analysis" for each organization.

An LIAM analysis has three steps: 1) data collection using the QUERY program; 2) role analysis using the "MAPUM" program; and 3) needs analysis using the "LOOKY" program. Your assignment is to analyze the four organizations involved in the WYMAN DAM PROJECT to determine the likely roles these organizations will play in the negotiations, their negotiating power, and their negotiation needs. After you have completed your analysis, the instructors will hand out an analysis of this project that we conducted so that you can compare your results to ours.

Be sure to analyze all 4 agencies so that Mapum will work

STEP ONE: DATA COLLECTION

Each group in your class will conduct an analysis of all the organizations in the WYMAN DAM PROJECT. That means that when you finish your group will have its own results for FWS, MDIF, CMP, TU, and Homeowners.

Answer each question with A – E or X if you want to skip

First, install LIAM on the hard disk of your computer by following the instructions in "README." Conduct data collection using QUERY. There are two ways to perform data collection with QUERY. 1) Each person records answers in QUERY for each organization--if there are five people in your group you will have five data sets for each organization. This has the benefit of collecting as much diverse information about an organization as possible. This is recommended for actual analysis in your office. 2) Answer questions in QUERY as a group. This has the benefit of starting discussions within your group and enhances understanding of why certain questions are answered as they are; also it is faster. We recommend that, for this exercise, you answer the questions in QUERY as a group. When you complete this step you should have data entered for each organization.

Helpful hints: 1) You will be asked if you want to give answers to questions about goals. These are open-ended questions and for the sake of time we suggest you answer "no" to this option. 2) You will be asked to give your name: answer with your group name or number. 3) You will be asked to give the project name: answer with WYMAN DAM. 4) You will be asked to give the organization name: answer with either FWS, MDIF, CMP, or HOMEOWNERS depending on who you are analyzing. 5) You will be asked to name other groups. This will later serve as a reminder, so list at least the four plus any others you can think of--a double carriage return continues. 6) When you are almost finished with the questions, you will be asked to list the interest groups that support the agency you are analyzing. Provide a list of one or two backers and proceed to answer questions about these supporters of the organization you are analyzing.

STEP TWO: ROLE ANALYSIS

Conduct a role analysis using the MAPUM program. To do this, simply type "MAPUM" and follow the instructions. First select the organizations to analyze by their number--if you have more than one QUERY analysis for a single organization they can be combined in this step (see instructions in README).

This program produces four things, some of which you may not want to use: 1) A summary of scores for each organization; 2) a role map showing where each organization falls on the two LIAM dimensions; 3) a histogram displaying relative power; 4) a plot ("perspective plot") showing each organization from the perspective of one other organization--we suggest you turn off this option; and 5) a paragraph describing the roles of each organization. This information is output to a file labeled "MAPO.DAT." You may look at MAPO.DAT using the DOS command "LIST" or you may retrieve MAPO.DAT into WordPerfect.

Hints: 1) You will want an 80 column width printout (y). 2) You may not wish to see the "arc dividing lines" which separate the moderate from extreme role positions--these differences are always reported in writing. 3) You will not want to see the perspective plot (n).

STEP THREE: NEEDS ANALYSIS

This step is more fun but not completely automated. Needs analysis is performed using LOOKY. LOOKY allows you to look at the results of each questionnaire. If more than one set of answers has been given for an organization in QUERY, you have the opportunity to compare the results from the different analyses of the same organization. LOOKY has three purposes: 1) to answer the question, What strengths and weaknesses does an organization possess? Where there is a weakness, you have identified a need. 2) To examine in depth the institutional analyses you have completed. Through option 3, you can scrutinize not only role and power but the constituent part of those attributes. 3) To review your QUERY responses and alter any you wish or answer those you skipped.

gives your score

To print the results of the LOOKY analysis, type "{control}P" where the menu asks you to choose between options 1 and 8, then type "3." You can lay the printouts for any one organization on a table and compare them side-by-side. Consistently high scores will indicate strengths, low scores indicate a weakness. Inconsistent scores suggest areas for further investigation. Use these scores to identify strengths and weaknesses in terms of issues in the Wyman Dam negotiation. Predict the needs of each party by looking at their power scores and the organization's preferred negotiation arena (as described by broker-arbitrator, advocate-guardian scores).

Do we have printers?

Scores 1—5
low to high

Choice 8 is a plot of an individual

Review Questions for Lab 1
LIAM Analysis

1. What are the differences between physical and statutory control of the resource? Who has statutory control and who has physical control in the Wyman Dam case?

2. Which organizations prefer a brokered or bargained agreement? Which organizations prefer a formal, arbitrated agreement? How does this preference relate to each organizations power base?

3. Which organizations are guardians, which are advocates?

4. How might the broker-arbitrator, advocate-guardian positions change over time?

5. Can you identify any likely allies from the role map?

IF 201
May 11-15, 1992
Fort Collins, CO

(circle appropriate lab #)

LAB # 1 2 3 4 5 6 7

1. Will what you learned in the lab be relevant to problems you encounter in your job?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the lab effective in reinforcing concepts introduced in the lecture?

_____ Yes, lab could stand alone without lecture.

_____ Yes, lab supported lecture.

_____ Somewhat, too much detail.

_____ Somewhat, not enough detail.

_____ No

If no, what needs to be changed?____

____

____

3. How much time were you given to complete the lab?

_____ less than one hour

_____ one to two hours

_____ more than two hours

4. Were you given enough time to get everything out of the lab you wanted to?

_____ Yes

_____ No

If no, how much time would you have liked to work on this lab? _____________

5. Were the written instructions for the lab clear, concise, and accurate?

_____ Yes

_____ No

If no, what problems did you encounter with the instructions?_________________

____

____

____

____

6. Did the software perform as you expected from reading the instructions?

_____ Yes

_____ No

If no, what problems did you encounter with the software?_____________________

____

____

____

____

7. Rate the complexity of the lab according to your expectations.

_____ Too simple.

_____ About right.

_____ Too complex.

8. Were the Review Questions and Discussions provided at the end of the lab helpful in reinforcing concepts and skills acquired in the lab?

_____ Yes

_____ No

If no, why not?____

____

____

____

9. Did you learn anything in the lab that will help you do your job better or more efficiently?

_____ Yes

What was it?____

____

____

_____ No

Why not? ____

____

____

____

10. Are there any subjects related to IF 201 for which you would like to see additional labs or tutorials developed? What are they?

8:00pm Tuesday

OVERVIEW OF ALTERNATIVES ANALYSIS

A. Formulation and evaluation of new alternatives.

1. Formulation of alternatives

a. Developing a new operation time series of discharges through the hydrology model component.

b. Developing a new microhabitat vs. discharge function, usually by habitat improvements, input in the channel structure model.

c. Modifying the macrohabitat component by reducing loading rates of pollutants, changing initial temperatures to simulate multi-level reservoir releases, or to simulate the planting of trees along the river by increasing shading in the temperature model.

d. Any or all of the above in combination.

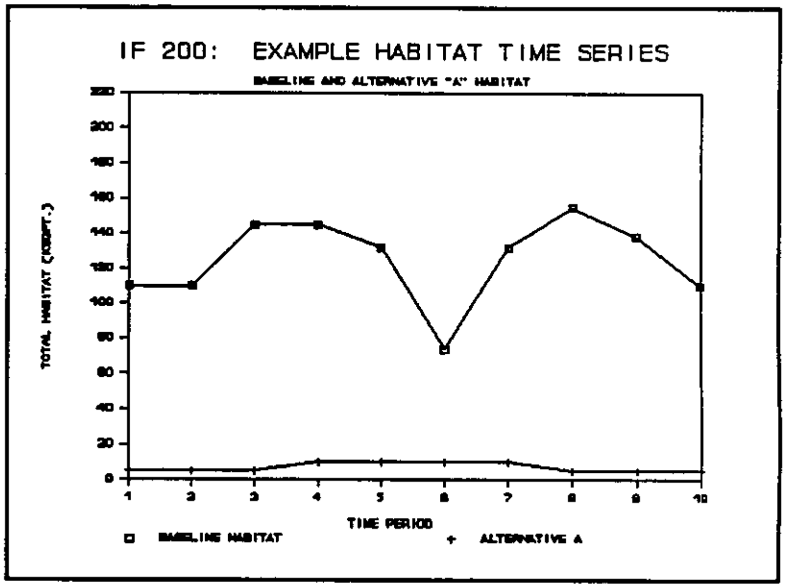


Figure 1. Example comparison of habitat time series under baseline conditions and under Alternative "A" operation.

2. Evaluation criteria for alternatives.

a. Effectiveness - does the new alternative achieve the desired habitat goal (e.g., no net loss)?

b. Feasibility - is it physically possible to operate the project according to the specifications of the alternative? (For example, will the alternative release pattern from a reservoir result in drying it up?)

Variability in water supply, history of droughts, storage cap

c. Risk - related to feasibility. Consists in part of analysis of how often the alternative is likely to fail. Also related to increased liability.

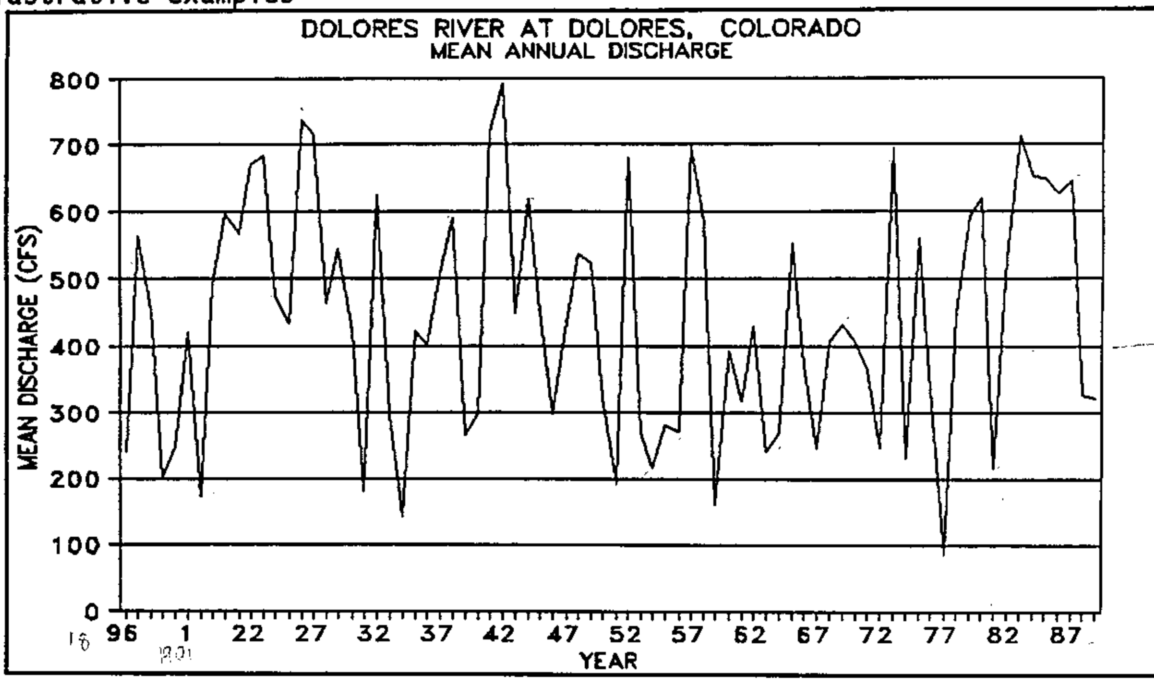
d. Economics - Modified benefit/cost analysis to determine which alternative best achieves the habitat objectives for the least amount of investment.

II.

INTRODUCTION TO TIME SERIES ANALYSIS

IF201
Introduction to Time Series Analysis Concepts

1. Illustrative examples



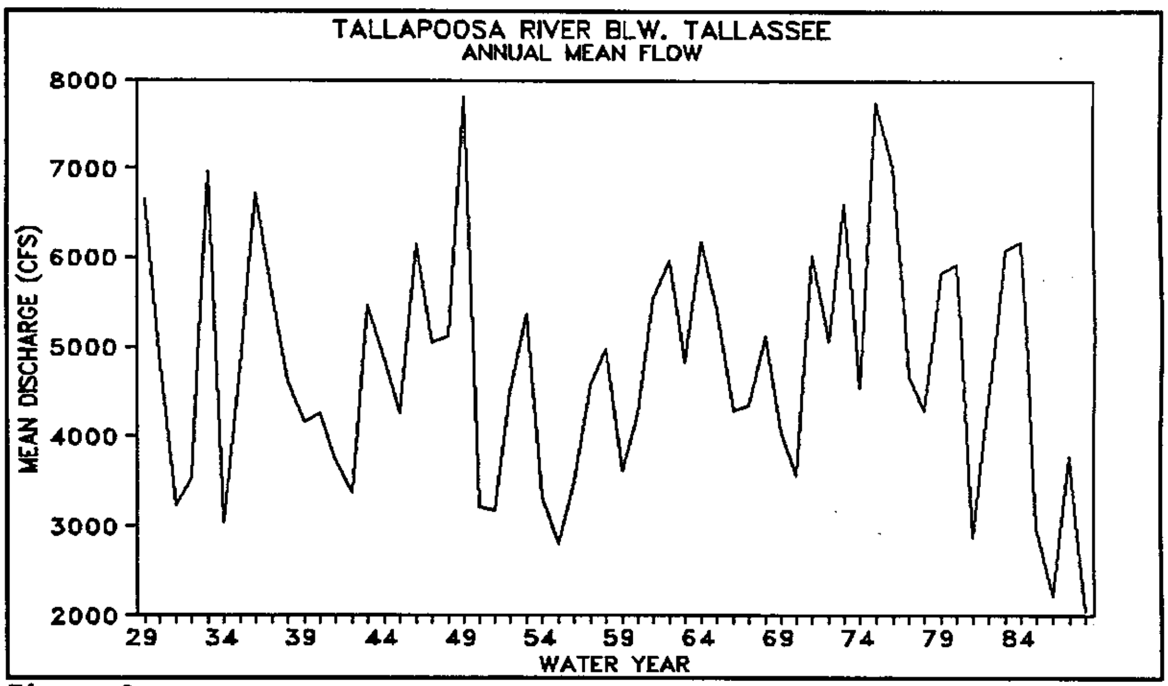
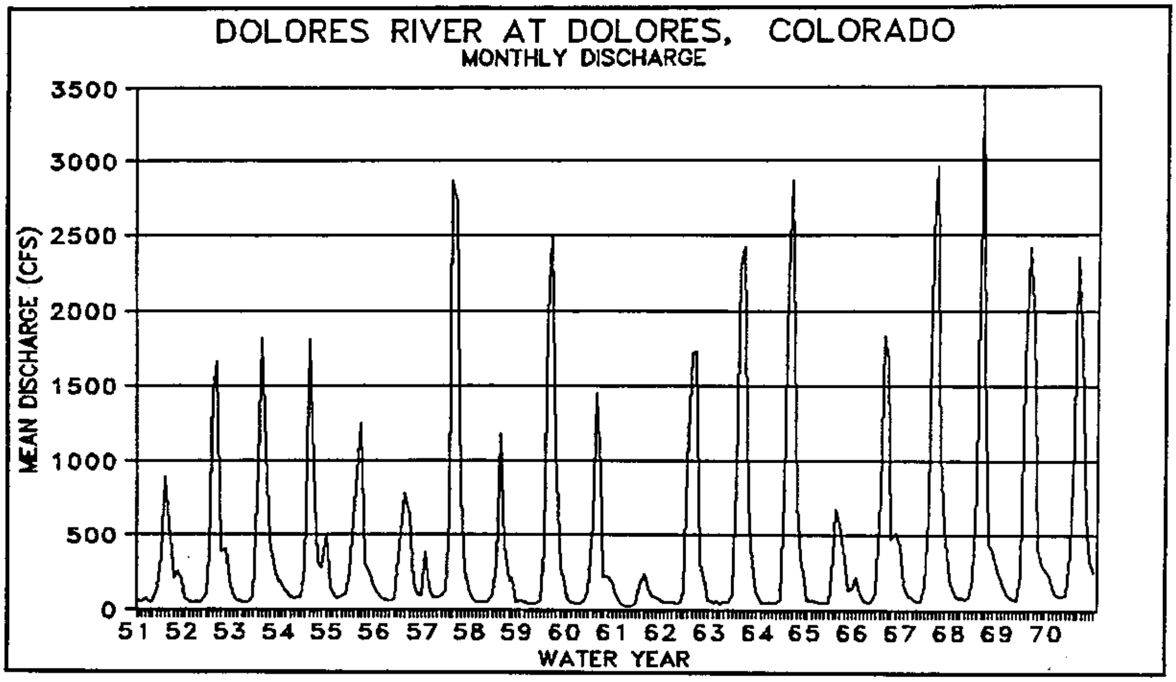


Figure 3

1. Illustrative examples.



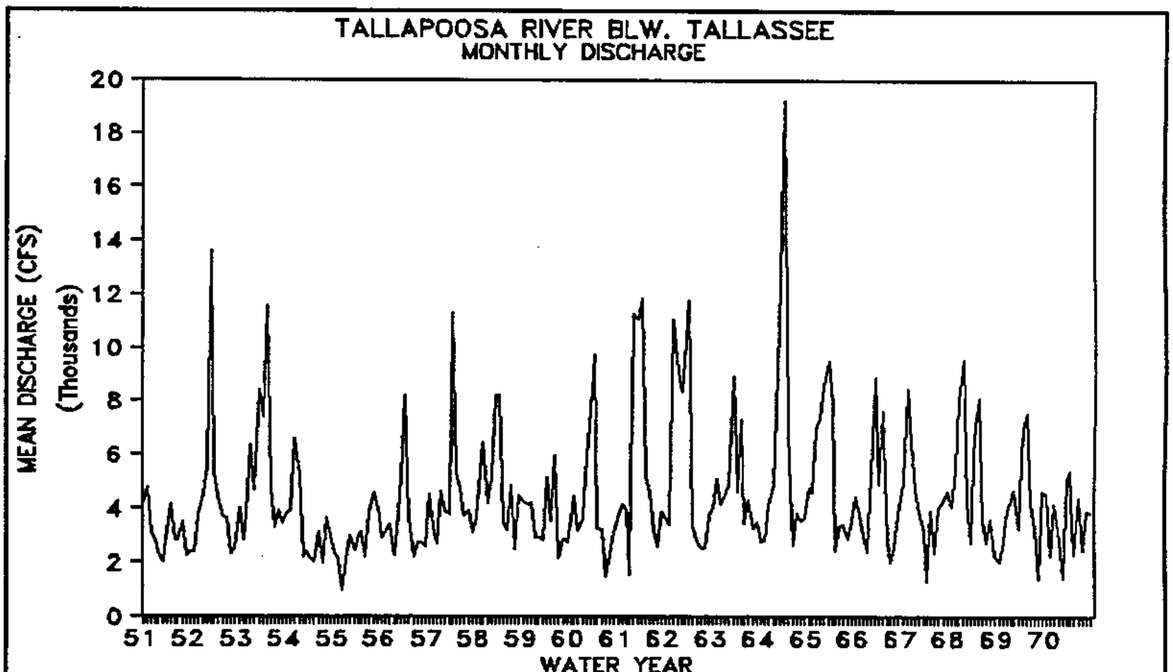
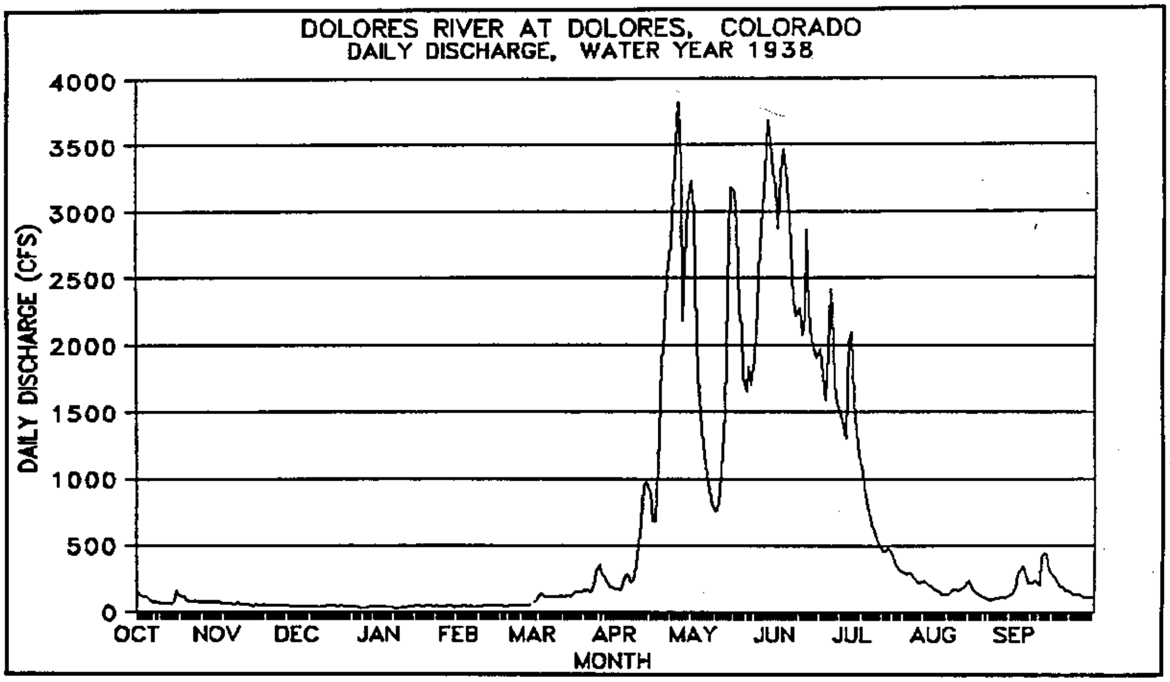


Figure 5

1. Illustrative examples



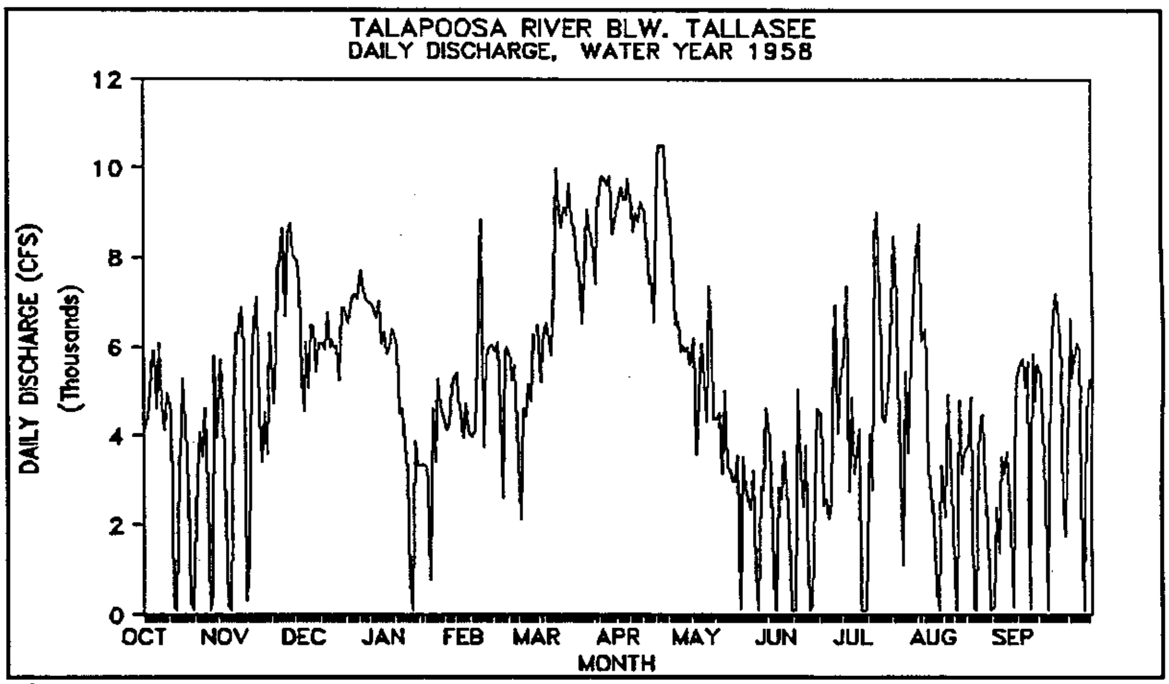


Figure 7

2. Comparison of events to derive system understanding

a. Must Take Care to use Commensurate Units

habitat and power outputs using same units in time for comparing alternatives

- Flow: cfs, AF, cms, cu. meters etc. over same time period (hours, days weeks)

- Must compare consistent time conditions, eg. time series of annual discharge events, time series of annual peak flow events, or time series of sequential flow events (history)

b. Time Series Analysis can be used to evaluate influence of previous conditions

recent history

- Watershed conditions: base flows depend on previous input to ground water, habitat depends on channel changing events, fish population depends on limiting event history. What would a time series of habitat events look like?

- Overall water supply: determine if conditions are wet, dry, or average. Time Series analysis helps to determine what these terms imply in a particular watershed.

trends magnitude of extreme events

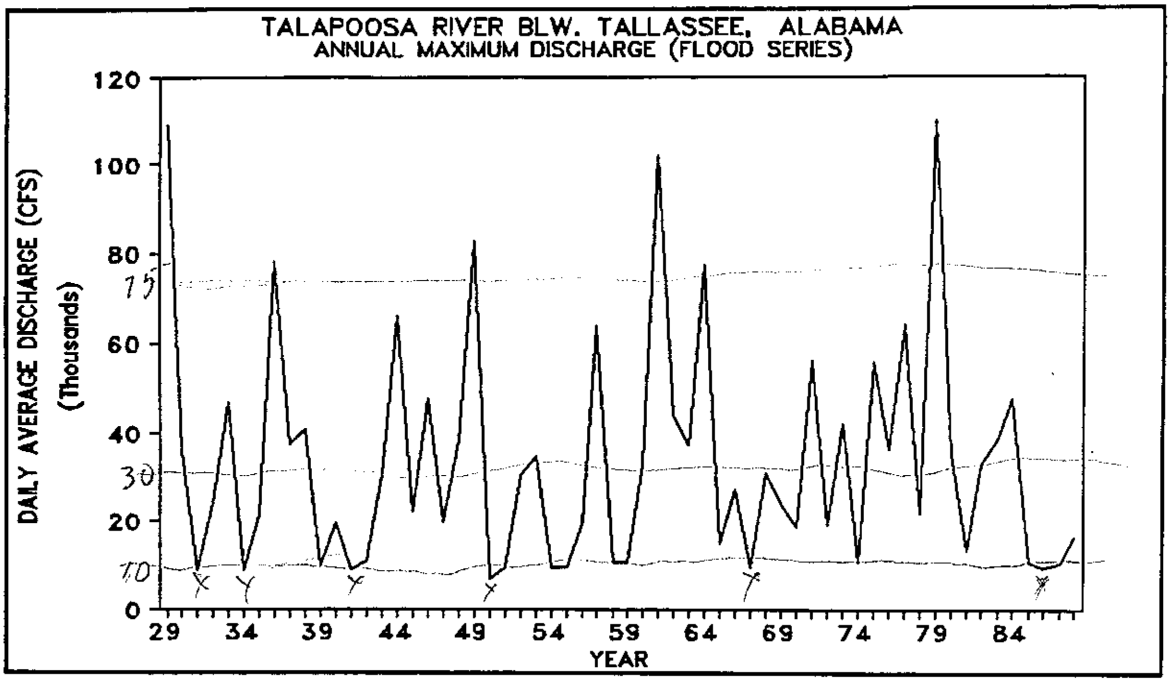
see annual series

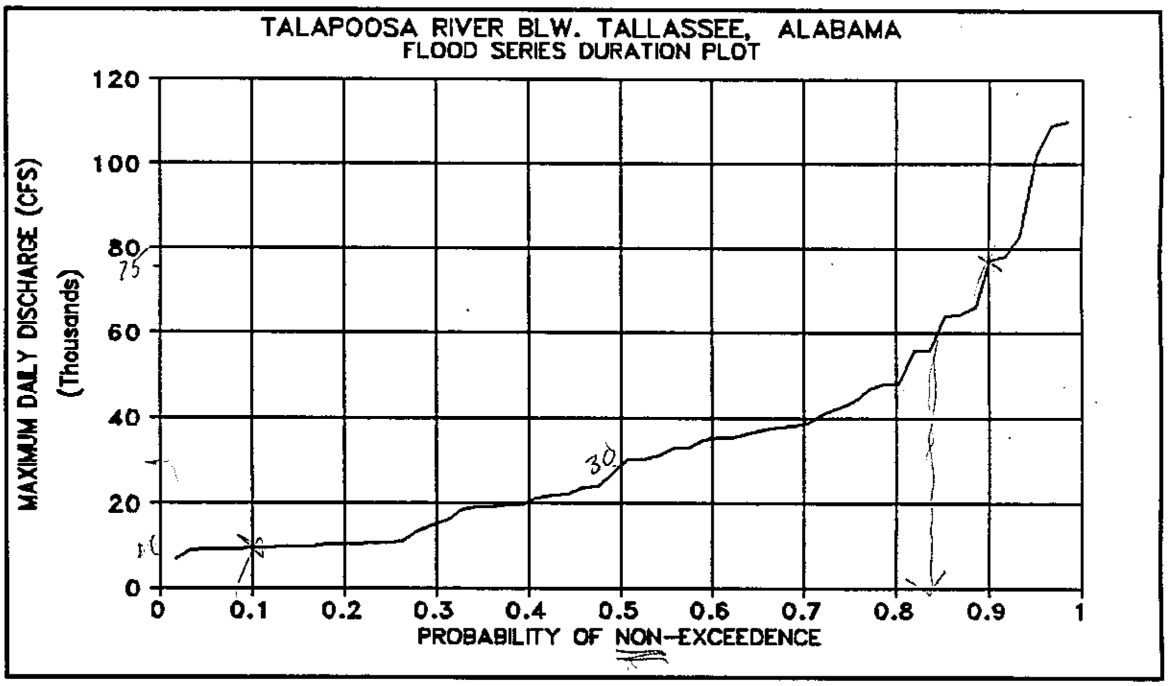
c. Statistics are used to summarize these items

- The statistics help to define measures to be used to specify operating criteria for water resource projects

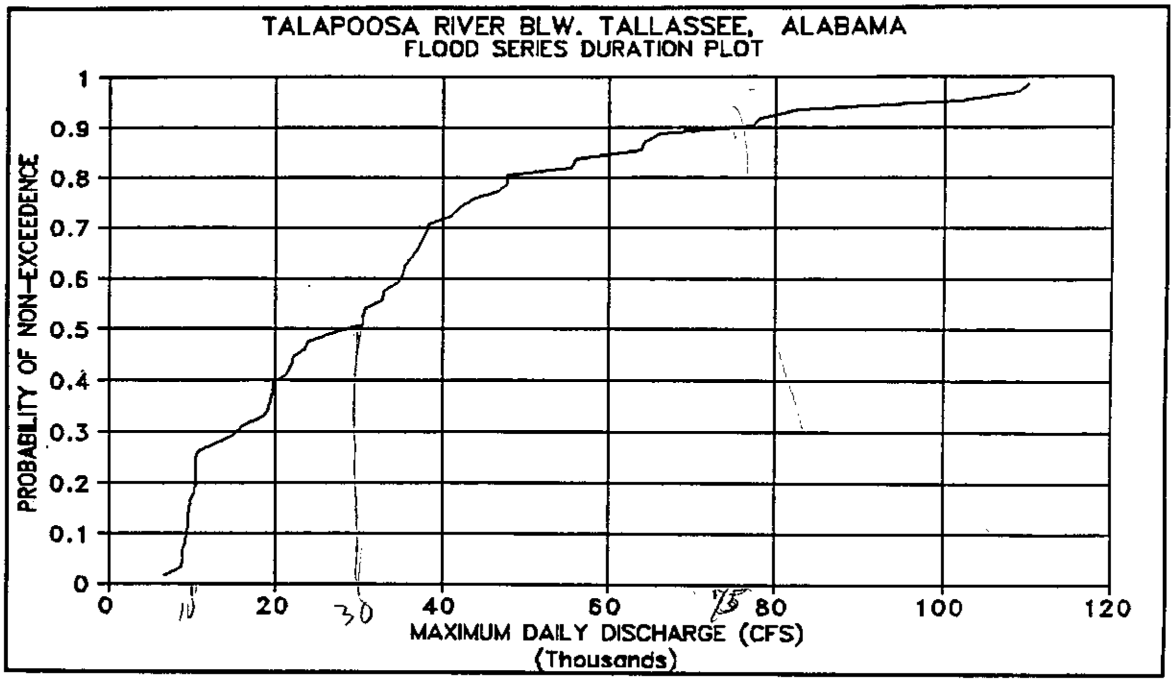
- The most common statistics are "Duration" statistics. These identify the frequency of occurance or exceedence of a particular type of event. Some illustrative examples are:

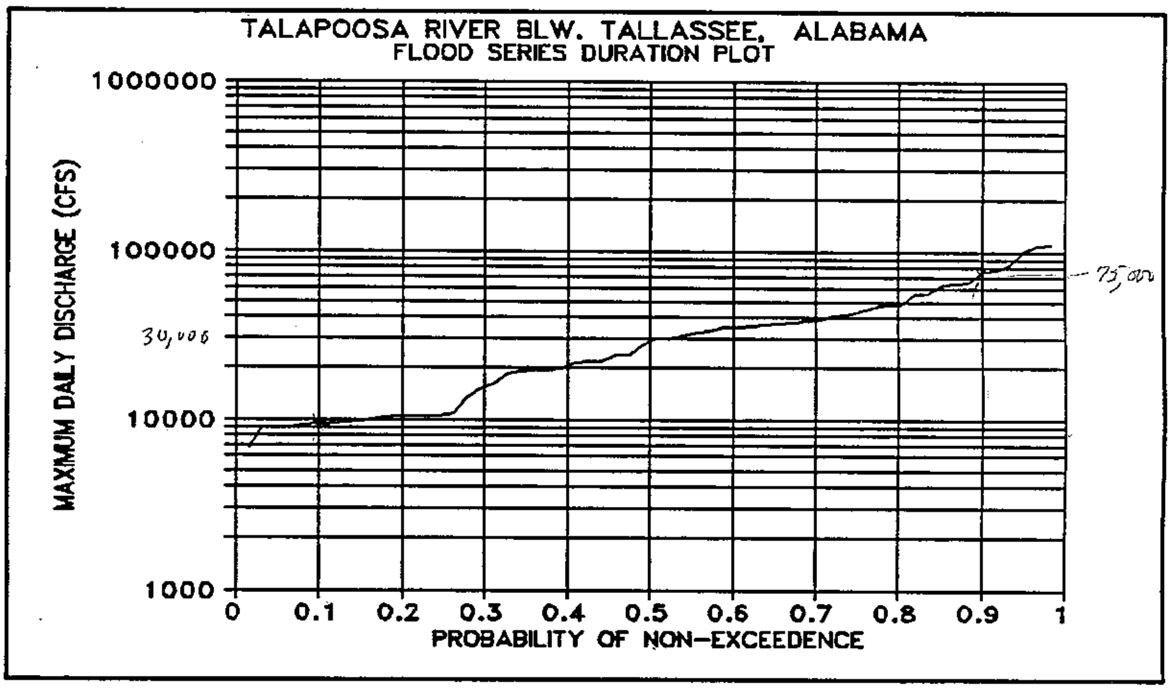
Instream flow advocates must learn to present their arguments with duration statistics.
This is the language/analysis of the water resource planner/engineer


TALAPOOSA RIVER BLW. TALLASSEE, ALABAMA
ANNUAL MAXIMUM DISCHARGE (FLOOD SERIES)
DAILY AVERAGE DISCHARGE (CFS)
(Thousands)
YEAR
0
20
40
60
80
100
120
29
34
39
44
49
54
59
64
69
74
79
84


TALAPOOSA RIVER BLW. TALLASSEE, ALABAMA
FLOOD SERIES DURATION PLOT
MAXIMUM DAILY DISCHARGE (CFS)
(Thousands)
PROBABILITY OF NON-EXCEEDENCE
0
20
40
60
80
100
120
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Watch for reversal of axis & label of axes





← Log plot

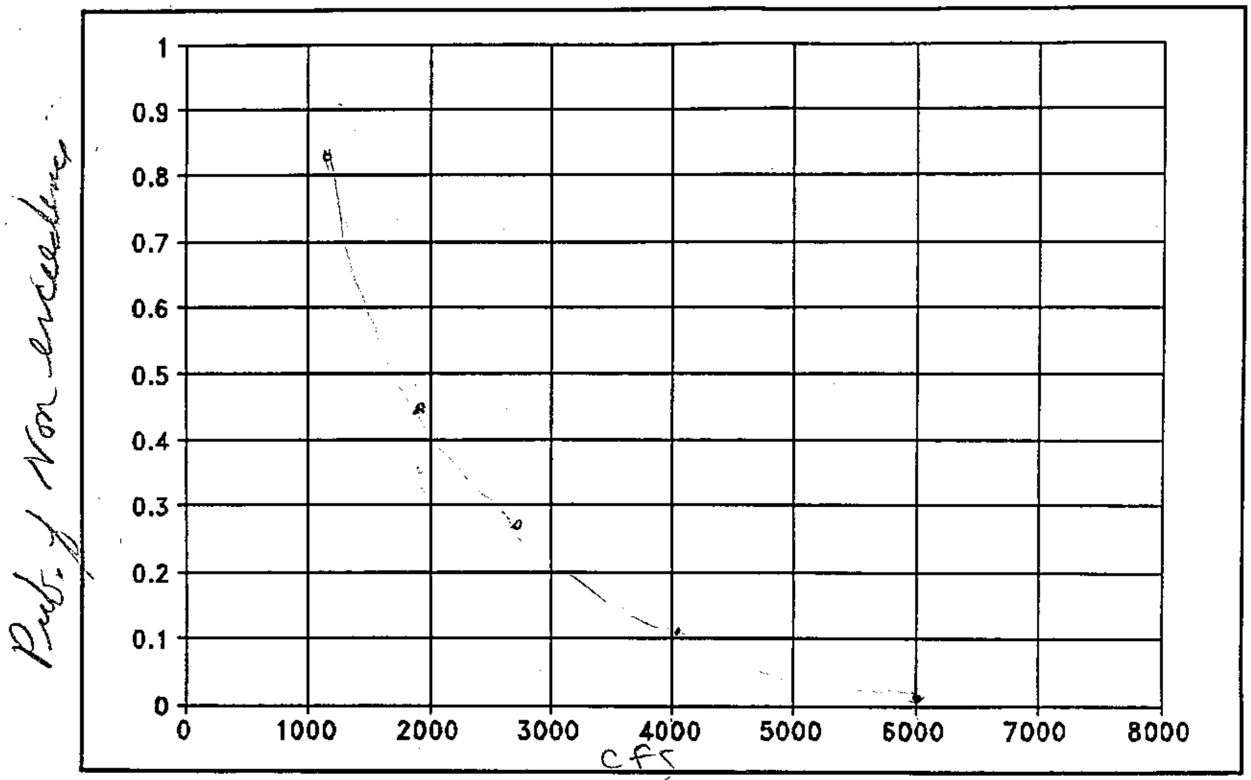
Log-Probability paper

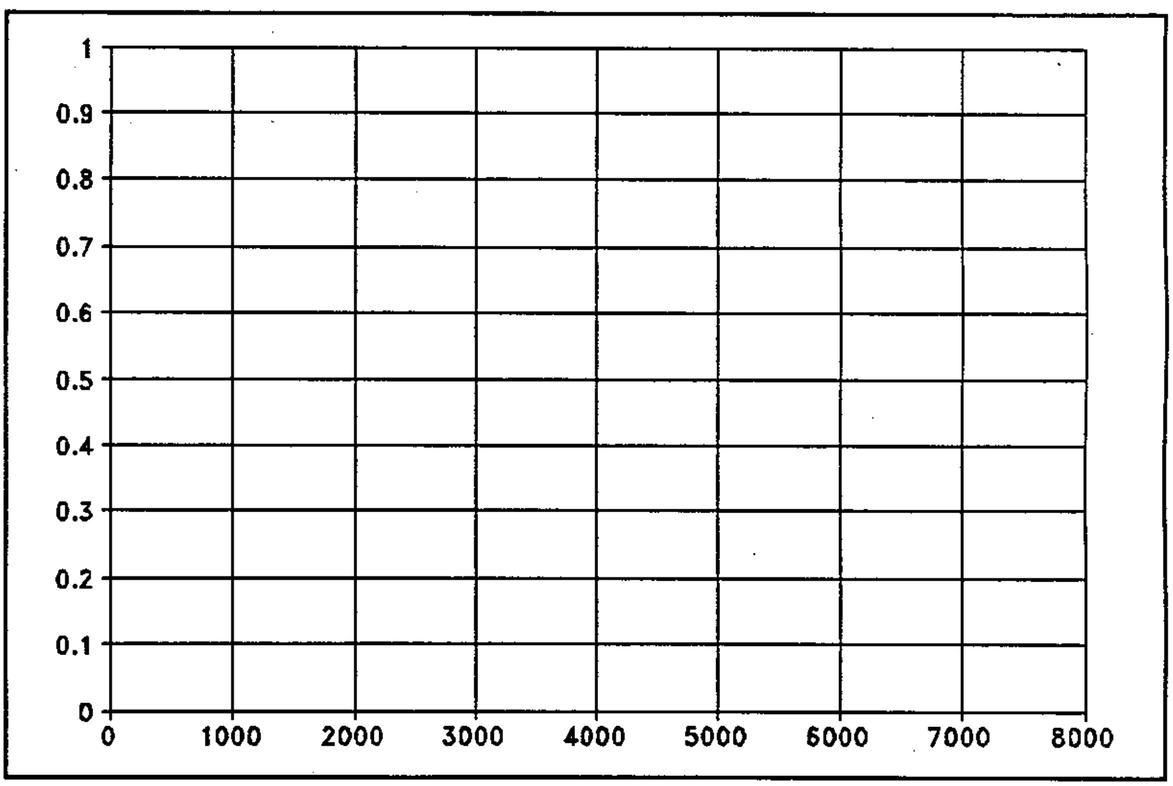
d. Duration Plot Exercise

Using the following average flows for August, construct a duration plot.

Procedure:
1. Sort the flows in ascending order.
2. Rank them (highest to lowest)
3. Calculate Plotting Position
4. Plot on Arithmetic Paper (Could be Semi-log or Arithmetic-Probability or Log-Probability paper)

year	August Mean Flow	Sorted Flows	Rank m	Position m/n+1
1929	4040	1220	10	.82
1930	5380	1980	9	.45
1931	2850	2840	8	.28
1932	4790	2850	7	
1933	5050	3460	6	
1934	1220	4040	5	.12
1935	3460	4790	4	
1936	2840	5050	3	
1937	1980	5380	2	
1938	6020	6020	1	.02


Prob. of Non exceedence
cfs
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1000
2000
3000
4000
5000
6000
7000
8000


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1000
2000
3000
4000
5000
6000
7000
8000

3. Time step size and record length for analysis

- Dictated by type of analysis... You would use a different same time step or period of record to analyze a peaking power situation than you would for a drought analysis. Why?

Rules of thumb for selecting time step and number of periods.

Type of Event	Time Step	Analysis Length
Flood Event	Hours to Days	Period of Record for frequency. Days for Event.
Drought	Months, Years	Period of Record for frequency. 5 - 10 years for operational response.
Hydro Peaking	15 Min to Hours	Seasonal Weeks Covering Range of Operations
Habitat Chronic	Days to Months	As many years as possible.
Habitat Acute	Hours to Days	Days covering full range of Lethal events.

- Flood Control tends to reduce the peak flows but continue moderately high flows a longer time. Is this an acute or chronic habitat event?

- A power plant is operated for peaking power but the flow fluctuations are well within the natural range. Is this an acute or chronic habitat event?

4. Use of these ideas to perform time series analysis.

a. Find the scope of the problem -- what this class is about.

- Is the problem a water management problem at all?

- Drought, transbasin diversion or other long term low flow condition

- Flood, Peaking poser or other short term high or low flow condition

b. Pick time step and length of analysis period based on the type of problem.

   - When would more than one time step and analysis period be needed?

c. Ensure that all time and measurement units match.

IF 201
May 11-15, 1992
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Lecture Evaluation
(circle appropriate lecture #)

Lecture # I II III IV V VI VII VIII IX

1. Was the subject of the lecture relevant to the stated objectives of the course?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the material covered in the lecture necessary to achieve one of the stated objectives of the course?

_____ Absolutely necessary for understanding concepts.

_____ Helpful, but not necessary.

_____ Would have been less confusing without the lecture.

3. Did the materials in the workbook follow the materials presented in the lecture?

_____ Workbook was easy to follow.

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_____ Lecture covered extraneous material not contained in workbook.

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4. Were lecture notes in the workbook helpful in following the lecture?

_____ Very helpful.

_____ Somewhat helpful.

_____ Would have been helpful if instructor had followed them.

_____ Lecture notes not provided.

5. Were audio-visual materials audible and/or visible?

_____ Yes

_____ No

If no, which need improvement and how can they be improved?

____

____

____

6. Did AV materials support the lecture materials?

_____ Yes

_____ No

If no, should the AV materials be replaced or eliminated?

_____ Replace (with)____

____

_____ Ditch them.

7. If this course were to be packaged as a correspondence course, what would be the best medium through which to present the materials covered in the lecture?

_____ None. The lecture is unnecessary.

_____ None. Interaction with a live instructor is essential.

_____ Good lecture outline plus video-taped lecture.

_____ Convert lecture notes to prose (i.e., text of covered materials).

_____ Text plus video-taped lecture.

_____ Other. ____

____

____

____

____

III.

HABITAT TIME SERIES ANALYSIS

8:00 Tues Show Batholow tape 10 min

IV. HABITAT TIME SERIES CONCEPTS

I. Linear transformation from units of discharge to units of habitat for corresponding time steps in a time series through use of a "look-up" table (Table IV.1).

A. For time step 1, find value of Q.

B. For Q at time step 1, find value of habitat by interpolation in look-up table.

C. Write value of habitat in corresponding time step position in series.

D. Go to time step 2, repeat for n time steps.

II. Assumptions in developing this type of time series.

A. Look-up table contains total habitat versus discharge function, <u>not</u> weighted usable area.

1. Temperature and water quality have been incorporated with physical microhabitat.

2. All habitat types in segment have been incorporated in the correct proportions.

B. The <u>amount</u> of habitat, not its rate of change, is important to the life stage under evaluation.

1. Organisms are sufficiently mobile to find suitable habitat when discharge changes (i.e., mobility of organism is greater than rate of change in position of suitable habitat).

2. Energetic costs of moving to new areas of suitable habitat are acceptable to the organism.

Note this afternoon we will consider rate of change in Lab 3

III. Variations on the theme.

A. Using different time steps corresponding to hydrologic variability and biological sensitivity.

B. Using different habitat versus discharge functions (look-up tables) corresponding to seasonal or diel changes in behavior.

1. Summer versus winter.

2. Day versus night.

3. Incremental changes in foraging behavior.

TABLE IV.1. TRANSFORMATION OF A FLOW TIME SERIES TO A HABITAT TIME SERIES THROUGH A LOOK-UP TABLE.

TIME SERIES DISCHARGE		LOOK-UP TABLE		TIME SERIES HABITAT	
TIME	FLOW	FLOW	HABITAT	TIME	HABITAT
1	1900	250	160096	1	195390
2	490	500	182040	2	181162
3	490	750	200267	3	181162
4	490	1000	212911	4	181162
5	490	1250	216706	5	181162
6	490	1500	209484	6	181162
7	1750	1750	200970	7	200970
8	4040	2000	191670	8	139198
9	3780	2500	173902	9	145617
10	5940	3000	161744	10	87564
11	6000	3500	152209	11	85964
12	5820	4000	140438	12	90763
13	3240	4500	124935	13	157167
14	2320	5000	111147	14	180298
15	2300	5500	99295	15	181009
16	2300	6000	85964	16	181009
17	5730	6500	74302	17	93163
18	6270	10000	33776	18	79667
19	6390			19	76868
20	6390			20	76868
21	5650			21	95296
22	3950			22	141615
23	3420			23	153735

IV. Habitat duration statistics

A. Developed the same way as discharge duration statistics, and subject to same ambiguities (e.g., ranked in ascending or descending order) and variations in graphical display (e.g., inverting x and y axes, logarithmic versus arithmetic plots).

B. Done for the same reasons-

1. Simplification and ease of interpretation

2. Reduction in volume of data to be evaluated

3. Assigns statistical probabilities and properties to individual events in time series.

C. Differences in interpretation between flow and habitat duration statistics.

1. Same amount of habitat can occur at more than one discharge in time series (figure IV.1). For example, compare the flows and habitat amounts for time steps 2, 3, 15, and 16 in table IV.1.

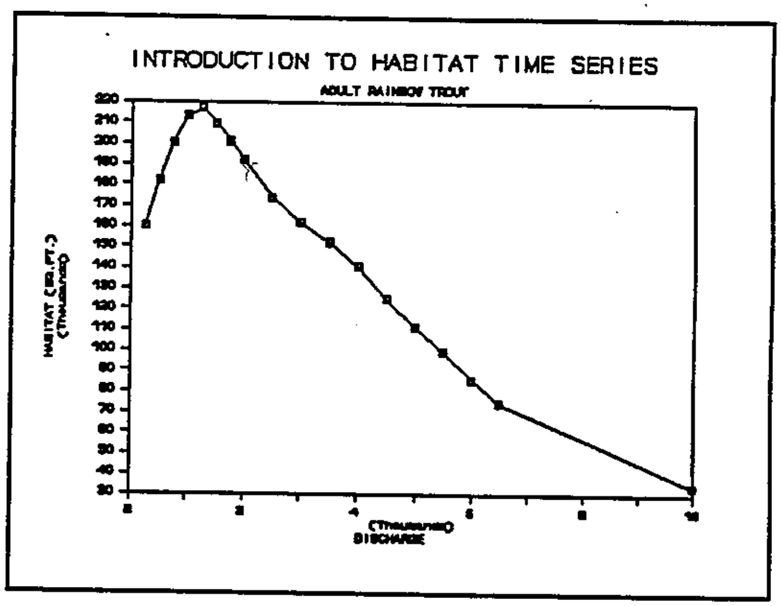

Figure IV.1. Example flow versus habitat function for adult rainbow trout in the Kennebec River.

2. High or low habitat amounts do not necessarily have the same exceedence probabilities as the individual discharges that cause them.

B. Habitat indexes

1. Developed to summarize critical parts of the habitat duration table for simple and standardized comparison of alternatives. These are illustrated in Table IV.2, which contains the habitat values from Table IV.1 ranked in descending order.

A. Average (column 3) - arithmetic average of all values in time series.

B. Maximum (column 4) - maximum of all values in time series.

C. Minimum (column 5) - minimum of all values in time series.

D. Index B - trimmed mean...arithmetic average of all values between 10% and 90% exceedence. Eliminates extremes and then averages.

E. Index A - arithmetic average of all values between median (50% exceedence) and 90% exceedence. Represents the average of the lower 40% of the values, excluding the extreme lowest values.

F. Index C - user defined averaging interval, but usually between 50% and 100% exceedence values. Represents the lowest 50% of the values.

Most useful for rapid flow change problems illustrated in lab 3 this afternoon

Table IV.2. Sorted habitat values used to derive various habitat indexes. Averaging interval highlighted.

(1) RANK	(2) EXC.	(3) AVERAGE	(4) MAX	(5) MIN	(6) INDEX B	(7) INDEX A	(8) INDEX C*
1	0.04	200970	200970	200970	200970	200970	200970
2	0.08	195390	195390	195390	195390	195390	195390
	0.1				188276	188276	188276
3	0.12	181162	181162	181162	181162	181162	181162
4	0.16	181162	181162	181162	181162	181162	181162
5	0.2	181162	181162	181162	181162	181162	181162
6	0.24	181162	181162	181162	181162	181162	181162
7	0.28	181162	181162	181162	181162	181162	181162
8	0.32	181009	181009	181009	181009	181009	181009
9	0.36	181009	181009	181009	181009	181009	181009
10	0.4	180298	180298	180298	180298	180298	180298
11	0.44	180298	180298	180298	180298	180298	180298
12	0.48	157167	157167	157167	157167	157167	157167
	0.5				155451	155451	155451
13	0.52	153735	153735	153735	153735	153735	153735
14	0.56	145617	145617	145617	145617	145617	145617
15	0.6	141615	141615	141615	141615	141615	141615
16	0.64	139198	139198	139198	139198	139198	139198
17	0.68	95296	95296	95296	95296	95296	95296
18	0.72	93163	93163	93163	93163	93163	93163
19	0.76	90763	90763	90763	90763	90763	90763
20	0.8	87564	87564	87564	87564	87564	87564
21	0.84	85964	85964	85964	85964	85964	85964
22	0.88	79667	79667	79667	79667	79667	79667
	0.9				78267	78267	78267
23	0.92	76868	76868	76868	76868	76868	76868
24	0.96	76868	76868	76868	76868	76868	76868
INDEX VALUE		143678	200970	76868	144355	112192	107145

C. Assumptions and interpretive characteristics of habitat indexes.

1. Average - assumes all habitat under time series is important to the species. Can be misleading if low habitat events are considered most important and reduction in these events are offset by increases in high habitat events (figure IV.2)

i.e. population can potentially increase and decrease as the habitat changes

means

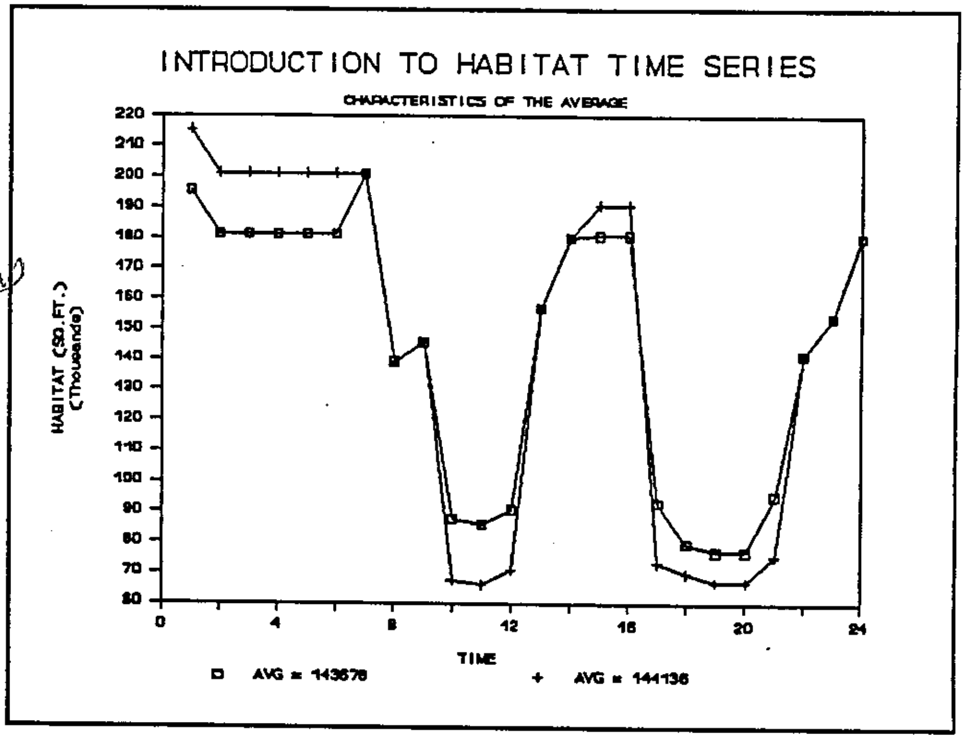

Figure IV.2. Characteristics of the average of all values under the habitat time series when used in comparison with an alternative.

2. Maximum - assumes habitat maximum has biological significance. Generally not used, but easy to generate. Can be used as an indication of whether phenomenon illustrated in figure IV.2 is occurring.

3. Minimum - assumes that the single lowest habitat value in time series is most important biologically. Validity of assumption may depend on length of time system is at minimum value. Cannot discriminate impact if project increases duration of low habitat events, but does not change magnitude (figure IV.3).

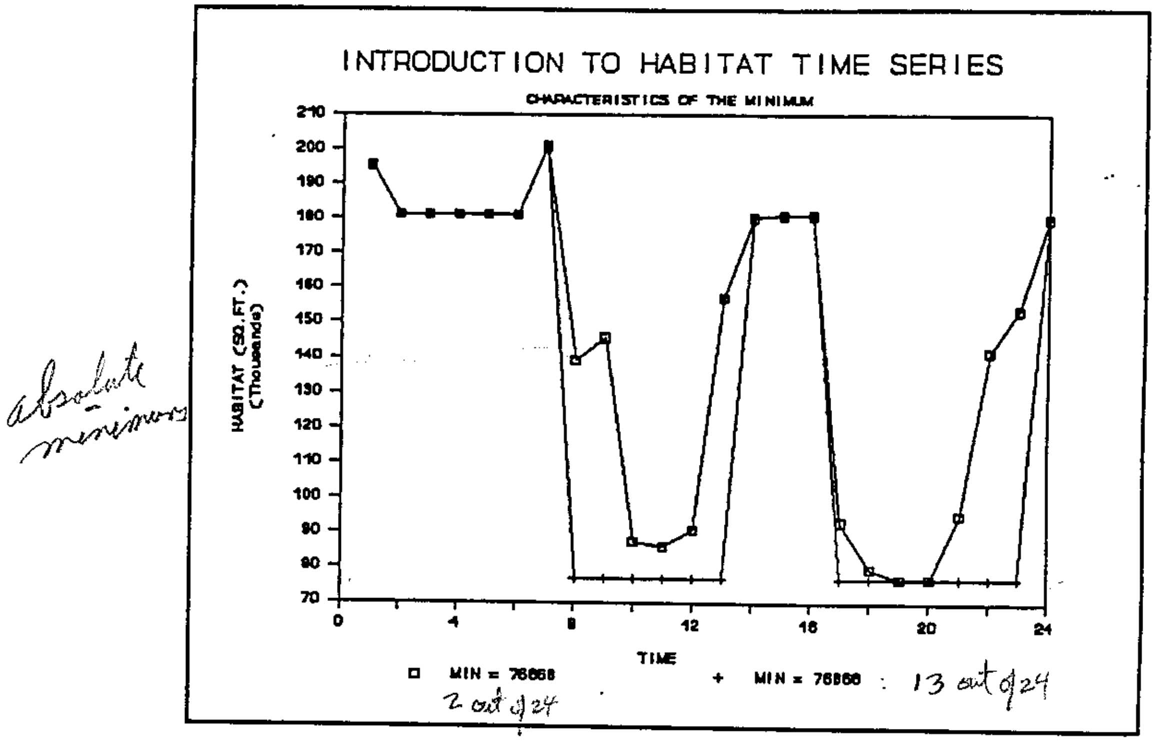

Figure IV.3. Characteristics of the minimum when used to compare alternatives.

4. Index B - Assumes the average is unduly influenced by extreme high or low events or both. Other assumptions and characteristics same as average. i.e. the distribution is not gradual or smooth

5. Index A - Assumes that low habitat events in time series are the most important biologically, but that extremely low events (i.e., with exceedence probabilities greater than 90%) occur too infrequently to be biologically significant. Validity of assumption may depend on time step (e.g., low habitat events may be more important on a daily scale than on an annual scale). Index is ~~responsive~~ indicative to changes in either the magnitude or duration of low events, but not responsive to changes in absolute minimum value.

6. Index C - User defines biologically significant averaging interval. By using averaging interval from median to 100% exceedence values, all low habitat events are assumed to be important. Values above median are considered excess habitat that cannot be used effectively due to previous limitations created by low habitat values. Index is responsive to any change, whether magnitude or duration of low habitat events or change in absolute minimum.

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____

____

____

____

9:00 Tues

LAB 2
INTRODUCTION TO HABITAT TIME SERIES AND HABITAT DURATION CONCEPTS

OBJECTIVES

TO DEVELOP SKILLS IN:

1. THE BASIC PROCEDURES OF GENERATING HABITAT TIME SERIES AND DURATION STATISTICS.

2. QUANTIFICATION OF HABITAT LOSSES AND GAINS USING HABITAT DURATION STATISTICS.

INTRODUCTION

The purpose of this lab is to teach you the basics of how to generate habitat time series and duration statistics and how to use ~~of~~ this information to quantify habitat losses and gains associated with different water management scenarios. Your assignment is to compare the existing release pattern(s) from the Wyman Project, Kennebec River, with three alternative release patterns described below.

We have chosen to use a spreadsheet approach for this lab because we feel that it is a better teaching vehicle. You could also use the time series programs in TSLIB to do the same things. A companion lab, showing how to develop the time series and duration statistics in TSLIB, is available on your diskette under the file name LAB2.APP if you are curious about using the TSLIB programs.

This document describes the use of a Lotus 1-2-3 template named HABTS2.WK1. This worksheet may be used, with modification, to calculate a habitat time series given a flow time series and a habitat versus flow relationship. Up to 8000 time steps with a length of your choosing may be employed. The worksheet also may be used to calculate the minimum, average, maximum, median, and various other exceedence-derived statistics. Any consistent set units may be employed, such as cfs-sq.ft/1000 ft. The worksheet as currently set up is limited to a single species/lifestage and does no error checking for the user.

One flow time series is present for each of four seasons (winter, spring, summer, fall) and for each of three water supply scenarios (dry, wet, average). We are unaware of the exact definitions used to select these flow time series sets. In addition, the habitat versus flow function for adult rainbow has been entered in the spreadsheet. This function was derived from the IFG-4 data set and SI curves supplied by the applicant. Comparable flow time series for the alternatives and additional habitat versus flow functions for different life stages are provided on your **LABSDAT** diskette. The instructions below will tell you which file to import for each iteration of this exercise.

THE ASSIGNMENT

Generate habitat time series and more specifically, habitat duration statistics for adult rainbow trout, for a normal water year, comparing the existing condition with all three alternative flow release scenarios. After you have finished these twelve runs, go to cell C12 and import the file containing the flow versus habitat function for rainbow fry, named **RBOWFRY.PRN** (/FIN RBOWFRY <CR>). Repeat the comparison runs for fry that you just completed for the adults, but only for spring and summer. If time permits, import the file containing the discharge versus habitat function for spawning and run all three scenarios. And if your group is really fast, repeat the process for a dry year. You thought we were kidding about the number of runs didn't you? Be prepared to answer the Review Questions below during the lab debriefing session.

INSTRUCTIONS

HOW IT WORKS

These instructions assume a limited but working knowledge of Lotus 1-2-3, Quattro, or similar spreadsheet software. To start off, make sure you are in the correct directory as identified by your instructors. Type 123 <CR> (throughout these instructions this symbol refers to "enter" or "carriage return"). When the empty 123 worksheet appears on your screen, type /FR(/File Retrieve) and space the cursor over to the file name **HABTS2.WK1** and <CR>. You should see the first page of the spreadsheet as represented by the extracted portion shown in Table 2.1 (three pages). As you read the steps below and before you start gaming with the spreadsheet, move the cursor across the columns at row 12 and compare the formulas or numerical entries with the description below so you have a better feel for what's going on. Your instructors will be happy to answer any questions because at this stage they have nothing better to do.

IMPORTANT: ☛ An abbreviated set of instructions appears at the top left of the spreadsheet. Some of the columns in the spreadsheet will appear white and others are green. The white columns are protected so you can't accidentally write anything over the equations used to compute whatever goes into the column. You can input data into any of the green columns, although you will be doing most of your work with columns B, C, D, and L. The spreadsheet is designed to generate a habitat time series, duration statistics, and graphics for a single life stage of a species under two alternative flow scenarios you wish to compare.

The flow time series for which habitat time series are to be generated are located in columns B and L. The flow time series representing the existing or baseline condition is located in column B and the time series for the alternative is located in column L. Each flow time series contains 168 hourly time steps, seven days of 24 hours each. Importable ASCII files have been prepared for this lab to represent the existing seasonal operation of the power plant and reservoir under dry, wet, and normal conditions. These files are all recognizable by the prefix "BASEQ" and the extension ".PRN." The two letters (e.g., DF, WSP) after the prefix refer to the season and type of water year. DF refers to a dry autumn (fall), WSP refers to a wet spring, NSM refers to a normal summer. Thus, a file named BASEQDW.PRN is an importable ASCII file containing hourly flows for the existing operation during a dry winter.

In addition to the twelve "baseline" flow scenarios, comparable sets of files have been prepared to represent three different alternatives that are under consideration for this project. The first alternative is an enhanced peaking scenario that might be proposed by the power company. Under this scenario, peak flows would be increased (either in magnitude or duration) but the existing base flow would remain the same. The files for the enhanced peaking alternative all have the prefix POWRQ with the same seasonal and water year conventions described above. The second alternative is a non-peaking scenario, commonly misnamed the "run of river" option. Flow files for this alternative all have the prefix RORQ, with the same convention for seasons and water years. The third alternative is the imposition of a standard to determine the minimum release from the reservoir, with no modification to the existing peaking regime. In this example, the minimum flow release was established as 1310 cfs using the New England Base Flow (NEBF) method. The prefix for all files representing this alternative is NEQ, with the same convention for season and water year as the rest of the flow files. Table 2.2 contains a summary of file names for all 48 of the pre-packaged flow files representing the gamut of alternatives described above. Start your analysis on the normal or average water year, and go all the way through the assignment. If you have time, repeat the analysis for the dry water year scenario.

Although the spreadsheet will contain a flow time series in both columns B and L, it is likely that neither you nor your instructors will know what season, water year type, or alternative they represent. **Because of it's general nature, the spreadsheet will not automatically keep track of things like this, so as you proceed it is very important for you to remember what season, water year type, species, life stage, and alternative you are running. When you get results out, whether you have them printed or write the results on the back of an envelope, be sure to write down all the particulars of the run. Otherwise, you will end up with about 100 duration tables that look identical except for the numbers on them. If you're working on more than one project at once, it's also helpful to write down the river to which the results apply. [Hint-this is the voice of experience speaking!]**

Table 2.1. Example lay-out of HABTS2.WK1 spreadsheet.

	A	B	C	D	E	F	G	H	I	J	K
1	KENNEBEC RIVER HABITAT TIME SERIES - EXAMPLE DURATION SPREADSHEET										
2	Steps: 1. Import flow scenario for existing condition into B12; for alternative into L12										
3	2. Import Q vs. Habitat function into C12.										
4	3. Press Alt-S to re-sort the data and calculate statistics										
5	4. Alt-Q shows Q time series; Alt-H shows habitat time series										
6	5. Alt-W shows WUA vs Q; Alt-D shows habitat duration.										
7	6. Alt-B compares duration stats; Alt-I compares duration indexes.										
8	------------------------------------EXISTING CONDITIONS--------------------------------										
9		ACTIVE	RAINBOW ADULT				ACTIVE	SORTED			
10	TIME	FLOW-TS	Q	WUA(Q)	B-TERM	A-TERM	HABTS	HABTS	RANK	DURATION	
11											
12	Day 1	1070	250	160096	88	138151	213974	68744	168	99.41	
13		1070	500	182040	73	145587	213974	73144	167	98.82	
14		1070	750	200267	51	162334	213974	74768	166	98.22	
15		1070	1000	212911	15	197732	213974	75701	165	97.63	
16		1070	1250	216706	-29	252815	213974	77567	164	97.04	
17		1070	1500	209484	-34	260570	213974	78267	163	96.45	
18		1070	1750	200970	-37	266070	213974	78267	162	95.86	
19		1070	2000	191670	-36	262742	213974	78267	161	95.27	
20		2100	2500	173902	-24	234690	188116	78267	160	94.67	
21		4800	3000	161744	-19	218954	116663	79667	159	94.08	
22		6060	3500	152209	-24	234609	84565	80133	158	93.49	
23		6090	4000	140438	-31	264454	83865	80366	157	92.90	
24		4510	4500	124935	-28	249030	124660	80366	156	92.31	

ACTIVE SORTED

	L	M	N	O	P	Q
1						
2						
3						
4						
5						
6						
7						
8	*********************ALTERNATIVE CONDITIONS**************					
9	ACTIVE	ACTIVE	SORTED			
10	FLOW-TS	HABTS	HABTS	RANK	DURATION	
11						
12	1310	214973	68744	168	99.41	
13	1310	214973	73144	167	98.82	
14	1310	214973	74768	166	98.22	
15	1310	214973	75701	165	97.63	
16	1310	214973	77567	164	97.04	
17	1310	214973	78267	163	96.45	
18	1310	214973	78267	162	95.86	
19	1310	214973	78267	161	95.27	
20	2100	188116	78267	160	94.67	
21	4800	116663	79667	159	94.08	
22	6060	84565	80133	158	93.49	
23	6090	83865	80366	157	92.90	
24	4510	124660	80366	156	92.31	

:

	R	S	T	U	V	W	X
1	RIVER:						
2	SEASON/WATER YEAR:						
3	SPECIES/LIFE STAGE:						
4	ALTERNATIVE:						
5							
6							
7							
8							
9	*********		COMPARATIVE STATISTICS				
10							
11	EXISTING			ALTERNATIVE		PERCENT CHANGE	
12	CONDITION			CONDITION		IN INDEX	
13	COUNT	168		168			
14	MINIMUM	68744		68744		0.00	
15	AVERAGE	163994		166011		1.23	
16	MAXIMUM	216706		214973		-0.80	
17	MEDIAN	181619		184029		1.33	
18	INDEX A	135871		135954		0.06	
19	INDEX B	168418		170928		1.49	
20	INDEX C	124979		125046		0.05	
21	APPROXIMATE						
22	EXCEEDENCE						
23	90%	81882		81882		0.00	
24	80%	101903		101903		0.00	
25	70%	142674		142674		0.00	
26	30%	201810		214684		6.38	
27	20%	212911		214973		0.97	

Table 2.2. Summary of prepared flow files for input to HABTS2.WK1 spreadsheet.

	DRY CONDITION	WET CONDITION	NORMAL CONDITION
EXISTING/WINTER	BASEQDW.PRN	BASEQWW.PRN	BASEQNW.PRN
EXISTING/SPRING	BASEQDSP.PRN	BASEQWSP.PRN	BASEQNSP.PRN
EXISTING/SUMMER	BASEQDSM.PRN	BASEQWSM.PRN	BASEQNSM.PRN
EXISTING/FALL	BASEQDF.PRN	BASEQWF.PRN	BASEQNF.PRN
STEADY RELEASE/WINTER	RORQDW.PRN	RORQWW.PRN	RORQNW.PRN
STEADY RELEASE/SPRING	RORQDSP.PRN	RORQWSP.PRN	RORQNSP.PRN
STEADY RELEASE/SUMMER	RORQDSM.PRN	RORQWSM.PRN	RORQNSM.PRN
STEADY RELEASE/FALL	RORQDF.PRN	RORQWF.PRN	RORQNF.PRN
NEBF/WINTER	NEQDW.PRN	NEQWW.PRN	NEQNW.PRN
NEBF/SPRING	NEQDSP.PRN	NEQWSP.PRN	NEQNSP.PRN
NEBF/SUMMER	NEQDSM.PRN	NEQWSM.PRN	NEQNSM.PRN
NEBF/FALL	NEQDF.PRN	NEQWF.PRN	NEQNF.PRN
ENHANCED PEAKING/WINTER	POWRQDW.PRN	POWRQWW.PRN	POWRQNW.PRN
ENHANCED PEAKING/SPRING	POWRQDSP.PRN	POWRQWSP.PRN	POWRQNSP.PRN
ENHANCED PEAKING/SUMMER	POWRQDSM.PRN	POWRQWSM.PRN	POWRQNSM.PRN
ENHANCED PEAKING/FALL	POWRQDF.PRN	POWRQWF.PRN	POWRQNF.PRN

GENERATING A HABITAT TIME SERIES COMPARISON

Let's do a habitat time series, starting off in the winter. Place the cursor at cell B12 and type /FIN (/File Import Numbers). When the menu of importable .PRN files appears at the top of the spreadsheet, space the cursor over to **BASEQNW** for a normal water year. You may also type in the file name, rather than spacing the cursor over. Once you have identified the appropriate file, simply <CR> to import the file into the proper location. Now, space the cursor over to cell L12. To import the flow file representing the augmented peaking alternative, type /FIN (/File Import Numbers) again. This time when the menu pops up, space over to **POWRQNW**. Then <CR> and the flow time series for your alternative will be imported into the spreadsheet. For now, that's all there is to running this thing.

When you import a flow file, here's what is going on within the spreadsheet. Importing one of the flow time series column B (labeled Active Flow-TS) will automatically calculate the resulting habitat time series in column G. This is accomplished by having a habitat versus flow relationship entered in columns C and D (labeled Q and WUA(Q) respectively). Note that the data pairs describing this relationship must be entered in ascending order and must encompass the entire range of flows that may be encountered. Having a flow event either lower than the lowest flow of higher than the highest flow in column C will cause an error. Also note that if you want to evaluate the habitat time series for a different species or life stage (you will want to do this shortly) all you have to do is import the flow versus habitat function (as a two-column block) into cell C12. An identical operation is going on simultaneously over in columns L-N for whatever alternative you stuck into column L. The alternative active habitat time series for the alternative is listed in column M.

The habitat time series in columns G and M (labeled Active Habitat-TS) are calculated by a step-wise interpolation scheme from the general formula y = a + bx. The slope (B-term) and intercept (A-term) for each flow-habitat pair are calculated in columns E and F.

Though the habitat time series in columns G and M are calculated automatically, the exceedence statistics in columns R through W require manual intervention. The Lotus macro Alt-S must be invoked (hold down the Alt key and type S) to sort the habitat time series ascending into columns H and N, respectively (Sorted HTS), so that exceedence statistics may be calculated from the ranks and durations fixed in columns I and J. The duration values are calculated by a standard formula Duration = rank/(count +1).

The exceedence statistics (90%, 80%, 70%, 30%, 20%, 10%, Index-A, Index-B, and Index-C) are approximate in that they use the closest duration levels to those desired, but may not be exact, and in any case, may not exactly match exceedence statistics calculated by TSLIB.

TAKE CARE OF YOUR OUTPUT

Generating a single habitat time series is pretty much child's play. The real trick is organizing and keeping track of the various runs you make and the results generated by each one. It is conceivable that you could make a hundred different runs in a two hour period, once you get the hang of it. The really important information for each run is summarized in columns R through W, labelled "COMPARATIVE STATISTICS." Below this heading you will see three columns of numbers and the corresponding duration statistic or index. The first column contains the stats and indexes for the existing condition, the second for the alternative, and the third, the percent change in the index (calculated as (alternative-existing/existing x 100%). What this table doesn't tell you is what species or life stage you are comparing the statistics for, what river you're working on, what the alternative was, what season of the year it is, or what kind of water year. If you do not have access to a printer, copy down everything in the table and then write down all the other information about the run. If you do have a printer, set your cursor at cell R1 and edit the entry for River Identification by pressing the F2 function key. Backspace to the colon after "River" and type in "Kennebec River below Wyman Dam." <CR>. This will enter the name of the river in the appropriate location. Cursor down to R2 and repeat the process for the next entry, and so on. You can then print out the table by typing /PP (/Print Printer). When Lotus asks you for the Range to print, move the cursor to R1, and type a period (.); now, push down-arrow to block off the vertical length of the table, then push right-arrow to block off the horizontal length of the table, and <CR>. You will now return to the PRINT menu, at which point type G (Go), Q (Quit), and your printout should start immediately. If it doesn't, there is probably something wrong with the configuration of Lotus for the printer you have. Your instructors may or may not be able to fix it. If it can't be fixed, you can still get a printout by typing /PF (/Print File). Lotus will then ask you for a name for the file it will create. Enter anything you want but remember what you called it. Lotus will automatically tag on an extension of .PRN. Block off the same Range noted previously, <CR>,G,Q as before. Type /S to exit back to the system. When the DOS prompt comes up, type "print <u>file name.prn</u>" (the file name is whatever you called it after the /PF command). <CR>. If a message comes onto your screen to list the print device, just <CR> again. Your printer should come to life right away. If it doesn't, request assistance from one of the instructors.

MORE ON OUTPUT

The spreadsheet is equipped with an array of macros designed to produce different kinds of graphics. By pressing ALT-Q, you get a comparison of the existing flow regime and the alternative entered in column L. ALT-H produces the two habitat time series for the existing and alternative conditions. ALT-W generates a graph showing the relation between discharge and WUA. ALT-D displays the respective habitat duration curves for the two alternatives. ALT-B produces bar graphs comparing the duration statistics (minimum, average, maximum, and median) for the existing and alternative conditions. ALT-I gives you bar graphs of the three habitat indexes (Index-A,-B, and -C).

By pressing the ESC key or the space bar, the graph will disappear and you will find yourself back in the spreadsheet. The macros are set up this way so you can skip quickly from one comparison to another. Operator intervention will be needed if you wish to generate hard copy of these graphics. Although the points and lines drawn on the graph will be correct for whatever comparison you're making, the titles and legends will probably be wrong. To change the titles on the graph, type /GV (/Graph View). Whatever graph you were working on last will pop up on the screen. By pressing ESC, the graph will disappear and you will find yourself in the Graph menu. Type O (options) and T (Titles) if you wish to edit the titles or axis labels on the graph, or O (options) and L (Legend) if you wish to change the legend titles. Type Q (Quit) to get out of the Options menu and back to the Graph menu. You can view the modified graph by typing V (View), then ESC to remove the graph from the screen. If you want hard copy, type S (Save). You will be prompted for a file name under which to save your graph (as a .PIC file). Enter the file name, and type Q to get out of the Graph menu. It takes quite a while to print graphs out, so try to be a little selective about the ones you save. Ask your instructor if you need help producing hard copy on your printer.

<u>MODIFYING HABTS.WK1</u>

This spreadsheet is set up as an example only. Any 168-time-step data set could be read in without modification by using the Lotus command /File Import Numbers for a columnar file. Modifying it to work for another data set should be done with care as it is not general if you wanted to change the number of time steps or add to the points in the habitat versus flow function. Check the formulae in the original template first to understand how they work. Both ranges and macros would need to be modified for almost any change. Though it would work in principle for a small data set, using fewer than 10 time steps would not provide statistically legitimate results.

Note that there is also an unused macro (Alt-M) which is a general macro for finding the median of an arbitrary range. It originated from an article in PC Magazine, May 30, 1989, page 392.

REVIEW QUESTIONS

1. Compare the habitat duration statistics for the existing condition with those from the New England Base Flow alternative. Notice that there is no change in the amount of habitat occurring at the low habitat events (those with high exceedence probabilities). Why is the NEBF apparently ineffective in alleviating the frequent occurrence of low habitat in the Kennebec River?

2. Compare the habitat duration statistics for the existing condition with those from the Steady Release alternative. Why does this alternative result in an improvement in the low habitat events? What does the slope of the habitat duration curve tell you about the variability of the habitat over time?

3) For the water year type assigned your group, what is the net effect of each alternative in percent increase or decrease of habitat? Which index or indices did you base your decision on for each season and why? Consider only the rainbow trout life stages which you were able to complete.

4. Index-C shows a 52% increase in fry habitat under the enhanced peaking scenario during a dry summer, compared to the existing condition. Examine figure 2.1 and describe why Index-C (as defined in this analysis) is not the appropriate habitat index for comparison in this case. Discuss why Index-C may or may not ever be a valid habitat index to use to evaluate fry habitat.

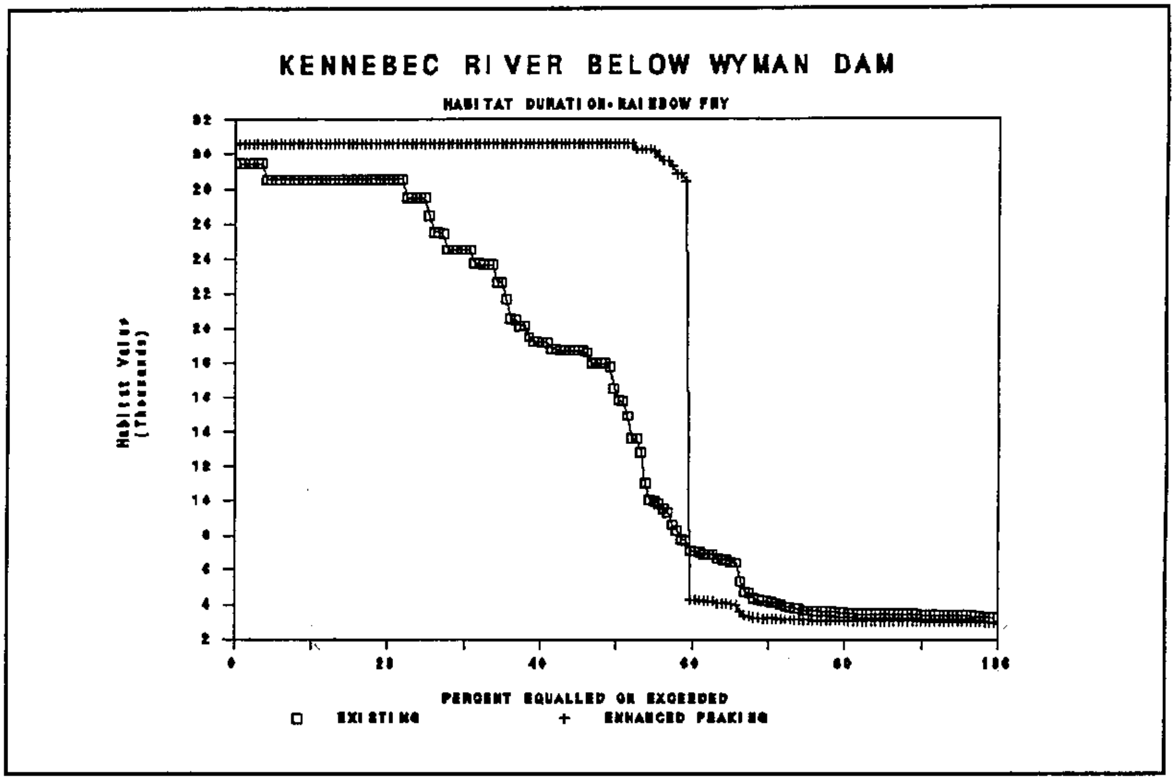


Figure 2.1. Habitat duration curve for rainbow trout fry during dry summer conditions, comparing existing condition with enhanced peaking scenario.

IF 201
May 11-15, 1992
Fort Collins, CO

(circle appropriate lab #)

LAB # 1 2 3 4 5 6 7

1. Will what you learned in the lab be relevant to problems you encounter in your job?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the lab effective in reinforcing concepts introduced in the lecture?

_____ Yes, lab could stand alone without lecture.

_____ Yes, lab supported lecture.

_____ Somewhat, too much detail.

_____ Somewhat, not enough detail.

_____ No

If no, what needs to be changed?____

____

____

3. How much time were you given to complete the lab?

_____ less than one hour

_____ one to two hours

_____ more than two hours

4. Were you given enough time to get everything out of the lab you wanted to?

_____ Yes

_____ No

If no, how much time would you have liked to work on this lab? ____________

5. Were the written instructions for the lab clear, concise, and accurate?

_____ Yes

_____ No

If no, what problems did you encounter with the instructions?______________

____

____

____

____

6. Did the software perform as you expected from reading the instructions?

_____ Yes

_____ No

If no, what problems did you encounter with the software?__________________

____

____

____

____

7. Rate the complexity of the lab according to your expectations.

_____ Too simple.

_____ About right.

_____ Too complex.

8. Were the Review Questions and Discussions provided at the end of the lab helpful in reinforcing concepts and skills acquired in the lab?

_____ Yes

_____ No

If no, why not?____

____

____

____

9. Did you learn anything in the lab that will help you do your job better or more efficiently?

_____ Yes

What was it?____

____

____

_____ No

Why not? ____

____

____

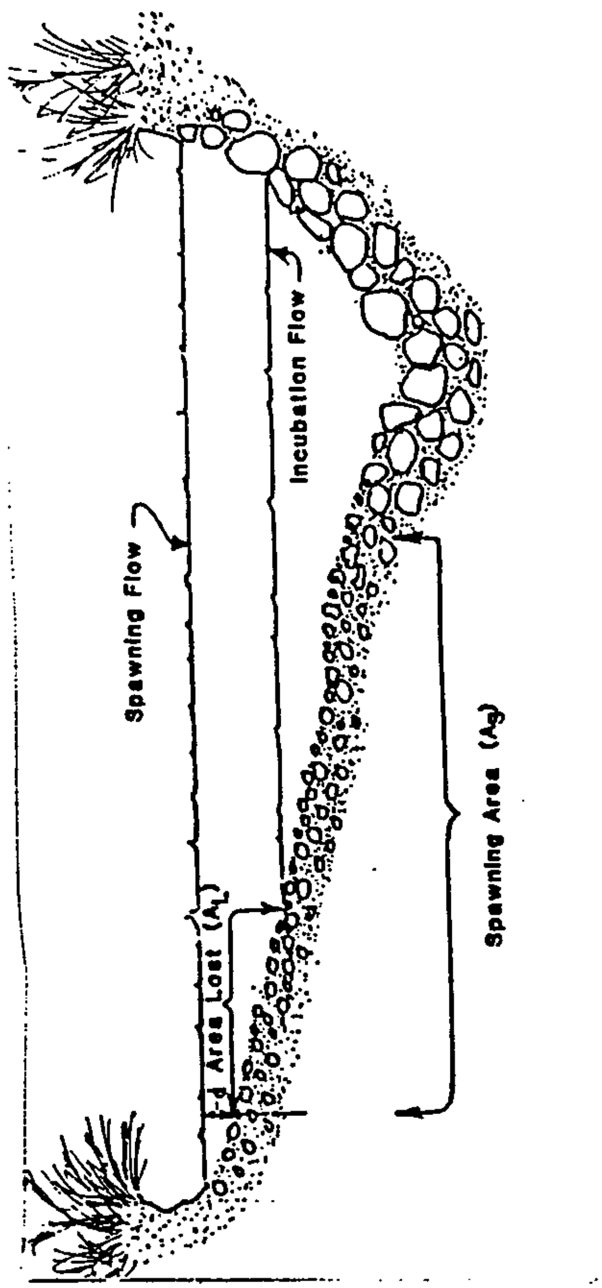
____

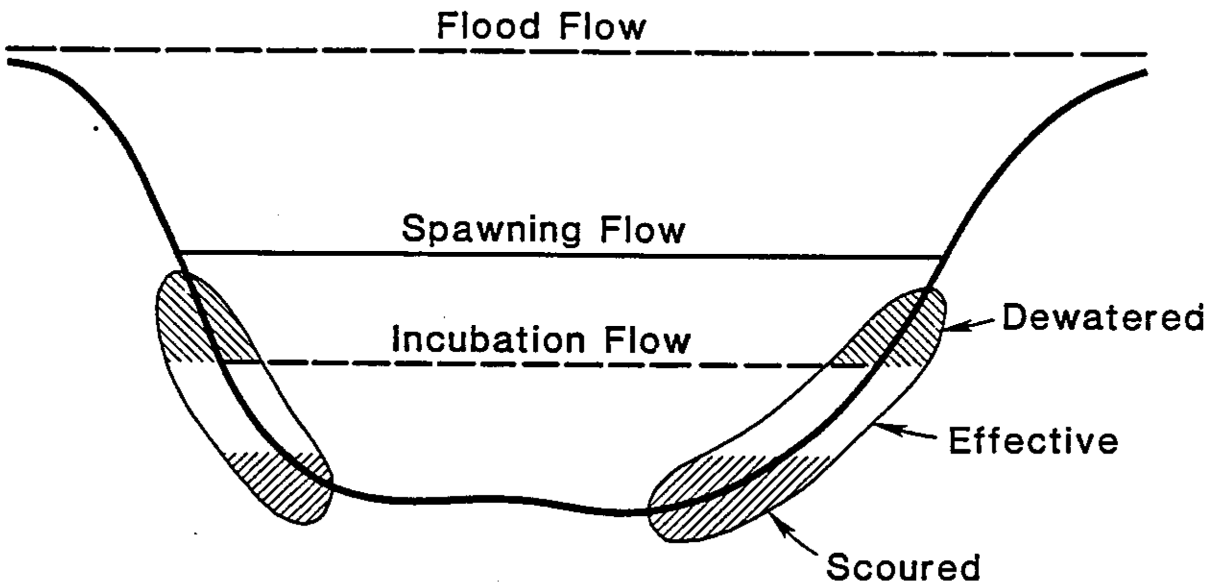
10. Are there any subjects related to IF 201 for which you would like to see additional labs or tutorials developed? What are they?

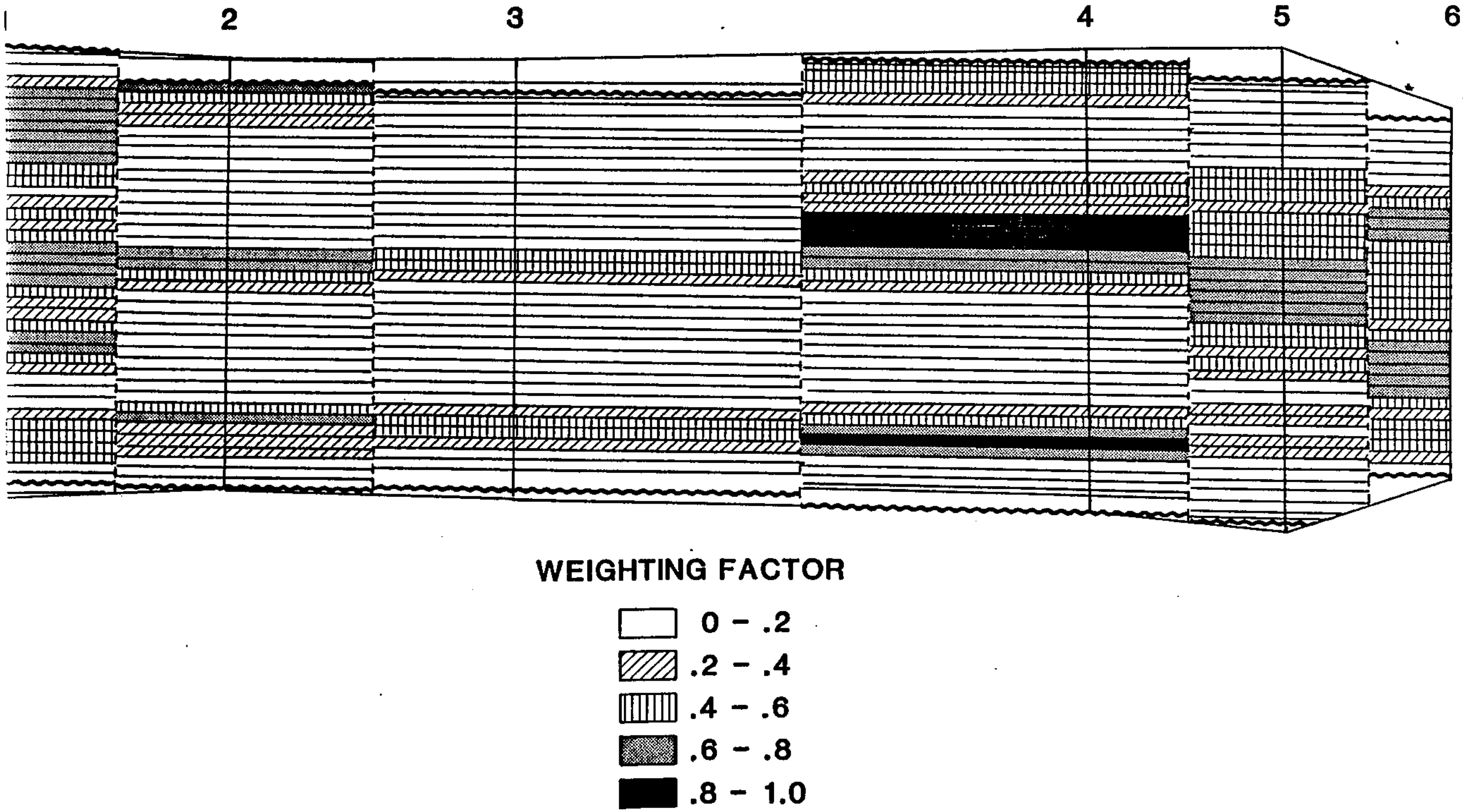
2:00pm Tues

IV.

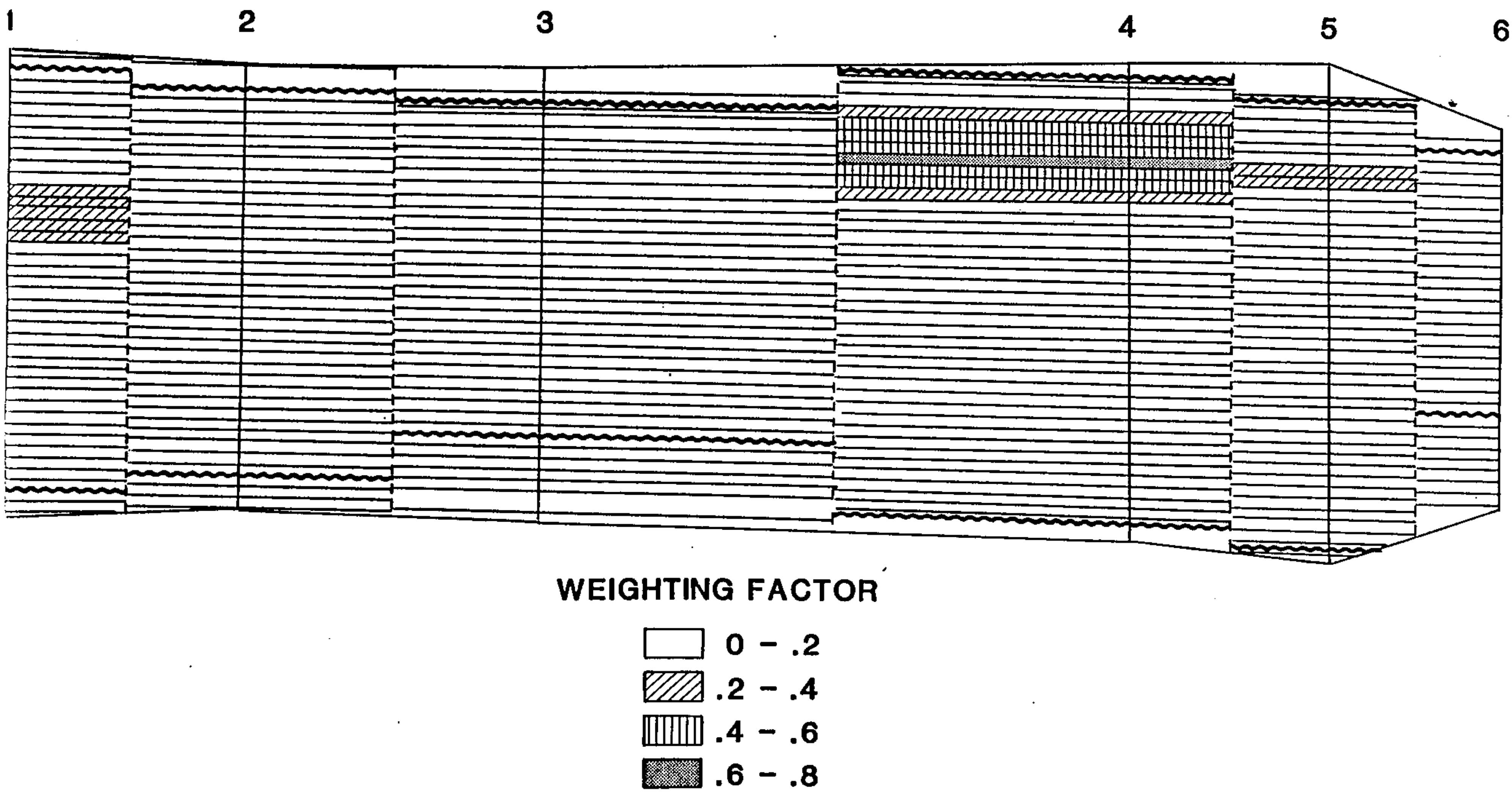
RAPID FLOW FLUCTUATIONS

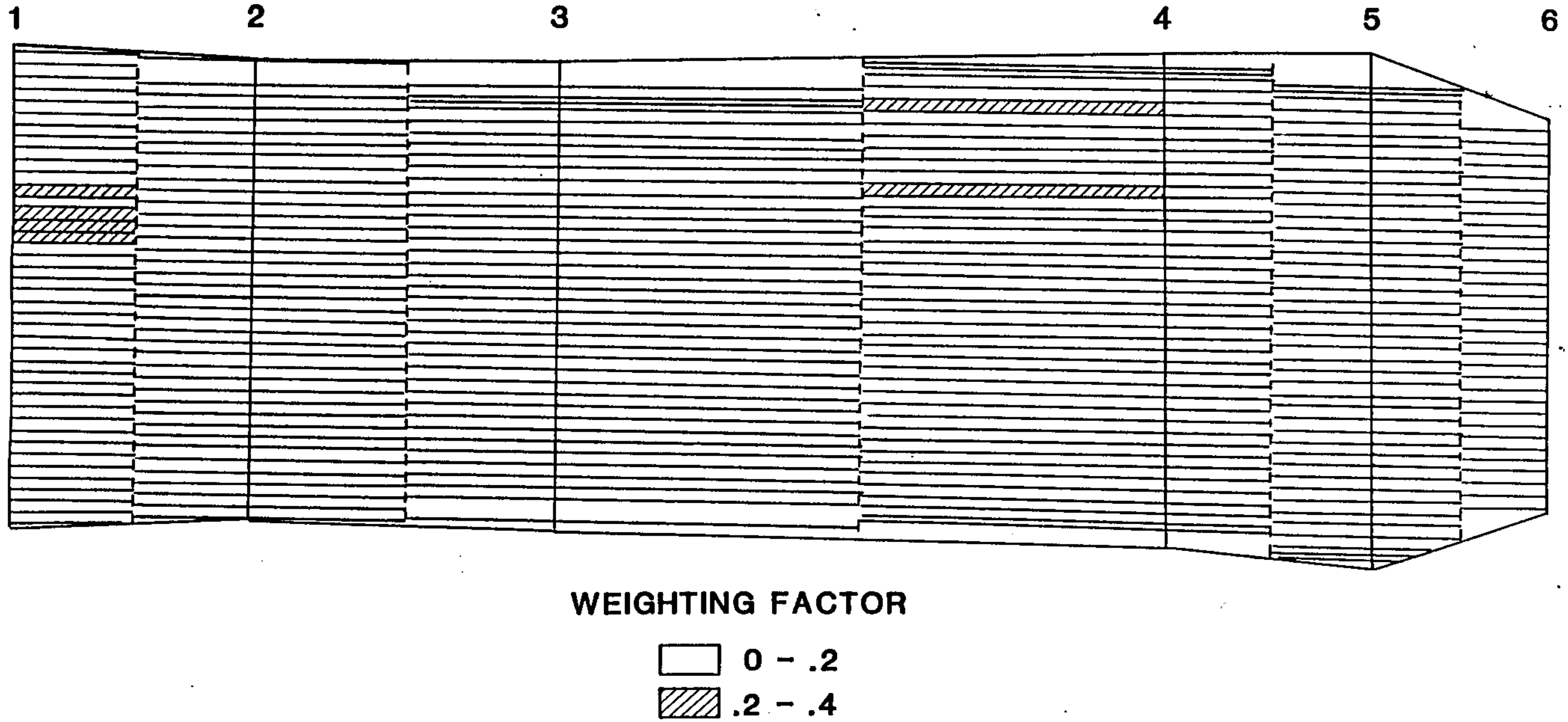

Spawning Flow
Incubation Flow
Area Lost (AL)
Spawning Area (As)

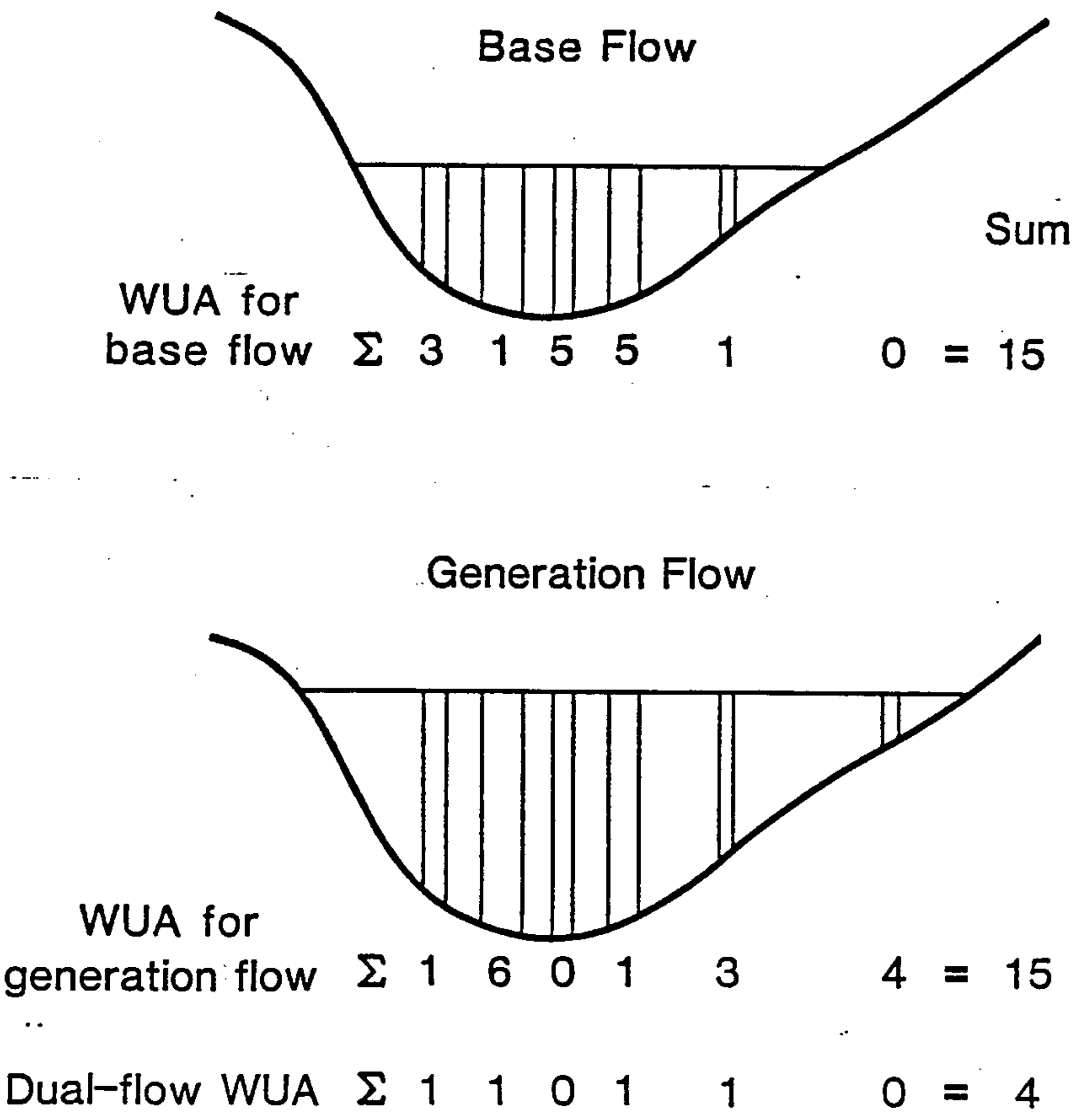

Flood Flow
Spawning Flow
Incubation Flow
Dewatered
Effective
Scoured

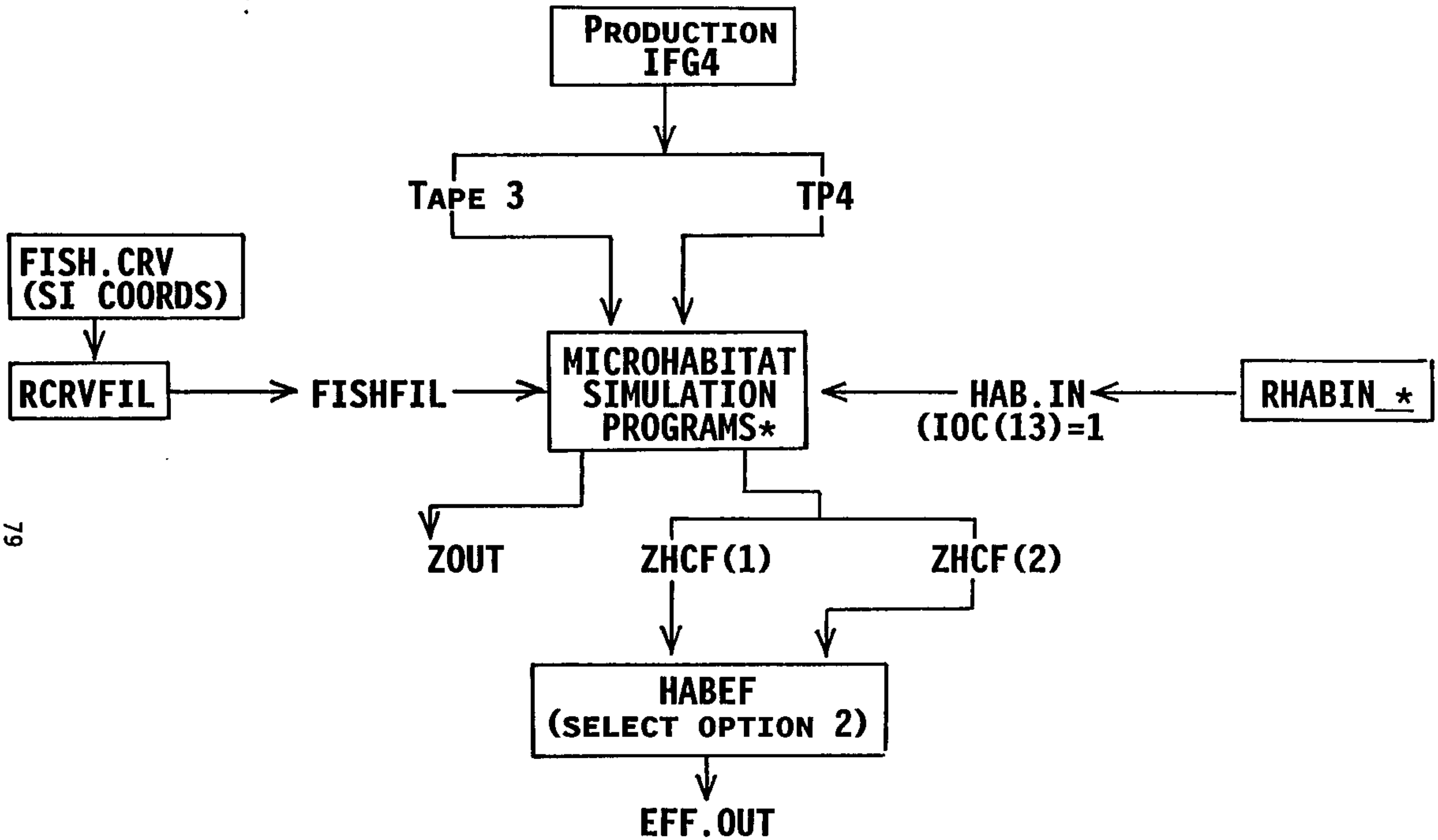


1
2
3
4
5
6
WEIGHTING FACTOR
0 – .2
.2 – .4
.4 – .6
.6 – .8
.8 – 1.0


1
2
3
4
5
6
WEIGHTING FACTOR
0 – .2
.2 – .4
.4 – .6
.6 – .8


1
2
3
4
5
6
WEIGHTING FACTOR
0 – .2
.2 – .4


Base Flow
Sum
WUA for
base flow Σ 3 1 5 5 1 0 = 15
Generation Flow
WUA for
generation flow Σ 1 6 0 1 3 4 = 15
Dual–flow WUA Σ 1 1 0 1 1 0 = 4


PRODUCTION
IFG4
TAPE 3
TP4
FISH.CRV
(SI COORDS)
RCRVFIL
FISHFIL
MICROHABITAT
SIMULATION
PROGRAMS*
HAB.IN
(IOC(13)=1
RHABIN_*
ZOUT
ZHCF(1)
ZHCF(2)
HABEF
(SELECT OPTION 2)
EFF.OUT

PROGRAM - EFHTBL
PAGE - 1

DATE - 90/02/07. WILLIAMS FORK RIVER SECTION 1
TIME - 21.24.45. ONE MILE BELOW KINNEY CREEK CONFLUENCE LAB 10 - IFG4 DATA SET
SPECIES - HYDRO-PEAKING IMPACT ON SPAWNING

BASE FLOWS	GENERATION FLOWS 5.0	10.0	25.0	50.0	100.0	250.0	500.0	750.0	1000.0	1500.0	-I
5.0	1034.3	1034.3	1034.3	1034.3	1034.3	755.1	324.5	186.1	80.0	.4	-I
10.0	1034.3	2114.6	2114.6	2114.6	2114.6	1206.5	416.8	237.1	104.5	9.6	-I
25.0	1034.3	2114.6	5189.8	5189.8	5052.5	1937.1	545.5	309.7	109.8	9.6	-I
50.0	1034.3	2114.6	5189.8	9635.5	9418.0	3205.6	867.0	340.0	112.1	9.6	-I
100.0	1034.3	2114.6	5052.5	9418.0	12968.1	5416.0	1541.2	682.2	390.1	247.7	-I
250.0	755.1	1206.5	1937.1	3205.6	5416.0	11565.5	4047.6	2197.2	1347.1	591.8	-I
500.0	324.5	416.8	545.5	867.0	1541.2	4047.6	6729.4	4132.9	2316.9	819.9	-I
750.0	186.1	237.1	309.7	340.0	682.2	2197.2	4132.9	4354.8	2338.0	841.1	-I
1000.0	80.0	104.5	109.8	112.1	390.1	1347.1	2316.9	2338.0	2339.0	841.1	-I
1500.0	.4	9.6	9.6	9.6	247.7	591.8	819.9	841.1	841.1	841.1	-I

IF 201
May 11-15, 1992
Fort Collins, CO

Lecture Evaluation

(circle appropriate lecture #)

Lecture # I II III IV V VI VII VIII IX

1. Was the subject of the lecture relevant to the stated objectives of the course?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the material covered in the lecture necessary to achieve one of the stated objectives of the course?

_____ Absolutely necessary for understanding concepts.

_____ Helpful, but not necessary.

_____ Would have been less confusing without the lecture.

3. Did the materials in the workbook follow the materials presented in the lecture?

_____ Workbook was easy to follow.

_____ Workbook was somewhat out of order with presentation.

_____ Workbook contained extraneous materials not covered in lecture.

_____ Lecture covered extraneous material not contained in workbook.

_____ Lecture and workbook were totally out of synch.

4. Were lecture notes in the workbook helpful in following the lecture?

_____ Very helpful.

_____ Somewhat helpful.

_____ Would have been helpful if instructor had followed them.

_____ Lecture notes not provided.

5. Were audio-visual materials audible and/or visible?

_____ Yes

_____ No

If no, which need improvement and how can they be improved?

____

____

____

6. Did AV materials support the lecture materials?

_____ Yes

_____ No

If no, should the AV materials be replaced or eliminated?

_____ Replace (with)____

____

_____ Ditch them.

7. If this course were to be packaged as a correspondence course, what would be the best medium through which to present the materials covered in the lecture?

_____ None. The lecture is unnecessary.

_____ None. Interaction with a live instructor is essential.

_____ Good lecture outline plus video-taped lecture.

_____ Convert lecture notes to prose (i.e., text of covered materials).

_____ Text plus video-taped lecture.

_____ Other. ____

____

____

____

____

IF 201
LAB 3

ANALYZING IMPACTS OF HYDROPEAKING USING HABEF

OBJECTIVE

TO DEVELOP SKILLS IN ANALYZING HABITAT AVAILABILITY FOR IMMOBILE ORGANISMS UNDER CONDITIONS OF RAPIDLY VARYING STREAMFLOW.

This lab illustrates the application of PHABSIM to the analysis of instream flow below hydroelectric projects. The defining characteristic of a hydropeaking project is the large difference between the base and the generation flows. The base flow is either the project's minimum release or leakage; generation flows occur when the project is peaking. These dual flows, the daily minimum and maximum, must also govern the habitat analysis. The objective of the analysis illustrated in this lab is to determine the effect of different combinations of generation and base flows on different kinds of aquatic organisms.

OVERVIEW: The idea of dual flow habitat is best understood when compared to steady flow habitat. Steady flow habitat is the habitat that exists when the stream flow is constant. At constant flow, the statement "at 85 cfs there is a weighted useable area of 101 sq ft/linear ft of stream for adult smallmouth bass" means there is always 101 sq ft/ft of habitat. Though stream flow is rarely truly steady, the relationship is assumed to hold because 1) aquatic organisms have time to adjust to the slowly changing habitat conditions, and 2) aquatic organisms can tolerate variation about a mean habitat condition if the variation about the mean is small.

Rapid, frequent, and large magnitude changes in streamflow are not consistent with the assumptions made for steady flow habitat. Since the discharge and habitat value for each cell may change dramatically, one of two things must occur. Mobile organism must move to maintain reasonable habitat conditions; organism with restricted mobility must weather the changing and often degrading habitat conditions that result. Obviously, the definition of a mobile versus immobile organism depends on the rate of change versus the organism's ability to move.

In salmonids and many other families of riverine fishes there are several transitional periods during which target organisms may be considered immobile. The first period is the time between spawning and emergence. The second common period of concern is the interval between emergence and the end of the first growing season (often called the fry period). A third period emerging as a concern is the interval between incubation and emergence, the so-called swim up period. The common feature to all species affected by fluctuations in streamflow is that none of the reproductive or early life history stages is pelagic.

Species that dig redds, build nests, broadcast demersal eggs, or attach eggs to the substrate or vegetation can be at risk due to flow fluctuations. Likewise, species whose young depend on stationary, reliable rearing habitats can be decimated by rapid changes in flow.

This lab will rely on PHABSIM's HABEF program. This program uses two files created by the one of the microhabitat simulation programs within PHABSIM: HABTAT, HABTAV, or HABTAE programs. Since all of these programs are probably new to you if you have not had IF 310, a brief review of basic PHABSIM is warranted. We start with a calibrated "production" input file for IFG4. For this lab, the IFG4 input file we will be using is named **LAB3.IN4**. Our goal in this lab is not to teach you how to run IFG4 or any other hydraulic simulation program for that matter. There are some things you need to know about, however, so you don't make mistakes that could make you look foolish. Look at the first few lines of **LAB3.IN4**, which are shown in figure 3.1. Pay particular attention to the lines labelled **IOC** (which stands for Input/Output Control) and **QARD**. The numbers following QARD are discharges for which depths and velocities are to be simulated by IFG4. If the IOC line has a 0 or 2 in the position of the bold **2**, you can change the flow values on the QARD lines to predict depths and velocities at discharges other than the current values. If there is a 1 in that position, do <u>not</u> change the flows on the QARD lines. You will end up with totally bogus results if you do. Since we do have IOC(8)=2, you are permitted to change the flows on the QARD's. This would be a good idea as you get into the lab, because you want to simulate flows that correspond somewhat to the flows included in Table 3.1. For example, we have a QARD for a discharge of 250 cfs, but the flow has never been that low. In contrast, the highest QARD flow is 6500 and there are lots of discharges higher than that.

```
MAINE RIVER - DAM REACH IFG-4  PREPARED BY HABITAT MAPPING ANALYSIS
ONE FLOW DECK
IOC        0000000200001
QARD   250.
QARD   500.
QARD   750.
QARD  1000.
QARD  1250.
QARD  1500.
QARD  1750.
QARD  2000.
QARD  2500.
QARD  3000.
QARD  3500.
QARD  4500.
QARD  5500.
QARD  6500.
XSEC      1    0.0     1.00      92.10
          1-15.0101.1-10.0 99.9 -5.0 99.4  0.0 99.0  5.0 97.7 10.0 97.5
          1 20.0 97.0 26.0 96.9 36.0 95.8 46.0 95.5 56.0 94.8 66.0 94.4
          1 76.0 93.7 86.0 93.4 96.0 92.9106.0 92.1116.0 91.6126.0 91.2
          1136.0 91.0146.0 90.6156.0 90.4166.0 90.5176.0 90.6186.0 90.2
```

Figure 3.1. Initial lines of data in a production IFG4 input file.

Figure 3.2 illustrates the most simple path possible through PHABSIM. When IFG4 is run, it produces two secondary files, TAPE 3 and Tape 4. TAPE 3 contains all the information about the characteristics of the channel: distances between transects, cell lengths, bed elevations, substrate indexes, and so on. Tape 4 contains the water surface elevations for each transect and the predicted velocities for each cell, for every discharge entered for simulation in IFG4. Tape 4 is rearranged automatically via an essentially invisible program called PHABARR, which produces another secondary file called TP4.

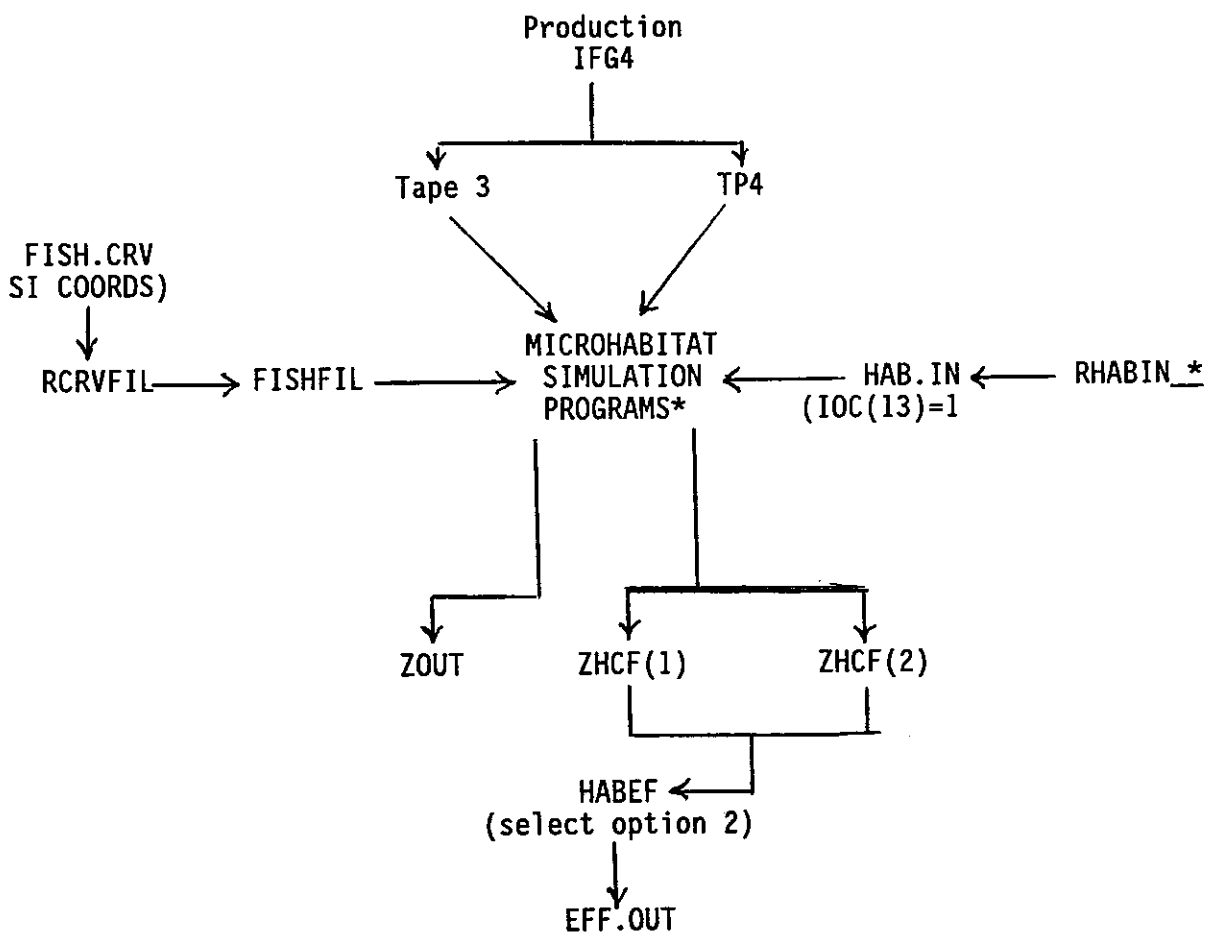


Figure 3.2. Abbreviated pathway through PHABSIM from production run IFG4 to HABEF. *One of several microhabitat simulation programs, including HABTAT, HABTAE, or HABTAV could be used here. _*_ Program to create input file must match microhabitat simulation programs to which it is input.

Tape 3 and TP4 contain information about the river; now you need to provide information about the microhabitat requirements of the critter you're dealing with. This comes in the form of SI criteria coordinates--in this lab you have a canned file already built for this named **LAB3.CRV**. The good news about this file is that you can read it and edit it if you wish to change criteria (get help from your instructor if you want to do this). The bad news is that none of the microhabitat simulation programs can read LAB3.CRV; the programs are expecting an "unformatted" input file called **FISHFIL.** FISHFIL is created by running your SI criteria file through a program called **CRVFIL** (RCRVFIL is the batch file that runs the program).

The next thing you need to do is create an input file for the microhabitat simulation program to tell it what to do and who to do it to. There are several microhabitat simulation programs that you could use in conjunction with HABEF and it is important to create the appropriate set of instructions for whatever program you are using. The batch files to run the programs that create the file of instructions all start with the prefix RHABIN*. If you're running HABTAE as the microhabitat simulation program, for example, the instructions would be generated by running a batch file named RHABINE. You will be required to run one of these to create the instructional file for HABTAE in this lab. There are only two really important things to remember when you're building this file. On the IOC (options) line, you must turn on option 13 and option 8 must be set to 0. For this lab, set all options to 0 except option 13. Otherwise you may trigger some options that neither you nor your instructors are prepared to deal with right now.

You are allowed to enter only one criteria set at a time when running HABEF, so when the program asks "How many curves?" you should enter 1. The program will then ask you for the curve set ID number. We'll tell you what numbers to enter when the time comes.

Once you have your Tape 3, TP4, FISHFIL, and "INSTRUCTIONS" file, you're ready to run the microhabitat simulation program of your choice. For this lab we will be using HABTAE. When you turned on option 13 in the "INSTRUCTIONS" file, you told HABTAE to produce a file that contains the composite suitability of every cell in the reach, at every flow you originally had on the QARD lines in IFG4. This is a big monger! This file comes out of HABTAE with a default name of ZHCF and will contain the composite suitabilities for all the cells for whatever life stage ID number you entered.

HABEF requires <u>two</u> ZHCF files as input. This can be handled several ways. For example, if you were evaluating the composite effects of hydropeaking on spawning and incubation, you might run HABTAE once with spawning criteria and name the ZHCF file "SPAWN.OUT". Then you'd run it again with incubation criteria and name the ZHCF file "INC.OUT." But what if you're evaluating an immobile organism that has the same microhabitat criteria all the time, such as fry? In this case, you'd simply run HABTAE once with fry criteria and name the ZHCF file FRY1. You could then copy FRY1 into a second file, call it FRY2, and HABEF will be happy.

HABEF has the capability of generating lots of different kinds of comparisons in addition to "effective habitat" resulting from rapid flow fluctuations. The options available to you (by invoking different option numbers) when running HABEF are summarized as follow:

1 Union of two life stages or species. This is useful when one is interested in the total habitat for a combination of species (i.e., brook and rainbow trout).

2 Streamflow variation analysis (minimum WUA). The minimum weighted usable area (WUA) for each cell is chosen as the WUA for that cell. Every flow in the first ZHCF file is matched with every flow in the second ZHCF file. Option 2 is useful when there are rapid changes in streamflow, i.e., hydropeaking.

3 Competition between species or life stages. For example, this analysis would indicate where brook and rainbow trout "compete" for space.

4 Streamflow variation analysis (maximum WUA). The maximum WUA for each cell is chosen as the WUA for that cell. Every flow in the first ZHCF file is compared to every flow in the second ZHCF file. Option 4 is useful when there are slow changes in streamflow, i.e., normal changes due to dry vs. rainy season such as is typical for fall spawning in the Northwestern U.S.

5 Minimum WUA analysis. This option is similar to Option 2 except that the first flow in the first ZHCF file is compared only to the first flow in the second ZHCF file, the second to the second, and so forth through both files.

6 Maximum WUA analysis. This option is similar to Option 4 except that the first flow in the first ZHCF file is compared to the first flow in the second ZHCF file, the second to the second, and so forth through both files.

7 Effective spawning analysis. This option is functionally similar to Option 2 except that if the cell WUA in the second file is greater then zero, then the WUA on the first is considered "effective"; but if the area in the second is zero, then the area on the first is considered "ineffective" and made equal to zero.

8 Stranding index analysis. This option is functionally similar to Option 7 except the results on the second ZHCF file must indicate where stranding would not occur. Thus, the suitability index curves used as input to HABTAE to generate the second ZHCF file should be for non-stranding -- escape. One possibility is that the suitability index for velocity and channel index would be 1.0 for all velocities and channel indexes. For depth, the index might be 0.0 for depths less than some minimum, and 1.0 for depths greater than the minimum.

This should give you a general idea of the pathway through PHABSIM to HABEF. Continue now with the more detailed instructions on how to get through your assignment.

THE PROBLEM:

The magnitude of unsteady flows in the Kennebec River is illustrated in Table 3.1 for dry, average, and wet water years under the existing and alternative flow regimes introduced in Lab 2. The goal of this lab is to evaluate the effects of these flow fluctuations on the effective habitat of rainbow and brook trout during the spawning-incubation interval and during the fry period. For the normal water year, determine the effective habitat available for spawning-incubation and for fry under the existing project operation and each alternative presented in Lab 2. Be prepared to discuss the review questions at the end of the lab.

Table 3.1. Maximum and minimum flows associated with spawning-incubation and emergence-fry time periods, for existing conditions and three alternatives evaluated in Lab 2.

Alternative	Water Year type	Flow Range Spawn-Inc rainbow	Flow Range Emerg-Fry rainbow	Flow Range Spawn-Inc brook	Flow Range Emerg-Fry brook
Existing	Dry	1400-9000	600-6600	490-7000	1500-9000
NEBF	Dry	1500-9000	1310-6600	1310-7000	1500-9000
Steady Release	Dry	4400-5100	2800-3650	2800-3100	4400-5100
Enhanced Power	Dry	490-9000	490-8000	490-8500	490-9000
Existing	Average	490-7500	490-7600	490-7500	490-7600
NEBF	Average	1310-7600	1310-7600	1310-7500	1310-7600
Steady Release	Average	4800-6700	3300-3682	3340-3700	4800-6700
Enhanced Power	Average	490-8200	490-8600	490-8600	490-8200
Existing	Wet	4700-9100	490-8300	490-9100	4700-9130
NEBF	Wet	4700-9100	1310-8300	1310-9100	4700-9100
Steady Release	Wet	7200-8300	3800-5600	3300-5900	7200-8300
Enhanced Power	Wet	7000-8900	490-9000	490-9000	7000-8900

INSTRUCTIONS:

Step 1: **Generate files for dual flow analysis (HABEF).**

LAB3.IN4 is a "more or less ready to go" IFG4 data set and LAB3.CRV is a formatted criteria curve file containing suitability indices for several life stages of rainbow and brook trout. The first thing you'll want to do is to check out the flows you'll need to simulate for the scenarios and water year being analyzed. Change the flows on the QARD lines to include the flows you'll be evaluating (You can do this because IOC(8)=2). The flows on the QARD's don't have to exactly match those in Table 3.1, but they should be close. For example, there's a flow of 9130 under the existing wet year scenario for the brook trout fry period; 9100 is good enough. Get rid of any QARD's you won't be needing. The programs you will be running take quite a bit of time and hard disk space, so reducing the number of flows will increase your efficiency somewhat.

1.1 Run IFG4 on LAB3.IN4 to create the appropriate attribute files (TAPE3 and TP4).

To run IFG4, you should type something like:

RIFG4 LAB3.IN4

In addition to the desired Tape 3 and TP4 files, IFG4 will create output files named ZOUT and ZVAFF. For this lab, we are not really interested in these output files, but you are welcome to look at them if you wish.

1.2 Create your unformatted "FISHFIL" and HABTAE "INSTRUCTIONS" files. Nothing difficult here; just type:

RCRVFIL LAB3.CRV

FISHFIL will be created automatically as the default file name.

To create the "INSTRUCTIONS" file for HABTAE, type:

RHABINE LAB3.HIN

Answer the questions as you think appropriate, but whatever you do, make Option(8) = 0 and Option(13) = 1. When asked how many curves, what the program really wants to know is how many criteria sets (i.e., life stages) you're going to run. Enter 1. Then the program will ask you for a criteria set ID number. For spawning rainbow trout, enter 1003. For rainbow trout fry, enter 1000. If you're evaluating brook trout, the ID numbers are 2000 for fry and

LAB3.HIN

2003 for spawning. Remember, you are only allowed to enter one life stage at a time going into HABEF.

NOTE: Since everything on LAB3.HIN will be the same for all life stages, except the ID number, you can change the life stage simply by editing the file and changing the number on the **CURVES** line.

1.3 Run HABTAE with IOC(13)=1 to create the ZHCF files for rainbow trout spawning. First, make sure the ID number in **LAB3.HIN** is 1003 and then type:

RHABTAE LAB3.HIN

Before you do anything else, copy your ZHCF files to a separate file name. For example:

copy zhcf rbowsex.hcf

Look at the file **ZOUT** briefly. This shows how much usable habitat you'd have for spawning at different flows, provided that the flow was steady. More importantly, right at the beginning of the **ZOUT** file, there is a table that tells you how long your reach length is (the sum of individual cell reach lengths). You will need that value later when you run HABEF, so right it down someplace.

Now, change the ID number in **LAB3.HIN** to 1000 for rainbow trout fry, and repeat the procedure. Copy the ZHCF file to a file for rainbow fry (e.g., rbowyoy.hcf). Repeat the procedure for brook trout spawning and fry.

Step 2: Run HABEF using the streamflow variation analysis (option 2).

Now for HABEF. The basic assumption of HABEF is that the habitat value for non-mobile organisms results from the minimum of the habitat at the generation and base flow when the comparison is done on a cell-by-cell basis. This is enabled by Option 2 in HABEF. We are taking a shortcut in this lab that requires a biological assumption that may or may not be correct. Notice that our criteria file (**LAB3.CRV**) contained no criteria for egg incubation for either species. We are assuming here, that the incubation criteria are the same as the spawning criteria (i.e., in salmonids, mother knows best). It is not necessary to confine ourselves to this assumption, but there's a discussion question below about what we'd have to do differently to avoid it. Anyway, that's how we're doing it here.

2.1 Run HABEF using the streamflow variation analysis (option 2) for Rainbow Trout - Spawning.

2.1.1 Before running HABEF you will need to determine the total reach length. Remember the previous step.

2.1.2 Run HABEF using the ZHCF file for rainbow trout spawning (rbowsex.hcf). Because of the aforementioned assumption, we will use the same ZHCF file twice. Consider the first file to be the base flow file and the second file to be the generation flow file.

```
RHABEF rbowsex.hcf rbowsex.hcf spawn.OUT spawn.TBL
```

2.1.2.1 Select Option 2 - Streamflow Variation Analysis (Minimum WUA).

2.1.2.2 Enter the total reach length.

2.1.2.3 When asked for a label for the first set, enter Base. Enter Generation for the label for the second set.

2.1.2.4 Enter whatever you would like for the title for the table, e.g., Hydropeaking Analysis for Kennebec River.

Be patient because HABEF is comparing the habitat value of each cell at each flow in the first ZHCF file to each habitat value of each cell at each flow in the second ZHCF file. Whew!

2.1.2.5 Set your printer (if you have one) for wide print, then print and review the results (spawn.out). If you don't have a printer, edit the spawn.out file and skip to the effective habitat table at the very end (naturally, we save the best for last). You will probably want to use this output in Lab 5, so you'd be well advised to extract the table and copy it to a small file that can be quickly retrieved and reviewed.

2.1.3 Now, repeat step 2.1.2 using the ZHCF files you prepared for rainbow trout fry and for brook trout spawning and fry. If you have time, repeat for a dry water year.

DISCUSSION QUESTIONS:

1. Refer to page 2 of the HABEF output. What is "used" usable area? How and why is it different from "weighted" usable area?

2. Note the cells in the effective habitat table where the generation flows are the same as the base flows. Why is the effective habitat always less when the generation and base flow are not the same?

3. Earlier, we assumed that whatever constituted good conditions for spawning also provided good conditions for incubation. What would we have had to do to use different criteria for incubation? How might the incubation criteria for brook trout differ from incubation criteria for rainbow trout?

4. Why do the flows vary under the "steady flow" scenario?

5. The habitat time series analysis conducted in Lab 2 indicated that the New England Base Flow method was an ineffective alternative for providing additional habitat compared to the existing condition. Would you draw the same conclusion with regard to reproduction and early life history stages of rainbow trout and brook trout? What phenomenon is going on here? Which of the alternatives will potentially provide the greatest benefit in terms of year class strength?

IF 201
May 11-15, 1992
Fort Collins, CO

(circle appropriate lab #)

LAB # 1 2 3 4 5 6 7

1. Will what you learned in the lab be relevant to problems you encounter in your job?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the lab effective in reinforcing concepts introduced in the lecture?

_____ Yes, lab could stand alone without lecture.

_____ Yes, lab supported lecture.

_____ Somewhat, too much detail.

_____ Somewhat, not enough detail.

_____ No

If no, what needs to be changed?____

____

____

3. How much time were you given to complete the lab?

_____ less than one hour

_____ one to two hours

_____ more than two hours

4. Were you given enough time to get everything out of the lab you wanted to?

_____ Yes

_____ No

If no, how much time would you have liked to work on this lab? ______________

5. Were the written instructions for the lab clear, concise, and accurate?

_____ Yes

_____ No

If no, what problems did you encounter with the instructions?________________

____

____

____

____

6. Did the software perform as you expected from reading the instructions?

_____ Yes

_____ No

If no, what problems did you encounter with the software?____________________

____

____

____

____

7. Rate the complexity of the lab according to your expectations.

_____ Too simple.

_____ About right.

_____ Too complex.

8. Were the Review Questions and Discussions provided at the end of the lab helpful in reinforcing concepts and skills acquired in the lab?

_____ Yes

_____ No

If no, why not?____

____

____

____

9. Did you learn anything in the lab that will help you do your job better or more efficiently?

_____ Yes

What was it?____

____

____

_____ No

Why not? ____

____

____

____

10. Are there any subjects related to IF 201 for which you would like to see additional labs or tutorials developed? What are they?

V.

RESERVOIR OPERATIONS

Overall Alternative Definition means preparing for a negotiation where alternatives must be worked out.

The alternatives must be feasible:

- physically
- biologically

They will be tested:

- economically
- politically

They must fit within regulatory constraints.

@@@@@ OH @@@@@

1. Steps in Evaluation of alternatives (BIOLOGICAL EVALUATION)

    A. Evaluate existing habitat limitations

    B. Compare with habitat limitations under proposed alteration

    C. Identify problem areas

    D. Formulated alternatives based on objectives and identified problem areas

    E. Develop habitat indexes for alternatives

    F. Compare with like indexes for baseline

@@@@@ OH @@@@@

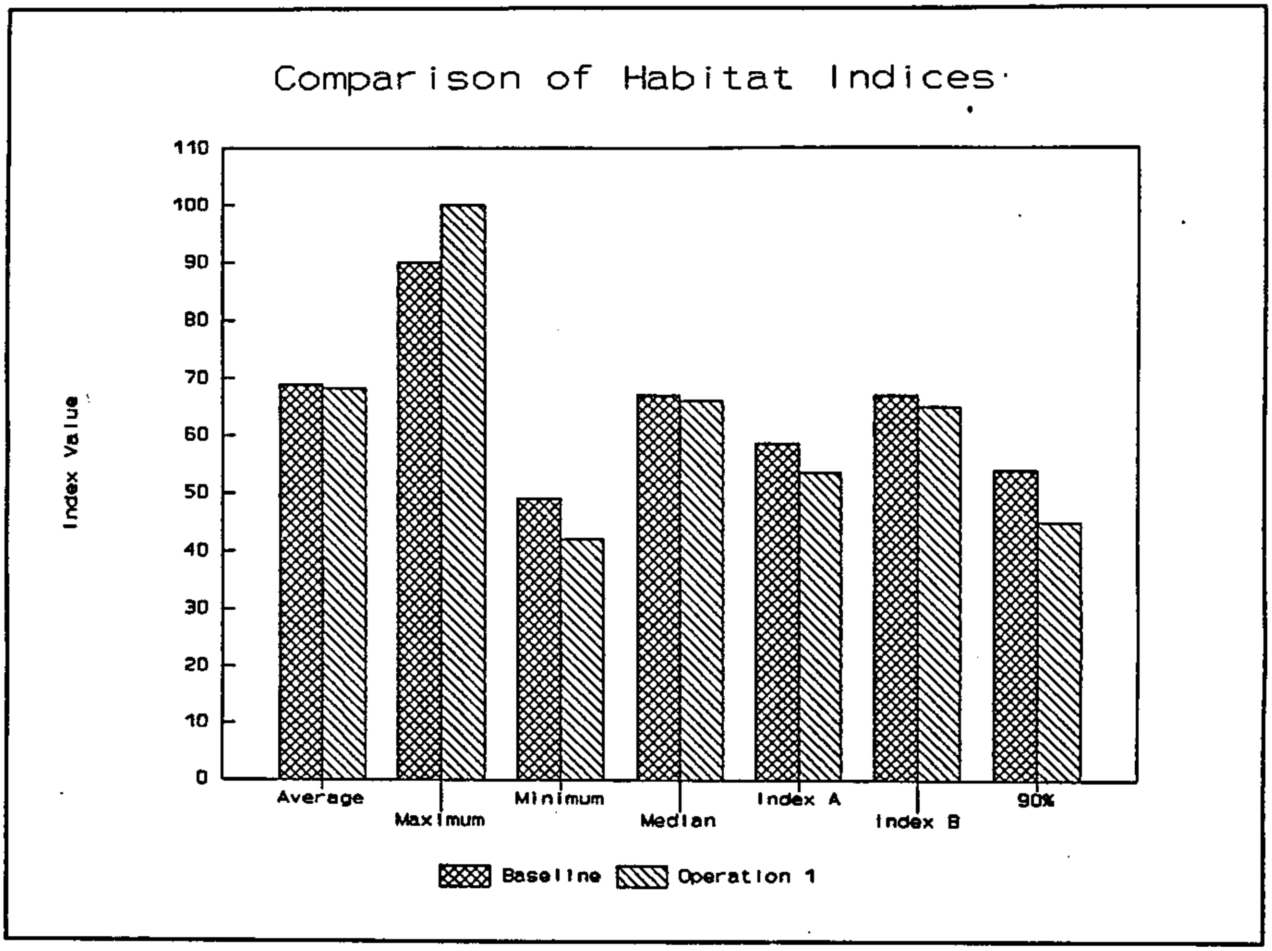
NOTE: Bar Chart: Baseline compared to Operation 1

"Operation" often implies a reservoir. The following discussion are about reservoir operations and physical feasibility in reservoir operations.

Overhead 1

1. STEPS IN EVALUATION

A. EVALUATE EXISTING HABITAT LIMITATIONS.
B. COMPARE WITH HABITAT LIMITATIONS UNDER PROPOSED ALTERATION.
C. IDENTIFY PROBLEM AREAS.
D. FORMULATE ALTERNATIVES BASED ON OBJECTIVES AND IDENTIFIED PROBLEM AREAS.
E. DEVELOP HABITAT INDEXES FOR ALTERNATIVES.
F. COMPARE WITH LIKE INDEXES FOR BASELINE.


Comparison of Habitat Indices
Index Value
110
100
90
80
70
60
50
40
30
20
10
0
Average
Maximum
Minimum
Median
Index A
Index B
90%
Baseline
Operation 1

@@@@@ OH @@@@@

Reservoir Water Budget   Bucket and Equations show Basic Mass balance

How does this work? Look at mass balance in column H of YEAROP spreadsheet in LAB 6.

General concept

$S_t = S_{t-1}$ + Inflow + Rain - Release - Evap - Spill - Ground Seepage - Dam Leakage

@@@@@ OH @@@@@

Rule Curves

Risk avoidance measure

How this one works - depends on accurate runoff forecast

What do you do when forecast is not long term or has wide variance?

Rain fed vs Snow fed system?

@@@@@ OH @@@@@

Storage management over a long term

Critical Period Concept

@@@@@ OH @@@@@

Matching demand to supply. If IFR targets represent a typical demand, then lower demand gives higher reliability in critical times.

How do you know you are in a critical period at its beginning?

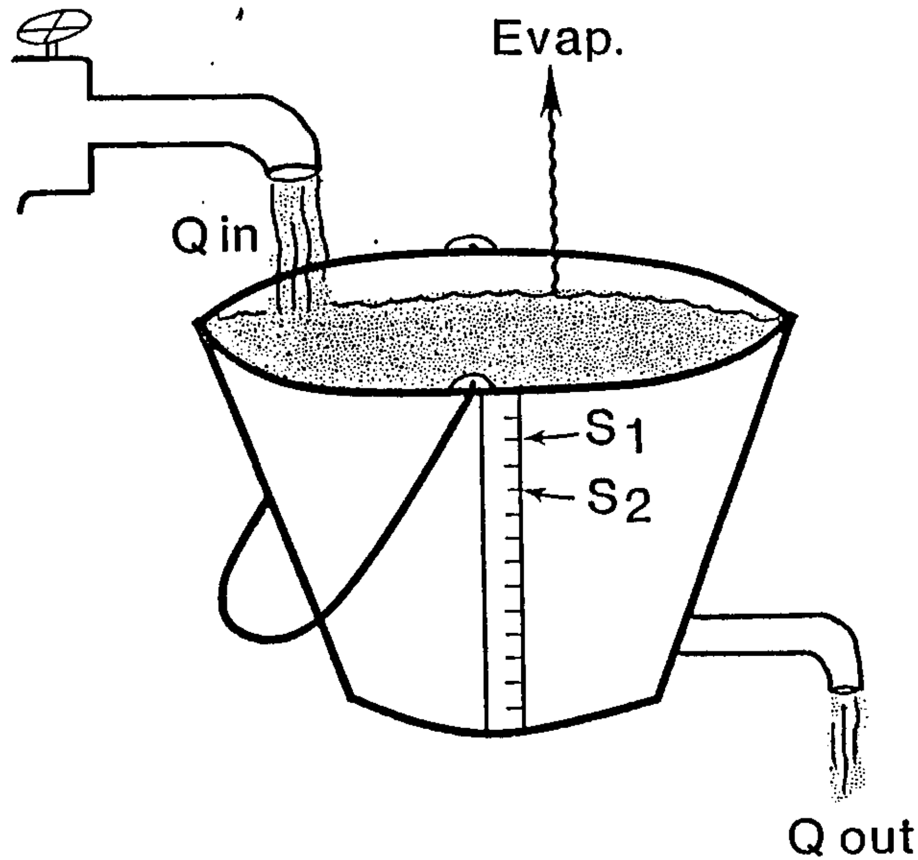
You don't. That is why rule curves hedge.

@@@@@ OH @@@@@

Hedging levels: Reservoir operation concepts: modify rule curve if thresholds passed

Hedging demands: Set targets lower when Reservoir is drawn down

Reservoir Water Budget



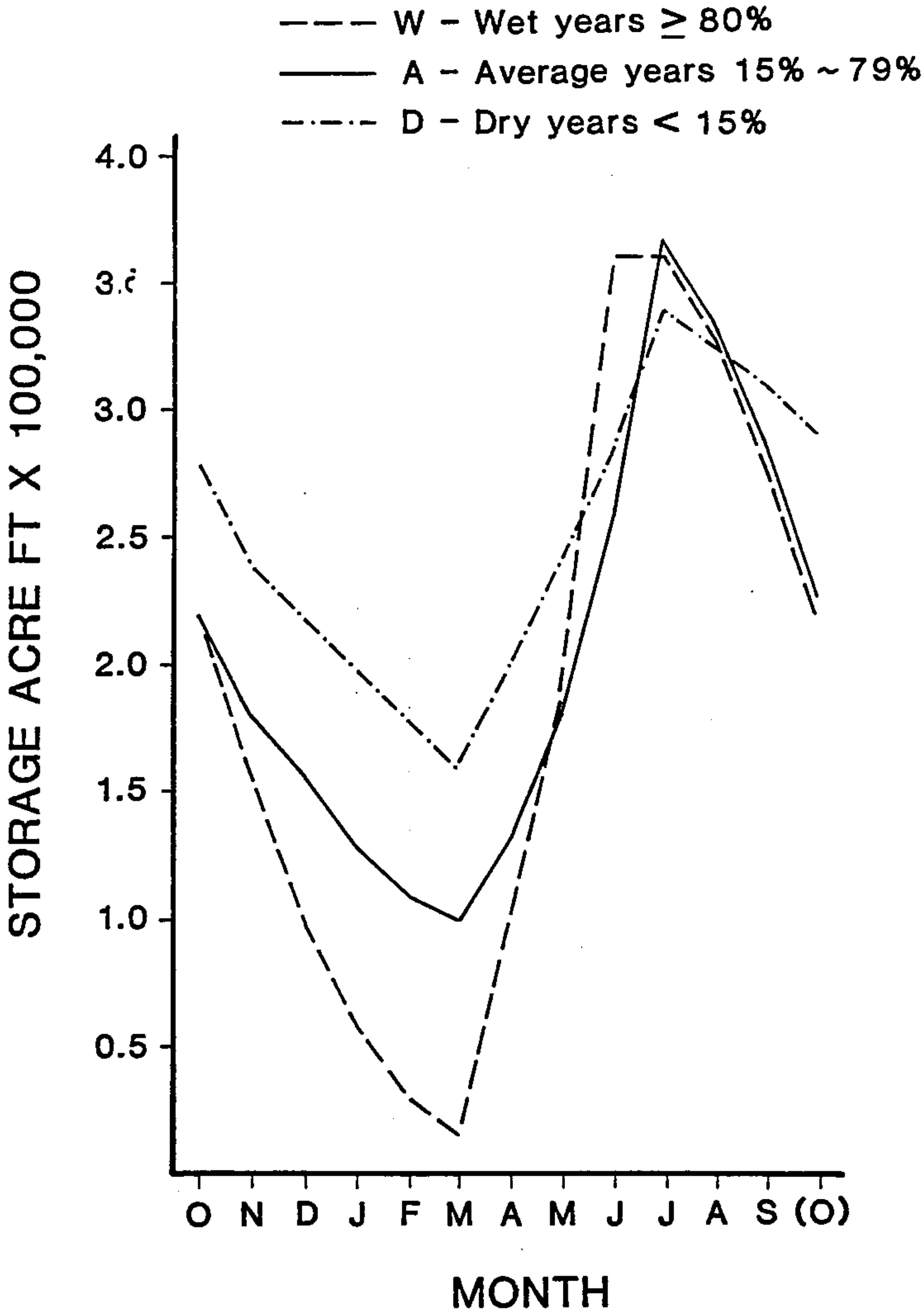
$S_2 = S_1 + Q_{in} \pm E_{rate} \times Area - Q_{out}$

if $S_2 <$ rule curve, then

$S_2 = S_1$ for next iteration

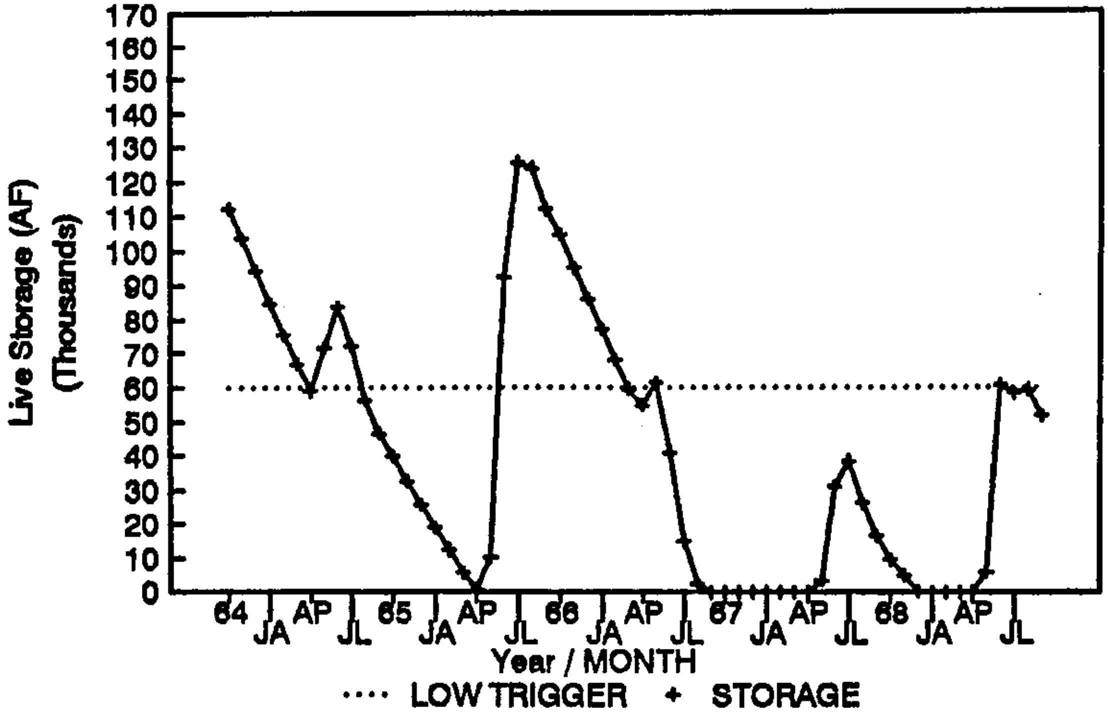
if $S_2 >$ rule curve, then

decrease Q_{in} or increase Q_{out}

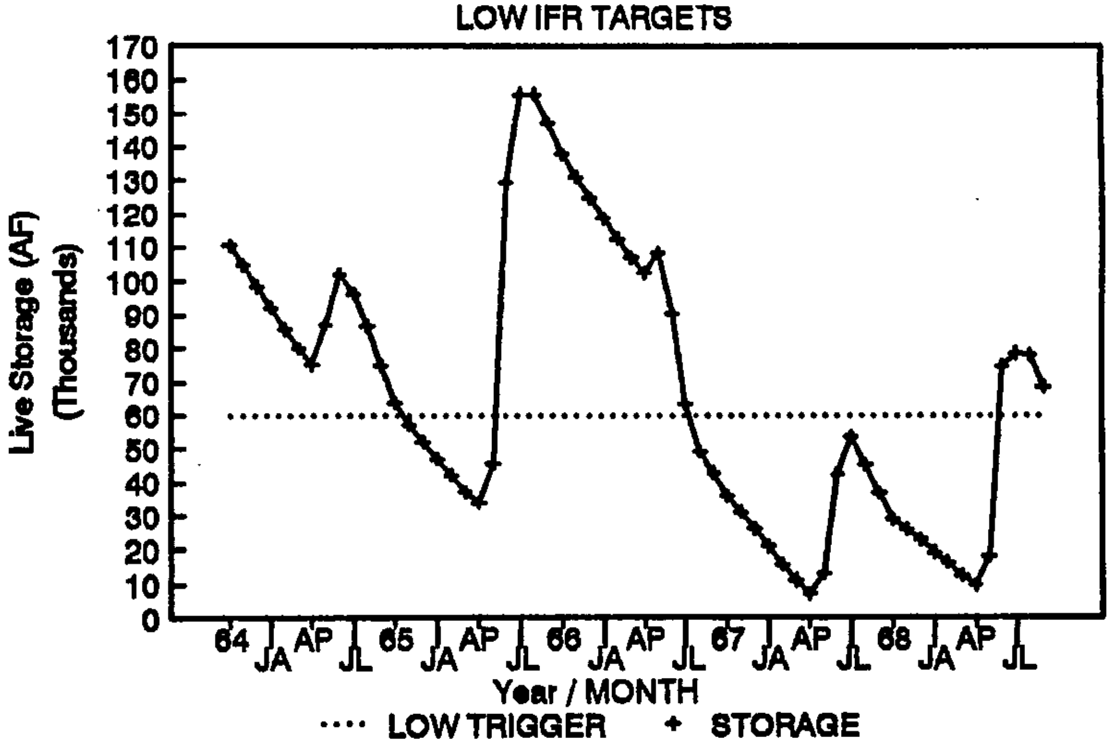


Example of a Reservoir Operation Rule Curve

GREY MOUNTAIN RESERVOIR STORAGE
HIGH IFR TARGETS



GREY MOUNTAIN RESERVOIR STORAGE
LOW IFR TARGETS



@@@@@ OH @@@@@

Allocating Water: Water Budgets. Each use has a defined amount of storage.

Can be operated independently or conjunctively. If independent, each has same considerations of rule curve, hedging, meeting objectives.

@@@@@ OH @@@@@

Managing storage for instream flow: Supplying water

Considerations:

- Are fish needs in phase with other uses?
- Can the channel be changed to make good habitat under the managed flow regime?
- Size of water budget
- Survival minimums (compared to available)
- Location in stream (What else is going on)

Procedure, Start with minimum and work up by season, life stage

Combine long and short term thinking - OPS model required.

Run several alternatives and compare.

Plan releases as make-up water when stream is deficient

Plan storage to reduce hight flows when possible

@@@@@ OH @@@@@

General approach: DEFINE YOUR STUDY OBJECTIVES ###########################

2. Approach to formulation of alternatives depends on study objectives

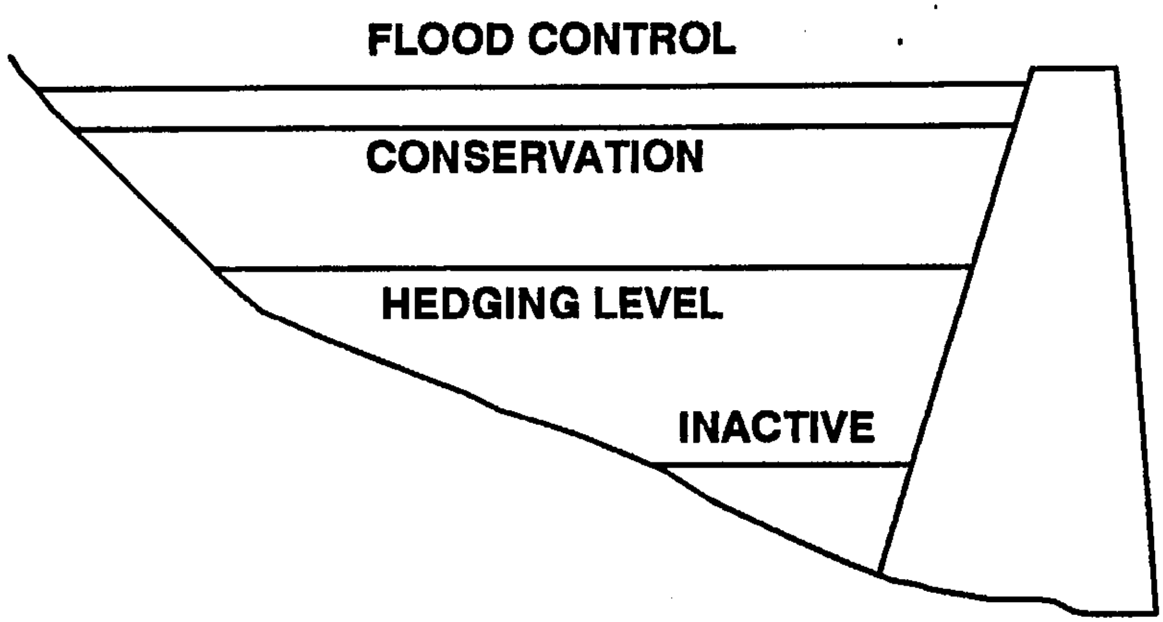
A. New reservoir: calculation of "mitigation bill" and formulation of in-kind mitigation alternatives.

B. New hydropower project: determination of "no net loss" alternatives

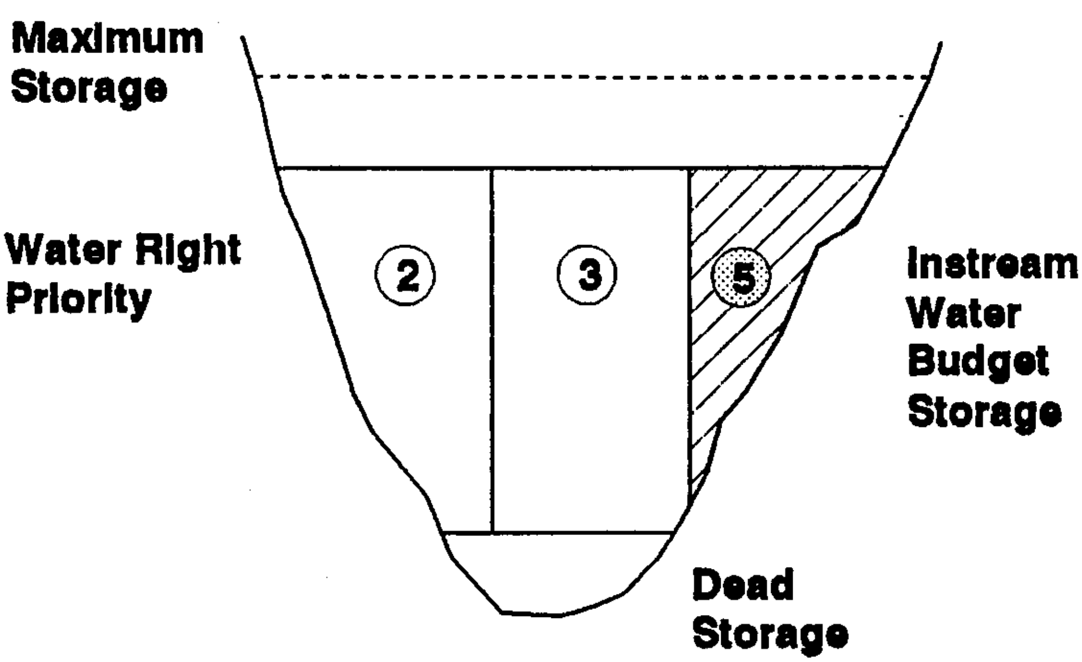
C. Existing Federal projects: determination of "enhancement" alternatives

D. FERC relicensing projects: Determination of "Historical mitigation" or "Enhancement" alternatives

@@@@@ OH @@@@@



MULTI-PURPOSE RESERVOIR WITH THREE STORAGE RIGHTS



3. General process in formulation alternatives and evaluating alternatives

A. Examine baseline habitat time series & durations curves to determine potential habitat limiting events: magnitude, time of year, affected life stages, yearly occurrence, etc.

@@@@@ OH @@@@@

B. If biological data are available, identify probable habitat bottlenecks under existing conditions. Can they be relieved by alternative operations?

C. Determine (to the extent possible) the underlying variable(s) responsible for existing habitat limitations or bottlenecks.

IFIM analysis techniques can help you measure the what, where, when reductions in habitat value if you define them, but it doesn't tell you which ones are the critical ones, the population limiting ones.

@@@@@ OH @@@@@

Example: restricted spawning habitat due to flow fluctuation during spawning/incubation period

Example: limited fry habitat due to high flows during emergence

Example: low adult habitat in August due to high temperatures related to flow depletion during summer

Example: oxygen depletion when flows are near zero for 10 days in a row in dewatered streams

@@@@@ OH @@@@@

Example: passage problems if flows are too high or too low

Example: power generation doesn't las long enough to get recreational boaters through canyons with certainty

@@@@@ OH @@@@@

D. Compare baseline habitat time series with proposed alternative 1. This is usually the "with project" scenario proposed by the applicant

E. Determine the effect of the proposed change on existing habitat limitations or bottlenecks

1. Does the proposed change affect the <u>magnitude</u> of existing limited habitat?

2. Does the proposed change affect the <u>frequency</u> with which a limiting

habitat event occurs?

3. Does the proposed change lengthen the duration of low habitat events?

4. Does the proposed change alter the spatial distribution of habitat values?

5. Does the proposed change alter the timing of habitat limiting events?

6. Does the proposed change create new potential habitat limitations, either within or across years?

@@@@@ OH @@@@@

F. Isolate general problems and solicit general solutions, looking for common objectives.

Example: problem is too much flow in spring and too little in winter.
Solution: store water in spring and release over winter.

Example: flow fluctuations during spawning period drive small mouth bass from their nests?
Solution: stabilize flows during spawning season.

@@@@@ OH @@@@@

G. Use IFIM to generate the habitat response resulting from the suggested solution.

H. compare resulting habitat indexes with baseline and objectives

- Does the alternative achieve the stated objectives?

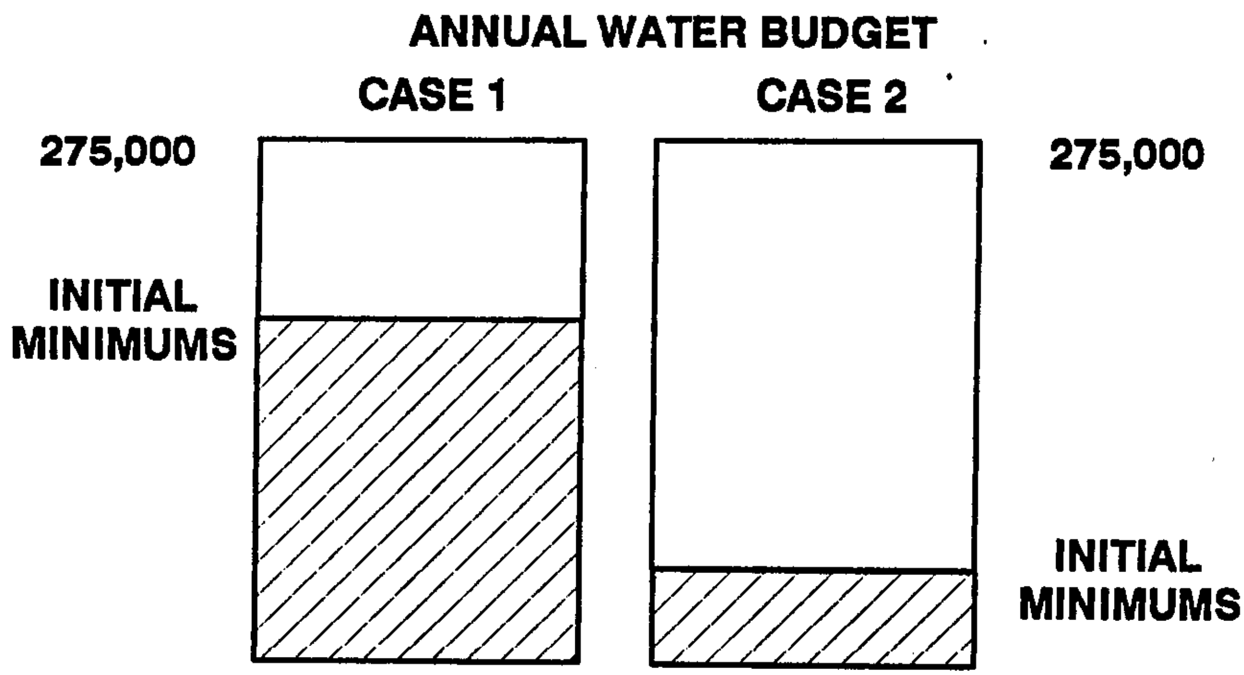
- No. Modify alternative and try again.

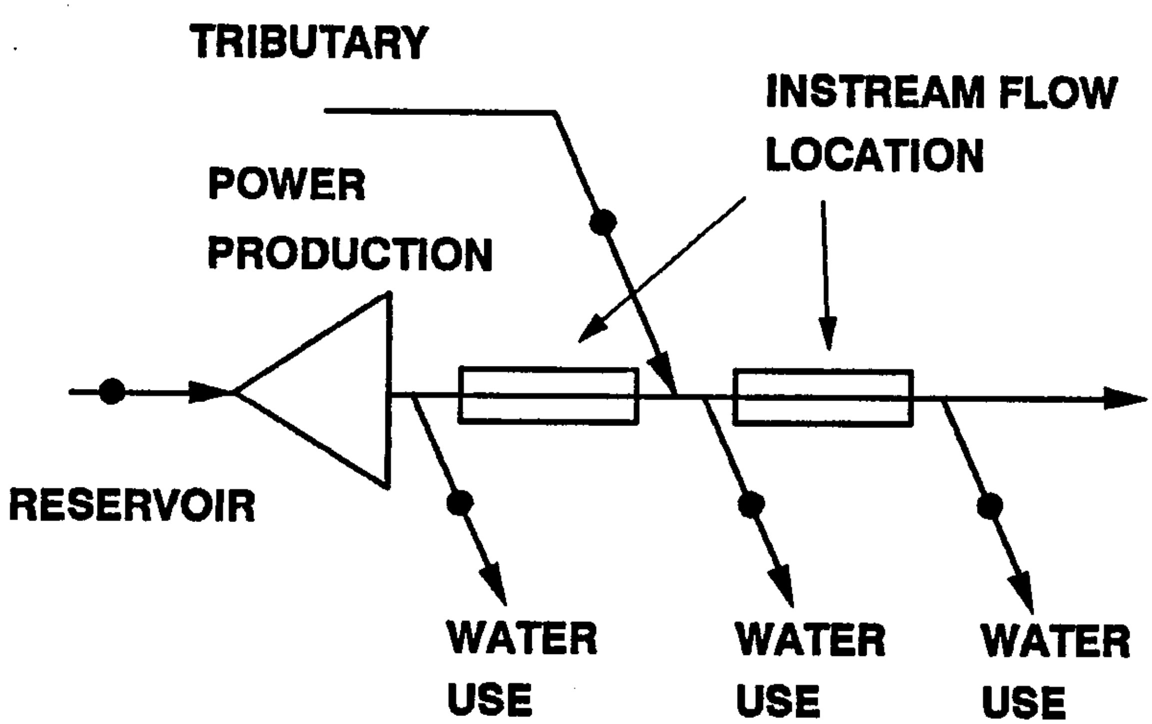
- Yes. test feasibility and analyze risks associated with alternative.

@@@@@ OH @@@@@

I. If, after numerous tries, you cannot find a feasible, effective alternative, it may be necessary to redefine your objective or redefine the original proposal.

Don't get trapped into choosing the best from a set of poor alternatives


ANNUAL WATER BUDGET
CASE 1
CASE 2
275,000
275,000
INITIAL
MINIMUMS
INITIAL
MINIMUMS


TRIBUTARY
INSTREAM FLOW
LOCATION
POWER
PRODUCTION
RESERVOIR
WATER
USE
WATER
USE
WATER
USE

IF 201
May 11-15, 1992
Fort Collins, CO

Lecture Evaluation

(circle appropriate lecture #)

Lecture # I II III IV V VI VII VIII IX

1. Was the subject of the lecture relevant to the stated objectives of the course?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the material covered in the lecture necessary to achieve one of the stated objectives of the course?

_____ Absolutely necessary for understanding concepts.

_____ Helpful, but not necessary.

_____ Would have been less confusing without the lecture.

3. Did the materials in the workbook follow the materials presented in the lecture?

_____ Workbook was easy to follow.

_____ Workbook was somewhat out of order with presentation.

_____ Workbook contained extraneous materials not covered in lecture.

_____ Lecture covered extraneous material not contained in workbook.

_____ Lecture and workbook were totally out of synch.

4. Were lecture notes in the workbook helpful in following the lecture?

_____ Very helpful.

_____ Somewhat helpful.

_____ Would have been helpful if instructor had followed them.

_____ Lecture notes not provided.

5. Were audio-visual materials audible and/or visible?

_____ Yes

_____ No

If no, which need improvement and how can they be improved?

____

____

____

6. Did AV materials support the lecture materials?

_____ Yes

_____ No

If no, should the AV materials be replaced or eliminated?

_____ Replace (with)_______________________________

____

_____ Ditch them.

7. If this course were to be packaged as a correspondence course, what would be the best medium through which to present the materials covered in the lecture?

_____ None. The lecture is unnecessary.

_____ None. Interaction with a live instructor is essential.

_____ Good lecture outline plus video-taped lecture.

_____ Convert lecture notes to prose (i.e., text of covered materials).

_____ Text plus video-taped lecture.

_____ Other. _______________________________

____

____

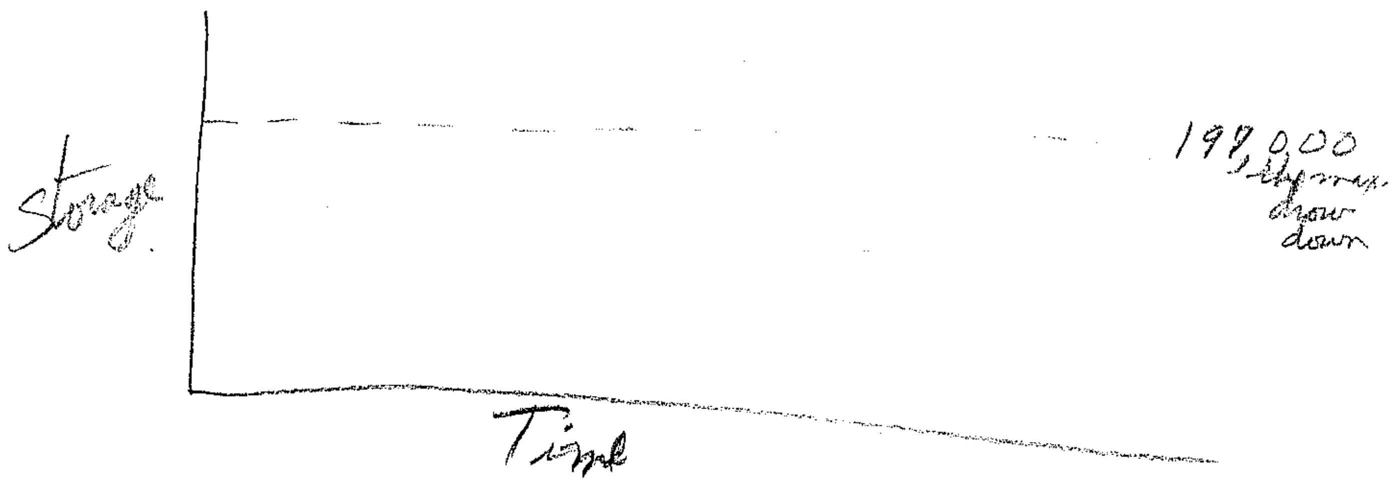
____

____

LAB 4

1. Trout (Salmon restoration)
2. Power revenue
3. Lake level

\Yearop.WK1
INDRY.PRN



Column J
average
daily
release

IF 201
LAB 4
INTRODUCTION TO RESERVOIR OPERATIONS MODELS AND FEASIBILITY ANALYSIS

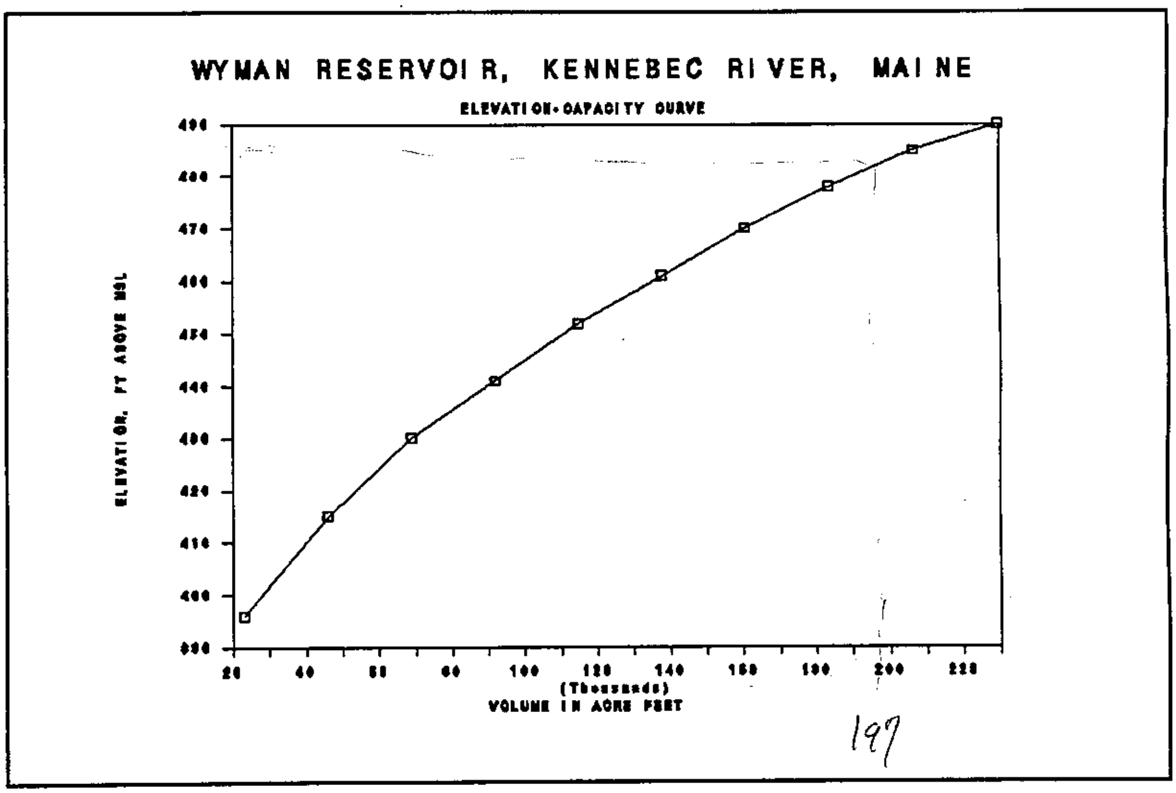
OBJECTIVES

1. TO REINFORCE CONCEPTS OF WATER SUPPLY DETERMINATIONS AND THE USE OF RESERVOIR OPERATIONS MODELS IN INSTREAM FLOW STUDIES.

2. TO DEVELOP SKILLS IN THE ANALYSIS OF FEASIBILITY AND RISK IN THE EVALUATION OF INSTREAM FLOW ALTERNATIVES.

INTRODUCTION

The project reservoir, Wyman Lake, is 14.4 miles long and at full capacity has a volume of approximately 206,000 acre feet and a surface area of 3,000 acres. "Full pond" elevation is 485 feet above MSL, and for this exercise has been defined as the spillway elevation. Since 1934, normal project operation has allowed up to two feet of drawdown on weekends, refilling during the week to elevation 485 ft. In the early spring, Wyman Lake is normally drawn down from four to eight feet in order to capture spring snow-melt and average rainfall which will fill the reservoir to full pond elevation. Figure 4.1 shows the elevation-capacity curve for Wyman Lake.



Figu 4.1

re 4.1. Elevation-capacity curve for Wyman Lake, Kennebec River, Maine.

Judging from the historical release patterns from Wyman Dam, it appears that the powerhouse contains three or four generators, with a maximum combined capacity of 8800 cfs. For this lab, we have assumed four generators, three with a maximum capacity of about 2500 cfs each, and one of about 1250 cfs. Maximum generator efficiency occurs at approximately 91% of maximum generator capacity. Generally, when the generators come on line, they are stepped-up from the smaller unit to the larger ones as the water supply allows (e.g., one, two, or all three at once depending on reservoir storage, inflow, and power demand).

Historically, the peak power demand has occurred during the winter and during the morning and evening hours. This has resulted in a bi-modal generation release pattern. During off-peak hours, a base flow of 490 cfs has been released and it is assumed that this discharge is used for base power generation. When reservoir elevation is greater than or equal to 485 ft and the reservoir outflow is greater than 8800 cfs, we have termed the excess release a "spill" whereas it is more appropriately termed an "uncontrolled release."

There are several existing or potential constraints on the operation of the reservoir and powerhouse. The lake is surrounded by private property, much of which is developed with summer homes, docks, and boat houses. For the most part, these are all second homes that are occupied primarily during the summer months. There are few, if any, year-round residents. Nevertheless, a Homeowners' Association has formed to resist any attempts to increase lake level fluctuations during the summer.

The existing instream flow release is not a required release on the part of the power company. Leakage from the dam accounts for about 50 cfs of the base outflow from the reservoir.

INSTRUCTIONS

For this lab, we will be using a reservoir operations model formulated for a spreadsheet named **YEAROP.WK1**. This model performs a reservoir mass balance based on daily inflow and outflow, using the equation:

$$S_t = S_{t-1} + \text{Inflow} - \text{Release}$$

In this equation, Release consists of two controllable components, the <u>minimum</u> instream flow release and the power release. There is no provision in this model to directly control the maximum instream flow release. Power releases are determined on the basis of available inflow, available storage, and the target power production. If available inflow + storage are insufficient to meet the total power target <u>and</u> the minimum instream flow release, this model automatically cuts back on the power release. The instream flow release has precedence over power releases and maximum drawdown when there are shortages in the available water supply.

Reservoir storage is not allowed to go below the maximum drawdown to satisfy power demands, but it is allowed to satisfy instream flow releases. Maximum drawdown can be manipulated in the formulation of feasible alternatives, but remember that you have a Homeowner's Association watching your every move when you reset the drawdown level during the summer!

We have followed the convention started by the group that conducted the original study of the Wyman project. They identified 1974 as a wet water year, 1977 as an average water year, and 1980 as a dry year. Daily inflows for those three years were retrieved from USGS streamflow records and prepared as importable ASCII files for Lotus: INWET.PRN (1974 daily inflow), INAVG.PRN (1977 daily inflow), and INDRY.PRN (1980 daily inflow).

To start the exercise, access Lotus 1-2-3 and Retrieve **YEAROP.WK1**. The spreadsheet as represented in this documentation by Figure 4.2. When the spreadsheet appears on your screen, move the cursor around to figure out what you can and cannot manipulate within the model. Note that the month is recorded in column A and the day in column B. You will need to be able to locate specific weeks in the model later in this lab. The two most obvious things you can change are the power target releases located in cells J2-J13 and the instream flow releases located in cells F2-F13. You have the option of changing these outflows on a monthly basis if you choose. You can also change the maximum drawdown level, but you cannot have different drawdown levels for different times of the year. This means you cannot draw the reservoir down more in the winter than in the summer. For now you're stuck with that limitation, but you can approximate an early season drawdown by changing the starting storage in cell H23. If you assume that the reservoir is not full on October 1, the effect is roughly equivalent to allowing a winter drawdown.

When you first access the spreadsheet, the inflows recorded in column C are for an average water year. The instream flow, power targets, and maximum drawdown have been pre-set to represent the case for the existing situation: Instream flow target = 490, maximum drawdown level = 197,000 AF (obtained from figure 6.1, by estimating volume at elevation 483 ft.). Power targets were estimated for the baseline condition by removing all non-generation flows (e.g., anything less than 500 cfs) from the baseline flow files from Lab 3, and averaging the remaining flows in the time series. Estimated power targets are given below for normal, dry, and wet years in units of cfs-days.

Normal year (file)	Power target (cfs-day)	Dry year (file)	Power target (cfs-day)	Wet year (file)	Power target (cfs-day)
BASEQNF	**3400**	**BASEQDF**	**3000**	**BASEQWF**	**4400**
BASEQNW	**3400**	**BASEQDW**	**2600**	**BASEQWW**	**6000**
BASEQNSP	**5000**	**BASEQDSP**	**4800**	**BASEQWSP**	**7800**
BASEQNSM	**3400**	**BASEQDSM**	**3200**	**BASEQWSM**	**4400**

Note that a cfs-day is equivalent to a steady flow averaged over a 24-hour period. It is not necessarily a steady flow, however. For example, if the project peaked at 7500 cfs for eight hours and at 4500 cfs for eight hours, the power release would be calculated as ((7500*8)+(4500*8))/24 = 4000 cfs-day. Therefore, even though the power targets above appear to be low compared to the hourly flows you saw in Lab 2, remember that they do not include released base flows and do include peaking episodes of varying magnitude and duration.

TOTAL INFLOW (AF)	MINIMUM FLOW REQUIREMENT				AVERAGE D
3616998	Oct	490 cfs	972 (AF)		3400
POWER DEMANDS (AF)	Nov	490 cfs	972 (AF)		3400
2753454	Dec	490 cfs	972 (AF)		3400
FEASIBLE DEMANDS (AF)	Jan	490 cfs	972 (AF)		3400
2616493	Feb	490 cfs	972 (AF)		3400
	Mar	490 cfs	972 (AF)		3400
Reservoir Maximum	Apr	490 cfs	972 (AF)		5000
Drawdown Level	May	490 cfs	972 (AF)		5000
197000	Jun	490 cfs	972 (AF)		5000
Minimum Level for Year	Jul	490 cfs	972 (AF)		3400
195465.	Aug	490 cfs	972 (AF)		3400
Fraction of Power	Sep	490 cfs	972 (AF)		3400
Flows Delivered			--------		
0.95025			354744 ANNUAL (AF)		

Month (A)	Day (B)	Inflow (cfs) (C)	Inflow (AF) (D)	Min Q Target (cfs) (E)	Feasible Power Q (cfs) (F)	Demand W/Min Q (AF) (G)	Storage (AF) (H)	Release (AF) (I)	Release Average Daily (cfs) (J)
INFLOW YR=AVERAGE					Beginning Storage 206613				
10	1	3330	6605	490	3400	6744	206474	6744	3400
	2	3180	6307	490	3400	6744	206038	6744	3400

Figure 4.2. Columns A-J, Rows 1-25 for orientation to YEAROP.WK1 spreadsheet.

alt S Storage
alt P Power
alt R Release

:

AVERAGE DAILY POWER FLOW TARGET

3400 cfs	6744 (AF)	Oct
3400 cfs	6744 (AF)	Nov
3400 cfs	6744 (AF)	Dec
3400 cfs	6744 (AF)	Jan
3400 cfs	6744 (AF)	Feb
3400 cfs	6744 (AF)	Mar
5000 cfs	9917 (AF)	Apr
5000 cfs	9917 (AF)	May
5000 cfs	9917 (AF)	Jun
3400 cfs	6744 (AF)	Jul
3400 cfs	6744 (AF)	Aug
3400 cfs	6744 (AF)	Sep

AF)	2753455	ANNUAL (AF)

Release Average Daily (cfs) (J)	Spills Average Daily (cfs) (K)	Up Bnd Storage (AF) (L)	Unbounde Storage (AF) (M)	Trigger Level (AF) (N)	STORAGE FAILURE INDEX (O)	IFR PLOT SYMBOLS (P)	POWER PLOT SYMBOLS (Q)	RAW POWER TARGETS (r)
		206613		197000	0			
3400	0	206474	206474	197000	0	490	3400	3400
3400	0	206038	206038	197000	0			3400

Figure 4.2 continued. Columns J-R, Rows 1-25 for orientation to YEAROP.WK1 spreadsheet.

THE ASSIGNMENT

For the normal water year, find feasible solutions to the Review Questions at the end of this lab. In order to answer some of the questions, and in preparation for subsequent labs, it will be necessary to convert the mean daily flows for a sampled week back to hourly flows. The descriptions of several spreadsheets to accomplish this are given below.

Locate the week you wish to convert to hourly flows by finding the appropriate dates in columns A and B of the YEAROP.WK1 spreadsheet. To make things more directly comparable, you should use the same weeks as in Lab 2. Move your cursor to the corresponding row position in Column I. This is the average daily combined release (including spills) for Day 1 of whatever week you are in. Export this, and the next six numbers in the column, to a .PRN file by /PF (/Print File). Enter a recognizable file name when prompted by Lotus to do so. Specify the range to be exported by typing R (Range). Enter a period (.) in your current cell and use the down arrow to space down six rows. You should have a total of seven flows highlighted now. <CR>. Type O (options), O (other), U (unformatted), G (Go), Q (quit). You may now move the cursor down to the next block of days to be exported and repeat the process.

Winter 2/17-23, Spring

There are four spreadsheets available to convert a series of average daily flows into a series of hourly flows, one for each season, as represented by Figure 4.3. These are named FALLDIST.WK1, WINDIST.WK1, SPRDIST.WK1, and SUMDIST.WK1, respectively. These spreadsheets all use the same basic rules for synthesizing the hourly flow schedule. First, the average daily flow is compared against the minimum flow release on a 24-hour basis. Next, flow in excess of the minimum is determined. If sufficient water is available, the first "block" of water available for peaking is allocated. If there is still water available, the next "peaking block" is filled. This process is continued, hour by hour, until the entire volume available for the 24-hour period has been allocated. The spreadsheets also provide an estimate for the power produced and revenues generated for the week. Base power generation is assumed when only the minimum flow is released and is priced at $0.02 per KWH. Peak power generation is assigned when flow in excess of the minimum flow is released, and is priced at $0.10 per KWH. This will give you a fairly realistic idea of how your instream flow recommendation will impact the profit line for the company.

distribute spreadsheets

average daily flows by season
1988
dry year

Fall 11/15-21	Winter 3/2-8	Spring 6/8-14	Summer 7/6-12
2835	2475	4074	2832
2892	2392	4902	3052
2919	2878	4866	2917
2878	2731	4878	3189
3055	2826	4993	3654
2949	2614	5087	3362
2997	2575	4408	3179

```
FALL     DISTRIBUTE DAILY DISCHARGE INTO AN HOURLY PEAKING PATTERN
     *** Press TAB for instructions in next screen
                                   RESERVOIR PARAMETERS
          DAILY  MIN FLOW          Head              89 ft
        TOTAL CFS  (CFS)           Efficiency      0.75
           -----   -----           KW /1 cfs      5.650 KW
DAY1        8100    1310           Max. Powerplant
DAY2        6200    1310           Discharge       8800 CFS
DAY3        6300    1310           Powerplant
DAY4        8400    1310           Capacity       49716 KW
DAY5        8500    1310           Value of Power
DAY6        5600    1310           ON Peak          0.1 $ / KWH
DAY7        7700    1310           OFF Peak        0.02 $ / KWH
                                   WEEKLY POWER REVENUE: $119,061
                                   -------------------------------
                     POWER  POWER      POWER
                     FLOWS PRODUCED  REVENUE
     day     hour            (KW)       ($)                       PEAK INDE

       1        1    1310    7441       149
                2    1310    7441       149
```

Figure 4.3. Columns A-J, Rows 1-25 for orientation to FALLDIST.WK1 spreadsheet.

GENERATE RELEASE PATTERN

GENERATE IDEAL TARGET FLOWS FOR SEASON
WITH STAGED PRIORITY STRUCTURE

DAY 1

QIN= 8100 cfs-days
MINQ= 1310 cfs-days
PWRQ= 162960 cfs-hours

Hourly Generation Target Flows Stepped up

hour	minq	1	2	3	4
1	1310				
2	1310				
3	1310				
4	1310				
5	1310				
6	1310				
7	1310		1200		

Figure 4.3 continued. Columns J-R, Rows 1-25 for orientation to FALLDIST.WK1 spreadsheet.

Access one of the **DIST** spreadsheets and import the corresponding .PRN file of mean daily flows to cell B7. Enter the instream flow release (i.e., the minimum flow) in cell C7. Press the function key F9 for manual recalculation of the spreadsheet. When the "READY" indicator appears in the upper right-hand portion of the screen, the conversion to hourly flows is completed. ALT-A plots the 7-day flow pattern that results and the power revenue is updated in cell G14. Of later importance are the hourly releases themselves. These are located in the Range AI20..AI199. As you work your way through this assignment and you enter the assigned alternatives in the YEAROP.WK1 spreadsheet, Print this range to a file (use Options Other Unformatted when you do this). **Make sure you capture the whole Range.** The hourly flows contained therein will be used in subsequent labs to evaluate the habitat-related consequences of each of the alternatives.

REVIEW QUESTIONS

1. The maximum power demand in this system occurs during the winter, from December through February. The following constraints are in effect: mandatory minimum release is 490 cfs and maximum allowable drawdown is 2 ft below full pond (i.e., 483 ft). What release pattern maximizes the power release during January and February without violating the 2 ft maximum drawdown rule in March? (Hint- experiment with storing in December and March to maximize releases in January and February. Note that there are probably several "correct" approaches that will work).

2. Based on a week's worth of daily flows sampled from the January-February daily flow time series, calculate the weekly revenue to the power company from the WINDIST.WK1 spreadsheet.

3. Based on the same week's daily flows from question 2 and a maximum allowable

drawdown of 2 feet, what change in power revenue results from implementing the NEBF during the winter? (Calculate only for the sampled week, not the whole winter).

4. Select the same seven-day period from the YEAROP.WK1 spreadsheet that was used for the winter analysis during lab 2 (2/17-23/74). Export these seven daily flows to the WINDIST.WK1 spreadsheet. By increasing the instream flow release in cell C7, you cut down on the amount of water available for peaking. Change the flow in C7, press function key F9, and then invoke ALT-A. Determine through this process what minimum flow would need to be specified in order to achieve steady releases during that week (i.e., eliminate peaking entirely). What loss in gross power revenues results from the conversion to steady release?

5. Input the steady flow release determined from question 5 back into the YEAROP.WK1 spreadsheet under minimum instream flow release. Recalculate the spreadsheet and access the plot of storage versus time (ALT-S). What difference does this instream flow alternative make in the reservoir mass balance during the winter months, compared to the results from questions 1 and 3? What attributes of the different release alternatives contribute to this result?

6. Determine the pattern of flow releases to maximize the power release during January and February with a mandatory minimum release of 490 cfs and a maximum

drawdown of 8 feet. (i.e., repeat question 1 but modify the maximum drawdown volume in cell C10 of the YEAROP.WK1 spreadsheet). How does the power revenue for this alternative compare with the amount indicated under question 2?

7. Determine an average daily power release designed to maximize total power releases over the entire year (for the water year type assigned your group) for the following scenarios:

Instream flow	Maximum Drawdown
490 cfs	2 feet
490 cfs	8 feet
1310 cfs	2 feet
1310 cfs	8 feet

8. Estimate the total annual revenue to the power company under each scenario.

NOTES

NOTES

IF 201
May 11-15, 1992
Fort Collins, CO

(circle appropriate lab #)

LAB # 1 2 3 4 5 6 7

1. Will what you learned in the lab be relevant to problems you encounter in your job?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the lab effective in reinforcing concepts introduced in the lecture?

_____ Yes, lab could stand alone without lecture.

_____ Yes, lab supported lecture.

_____ Somewhat, too much detail.

_____ Somewhat, not enough detail.

_____ No

If no, what needs to be changed?____

____

____

3. How much time were you given to complete the lab?

_____ less than one hour

_____ one to two hours

_____ more than two hours

4. Were you given enough time to get everything out of the lab you wanted to?

_____ Yes

_____ No

If no, how much time would you have liked to work on this lab? ______________

5. Were the written instructions for the lab clear, concise, and accurate?

_____ Yes

_____ No

If no, what problems did you encounter with the instructions?________________

____

____

____

____

6. Did the software perform as you expected from reading the instructions?

_____ Yes

_____ No

If no, what problems did you encounter with the software?____________________

____

____

____

____

7. Rate the complexity of the lab according to your expectations.

_____ Too simple.

_____ About right.

_____ Too complex.

8. Were the Review Questions and Discussions provided at the end of the lab helpful in reinforcing concepts and skills acquired in the lab?

_____ Yes

_____ No

If no, why not?____

____

____

____

9. Did you learn anything in the lab that will help you do your job better or more efficiently?

_____ Yes

What was it?____

____

____

_____ No

Why not? ____

____

____

____

10. Are there any subjects related to IF 201 for which you would like to see additional labs or tutorials developed? What are they?

VI.

NETWORKING
PULSE ATTENUATION

Characteristics of Hydropeaking analyses

- Short time steps involved
- Subsampling of hydrologic period of record
- Pulse attenation
- Biological Effects
    - disruption of spawning
    - migration of suitable habitat
    - stranding
    - disruption of macroinvertebrate production

@@@@@ OH @@@@@

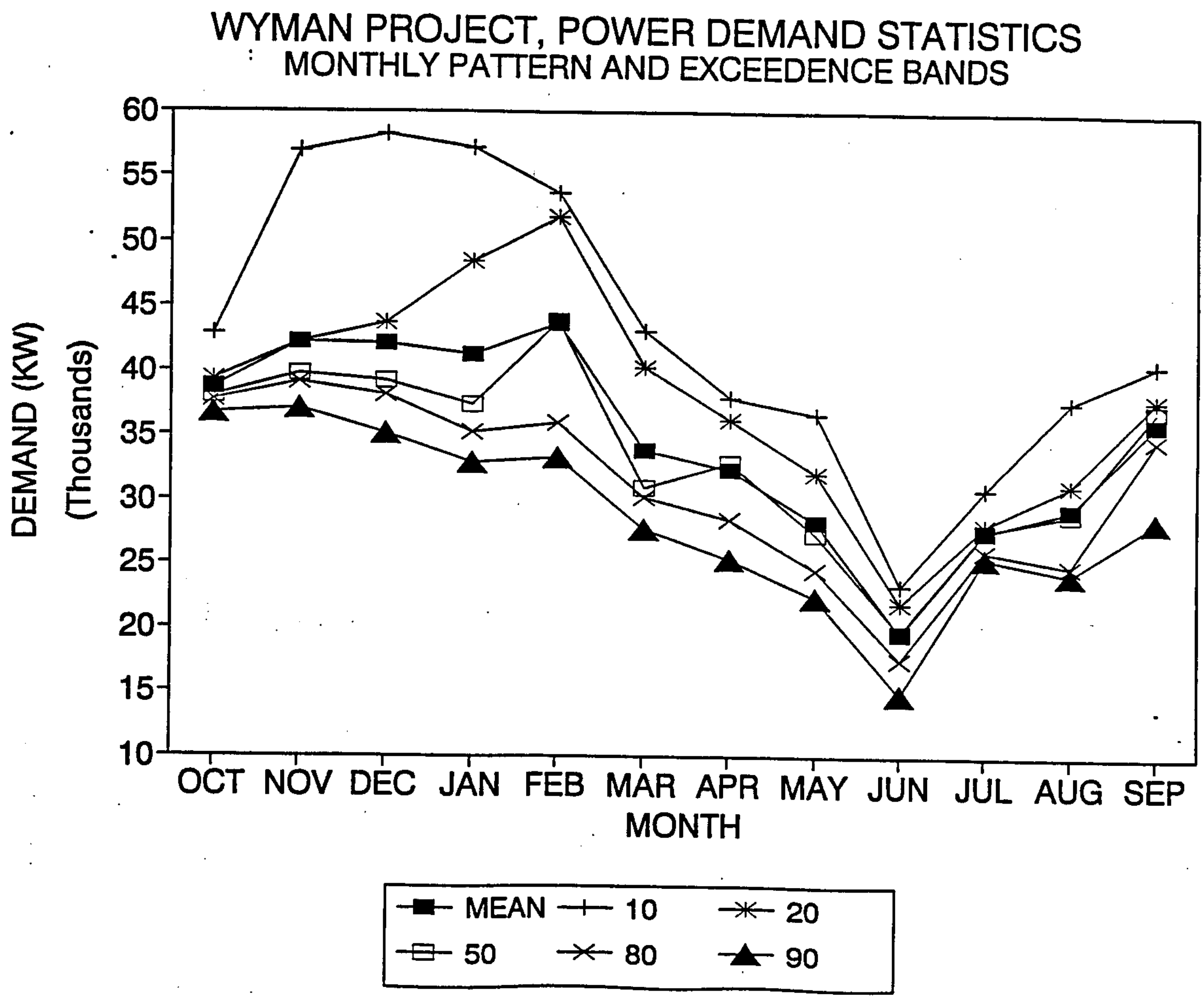
Potential stratifictions for sub-sampling hydrologic records

- Annual hydrograph
    - low flow months
    - high flow months
- Power demand
    - high demand months
    - low demand months
- Biological requirments
    - spawning / incubation period
    - fry emergence
    - migrations
    - critical rearing periods

@@@@@ OH @@@@@

Wyman project power demand statistics - monthly pattern

Where would you sample ????



WYMAN PROJECT, POWER DEMAND STATISTICS
MONTHLY PATTERN AND EXCEEDENCE BANDS
DEMAND (KW)
(Thousands)
60
55
50
45
40
35
30
25
20
15
10
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH
MEAN
10
20
50
80
90

Subsampling Hydrologic Records for Hydropeaking Applications

1. Obtain mean monthly flows for appropriate period of record
2. If in USGS format, use LPTDUR
3. If not in USGS format, enter to LOTUS spreadsheet
4. Define exceedence probabilities for Wet, Normal, Dry months (OR OTHER CATEGORIES AS APPROPEIATE)
5. Sort data from high to low by discharge for each month
6. Develop flow duration statistics
7. Identify years for which the mean monthly flows fall into each category.

NOTE: this strategy defines things for overall evaluation, operational evaluation must consider sequences of months intact. How to deal with them?

@@@@@ OH @@@@@

Kennebec River Near Bingham, ME

Duration of sampled months

@@@@@ OH @@@@@

Pulse attenuation example using running mean

NOTE: delay of peak, filling of troughs, reduction of peak

locally differs

@@@@@ OH @@@@@

Alternate Pulsing flow regime Would this difference be meaningful????

KENNEBEC RIVER NEAR BINGHAM, ME

SAMPLING OF MEAN MONTHLY DISCHARGES
BY
WET, NORMAL, AND DRY MONTHS

WET MONTHS

YEAR	OCT	YEAR	FEB	YEAR	MAY	RANK	EXC.PROB
1982	7561	1970	6783	1974	22161	1	0.052631
1978	6178	1978	6483	1969	20296	2	0.105263
1977	5278	1974	5596	1970	14356	3	0.157894
1974	3968	1982	5046	1983	13594	4	0.210526
1975	3870	1984	4649	1973	13302	5	0.263157

NORMAL MONTHS

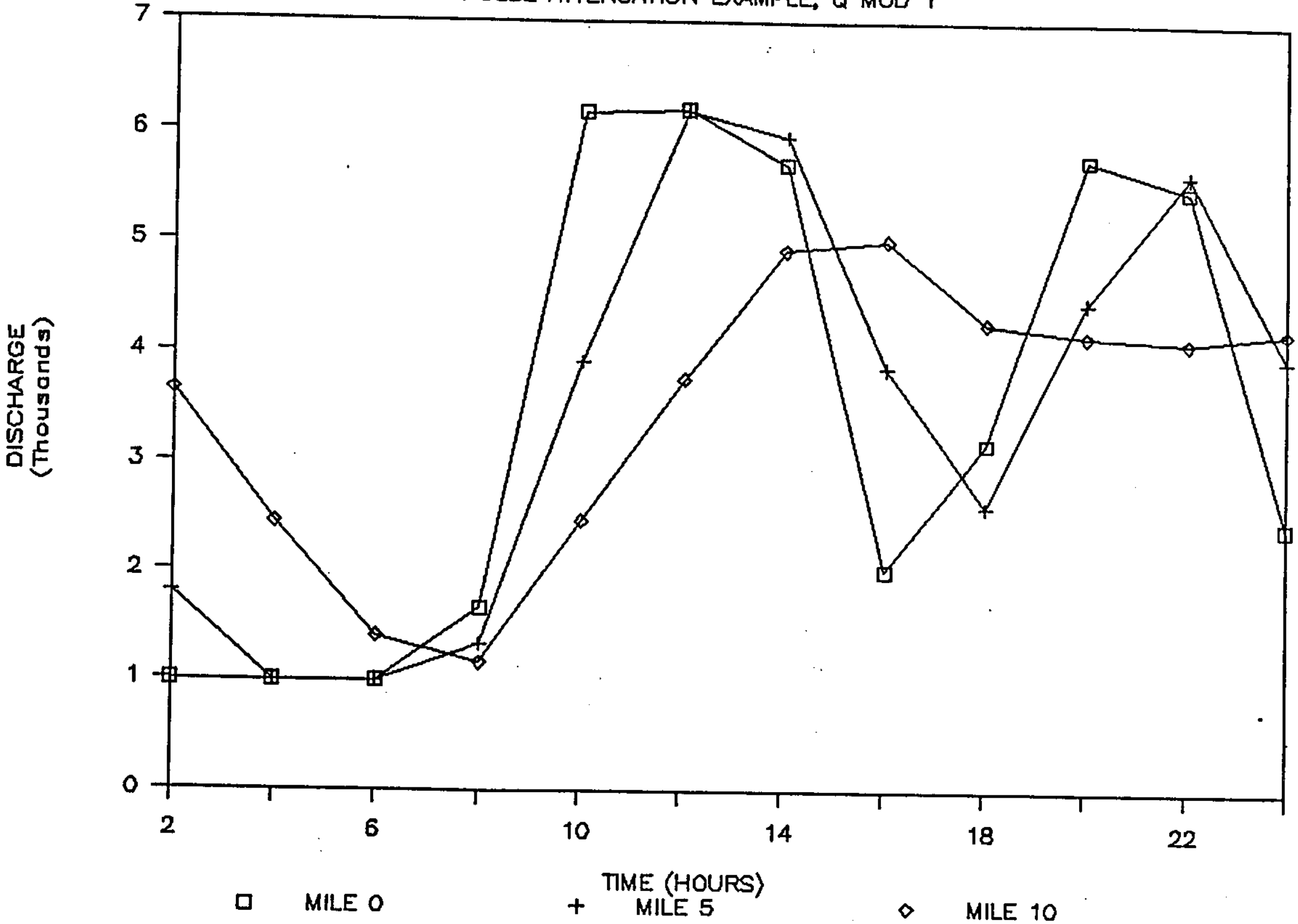
YEAR	OCT	YEAR	FEB	YEAR	MAY	RANK	EXC.PROB
1970	3855	1977	4533	1972	13182	6	0.315789
1968	3712	1968	3971	1984	12938	7	0.368421
1971	3465	1975	3752	1979	12712	8	0.421052
1979	3388	1967	3470	1976	11990	9	0.473684
1967	3373	1973	3346	1978	10187	10	0.526315
1969	3315	1971	3263	1982	9454	11	0.578947
1983	3197	1981	3092	1971	9269	12	0.631578
1984	3190	1969	3008	1975	6834	13	0.684210

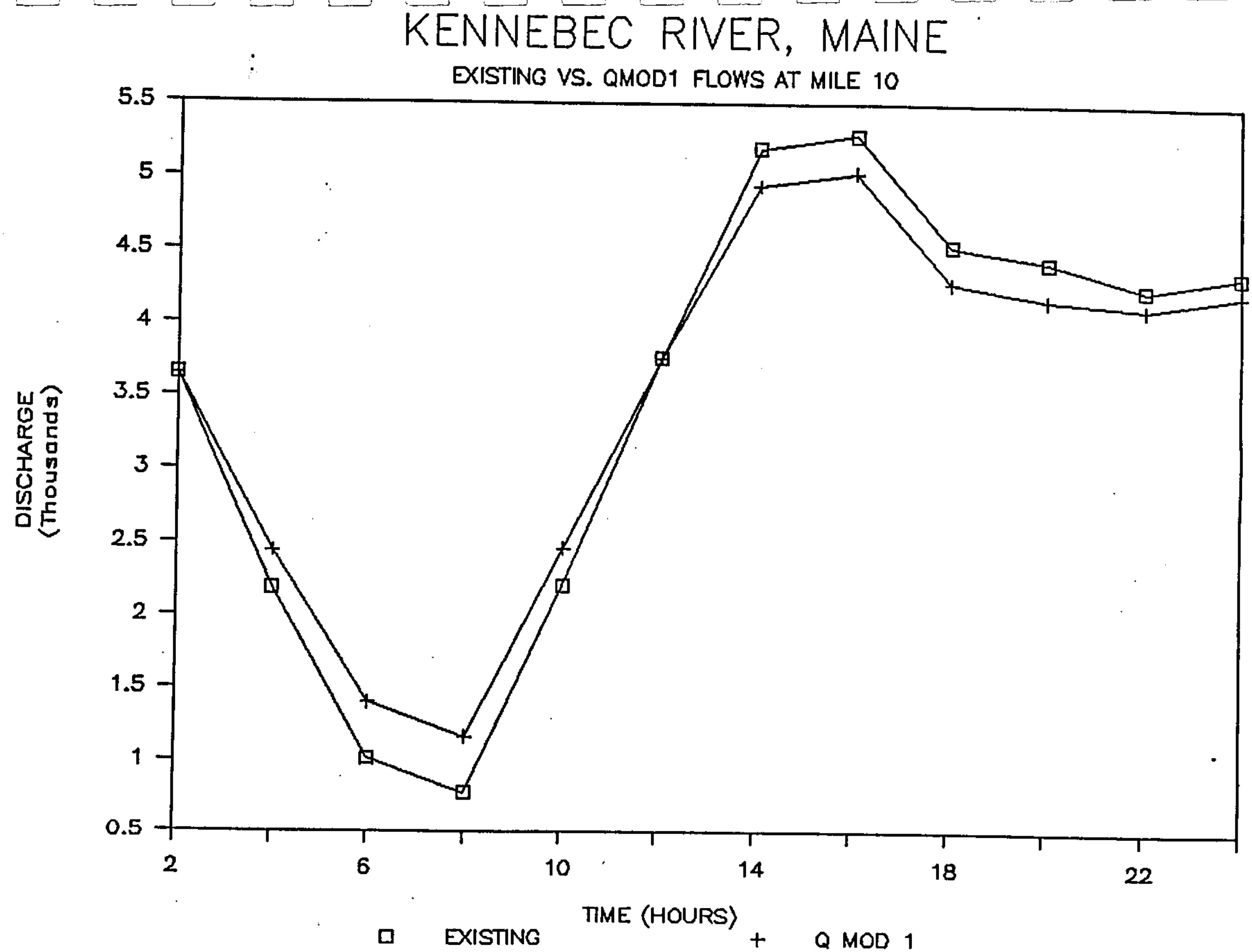
DRY MONTHS

YEAR	OCT	YEAR	FEB	YEAR	MAY	RANK	EXC.PROB
1973	3150	1980	2999	1977	5678	14	0.736842
1976	3122	1976	2863	1968	5375	15	0.789473
1972	2948	1983	2721	1967	5013	16	0.842105
1980	2780	1979	2576	1981	4310	17	0.894736
1981	2638	1972	1624	1980	2192	18	0.947368

KENNEBEC RIVER, MAINE

PULSE ATTENUATION EXAMPLE, Q MOD 1




KENNEBEC RIVER, MAINE
EXISTING VS. QMOD1 FLOWS AT MILE 10
DISCHARGE (Thousands)
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
2
6
10
14
18
22
TIME (HOURS)
EXISTING
Q MOD 1

@@@@@ OH @@@@@

FACTORS AFFECTING PULSE ATTUNUATION

- SLOPE
- CHANNEL ROUGHNESS
- EXISTING FLOW IN CHANNEL
- PULSE MAGNITUDE
- TRIBUTARY INFLOW
- LENGTH OF REACH
- BANK STORAGE

@@@@@ OH @@@@@

Methods of Determining Pulse Attunuation

- Empirical - low tech: Staff Gage
- Empirical - high tech: Continuous stage recorders
  Float/Counterweight
  Manometers
  Ultrasonic Rangers
- Mathematical - low tech: Running means - POOR
- Mathematical - high tech: Routing models

NETWORK HYDROLOGY

Flow Time Series at Many Locations: Currently Available Methods

1. Flow time series from
   - Models like: PROSIM, HEC3/5, many others
   - Data like USGS Gages
2. Propogation of flow changes in Temperature Model Hydrology Data File
   - TDELTAQ Program
   - NOT HYDROPOWER, Handles mean daily flow as smallest increment, Limited to cases where steady state applies

@@@@@ OH @@@@@

NETWORK HABITAT

Habitat Time Series at Many Locations

HABNET Program

Flow Time Series from Network Hydrology

+

WUA from PHABSIM

YIELDS Habitat time series at many locations

LIMITATIONS: monthly format, numbers OK if you trick it

Other Analyses:

Habitat Duration Statistics

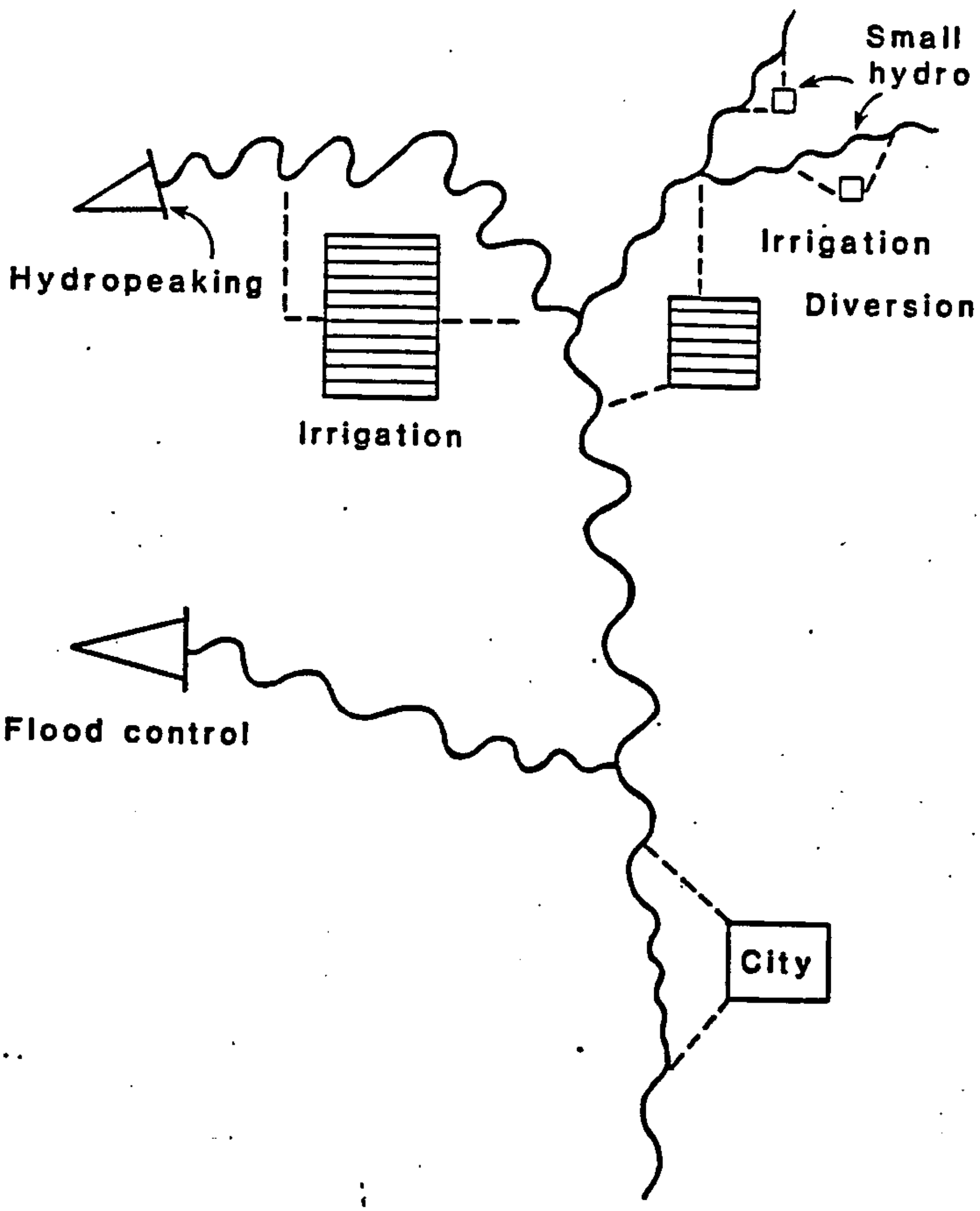
Basin Wide Habitat Summation

@@@@@ OH @@@@@

Serial/Parallel Network: Where you would apply network

Discussion of what to look for.

PHYSICAL CONFIGURATION
Serial/Parallel Networks



INTRODUCTION OF HABNET

Basic Concept of Network Habitat Analysis

- Find Blockages
- Perform time series analysis at numerous sites
- Aggreagate by life stage
- compare Alternatives starting with aggregates (subdivide if necessary)

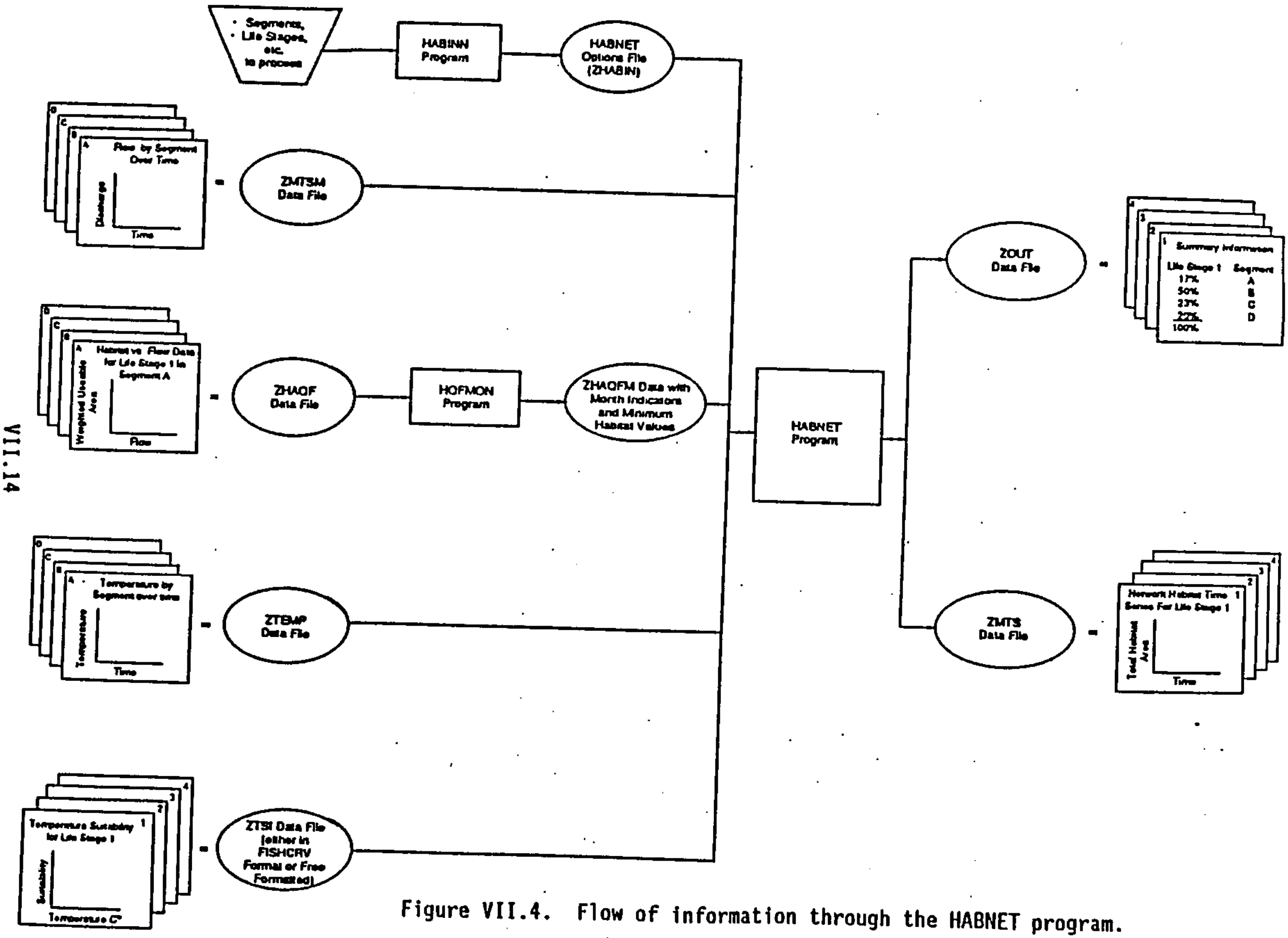


Figure VII.4. Flow of information through the HABNET program.

IF 201
May 11-15, 1992
Fort Collins, CO

Lecture Evaluation

(circle appropriate lecture #)

Lecture # I II III IV V VI VII VIII IX

1. Was the subject of the lecture relevant to the stated objectives of the course?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the material covered in the lecture necessary to achieve one of the stated objectives of the course?

_____ Absolutely necessary for understanding concepts.

_____ Helpful, but not necessary.

_____ Would have been less confusing without the lecture.

3. Did the materials in the workbook follow the materials presented in the lecture?

_____ Workbook was easy to follow.

_____ Workbook was somewhat out of order with presentation.

_____ Workbook contained extraneous materials not covered in lecture.

_____ Lecture covered extraneous material not contained in workbook.

_____ Lecture and workbook were totally out of synch.

4. Were lecture notes in the workbook helpful in following the lecture?

_____ Very helpful.

_____ Somewhat helpful.

_____ Would have been helpful if instructor had followed them.

_____ Lecture notes not provided.

5. Were audio-visual materials audible and/or visible?

_____ Yes

_____ No

If no, which need improvement and how can they be improved?

____

____

____

6. Did AV materials support the lecture materials?

_____ Yes

_____ No

If no, should the AV materials be replaced or eliminated?

_____ Replace (with)____

_____ Ditch them. ____

7. If this course were to be packaged as a correspondence course, what would be the best medium through which to present the materials covered in the lecture?

_____ None. The lecture is unnecessary.

_____ None. Interaction with a live instructor is essential.

_____ Good lecture outline plus video-taped lecture.

_____ Convert lecture notes to prose (i.e., text of covered materials).

_____ Text plus video-taped lecture.

_____ Other. ____

____

____

____

____

VII.
ELEMENTS OF NEGOTIATION

ELEMENTS OF NEGOTIATION

I. THE WHOLE PROCESS OF DEVELOPING AN IFIM STUDY IS ONE OF NEGOTIATION. NEGOTIATION OCCURS OVER ALMOST ALL PIECES OF THE STUDY, BUT CERTAINLY WHEN YOU ARE READY TO SIGN AGREEMENTS.

II. BASIC CONSIDERATIONS IN NEGOTIATION.

A. Bottom Line versus Best Alternative to a Negotiated Agreement (BATNA)

B. Principled Bargaining

C. Position-based versus Interest-based bargaining

D. The traps of agreement

E. What constitutes a successful negotiation?

1. Each party believes that an agreement was reached
2. The agreement included an understanding of implementation procedures and monitoring
3. The parties are willing to engage in future negotiations

III. BASIC NEGOTIATION STRATEGIES

A. Competitive:

1. Normative
2. Positional
3. Image-oriented
4. Inflexible
5. Few concessions
6. Illusion of real concession
7. Force opponent to make concessions
8. Ignore opponent's arguments and threats.

B. Cooperative:

1. Accommodative
2. Objective of a fair and equitable result
3. Trusting interpersonal relationship
4. Encourage concessions
5. "Give a little to get a little"
6. Create moral obligation to reciprocate.

C. Integrative:

1. Focus on problems not people
2. Focus on interests not positions
3. Invent a solution
4. Free exchange of information
5. Generate a variety of possibilities before deciding
6. First negotiate an objective standard for success, then negotiate the issues.

IV. NEGOTIATION OF INSTREAM FLOW ISSUES

A. Carefully examine your interests before entering the negotiation: plan.

B. Check your assumptions about the other side.

C. Know the other side's facts.

D. Concentrate on the process of decision-making at an early stage--process can affect content.

NOTES

IF 201
May 11-15, 1992
Fort Collins, CO

Lecture Evaluation

(circle appropriate lecture #)

Lecture # I II III IV V VI VII VIII IX

1. Was the subject of the lecture relevant to the stated objectives of the course?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the material covered in the lecture necessary to achieve one of the stated objectives of the course?

_____ Absolutely necessary for understanding concepts.

_____ Helpful, but not necessary.

_____ Would have been less confusing without the lecture.

3. Did the materials in the workbook follow the materials presented in the lecture?

_____ Workbook was easy to follow.

_____ Workbook was somewhat out of order with presentation.

_____ Workbook contained extraneous materials not covered in lecture.

_____ Lecture covered extraneous material not contained in workbook.

_____ Lecture and workbook were totally out of synch.

4. Were lecture notes in the workbook helpful in following the lecture?

_____ Very helpful.

_____ Somewhat helpful.

_____ Would have been helpful if instructor had followed them.

_____ Lecture notes not provided.

5. Were audio-visual materials audible and/or visible?

_____ Yes

_____ No

If no, which need improvement and how can they be improved?

____

____

____

6. Did AV materials support the lecture materials?

_____ Yes

_____ No

If no, should the AV materials be replaced or eliminated?

_____ Replace (with)____________________________________

_____ Ditch them. ____________________________________

7. If this course were to be packaged as a correspondence course, what would be the best medium through which to present the materials covered in the lecture?

_____ None. The lecture is unnecessary.

_____ None. Interaction with a live instructor is essential.

_____ Good lecture outline plus video-taped lecture.

_____ Convert lecture notes to prose (i.e., text of covered materials).

_____ Text plus video-taped lecture.

_____ Other. ____

____

____

____

____

LAB 5
INTERACTIVE NEGOTIATIONS WITH IFIM

OBJECTIVES

TO DEVELOP SKILLS IN:

1. **GROUP DYNAMICS, CONFLICT MANAGEMENT, AND LEADERSHIP IN PROBLEM RESOLUTION AND NEGOTIATION.**
2. **FORMULATING ALTERNATIVES THROUGH CONSENSUS BUILDING.**
3. **QUANTITATIVE EVALUATION OF ALTERNATIVES USING TOOLS OF IFIM.**

INTRODUCTION

"If you want something done right, do it yourself!" If you've ever negotiated with a teenager about mowing the lawn or cleaning up his or her room, you can appreciate the truth of this axiom. By now, it should be fairly apparent that none of the parties to the Wyman problem can "do it themselves." Any solution proposed by Central Maine Power without input from FWS and MDIF, or vice versa, will likely be challenged out-of-hand.

Some people are uncomfortable with the idea of negotiation. Compromise and accommodation are often equated with giving in and acquiescence. Conflict is assumed to be inherent to the process, and many of us try to avoid conflict if we can. However, in the hierarchy of human mechanisms for dispute resolution (i.e., negotiation, litigation, assassination, warfare), negotiation is relatively benign. The purpose of this lab is to give you some experience in the art of integrative negotiation and real-time alternatives analysis. We focus on integrative negotiation because it is perhaps the highest (most civilized) form of problem solving and the most difficult to achieve. It is also the most pleasant form of negotiation, once you get there.

There are several strategies (as opposed to tactics) to making negotiations more successful and less stressful. Perhaps the most important is the management of conflict and turning it into a positive force rather than a negative one. This involves the fostering of trust relationships and the separation of issues, values, and personalities. This is hard work and, like learning to play the piano, is a skill that takes a lot of practice. Successful negotiations also rely on the ability to quantify proposals or alternatives in terms of the interests and needs of the negotiating parties. This is where IFIM comes in, because it allows a quantitative evaluation of proposals as they are formulated. You already know how to do the individual steps. In this lab, we put them all together.

THE ASSIGNMENT

The class will be reconfigured into negotiating teams of five people. Each person will be assigned the role of representing one of the parties to the Wyman project: an engineer from CMP, a fisheries biologist from FWS, a district fisheries manager from MDIF, a member of the Homeowners Association, and a representative from Trout Unlimited. Each team will formulate an alternative through negotiation, and evaluate that alternative for habitat effectiveness, feasibility, risk, and cost effectiveness. Modification and re-evaluation of alternatives is encouraged. During the lab debriefing, each team will present its alternative to the class. The team with the best alternative wins the undying admiration of its classmates. Be innovative, but be able to back up your alternatives with facts.

INSTRUCTIONS

Phase 1

Values are beliefs about life which individuals (and agencies) hold dear and base their life actions on. They are often the largest source of conflict in negotiations over instream flows. It will be important for you to assume the values of the agency you represent, because part of this exercise is designed to help you learn to deal with value conflicts. This doesn't mean you have to act like a jerk, however, just because you think the people you represent act like jerks.

1. (10 minutes) At the beginning of the lab, you were assigned an agency role. Join with other members of the class who were assigned the same role (e.g., FWS, CMP) and try to figure out the BATNA for your agency. When you have made this determination, join the negotiating group to which you were assigned.

TEAM MEETING #1

A. (5 minutes) Each group will be provided with a facilitator whose job it is to keep the negotiation on track, encourage participation (solicit input from people who clam up or withdraw), enforce ground rules, summarize issues, and test consensus. The facilitator will be introduced to the Team and will summarize his or her role in the negotiation. After being introduced to the facilitator, each member of the team should introduce himself or herself and tell the group which agency he or she represents. It is appropriate at this time to reveal your agency's interests and concerns about the Wyman Project, but keep your BATNA to yourself.

B. (5 minutes) Set ground rules for the conduct of the negotiation. Ground rules are simply group norms that are agreed upon before the negotiation starts up. Example ground rules are:

a. Only one person speaks at a time (don't interrupt).
b. Attack the problem, not the person (be respectful).
c. No cheap shots.
d. Everybody participates.
e. Celebrate achievements.

You are free to make up whatever ground rules you want, but they will be enforced by the facilitator. Ground rules will be recorded and posted where everyone can see them.

C. (20 minutes) Define an idealized objective for the team. Create a vision of the ideal solution--If our solution to the problem were as good as it could be, what would it look like? While you're wrestling with this problem, remember your agency's values, BATNA, and who you have to answer to after the meeting.

Write an objective that embodies the ideal. Test for consensus. Write another one. Test for consensus. You get the idea. When you get done, there should be just one idealized objective that all the members of the team can accept (if not embrace).

D. (20 minutes) Identify problem areas. For this lab it might be easiest to tackle these by season. Be cognizant that every solution breeds new problems...don't confine your analysis simply to the habitat time series outputs.

BREAK (5 minutes)

TEAM MEETING #2

E. (15 minutes) Brainstorm possible solutions. Tackle one problem at a time. Hint-you can work on your trust relationships by using the salami technique: start with the simplest problem first and work into the more difficult problems. During brainstorming, it is important to follow several rules:

a. Don't criticize ideas. Facilitators will be on guard for judgmental critiques of ideas at this time.
b. Don't interrupt.
c. Write down every idea, no matter how outrageous it sounds at the time.
d. Facilitators, be sure to get ideas from everyone. Solicit ideas from less vocal members of group.

F. (25 minutes) Negotiate a combined proposal to be tested. Go through the possible solutions one at a time and rank by value voting or other consensus building techniques. The combined proposal should specify the project operating rules to be tested (e.g., seasonal minimum or maximum flows), performance criteria (e.g., change in habitat for x life stage, difference in gross revenue from power production), and operational constraints (lake level maintained within z feet of full pond). The proposal should say what you're going to try for each season of the year.

Write down and post the combined proposal, specifying project operating rules, performance criteria, and operational constraints to be observed.

Make assignments to test combined proposal.

Phase 2

A. (15 minutes) Evaluate the feasibility of the proposal in the **YEAROP.WK1** spreadsheet. We recommend looking at feasibility first, because if it's impossible, there's no point in looking at anything else. If you find out that you have an infeasible proposal (e.g., minimum pool level is violated), re-negotiate a new proposal. (This could include re-defining minimum pool level). Modify the proposal and re-test feasibility.

B. (75 minutes) Evaluate habitat effectiveness, cost effectiveness, and risk of feasible alternative.

a. Select week(s) of interest from **YEAROP.WK1** and enter in appropriate location in ***.DIST.WK1** spreadsheet. Follow instructions from Lab 4 if you've forgotten how to do this. Recalculate the spreadsheet and record the gross revenue for the selected week.

b. Print the hourly flow time series from the DIST spreadsheet to a .PRN file.

c. Enter the hourly flow time series into the **HABTS2.WK1** spreadsheet (see Lab 2) for mobile life stages present during the season of interest.

d. Find the minimum and maximum flows for the hourly flow time series and look up the effective habitat values for immobile life stages, generated in Lab 3.

C. Break for Lunch.

1:15

Phase 3

TEAM MEETING #3

A. (20 minutes) Debrief team about test results for assigned portions from Phase 2. Compile and record test metrics for performance criteria below proposal on flip chart:

Season
Habitat effect (percent change (±)from baseline)
Feasibility (maximum lake drawdown, water budget)
Cost effect (percent change in revenues (±)from baseline)
Risk (Number of years out of 50 where alternative fails)

B. (10 minutes) Isolate specific problem areas or opportunities for improvement in any or all of the metrics from the debriefing. Evaluate across seasons as well as within a season.

C. (15 minutes) Brainstorm possible alternatives to address problems and opportunities. **Look hard at cross-season tradeoffs during this session!**

SHORT BREAK.

Phase 4

TEAM MEETING #4

A. (30 minutes) Negotiate new combined proposal to be tested, using the same techniques employed in Team Meeting #2 (Phase 2). Build consensus on new alternatives to be tested.

B. (10 minutes) Record new combined alternative. Specify new project operations rules, operational constraints, and performance criteria.

C. (5 minutes) Make assignments for next test sequence. Develop agenda items for next meeting (if there were to be a next meeting, what would your team do next?). Elect spokesperson for the Team for class debriefing session.

DEBRIEFING

4:00 pm

(EACH TEAM GETS 10 MINUTES)

A. Present the Team's Idealized Objective and the original combined proposal.

B. Present performance criteria test results for original combined proposal.

C. Present revised combined proposal and Team's next meeting agenda.

D. Respond to questions and comments from other Teams.

E. General discussion with instructors following Team presentations.

GENERALIZED AGENDA FOR LAB 5

8:00 - 8:30 LAB 5 BRIEFING

8:30 - 8:40 AGENCY REP'S MEETINGS

8:40 - 9:30 TEAM MEETING #1

9:30 - 9:40 BREAK

9:40 -10:30 TEAM MEETING #2

10:30 -12:00 ALTERNATIVE TESTING

12:00 - 1:15 LUNCH

1:15 - 2:00 TEAM MEETING #3

2:00 - 2:05 BREAK

2:05 - 2:45 TEAM MEETING #4

2:45 - 3:00 BREAK

~~3:00 - 3:45~~ 4:00 - 5:00 LAB 5 DEBRIEFING

NOTES

To cause reservoir to store, decrease outflows col's E & T
reduce instream flow release and/or power targets

To cause drawdown
- increase outflows, either by increasing IFR or power release
- change maximum allowable drawdown number on yearop

To reduce peaking, increase IFR
watch out for spills!

For variable drawdown rules, enter max. allowable drawdown in col. N

IF 201
May 11-15, 1992
Fort Collins, CO

(circle appropriate lab #)

LAB # 1 2 3 4 5 6 7

1. Will what you learned in the lab be relevant to problems you encounter in your job?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the lab effective in reinforcing concepts introduced in the lecture?

_____ Yes, lab could stand alone without lecture.

_____ Yes, lab supported lecture.

_____ Somewhat, too much detail.

_____ Somewhat, not enough detail.

_____ No

If no, what needs to be changed?____

____

____

3. How much time were you given to complete the lab?

_____ less than one hour

_____ one to two hours

_____ more than two hours

4. Were you given enough time to get everything out of the lab you wanted to?

_____ Yes

_____ No

If no, how much time would you have liked to work on this lab? ____________

5. Were the written instructions for the lab clear, concise, and accurate?

_____ Yes

_____ No

If no, what problems did you encounter with the instructions?______________

____

____

____

____

6. Did the software perform as you expected from reading the instructions?

_____ Yes

_____ No

If no, what problems did you encounter with the software?________________

____

____

____

____

7. Rate the complexity of the lab according to your expectations.

_____ Too simple.

_____ About right.

_____ Too complex.

8. Were the Review Questions and Discussions provided at the end of the lab helpful in reinforcing concepts and skills acquired in the lab?

_____ Yes

_____ No

If no, why not?____

____

____

____

9. Did you learn anything in the lab that will help you do your job better or more efficiently?

_____ Yes

What was it?____

____

____

_____ No

Why not? ____

____

____

____

10. Are there any subjects related to IF 201 for which you would like to see additional labs or tutorials developed? What are they?

VIII.
QUALITY ASSURANCE IN IFIM STUDIES

SPECS EVALUATION REPORT FOR WYMAN PROJECT
SAMPLING OF THE HYDROLOGIC RECORD
REF: SPECS STEP 28

1. At page 9 of the Final Report, the statement is made that "Flow records at Wyman Dam over the past 20 years were examined to select years and seasons that could be characterized as representing 'wet','dry', and 'average' streamflow conditions." Turn to the first set of hourly flow data in the appendix of the report (noted as page 136). Notice that the investigators defined wet, dry, and average years instead of wet, dry and average seasons or months in their selection process. This is evident because all the "average" samples are recorded for water year 1974. All the "dry" samples are recorded for 1980 and all the "wet" samples come from water year 1977.

A. What are the exceedence probabilities of the mean annual discharges for the wet, dry, and average years? Are these realistic probabilities for the type of water year being depicted?

Water Year Type	Year	Exceedence
Dry	1980	
Average	1974	
Wet	1977	

A. KENANNQ.PRN in your lab 6 directory contains the mean annual flows for the Kennebec River, near Bingham, ME. Access Lotus 1-2-3 and import this file. Sort the data in descending order, with Q as the primary sort key. Be sure to include the year in the data range being sorted. Rank the data from 1 to 20, with 1 associated with the highest flow. (in the next column over just enter 1-20 next to each of the sorted flows. In the next column, write an equation to calculate the exceedence probability. Enter the equation at the first row of numbers and copy the equation to the rest of the rows. Don't erase this spreadsheet!

B. November, 1980 was used to depict a dry fall water supply. What was the exceedence probability for the mean monthly discharge for November, 1980? Would you consider this exceedence probability to be a good representation of a dry November? What year or years would you recommend instead of 1980 to represent a dry November?

__________ November, 1980 exceedence probability

__________ Recommended year (first choice)

__________ Recommended year (second choice)

B. Import the file KENQNOV into your exceedence spreadsheet where your mean annual flows were located for question A. These are the mean monthly flows for all the Novembers from 1966 to 1986. Sort these data the same way you did in step A above. Record the exceedence probability for November 1980 in the space provided below the question. Record the years and the exceedence probabilities for the years you would have recommended instead of 1980 in the space provided. Don't erase your spreadsheet yet.

C. July, 1974 represented an average summer condition in this study. What was the exceedence probability of the average monthly flows that occurred in July, 1974? Is this an adequate descriptor of the water supply during a normal summer? What year or years would you have recommended instead of 1974 to represent a normal summer?

__________ July, 1974 exceedence probability

__________ Recommended year (first choice)

__________ Recommended year (second choice)

C. Do everything like you did for step B, only import the file KENQJUL into the year and flow locations of your spreadsheet. OK, now you can ditch the spreadsheet.

D. How would the method used to define wet, dry, and average conditions in this study conflict with the implementation of new operating rules (such as those developed in Lab 5) developed for the project?

GO TO SPECS STEP 56

2. SPECS step 56 asks whether the WUA vs Q function "looks right" for the organism under investigation. Curve A (square symbols) in figure 6.1 was derived for adult rainbow trout in the Kennebec River, using Habitat Suitability Criteria (HSC) from the FWS' "Blue Book." Examine the WUA vs Q response functions on SPECS pages 33-36. Which TYPE of response function does Curve A in figure 6.1 most resemble? Does the description of the organism associated with that TYPE fit adult rainbow trout?

__________ Functional response type

__________ Fits adult rainbow trout

__________ Doesn't fit rainbow trout

__________ Beats me. Ask me something about rainbow darters.

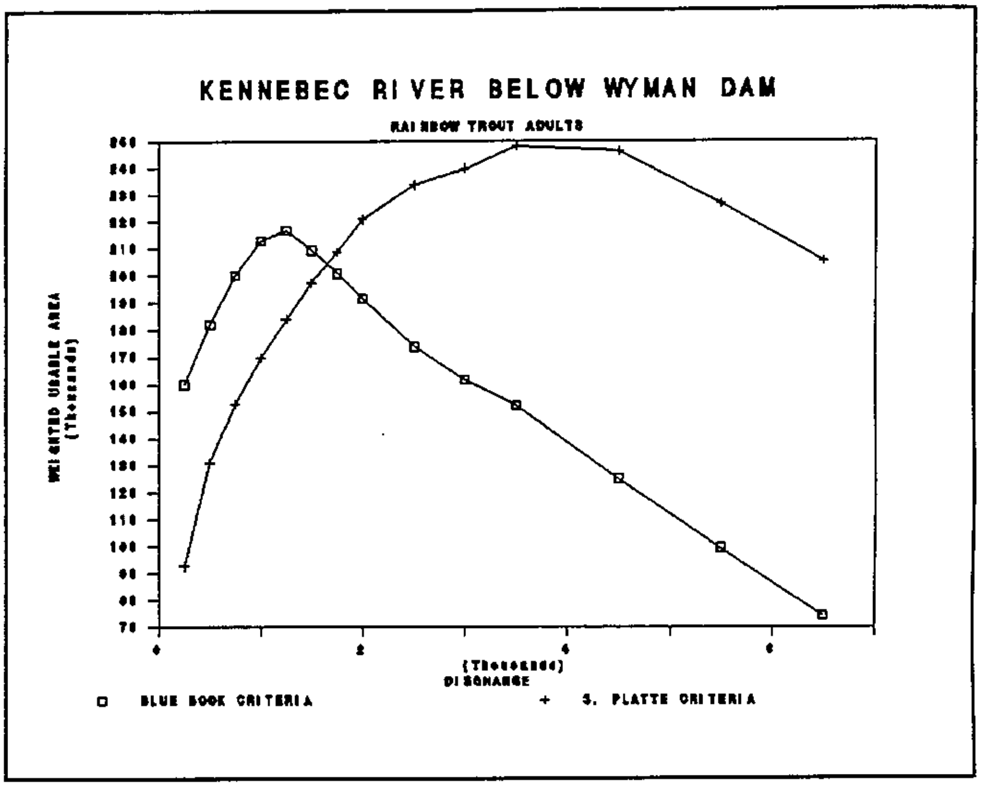


Figure 6.1. Curve A: WUA vs Q response function for adult rainbow trout, Kennebec River, Maine, based on HSC from FWS Blue Book. Curve B: WUA vs Q response function using adult rainbow trout HSC from South Platte River, Colorado.

3. Which TYPE of response function does Curve B (HSC from South Platte River, Colorado) in figure 6.1 most resemble? Does the description of the organism associated with that TYPE fit adult rainbow trout?

__________ Functional response type

__________ Fits adult rainbow trout

__________ Doesn't fit rainbow trout

3. How would the use of Curve B (South Platte criteria for adult rainbow trout) have changed your evaluation of the NEBF alternative? How would it have affected the formulation of your Team's alternative in Lab 5?

4. Review the minutes of the interagency meetings in the case study. How was the issue of the accuracy and reliability of HSC resolved prior to the formulation and evaluation of alternatives? What could the participants to the negotiation have done to ensure the reliability of the HSC?

GO TO SPECS STEP 58

5. What variables were used in the calculation of WUA for rainbow trout and brook trout in the Wyman study? Are these variables appropriate for a large, deep river like the Kennebec? How could the analysis been modified to apply small river criteria to a large river? How would this modification have affected the results?

GO TO SPECS STEP 62

6. Examine the map of the study area on page 22 and the description of the habitat types surveyed on page 4 of the Wyman report. Were there enough habitat types established to describe all the habitat types and their proportions in the study area? What habitat types are under-represented, if any, and how could their inclusion in the model have changed the results?

GO TO SPECS STEP 64

7. Each habitat type was replicated once, except for the fast riffle and shallow pool. One transect was used to represent each habitat type or replicate. What factors should you consider in evaluating the adequacy of their transect placement? Without conducting a site visit, how could you tell if too few transects were used or if their placement was critical to the model?

GO TO SPECS STEP 66

8. Examine the IFG-4 data set starting at page 79. Closely examine the block of data for transect 1 on page 79 (starts at line XSEC 1 and ends at line XSEC 2). Compare this block of data with transect 3 on page 80, transect 6 on page 82, and transect 8 on page 83. Something is missing. What is it? What habitat types are represented by transects 3, 6, and 8? What does the absence of certain data for these transects tell you about the field capabilities of the investigators in this study? How might the absence of these data have affected the outcome of the study?

9. Figures 6.4 and 6.5 are plots of the Velocity Adjustment Factors (VAF's) for the eight transects used in this study. Examine the VAF plot for transect 7. Now examine the cross sectional profile for transect 7 (figure 6.6). Why is the VAF for this transect different from the rest of them? What implication does this have for the results of the PHABSIM analysis?

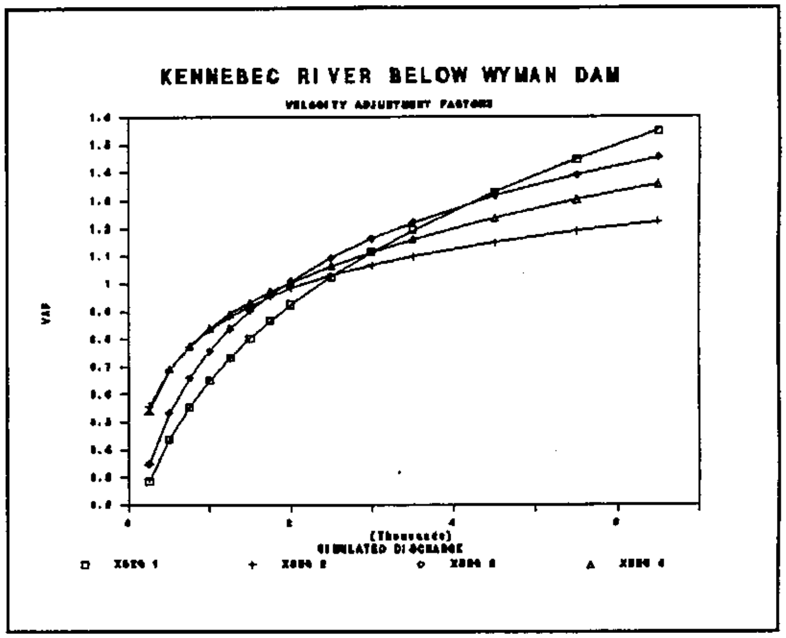


Figure 6.4. Velocity Adjustment Factors for transects 1-4, Kennebec River.

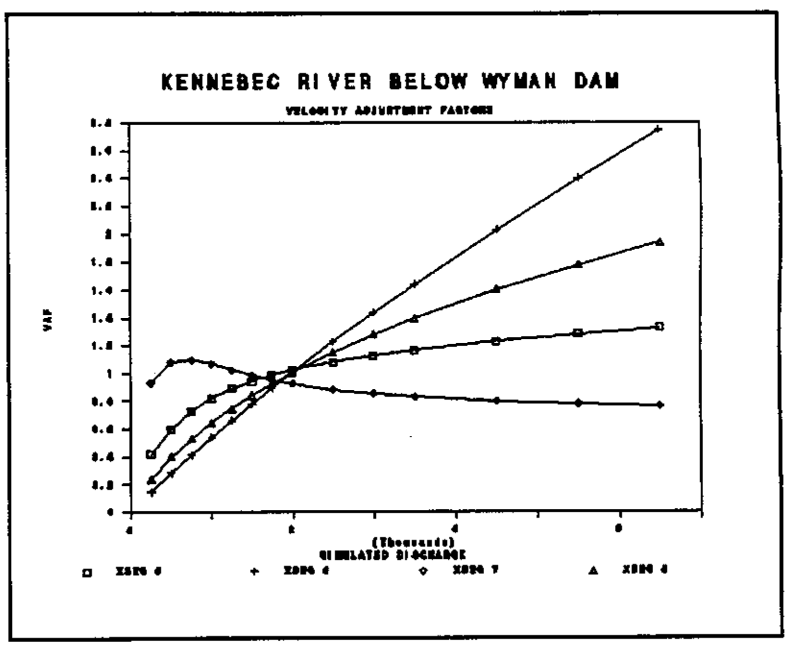


Figure 6.5. Velocity Adjustment Factors for transects 5-8, Kennebec River.

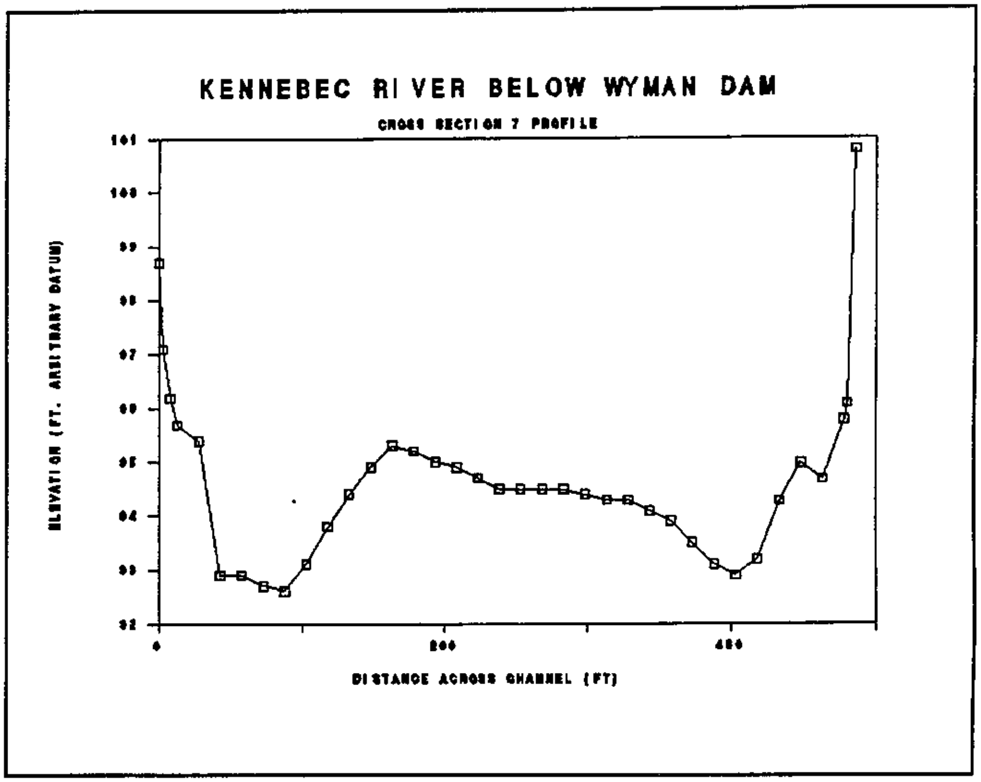


Figure 6.6. Cross sectional profile for transect 7, Kennebec River.

NOTES

IF 201
May 11-15, 1992
Fort Collins, CO

(circle appropriate lab #)

LAB # 1 2 3 4 5 6 7

1. Will what you learned in the lab be relevant to problems you encounter in your job?

_____ Highly relevant.

_____ Somewhat relevant.

_____ Barely related.

_____ Could have done without it.

2. Was the lab effective in reinforcing concepts introduced in the lecture?

_____ Yes, lab could stand alone without lecture.

_____ Yes, lab supported lecture.

_____ Somewhat, too much detail.

_____ Somewhat, not enough detail.

_____ No

If no, what needs to be changed?____

____

____

3. How much time were you given to complete the lab?

_____ less than one hour

_____ one to two hours

_____ more than two hours

4. Were you given enough time to get everything out of the lab you wanted to?

_____ Yes

_____ No

If no, how much time would you have liked to work on this lab? ______________

5. Were the written instructions for the lab clear, concise, and accurate?

_____ Yes

_____ No

If no, what problems did you encounter with the instructions?________________

____

____

____

____

6. Did the software perform as you expected from reading the instructions?

_____ Yes

_____ No

If no, what problems did you encounter with the software?_____________________

____

____

____

____

7. Rate the complexity of the lab according to your expectations.

_____ Too simple.

_____ About right.

_____ Too complex.

8. Were the Review Questions and Discussions provided at the end of the lab helpful in reinforcing concepts and skills acquired in the lab?

_____ Yes

_____ No

If no, why not?____

____

____

____

9. Did you learn anything in the lab that will help you do your job better or more efficiently?

_____ Yes

What was it?____

____

____

_____ No

Why not? ____

____

____

____

10. Are there any subjects related to IF 201 for which you would like to see additional labs or tutorials developed? What are they?

IX.
ANSWERS TO LAB DISCUSSION QUESTIONS

LAB 1

ANSWERS TO LAB 1 LIAM ANALYSIS

Attached are the results of an LIAM analysis conducted by NERC staff for the Wyman Dam. The LIAM results from MAPUM are followed by paragraphs describing the strengths and needs of the organizations. The Needs Analyses were prepared after using LOOKY to review actual scores. Our answers may be different from yours, there is no "right" score or analysis for any organization. These sample results are provided to give an example of what kind of information you can get by using LIAM to prepare for negotiations.

Legal Institutional Analysis Model (LIAM)

MAPO Table of respondent positions

Homeowners

Broker score -	*3.6*
Arbitrator score -	*2.7*
Advocate score -	*3.7*
Guardian score -	*3.9*
Constituency support -	*3.8*
Information power -	*1.8*
Resource power -	*2.9*

FWS--Enhancement

Broker score -	*2.8*
Arbitrator score -	*3.5*
Advocate score -	*4.8*
Guardian score -	*1.6*
Constituency support -	*3.9*
Information power -	*3.5*
Resource power -	*2.6*

MDIF

Broker score -	*2.6*
Arbitrator score -	*3.7*
Advocate score -	*4.2*
Guardian score -	*2.3*
Constituency support -	*3.6*
Information power -	*3.5*
Resource power -	*3.2*

CMP

Broker score -	*3.3*
Arbitrator score -	*2.8*
Advocate score -	*1.9*
Guardian score -	*4.7*
Constituency support -	*4.8*
Information power -	*3.5*
Resource power -	*4.0*

ROLE MAP FROM LIAM

Present economic arguments
If the pie is big enough can compromise to give everyone a piece

```
*******************************************************
*                          *                            A-Homeowners
*                          *                            B-FWS--Enhancement
*                          b                            C-MDIF
*                          r                            D-CMP
*                          o                           *
*                          k                           *
*                          e                           *
*                          rA Homeowners       D       *
*                          *                  CMP      *
******advocate***************************guardian******
*     B                    *                           *
*    FWS       C           *                           *
*             MDIF         *                           *
*                          *                           *
*                          a                           *
*                          r                           *
*                          b                           *
*                          i                           *
*                          t                           *
*                          .                           *
*                          *                           *
*******************************************************
```

regulatory arena
for
courts

Present factual arguments
alternatives analyses

ROLE ASSESSMENT FOR EACH ORGANIZATION

for **HOMEOWNERS**

Role Intensity: Moderate Broker-Guardian

Will cooperate in efforts to keep or push the decision into the distributive arena, where the outcome is a negotiated or brokered one. Will not resist efforts to prevent change in the traditional use and management of resources, but will prefer to build a political coalition to stop such changes and to protect economic and developmental values. Thus, will use economic, political, and constituency information to support its position. Will avoid taking absolute positions in bargaining situations and will readily compromise.

for **FWS-ENHANCEMENT**

Role Intensity: Extreme Advocate-Arbitrator

Will frequently speak out--in the media, at public meetings and the like--on behalf of environmental values and will lead efforts to change the traditional ways in which resources have been used and managed in the past. Will employ crusading techniques to protect the environment from the crises it feels are approaching, and generated and use scientific and technical data to support its position. Strongly believes in the correctness of its environmentally protective world view, and will join efforts to keep or push the conflict into the regulatory arena, where the decision is made by an arbitrating organization based on evidence presented by all sides to the dispute. Will take absolute positions in bargaining situations and not be open to compromise.

for **MDIF**

Role Intensity: Moderate Advocate-Arbitrator

Will cooperate in efforts to protect environmental and non-traditional values, and will contribute to campaigns to protect such values and to initiate changes in the ways in which resources have been traditionally used and managed in the past. Will not resist efforts to keep or push the conflict into the regulatory arena, where decisions are made by an arbitrating organization authorized to make the decision based on evidence presented by all sides to the dispute. Prefers and will use scientific and technical data to document its position. Will be somewhat demanding in bargaining situations and will not be very open to compromise.

for ***CMP***

Role Intensity: Extreme Guardian-Broker

Will actively promote its own economic interests and the interests of its substantial constituency, which it is obligated to protect. Thus, it will strongly resist proposed changes in the ways in which resources have been used and managed in the past, especially when these changes threaten those interests. Strongly believes in a world view that promotes "economic progress" over "environmental values" and will actively crusade to have those values protected in the decision outcome. Will seek to put together a political coalition on behalf of those values and cooperate in efforts to keep or push the conflict into the distributive arena. Is likely to have a close relationship with the potential broker, and will use economic and political data to influence the outcome. Will take absolute positions in bargaining situations, but will be willing to compromise, at least where some of its economic interests and those of its constituency are protected.

NEEDS ASSESSMENT

NEEDS ASSESSMENT FOR CENTRAL MAINE POWER

CMP is a powerful player in this negotiation setting. They are experienced at dealing with the issues at hand and have strong popular and political support. They have traditionally controlled the resource with little intervention from other interests and are very comfortable in that role. CMP prefers a negotiated solution, since they have less power and experience in more formal processes. Change makes CMP uneasy. They are not adept at analyzing objective scientific information supporting uses other than their own. Environmental interests can help CMP change by analyzing technical information to see how economic interests can be addressed when other demands are made on the resource. Flexibility has not been developed by CMP. They need to learn how to investigate alternatives for managing the resources other than those traditionally used.

NEEDS ASSESSMENTS FOR THE HOMEOWNERS ASSOCIATION

The Homeowners Association on its own does not have much power. They lack the statutory authority or the physical control over the resources to have much influence. Also, with few experts and little information their negotiating power is modest, at best. Affiliating with a strong political backer could help the Homeowners to have more influence. This might also increase the amount of objective information that the Homeowners Association possesses.

NEEDS ASSESSMENT FOR MAINE DEPARTMENT OF INLAND FISHERIES

The MDIF is an influential player in these negotiations. They have a strong power base supported by statutory authority, political skills and experience, and possession of objective information and the expertise to use it. Because their statutory authority is a cornerstone of the MDIF's participation in these negotiations, they prefer a formal, arbitrated process. They have considerably less leverage to influence a brokered agreement. The MDIF's major weakness is economic analyses. They are unlikely to understand how their demands will affect the economic viability of CMP's operations. CMP and MDIF will most likely have a difficult time understanding each other's proposals and how their concerns will be affected.

NEEDS ASSESSMENT FOR THE U. S. FISH AND WILDLIFE SERVICE--ENHANCEMENT

The FWS strongly desires a formal decision-making forum but is willing to negotiate. It is comfortable with a decision in which everyone receives some benefits. It is definitely interested in scientific information--probably about fish and wildlife to the exclusion of other facts. It is going to react to the initiatives of others and strongly favors changing decision-making toward preservation of nature. The FWS is not likely to have skill in analyzing economic data and is skeptical of economic development. The FWS has very low levels of control in this dispute, but it does enjoy modest level and broad base of public support. It is weak in personnel and funding but has experience and an intense interest in this dispute. The goals of the current administration do not run counter to the FWS's mission. The FWS has fairly clear information and knowledge of collection and dissemination techniques. It is familiar with using technical information and, more importantly, it is respected as an information provider. Those who support the FWS are popular with the public and fairly well organized. The FWS will need information on economics that can be expressed in terms it understands. The organization needs to sense fairness in the negotiations and requires funding support to carry out its's mission.

Review Questions for Lab 1
LIAM Analysis

1. What are the differences between physical and statutory control of the resource? Who has statutory control and who has physical control in the Wyman Dam case?

Maine Department of Inland Fisheries has statutory control of the fishery. The state has the legal authority to regulate its water resources, and MDIF has the authority of preserving and enhancing the fisheries. The FWS has similar interests but their only authority is to consult in this process.

Central Maine Power has physical control of the resource. They own and operate the dam. CMP alone has the physical control over how much water is released to the river below the dam.

The Homeowners Association has no physical or statutory control over the water, their power must come from another source.

2. Which organizations prefer a brokered or bargained agreement? Which organizations prefer a formal, arbitrated agreement? How does this preference relate to each organizations power base?

CMP prefers a brokered agreement. They have physical control of the resource, they own and operate the dam. This power gives them a strong negotiating position, they have room to make some concessions while still maintaining control of their own operations.

MDIF has statutory control of one element of the resource. This means that they have more power in a formal, arbitration arena than in a brokered negotiation. FWS also prefers a formal process, but they have less power over the resource than the MDIF.

3. Which organizations are guardians, which are advocates?

Central Maine Power and the Homeowners are guardians. They are happy with how decisions have been made in the past, and would like to maintain the status quo.

Maine Department of Inland Fisheries and the Fish and Wildlife Service are advocates. They represent environmental interests and are seeking to change how the dam has been traditionally operated.

4. How might the broker-arbitrator, advocate-guardian positions change over time?

Advocate-guardian positions are very unlikely to change. These positions represent the essential interests of each organization. Broker-arbitrator positions are much more likely to change over time. Organizations may be persuaded, or pushed into a different negotiating arena and may learn different ways of pursuing their interests.

5. Can you identify any likely allies from the role map?

Not too surprisingly, the FWS and MDIF appear to be potential allies in this negotiation. They are both in the Advocate/Arbitrator quadrant, they are quite close together on the Arbitrator scale, and they are close enough to share similar values as measured on the Advocate scale.

LAB 2

IF 201
REVIEW QUESTIONS-LAB 2

1. Compare the habitat duration statistics for the existing condition with those from the New England Base Flow alternative. Notice that there is no change in the amount of habitat occurring at the low habitat events (those with high exceedence probabilities). Why is the NEBF apparently ineffective in alleviating the frequent occurrence of low habitat in the Kennebec River?

1. The flow versus habitat functions show the largest amount of habitat at relatively low flows and the smallest amount at the high flows. Since the NEBF alternative only raises the base flow and does nothing about the peak flows, the lowest habitat events occurring under this alternative will be exactly the same as under the existing condition. The highest habitat events (i.e., those with the lowest exceedence probabilities) occurred at the base flow of 490 cfs under the existing condition. By elevating the base flow to 1310 under the NEBF alternative, the magnitude of the large habitat events was increased whenever this change occurred in the flow time series. This affects only the highest habitat events, not the low habitat events that are the focus of our evaluation.

2. Compare the habitat duration statistics for the existing condition with those from the Steady Release alternative. Why does this alternative result in an improvement in the low habitat events? What does the slope of the habitat duration curve tell you about the variability of the habitat over time?

This alternative is effective for the same reason that the NEBF was ineffective. In order to maintain a steady release, it is necessary to raise the base flow and lower the peaks. By reducing the peaks, there is an increase in magnitude of the low habitat events. It is interesting to note that in most, if not all of the seasons, there is also a reduction in the highest habitat events. This is because the low flows under a steady flow alternative are higher than the "optimum" flow from the Q vs. WUA curve. What this means is that you could <u>never</u> have a steady "optimum" flow under the operational constraints we have given you.

The habitat duration curves for the Steady Release alternative all tend to be much flatter than for the baseline or any of the alternatives. This means that the same amount of habitat is available more of the time; there is less variability in the amount of habitat. Since we have flattened out the hydrograph under this scenario, this result should make sense.

3) For the water year type assigned your group, what is the net effect of each alternative in percent increase or decrease of habitat? Which index or indices did you base your decision on for each season and why? Consider only the rainbow trout life stages which you were able to complete.

NORMAL YEAR): *The statistics and graphs were only generated for adults and fry.*

AUTUMN- *Adults only are considered during this season; fry are not present. Steady Release was chosen based on INDEX C. INDEX C indicates the lowest habitat events (between the median and 100% exceedance) of a given flow regime and thus probably represents the "bottleneck" that limits a population. The percent change in this index is a positive 43.9% under Steady Release versus a negative 22.1% for Enhanced Peaking. The NEBF alternative is virtually the same as the existing condition. Since NEBF affects only the minimum flow which will be released, one can conclude that it is the peaks, or highest flows, which are hammering the habitat. The Steady Release flow scenario is clearly the superior flow regime to reduce low habitat events.*

WINTER- *Adults only are considered during this season; fry are not present. Steady Release was chosen based on INDEX C. INDEX C indicates the lowest habitat events (between the median and 100% exceedance) of a given flow regime and thus probably represents the "bottleneck" that limits a population. The percent change in this index is a positive 59% under Steady Release versus a negative 17.1% for Enhanced Peaking. The NEBF alternative is virtually the same as the existing condition. Since NEBF affects only the minimum flow which will be released, one can conclude that it is the peaks, or highest flows, which are hammering the habitat. The Steady Release flow scenario is clearly the superior flow regime to reduce low habitat events.*

SPRING- *Both adults and fry must be considered during this season. The Steady Release is once again chosen but the decision making process is a bit more complicated. INDEX C shows a substantial improvement in reducing low habitat events for both life stages employing Steady Release versus Enhanced Peaking. More than INDEX C should be considered when evaluating the best alternative for fry however. We suggest also examining the Minimum. The range of environmental conditions fry can tolerate is much narrower than adults as evidenced by the small amount of available fry habitat relative to adult habitat. If the minimum is reduced, the fry that would have been present there will not simply hang on until suitable conditions exist, they will likely die. By the same token, if the minimum is increased (as it is with a Steady Release) the reach will be able to support that many more fry. Also consider the effect that peaking operations have on fry. Unlike adults, fry are almost totally at the mercy of the current. The stability of their habitat conditions is extremely important to their survival. Even if the minimum amount of available habitat remains unchanged or is improved, the fact that this suitable habitat does not remain in one place (and it probably will not under peaking operations) becomes crucial.*

This is why the Maximum is not terribly important. A high maximum value, and it is high under both the Present Conditions and Enhanced Peaking, tells you nothing about the duration of those conditions. The Habitat Time Series plot illustrates the folly in relying on the Maximum statistic.
<u>SUMMER-</u> Same answer as SPRING.

Answer (DRY YEAR): The statistics and graphs were only generated for adults and fry.

<u>AUTUMN-</u> Adults only are considered during this season; fry are not present. Steady Release was chosen based on INDEX C. INDEX C indicates the lowest habitat events (between the median and 100% exceedance) of a given flow regime and thus probably represents the "bottleneck" that limits a population. The percent change in this index is a positive 29.7% under Steady Release versus a negative 18.9% for Enhanced Peaking. The NEBF alternative is virtually the same as the existing condition. Since NEBF affects only the minimum flow which will be released, one can conclude that it is the peaks, or highest flows, which are hammering the habitat. The Steady Release flow scenario is clearly the superior flow regime to reduce low habitat events.

<u>WINTER-</u> Adults only are considered during this season; fry are not present. Steady Release was chosen based on INDEX C. INDEX C indicates the lowest habitat events (between the median and 100% exceedance) of a given flow regime and thus probably represents the "bottleneck" that limits a population. The percent change in this index is a positive 22.6% under Steady Release versus a negative 18% for Enhanced Peaking. The NEBF alternative is virtually the same as the existing condition. Since NEBF affects only the minimum flow which will be released, one can conclude that it is the peaks, or highest flows, which are hammering the habitat. The Steady Release flow scenario is clearly the superior flow regime to reduce low habitat events.

<u>SPRING-</u> Adults and fry must be considered during this season. The Steady Release is once again chosen but the decision making process is a bit more complicated. INDEX C shows a substantial improvement in reducing low habitat events for both life stages employing Steady Release versus Enhanced Peaking. More than INDEX C should be considered when evaluating the best alternative for fry however. We suggest also examining the Minimum. The range of environmental conditions fry can tolerate is much narrower than adults as evidenced by the small amount of available fry habitat relative to adult habitat. If the minimum is reduced, the fry that would have been present there will not simply hang on until suitable conditions exist, they will likely die. By the same token, if the minimum is increased (as it is with a Steady Release) the reach will be able to support that many more fry. Also consider the effect that peaking operations have on fry. Unlike adults, fry are almost totally at the mercy of the current. The stability of their habitat conditions is extremely important to their survival. Even if the minimum amount of available habitat remains unchanged or is improved, the fact that this suitable habitat does not remain in one place (and it probably will not under peaking operations) becomes crucial.

This is why the Maximum is not terribly important. A high maximum value, and it is high under both the Present Conditions and Enhanced Peaking, tells you nothing about the duration of those conditions. The Habitat Time Series plot illustrates the folly in relying on the Maximum statistic.

<u>SUMMER-</u> See discussion for question 4.

Answer (WET YEAR): The statistics and graphs were only generated for adults and fry.

<u>AUTUMN-</u> Adults only are considered during this season; fry are not present. Steady Release was chosen based on INDEX C. INDEX C indicates the lowest habitat events (between the median and 100% exceedance) of a given flow regime and thus probably represents the "bottleneck" that limits a population. The percent change in this index is a positive 43.5% under Steady Release versus a negative 16.4% for Enhanced Peaking. The NEBF alternative is virtually the same as the existing condition. Since NEBF affects only the minimum flow which will be released, one can conclude that it is the peaks, or highest flows, which are hammering the habitat. The Steady Release flow scenario is clearly the superior flow regime to reduce low habitat events.

<u>WINTER-</u> Adults only are considered during this season; fry are not present. Steady Release was chosen based on INDEX C. INDEX C indicates the lowest habitat events (between the median and 100% exceedance) of a given flow regime and thus probably represents the "bottleneck" that limits a population. The percent change in this index is a positive 12.2% under Steady Release versus a negative 3% for Enhanced Peaking. The NEBF alternative is virtually the same as the existing condition. Since NEBF affects only the minimum flow which will be released, one can conclude that it is the peaks, or highest flows, which are hammering the habitat. The Steady Release flow scenario is clearly the superior flow regime to reduce low habitat events.

<u>SPRING-</u> Both adults and fry must be considered during this season. Of all the water year types and seasons a wet spring is the time when the Enhanced Peaking alternative has the least affect on the available habitat for both life stages. In fact, INDEX C indicates that both the Enhanced Peaking and Steady Release alternatives slightly reduce low habitat events with Enhanced Peaking coming out the slight favorite. Basically if one looks only at INDEX C, the high flows which normally occur in a wet spring on the Kennebec River make this situation a toss-up. There is so much water that there is no place to put it. The reservoir fills and spills under the Existing Condition and employing Steady Release. The Enhanced Peaking alternative allows a maximum release of 9000 cfs. In many instances the peaking flows are less than the high flows which occur under the other scenarios. Once again, you should look and think further than INDEX C exclusively. We suggest also examining the Minimum. The Minimum is higher for both adults and fry using the Steady Release scenario. Also consider the effect that peaking operations have on fry. Unlike adults, fry are almost totally at the mercy of the current. The stability of their habitat conditions is extremely important to their survival. Even if the minimum amount of available habitat remains unchanged or is improved, the fact that this suitable

habitat does not remain in one place (and it probably will not under peaking operations) becomes crucial. With this in mind, and relying on INDEX C and the Minimum statistic, the Steady Release alternative gets the nod.

<u>SUMMER-</u> Adults and fry must be considered during this season. The Steady Release is once again chosen. INDEX C shows a substantial improvement in reducing low habitat events for both life stages employing Steady Release versus Enhanced Peaking. Again, more than INDEX C should be considered when evaluating the best alternative (especially for fry) and again we suggest examining the Minimum. The range of environmental conditions fry can tolerate is much narrower than adults as evidenced by the small amount of available fry habitat relative to adult habitat. If the minimum is reduced, the fry that would have been present there will not simply hang on until suitable conditions exist, they will likely die. By the same token, if the minimum is increased (as it is with a Steady Release) the reach will be able to support that many more fry. To repeat some of what was stated above, also consider the effect that peaking operations have on fry. Unlike adults, fry are almost totally at the mercy of the current. The stability of their habitat conditions is extremely important to their survival. Even if the minimum amount of available habitat remains unchanged or is improved, the fact that this suitable habitat does not remain in one place (and it probably will not under peaking operations) becomes crucial. This is why the Maximum is not terribly important. A high maximum value, and it is high under both the Present Conditions and Enhanced Peaking, tells you nothing about the duration of those conditions. The Habitat Time Series plot illustrates the folly in relying on the Maximum statistic.

4. Index-C shows a 52% increase in fry habitat under the enhanced peaking scenario during a dry summer, compared to the existing condition. Examine figure 2.1 and describe why Index-C (as defined in this analysis) is not the appropriate habitat index for comparison in this case. Discuss why Index-C may or may not ever be a valid habitat index to use to evaluate fry habitat.

Adults and fry must be considered during this season. As expected, the steady release alternative provides the greatest improvement in habitat for both adults and fry. The most interesting story, however, is that the comparative statistics for fry show an increase of about 52% (INDEX C) under the enhanced peaking regime. How could this happen? Peaking is supposed to be death on wheels for little fish. Look at the habitat duration curve for this alternative (figure 2.1). The habitat duration curve for the enhanced peaking alternative is characteristic of a bi-modal habitat distribution. Either you have a lot of it or you have very little. Indices A and C both assume that the habitat "trough" starts at the median; the median is the top end of the averaging interval. Clearly, for this duration curve the habitat "trough" starts around the 60% exceedance level. Therefore, both Index-A and Index-C are including events that are not of supreme importance to the fry. Either the Minimum should be used as the indicator statistic, or the averaging interval changed for Indexes A and C. This is why it's always a good idea to look over the graphic output and not rely solely on the tabulated statistics!

Should Index-C ever be used as a habitat index for fry? That depends on how well the index captures the "bottleneck" phenomenon for fry. If habitat reductions are relatively smooth and occur over an extended length of time (i.e., there are no catastrophic reductions that are obvious in the time series), Index-C is probably an appropriate way to look at the problem. Under a hydropeaking scenario, however, the habitat reductions and their consequences are immediate and Index-C may not be the best to use. Please note that in many streams in the midwest you can have the same type of phenomenon related to thunderstorms, but on a basis of daily rather than hourly flow fluctuations.

LAB 3

IF 201
LAB 3

DISCUSSION OF REVIEW QUESTIONS

1. Refer to page 2 of the HABEF output. What is "used" usable area? How and why is it different from "weighted" usable area?

   "Used" usable area simply means that at both of the two flows compared, the composite suitability was greater than zero (i.e., a CSI of 0.01 would still be considered "usable"). The "weighted" usable area is calculated on the smallest CSI value calculated for the cell at either the high or low flow in the comparison.

2. Note the cells in the effective habitat table where the generation flows are the same as the base flows. Why is the effective habitat always less when the generation and base flow are not the same?

   If you missed this one, you may have missed the whole concept of effective habitat. Effective habitat will always be equal to or less than the weighted usable area for a steady flow (i.e., generation and base flow are the same) because we have thrown in an additional criterion: the quality of each cell must remain constant over a range of flows. This is a pretty stiff rule to meet. Since HABEF takes the minimum value for CSI at either of the compared flows as the CSI for the cell, the only way you could change the flow and not reduce the CSI is if the CSI were the same at both flows. Sometimes this happens, but usually not for organisms with very narrow habitat tolerances and usually not over the range of flows we are considering in this example.

3. Earlier, we assumed that whatever constituted good conditions for spawning also provided good conditions for incubation. What would we have had to do to use different criteria for incubation? How might the incubation criteria for brook trout differ from incubation criteria for rainbow trout?

   (a) In order to use separate criteria for spawning and incubation, we would need to input a set of incubation criteria into our FISHFIL, run HABTAE twice (once with spawning criteria and once with incubation criteria) and then have two distinct ZHCF files as input to HABEF. Sounds worse than it really is.

   (b) Aside from possible differences in the locations that brook trout might spawn, as opposed to rainbow trout, and aside from differences in incubation success for the two species, the big difference (especially in Maine) is when they spawn. Brook trout are fall spawners with an incubation period that extends over the winter. If the river is subject to freezing, you should consider building criteria for brook trout incubation that will accomodate surface ice formation. Whereas you might get by just keeping rainbow trout eggs wet, you may need a minimum depth

of two feet or so to prevent the brook trout eggs from turning into caviar popsicles.

4. Why do the flows vary under the "steady flow" scenario?

Because of the way Wyman Lake has been operated historically, there is essentially no storage available in the reservoir. Even if the power company wanted to release a steady flow, what they're capable of doing is matching outflow to inflow on a daily basis. Since the inflow varies over time, the outflow has to vary.

5. The habitat time series analysis conducted in Lab 2 indicated that the New England Base Flow method was an ineffective alternative for providing additional habitat compared to the existing condition. Would you draw the same conclusion with regard to reproduction and early life history stages of rainbow trout and brook trout? What phenomenon is going on here? Which of the alternatives will potentially provide the greatest benefit in terms of year class strength?

The NEBF looks a little better from the perspective of HABEF because by raising the base flow, we have narrowed the window of total flow fluctuations. The amount of effective habitat for eggs and fry is still low under the NEBF alternative, but you could not conclude that it was totally ineffective, either. Obviously, the more you can reduce the range of flows, the more effective habitat you're going to have.

LAB 6

IF 201
LAB 6

SPECS EVALUATION REPORT FOR WYMAN PROJECT
SAMPLING OF THE HYDROLOGIC RECORD
REF: SPECS STEP 28

1. At page 9 of the Final Report, the statement is made that "Flow records at Wyman Dam over the past 20 years were examined to select years and seasons that could be characterized as representing 'wet','dry', and 'average' streamflow conditions." Turn to the first set of hourly flow data in the appendix of the report (noted as page 136). Notice that the investigators defined wet, dry, and average years instead of wet, dry and average seasons or months in their selection process. This is evident because all the "average" samples are recorded for water year 1974. All the "dry" samples are recorded for 1980 and all the "wet" samples come from water year 1977.

A. What are the exceedence probabilities of the mean annual discharges for the wet, dry, and average years? Are these realistic probabilities for the type of water year being depicted?

Water Year Type	Year	Exceedence
Dry	1980	.95
Average	1974	.045
Wet	1977	.45

Defining the median as a close approximation of an "average" year, it would appear that 1985 was about as average as they get. The year 1977 was sampled as a "wet" year in the report, but this year had an exceedence probability of about 45%...also fairly average. The year 1974 was used as an average year but it was the wettest year in the period of record. What is likely is that the authors of the report got 1974 and 1977 mixed up. The year 1980 was chosen to represent the "dry" year scenario. It was a dry year all right. In fact, it was the driest year they've had since 1940. Using the exceedence probabilities of 5% and 95%, as done in this study, means that you would be implementing your dry year or wet year contingency plans once every twenty years on the average. (See the relation between exceedence probability and recurrence interval?) It is very likely that you'd want some sort of hedging plan for years that were a little drier than normal for sure, and maybe for years that were a little wetter than normal. On this basis, we might recommend exceedence probabilities around 20% and 80% to define wet and dry years, respectively. We could then add a definition of extremely wet or extremely dry years at the 5-10% and 90-95% exceedence levels. We would certainly not want to build any kind of a contingency plan around 1980. Based on the period 1940-1986, we would only expect this kind of flow condition once every 47 years.

B. November, 1980 was used to depict a dry fall water supply. What was the exceedence probability for the mean monthly discharge for November, 1980? Would you consider this exceedence probability to be a good representation of a dry November? What year or years would you recommend instead of 1980 to represent a dry November?

.45 November, 1980 exceedence probability

1983 (.82) Recommended year (first choice)

1984 (.77) Recommended year (second choice)

C. July, 1974 represented an average summer condition in this study. What was the exceedence probability of the average monthly flows that occurred in July, 1974? Is this an adequate descriptor of the water supply during a normal summer? What year or years would you have recommended instead of 1974 to represent a normal summer?

.27 July, 1974 exceedence probability

1978 (.5) Recommended year (first choice)

1975 (.45) Recommended year (second choice)
or
1971 (.41) kind of a toss-up

D. How would the method used to define wet, dry, and average conditions in this study conflict with the implementation of new operating rules (such as those developed in Lab 5) developed for the project?

Dry, wet, and average conditions in this study were based on water year analyses, which are normally ok for snowmelt driven hydrologic systems like the Kennebec. The Kennebec, however, has so little storage flexibility that the operators of Wyman Dam probably have a planning horizon more like a week instead of a year. It is important to build in contingency plans for water shortages (especially) or water surpluses. These contingency plans need to be consistent with the forecasting horizon of the operator, so that the plan can be implemented as soon as a deviation from normalcy is detected. Where there is little operating flexibility, it is better to have lots of contingency plans. In this case, the contingency plan for the dry scenario is essentially worthless because it is so far removed from the normal condition. By triggering the contingency plan only under such extreme conditions, the operating rules for the normal condition will fail more often. Each time there is a failure with no backup plan, operators tend to make up their own rules to fit the situation, often on a day to day basis. This is equivalent to having no plan at all.

2. SPECS step 56 asks whether the WUA vs Q function "looks right" for the organism under investigation. Curve A (square symbols) in figure 6.1 was derived for adult rainbow trout in the Kennebec River, using Habitat Suitability Criteria (HSC) from the FWS' "Blue Book." Examine the WUA vs Q response functions on SPECS pages 33-36. Which TYPE of response function does Curve A in figure 6.1 most resemble? Does the description of the organism associated with that TYPE fit adult rainbow trout?

__TYPE A__ Functional response type

__________ Fits adult rainbow trout

__X__ Doesn't fit rainbow trout

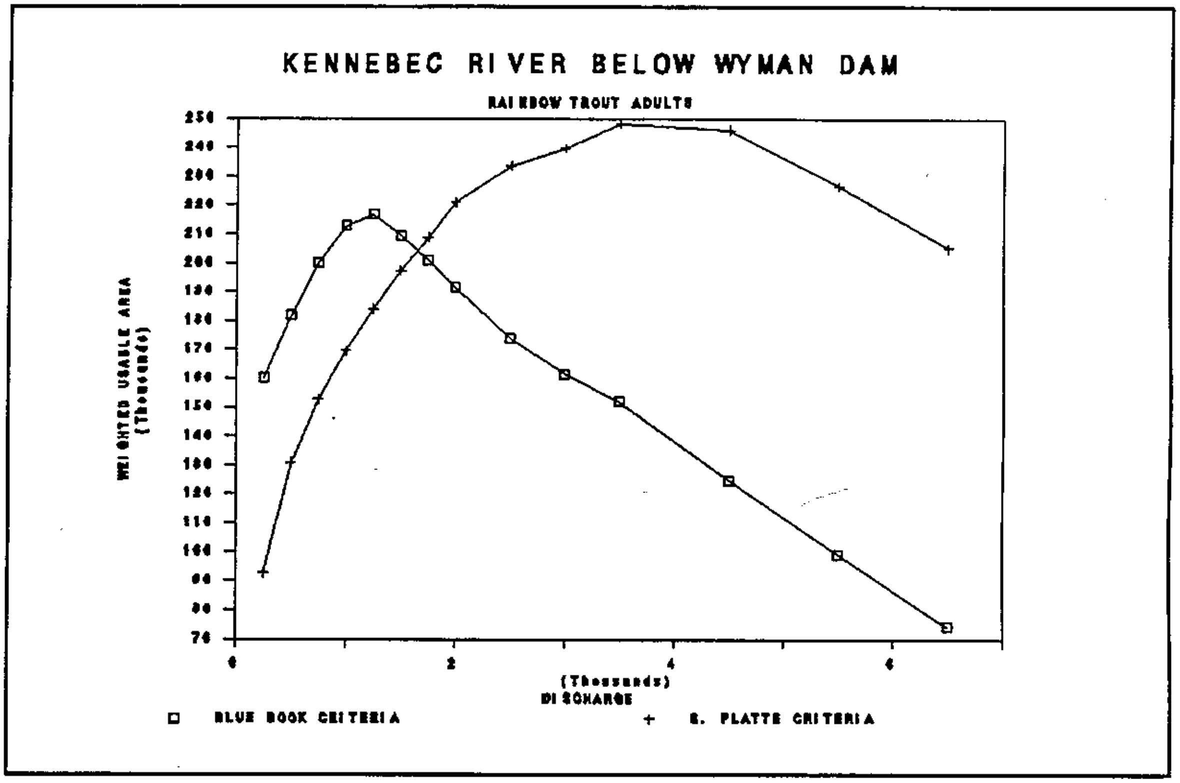


Figure 6.1. Curve A: WUA vs Q response function for adult rainbow trout, Kennebec River, Maine, based on HSC from FWS Blue Book. Curve B: WUA vs Q response function using adult rainbow trout HSC from South Platte River, Colorado.

3. Which TYPE of response function does Curve B (HSC from South Platte River, Colorado) in figure 6.1 most resemble? Does the description of the organism associated with that TYPE fit adult rainbow trout?

__TYPE D__ Functional response type

____X____ Fits adult rainbow trout

__________ Doesn't fit rainbow trout

4. How would the use of Curve B (South Platte criteria for adult rainbow trout) have changed your evaluation of the NEBF alternative? How would it have affected the formulation of your Team's alternative in Lab 5?

Using Curve A, the NEBF appeared to be ineffective because the habitat limitation was created at the high flow end of the curve. Increasing the base flow had no effect because the amount of habitat at the high flows was always much lower than the amount at the low flows. If the South Platte HSC had been used, the conclusions about the effectiveness of the NEBF would have been <u>exactly reversed</u>. Notice that in Curve B, the habitat amounts associated with flows less than 2000 cfs are all lower than the habitat amounts at the highest flows. Using Curve B, the amount of WUA at 1300 cfs is approximately double the amount at 490 cfs. Therefore, we should have concluded that the NEBF would be a very effective alternative.

Chances are, when you were developing your alternatives, you concentrated on methods of flattening out the hydrograph. More specifically, you probably went after the high flows and tried to reduce them to 3000 cfs or so. These are the flows that CMP makes its money on, so you probably met a lot of resistance from the CMP representative. In your evaluation of the cost effectiveness of your proposal, whatever you did probably ended up costing the company a lot of money. If Curve B had been used instead, you could have developed an effective alternative that had little or no effect on the peaking operation of the project, except for peaking lost to accomodate increased base flows or to provide steady flows during certain periods of the year. By raising the base flow to 2000 cfs and leaving the generation flow alone, it appears that the amount of WUA would have approximately tripled, compared to the baseline. The loss in revenues to CMP would have been much smaller, depending on how much this base flow reduced their peaking capability.

4. Review the minutes of the interagency meetings in the case study. How was the issue of the accuracy and reliability of HSC resolved prior to the formulation and evaluation of alternatives? What could the participants to the negotiation have done to ensure the reliability of the HSC?

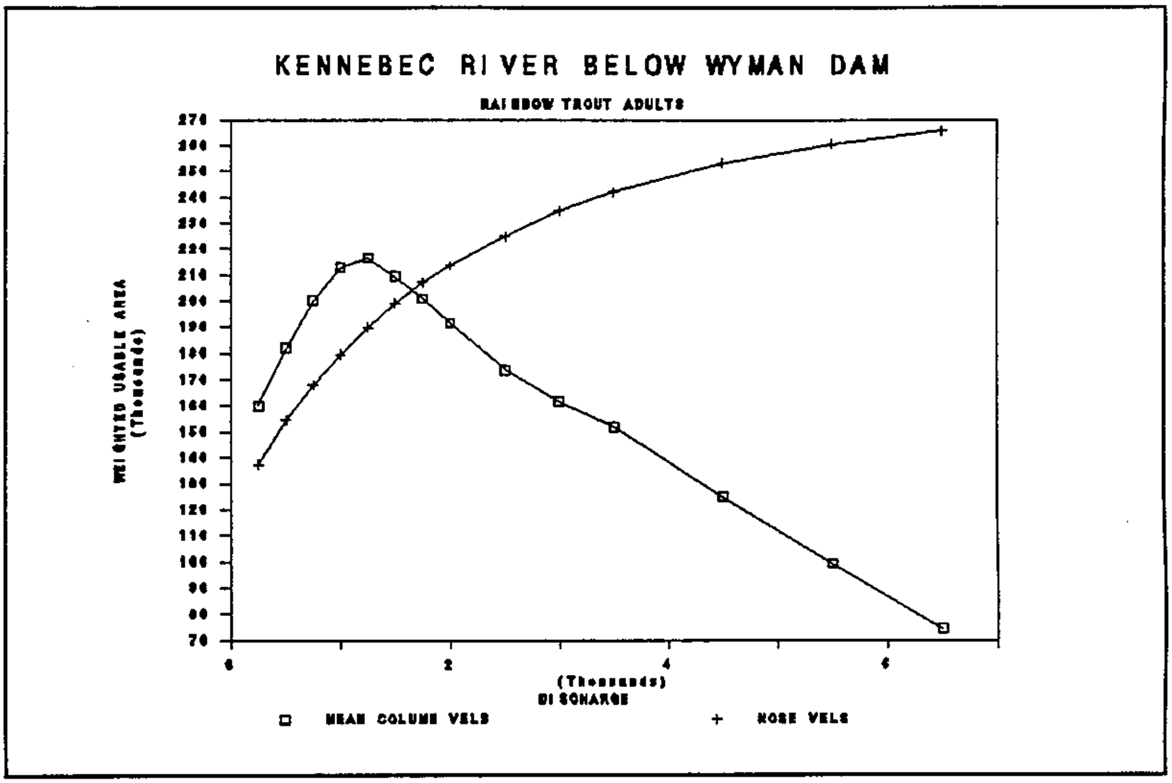
The minutes of the interagency meetings indicate that the participants actually had two sets of HSC to choose from. The Blue Book HSC we know about because they resulted in Curve A. The second set was from Bovee (1978). These criteria were similar to those derived from the South Platte and would have resulted in a WUA vs. Q response function more like Curve B. Both sets of criteria were sent out to all the participants for their review, and both sets were run through PHABSIM *by the consultant. We do not know how much the consultant influenced the choice of HSC, but we do know that at least three agency representatives (Russell, DeSandre, and Andrews) had reservations about the output using the Blue Book criteria. They came very close to solving the problem when DeSandre asked for an explanation of the sharp decline in adult habitat as flows increase (page 2 of second meeting). The reason this sharp decline occurs is because the Blue Book criteria show a preference for zero velocity by adult rainbow trout. Anyone who has spent any time at all observing adult rainbow trout in a river will know that this is patently untrue. Rainbow trout are drift feeders and they rely on the current to deliver food to them. Apparently, DeSandre's question was not answered, answered incorrectly, or the ramifications of the answer not fully comprehended by the participants.*

At the time this study was conducted, there was no scientific procedure available to test the validity of HSC in a "destination stream." Such a procedure now exists and is being refined to make it easier to apply in the field. The most obvious solution for avoiding the problem of using inaccurate HSC in a study is to test them in the stream where they are to be applied. Even in the absence of the test procedure, the FWS and MDIF representatives apparently suspected that something was wrong with Curve A. For some reason, these concerns were not adequately resolved before plunging ahead into the formulation of alternatives.

An interesting factoid about this study is that utilities often <u>favor</u> the use of CURVE A under the paradigm that the only issue is the base flow. Clearly, if that were the only issue in the Wyman Case, Curve A would favor a lower base flow recommendation than Curve B. The minutes of the first interagency meeting, however, make it very clear that base flow was <u>not</u> the only issue the agencies were concerned about. It is not clear whether the Blue Book criteria were vigorously challenged or what rationale was used in choosing them. [It may simply be due to the fact that the Bovee criteria were published in 1978 and the Blue Book criteria were "newer."] In our opinion, the adequacy of the Blue Book criteria provides sufficient reasonable doubt to question the validity of the entire study and any recommendations or conclusions based thereon. If nothing else, the use of the Blue Book criteria may end up costing CMP a lot more in lost revenues than necessary. Oh what tangled webs we weave!

5. What variables were used in the calculation of WUA for rainbow trout and brook trout in the Wyman study? Are these variables appropriate for a large, deep river like the Kennebec? How could the analysis been modified to apply small river criteria to a large river? How would this modification have affected the results?

Depth, mean column velocity, and substrate were the variables used to calculate WUA. HSC developed in a small stream will often show a higher utilization of shallow depths and lower velocities than HSC from a large stream. The depth criteria are often "corrected" by arbitrarily extending the optimal depth range. In a large stream, however, the lower end of the optimal depth range may be deeper than in a small stream. Mean column velocities from a small stream may approximate the near-bottom velocities in a large stream. Despite these differences, the only criterion we have a problem with is the use of substrate, particularly in adult rainbow trout. Cover would have been a much more logical *choice. In our studies in Colorado, however, we have found that adult rainbow trout are more or less indifferent about substrate or cover if the depths and velocities are suitable. Cover is important as it affects velocities, but can be incorporated into the model better through the strategic placement of transects rather than by assigning an SI value to it. The analysis could have been modified in one of two ways to account for the size difference between the Kennebec and the source streams for the HSC. The first would have been to develop HSC in a large source stream, using mean column velocities, and testing their transferability to the Kennebec. <u>Why might you not want to develop site-specific criteria in the Kennebec?</u> The second choice would be to use the mean velocity criteria to represent nose velocities in the Kennebec. [This option was suggested by Russell, but apparently never followed up.] This is a bit shakier option because of the biological assumption you'd have to make, and also because the prediction of nose velocity is nowhere near as accurate as mean column velocity. Figure 6.2 shows what would have happened if nose velocities had been calculated in the Kennebec rather than mean column velocities. Look familiar?*



Figu
re 6.2. Comparison of WUA vs Q response functions using mean column velocities and nose velocities in the Kennebec River. HSC from FWS Blue Book.

GO TO SPECS STEP 62

6. Examine the map of the study area on page 22 and the description of the habitat types surveyed on page 4 of the Wyman report. Were there enough habitat types established to describe all the habitat types and their proportions in the study area? What habitat types are under-represented, if any, and how could their inclusion in the model have changed the results?

The habitat types surveyed included run/glide, fast riffle, cross-riffle, shallow pool, and deep pool. It is apparent from the map that the study area also includes numerous large islands. Divided channels are distinct habitat types from single channels, and were omitted from this study. Because of differences in bed elevations at the inlet, the flow will be divided disproportionately between the two side channels. This will result in a different response to the total discharge, even though the habitat type in either of the side channels may be structurally similar to the main channel (e.g., may be riffles in both but will not behave the same). Additionally, islands commonly divide the channel into dominant and subordinate side channels. At the downstream end of the island, a <u>variable backwater</u> commonly develops in the subordinate channel over a wide range of flows. These backwater areas are tremendous rearing habitats for young fish. If you look at page 23 of the report, you will see that there was very little WUA calculated for fry and juveniles in the Kennebec River. The response functions for these life stages also peak at flows near zero. This is because fry and juveniles require low velocity areas. If none are measured in the stream, the only way to achieve low velocity areas is to reduce the discharge! Another habitat type that was missed were the mouths of the tributaries entering the Kennebec within the study area. Like subordinate side channels, tributary confluences form extensive variable backwaters (especially at high main channel flows) and serve as important nursery and rearing areas for small fish. The low WUA's for fry and juveniles and the near-zero flow peaks of the response functions are probably attributable to the omission of these habitat types from the model. Such omission may then have created a false impression of the importance of HABEF results. Rapid fluctuations in streamflow may <u>not</u> be all that important to fry or juveniles if they're all hanging out in the backwaters.

GO TO SPECS STEP 64

7. Each habitat type was replicated once, except for the fast riffle and shallow pool. One transect was used to represent each habitat type or replicate. What factors should you consider in evaluating the adequacy of their transect placement? Without conducting a site visit, how could you tell if too few transects were used or if their placement was critical to the model?

Factors you should consider in evaluating the adequacy of transect placement in each site include the number of transects used (obviously), how transects were selected, and the complexity of the habitat type. We (at NERC) use no fewer than two transects per site, for even the simplest of sites. The obvious advantage of using more than one transect per site is that you will incorporate more structural diversity into your model. For example, suppose there are a few randomly distributed boulders and other forms of cover within a site. If the transect crosses immediately downstream from one of the boulders, you'll have a gigantic cell with low velocities in your model. If the transect crosses where *there are no boulders, the model will have no area of low velocities. Additionally, having at least two transects allows you to compare water surface profiles across the range of flows you are going to simulate. This is a great help in calibrating the hydraulics models within PHABSIM and in maintaining quality control in the production run. And you can't do it with just one transect.*

The method used in placing the transect(s) is also an important consideration. We recommend a stratified random or systematic transect placement protocol. With the stratified random approach, the length of stream to be represented by the transect is delineated, usually on the basis of the distribution of cover objects in the channel. The transect is then placed randomly within the stratified length of stream. It's also hard to go wrong if you systematically put in a transect every ten feet, although you'll end up with lots of transects. [voice of experience again]. You cannot systematically place one transect, and even two would be stretching things.

The report indicates that numerous agencies were involved in the selection of transects in this project. That's good. However, representatives from FWS and CMP were not present and although MIDF was present, none of their employees had any training in PHABSIM field techniques at the time of the study. In other words, you had representatives from four different consulting firms deciding where to put transects and one person who had never had any instream flow training in charge of quality control in the field. Mercy! I'll bet that was interesting. If there is any question about the transects used in this study, it should be clear that it was FWS and CMP who really dropped the ball.

It should be obvious that more complex habitat types will require more transects than very simple ones. To illustrate the effects of transect placement and density in complex habitat types, we give you the results from a pocket water habitat type in the Cache la Poudre River in Colorado. We used 20 systematically placed transects in a 200-foot long PHABSIM site. Figure 6.3 shows how variable the WUA vs Q function can be for individual transects in a complex habitat type. As you can see, the WUA-Q functions for individual transects are all over the place.

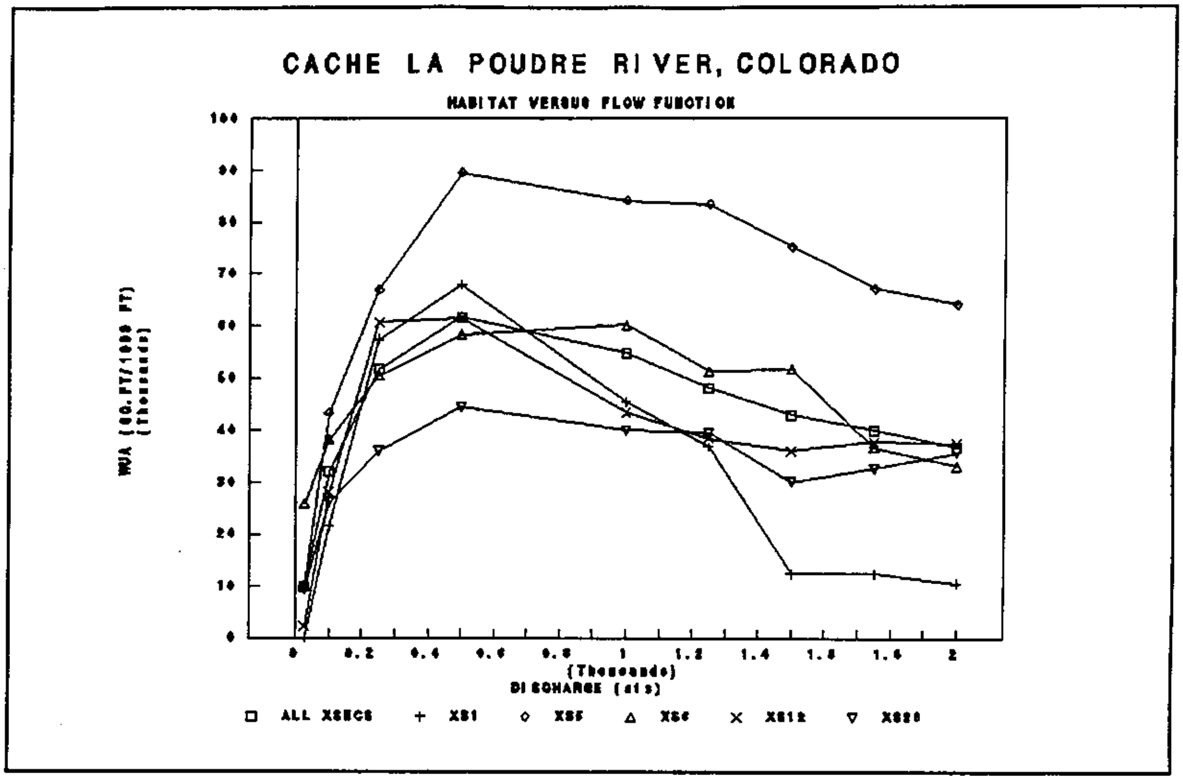


Figure 6.3. WUA vs Q response functions for individual transects in a pocket water habitat type, Cache la Poudre River, Colorado.

Without conducting a site visit, it is difficult to tell whether the transects used were sufficient for the job or placed correctly. It is even more difficult to criticize the transects used in this study, given the conspicuous absence of two of the most important and knowledgeable parties to the problem. Photo examination is probably the next best thing to a site visit, particularly if there are recent aerial photos of the study area. This will at least give you some indication of the complexity of the channel and the representation of the transects. Another technique that may be helpful is a sensitivity analysis. This is done by removing one or more transects from the IFG-4 input file and re-running the program. Theoretically, you should be able to remove 10% of the transects without changing the results, if there were enough transects to begin with. If the results do change, it doesn't necessarily mean that not enough were used, but it does indicate that you're on the borderline. If the results change very much upon removal of a transect, the model is very sensitive to that transect...that being the case, you want to make sure it's where you want it and representing what you want it to.

GO TO SPECS STEP 66

8. Examine the IFG-4 data set starting at page 79. Closely examine the block of data for transect 1 on page 79 (starts at line XSEC 1 and ends at line XSEC 2). Compare this block of data with transect 3 on page 80, transect 6 on page 82, and transect 8 on page 83. Something is missing. What is it? What habitat types are represented by transects 3, 6, and 8? What does the absence of certain data for these transects tell you about the field capabilities of the investigators in this study? How might the absence of these data have affected the outcome of the study?

Notice the line labelled VEL2 in the data block for transect 1. It has a bunch of numbers on it. So does line VEL2 for transects 2, 4, 5, and 7. These are calibration velocities that IFG-4 uses to determine the distribution of velocities across the transect. The VEL2 lines (nor any other VEL lines) for transects 3, 6, and 8 do not have any calibration velocities because they weren't measured. Transect 3 is a "fast riffle" and transects 6 and 8 are in deep pools. It is a safe bet that velocities were not measured on these transects because whoever did the field work lacked the equipment to measure anything over three or four feet deep, or moving at more that four feet per second.

IFG-4 works just fine without having calibration velocities. In fact, it may appear to work better because less measurement error is introduced to the model. Without them, however, the model lacks realism. There may be places in the stream with very high velocities right next to areas of low velocity (great feeding stations for salmonids) and you'd never know it. The lack of calibration velocities in the deep pools might not be too big of a problem if the pools are really deep (and these are) and don't have any huge boulders in them. The fast riffle might not miss them either if there are no large boulders or bedrock outcrops to create small scale variations in velocities. The real problem is that we'll never know. We wonder. If they were not equipped to measure deep or fast water, how reliable are the rest of their measurements? Things that make you go "Hmmm."

9. Figures 6.4 and 6.5 are plots of the Velocity Adjustment Factors (VAF's) for the eight transects used in this study. Examine the VAF plot for transect 7. Now examine the cross sectional profile for transect 7 (figure 6.6). Why is the VAF for this transect different from the rest of them? What implication does this have for the results of the PHABSIM analysis?

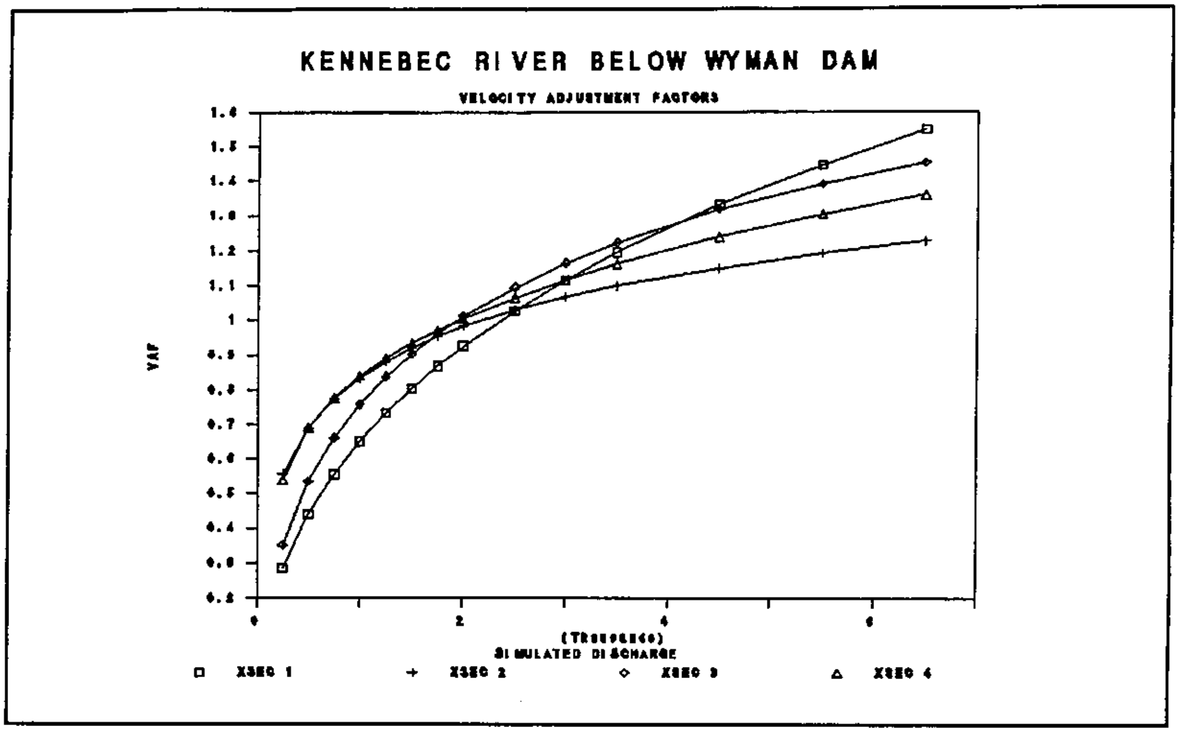


Figure 6.4. Velocity Adjustment Factors for transects 1-4, Kennebec River.

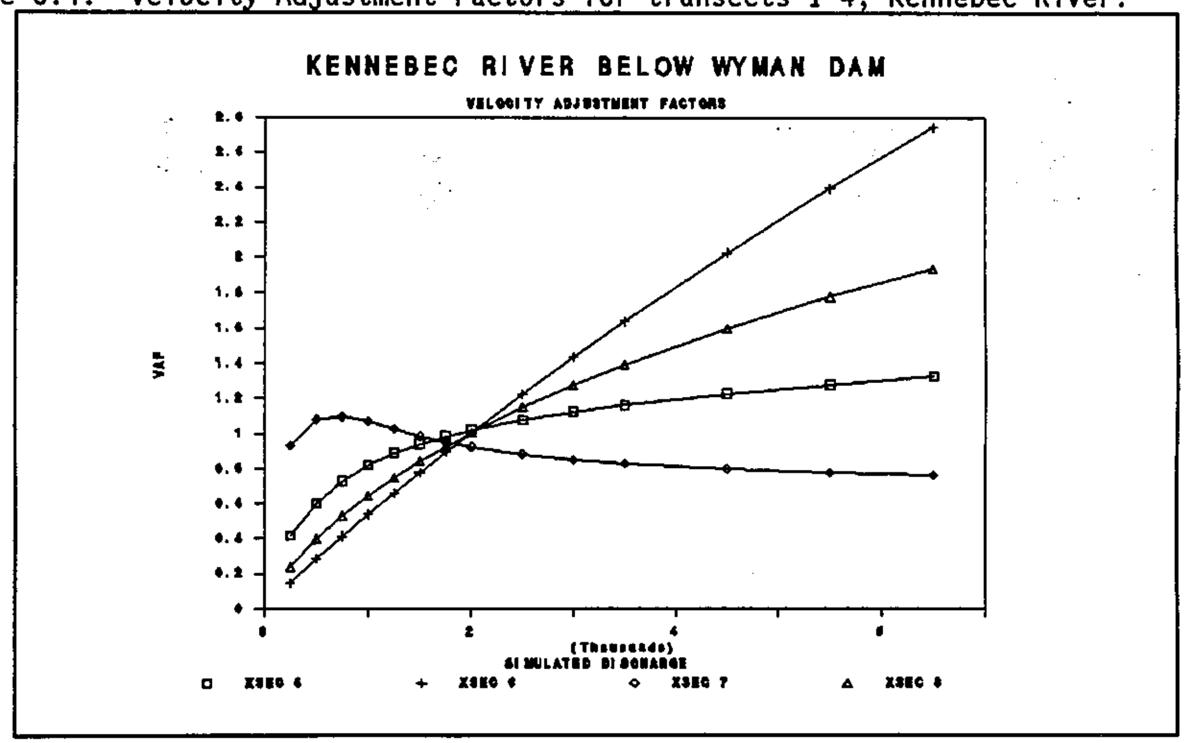


Figure 6.5. Velocity Adjustment Factors for transects 5-8, Kennebec River.

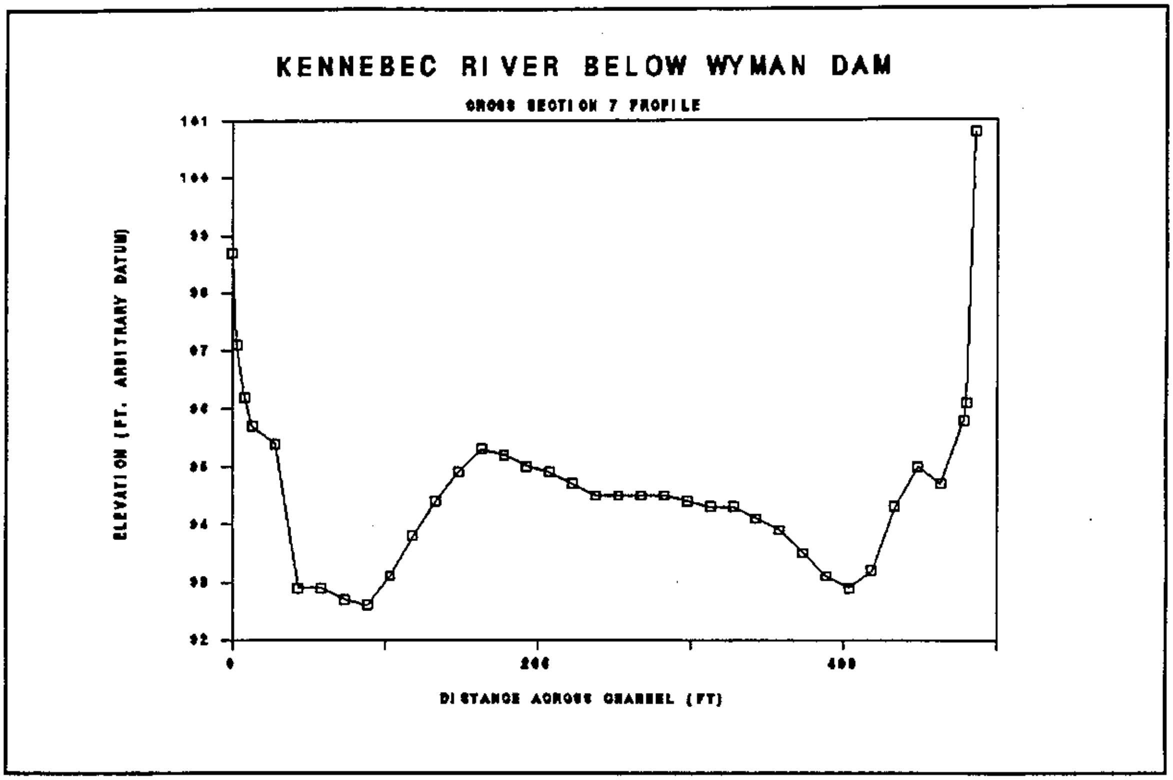


Figure 6.6. Cross sectional profile for transect 7, Kennebec River.

The report states that all hydraulic simulations were performed using IFG-4. There is something clearly wrong with transect 7 as indicated by its VAF plot. About 95% of the time, when you get a VAF response like this one, the water surface elevations predicted at the simulation flows are incorrect. Figure 6.6 shows the cross sectional profile for transect 7. It happens that this is <u>exactly</u> the kind of cross section that IFG4 performs miserably in the prediction of the stage-discharge relationship. Water surface elevations at transect 7 should <u>not</u> have been predicted from IFG4. What this VAF should tell you is that at low flows, the predicted depths will be too shallow and the predicted velocities will be too fast. At the simulated high flows, the depths will be too deep and the velocities too slow. How much of a difference this would make in the final outcome is hard to say. Transect 7 only represents 6.5% of the total study area, however, so the effect is probably going to be rather small. If the same thing had happened at Transect 1 (21.5% of the total) we'd be a little more concerned.

X.
HABNET TUTORIAL

INTRODUCTION TO NETWORK HABITAT ANALYSIS TUTORIAL

OBJECTIVE

TO DEVELOP SKILLS IN THE MANIPULATION OF STREAMFLOW DATA AND THE USE OF THE HABNET PROGRAM TO DEVELOP ALTERNATIVE HABITAT TIME SERIES FOR A SERIAL NETWORK.

INTRODUCTION

Thus far, the analysis of the Wyman Dam project has been confined to an evaluation of the tailwater reach immediately downstream from Wyman Lake. Many instream flow problems have a much broader geographic extent, with multiple downstream segments, multiple reservoirs in a water management network, tributaries containing habitat critical to a mainstem species, and river basins with numerous tributaries, reservoirs, and diversions. All of these types of configurations are termed networks. A <u>serial</u> network is one in which the investigation concentrates on a single (usually mainstem) river that has several longitudinal segments delineated by changes in hydrology, channel structure, or macrohabitat characteristics. A <u>parallel</u> network is one in which the investigation includes the analysis of at least two separate rivers that are hydrologically connected. An example would be an analysis of the habitat in two regulated tributaries and the mainstem below their confluence. A river basin study containing elements of multiple longitudinal segments in multiple hydrologically-connected streams is termed a <u>compound</u> network.

The goal in conducting a network analysis is usually to obtain the same kinds of habitat duration statistics and time series comparisons you generated in Lab 2, but for the entire network rather than for a single reach of one river. Simple networks can be handled in spreadsheets by incorporating separate functional relationships and "look-up" tables of total segment habitat versus discharge for each segment, separate columns for the discharge time series in each segment, and a column to add together the habitat time series for all the segments. As the networks become more complex, however, spreadsheets may become so large that they begin to tax the capacity of desktop computers. Worse, they can become sufficiently complex that the investigator can get lost in the spreadsheet. The TSLIB program, **HABNET**, was designed to calculate habitat time series for network applications. Ultimately, HABNET can be used to generate habitat duration output similar to what you produced in Lab 2 using the HABTS2.WK1 spreadsheet. In addition, HABNET has the capability of integrating microhabitat with temperature data and can generate habitat time series for an entire network of different stream reaches, a dendritic system of mainstem and tributaries, or specific portions of a network.

There are some aspects of HABNET that are a little less convenient than using a spreadsheet. The aspect that will take the most "getting used to" is that HABNET was designed to evaluate water allocation problems associated with reservoir operations and multiple consumptive withdrawals. A monthly time step is commonly used to evaluate this type of problem, so HABNET is expecting hydrologic input in a specified format (USGS format) having exactly twelve time steps (months) per time unit (year). In contrast to the HABTS2.WK1 spreadsheet, where you could use any time step you wanted as long as there were 168 of them, in HABNET you can use any number of time periods you want but each one must have 12 time steps. This format requirement means that in order to apply HABNET to hydropeaking problems, the hourly discharge data must be made to look like monthly data. The easiest way to do this is to use bi-hourly data instead (i.e., 12 bi-hourly discharge values per day).

The reach downstream from a hydropeaking facility will sometimes fit the description of a serial network due to the downstream attenuation of the pulse. This depends on the length of river downstream from the power plant to the next large tributary or reservoir. If this distance is relatively small, the effect of the hydropeaking can be captured in the tailwater reach. If the distance is large (which is a relative term as well), there will be different hydrologic time series for individual segments as you move downstream. Hydrologic data (i.e., pulse attenuation) must be generated external to HABNET, but may be entered as a network input at different locations (nodes) downstream from the project. The physical characteristics of the channel may also change as one moves downstream, resulting in different Q vs. total habitat functions at each location. Changes in streamflow pattern, microhabitat, or both can be integrated quite easily with HABNET.

ASSIGNMENT

Develop habitat duration statistics under the existing condition and the New England Base Flow alternative, normal winter conditions for adult rainbow trout in a serial network.

INSTRUCTIONS

NOTE: BEFORE PROCEEDING WITH THIS TUTORIAL, IT WILL BE NECESSARY TO INSTALL TSLIB ON YOUR COMPUTER. REFER TO INSTRUCTIONS ACCOMPANYING TSLIB FOR CREATING DIRECTORIES, AND MODIFICATIONS TO AUTOEXEC.BAT NECESSARY BEFORE RUNNING TSLIB SOFTWARE.

A. PREPARE HYDROLOGIC DATA FILES FOR HABNET.

1. SIMULATE PULSE ATTENUATION AND PREPARE BI-HOURLY FLOW TIME SERIES FOR INPUT TO HABNET. The first step in the procedure is to determine how the pulse from the hydropeaking project will be attenuated. This phenomenon has been simplified enormously in this lab by assuming that a running mean can be used to smooth the pulse pattern, and that it will be representative of the pulse attenuation. We have established three hydrologic nodes for the network hydrology model: at mile 0, at mile 5, and at mile 10 downstream from the dam. The hourly flows at mile 0 are the same as the release flows from the dam. The hourly flows at mile 5 are calculated as the average of the present hour's and the previous hour's releases at the dam. At mile 10, the hourly flows are averaged over the present hour and the previous two hours. This is crude, but the resulting downstream flow patterns are fairly reasonable.

Once we have calculated the hourly flows at each of the nodes, the next step is to remove every other value from the flow time series. This reduces the data from 24 hourly values to 12 bi-hourly values that we can use in HABNET. A spreadsheet named **A1OU8.wk1** (ATTENUATE. GET IT?) has been developed to perform this task for you.

Initiate Lotus 1-2-3 and retrieve the worksheet A1OU8. Place the cursor at cell A9 and import **BASEQNW** (/ F I N BASEQNW). The attenuated hourly flows will be automatically calculated in columns C and E. By invoking the macro ALT-D, Lotus will copy the values from the hourly flow range (A9..E176) to the range A178..E345 and then delete every other value in the time series. The bi-hourly flow range you are looking for will end up in A178..A261 for mile 0, C178..C261 for mile 5, and E178..E261 for mile 10. Print each of these ranges to a separate file (e.g., mile0.prn, mile5.prn, mile10.prn). Remember to use Options, Other, Unformatted when you print the range to the file.

2. ENTER FLOW TIME SERIES TO USGS FORMATTED INPUT FILE.

The program used to convert your columnar data into USGS format is called **QIN.** Directions for running QIN can be found on page **II.41** in the TSLIB manual. **QIN** was designed to be an interactive program which prompts the user for things like titles (2) describing the stream reach and alternative, station ID, whether or not the data are continuous, and the first time period (year) in the series. In the interactive mode, the user would then patiently enter one flow at a time until finished with all the entries. The other option is to build a "free-formatted" file containing all this information. This makes more sense, since we already have the flows listed in the .PRN files we just built. Using your DOS editor, add five lines of information above the first discharge listed in the .PRN file. The first two lines will be titles, the third line is a station ID (enter **SEG 1** here), enter 1 on the fourth line, and enter **1985** on the fifth line. When you finish, your input file should look something like this:

```
KENNEBEC RIVER, MAINE
SAMPLE DATA SET FOR ENTRY TO QIN
SEG 1
1
1985
         490
         490
         490
        1500
        6330
        6000
        5040
        2100
        3120
        6360
        5140
          .
          .
          .
          .
```

One unhandy aspect of using QIN for hydropeaking is that the program expects to write sequential years on the output file, instead of sequential days. We have tried different ways of putting in dates (e.g., 0212 for February 12) instead of years, but the program bombs every time. Also, QIN assumes that all streamflow data was collected in the twentieth century, so it wigs out if you don't put the date in as 19.. something. Don't worry about the 1985 we just put in; we'll fix it on the output later.

To run **QIN**, type:

RQIN, MILEO.US, MILEO.PRN

All executable programs in TSLIB are run by invoking a batch file. That's what the "R" in RQIN stands for. The syntax for this program places the name of the output file ahead of the input file. Many of the programs under the IFIM umbrella do this, so if you're ever unsure about the syntax, simply type in the batch file name and nothing else. A little cheat sheet will appear on your screen telling you what goes where.

When you type in the execute command above, QIN will respond by asking you whether the format of the output data file is to be in daily (WATSTORE) or monthly (USGS) format. Enter a **2** here, because you want the output to be in monthly (12 time step) format. Next, QIN will ask whether the data are to be entered directly from the keyboard or from a free-formatted file. Enter a **1** here. Quick as a bunny, the job will be done and you should end up with a file that looks like this:

```
KENNEBEC RIVER, MAINE
SAMPLE DATA SET FOR ENTRY TO QIN
Q        SEG 1    1985   1    490    490    490   1500   6330   6000
Q        SEG 1    1985   2   5040   2100   3120   6360   5140   2610
Q        SEG 1    1986   1    490    490    490   1660   6180   6720
Q        SEG 1    1986   2   6220   2010   3170   6270   5480   2410
Q        SEG 1    1987   1    490    490    490   1740   6260   6180
Q        SEG 1    1987   2   6270   4300    390   6090   6090   3010
Q        SEG 1    1988   1    490    490    490   3490   6240   6550
Q        SEG 1    1988   2   6270   2060   2000   7020   6150   2960
Q        SEG 1    1989   1    740    490    490   1650   5700   6440
Q        SEG 1    1989   2   6550   2470   1650   6330   6240   2740
Q        SEG 1    1990   1   1550    490    490    490   4600   6030
Q        SEG 1    1990   2   6670   2630   4170   5580   6550   4500
Q        SEG 1    1991   1   1800    250    490    490   2420   6150
Q        SEG 1    1991   2   5380   4570   4360   5520   6980   4910
```

3. Repeat step 2 for flow time series at mile 5 and mile 10. Nothing too special about this step if you got the last one right. Name your output files MILE5.US and MILE10.US respectively, use the same starting year (1985), and use **SEG 2** and **SEG 3** as the station ID's for the two output files.

4. Return to step 1, import NEQNW into the A10U8.wk1 spreadsheet, and build USGS formatted data files for the New England Base Flow Alternative. Follow the exact procedure outlined above, <u>except</u> be sure to name your output files something other than MILE0.US, MILE5.US, or MILE10.US. Otherwise, QIN will simply write over what you just did. Write down your file names someplace so you don't forget what they are or what's in them.

B. REVIEW THE INSTRUCTIONS FOR HABNET AND FAMILIARIZE YOURSELF WITH THE FORMAT OF INPUT FILES.

Instructions for **HABNET** can be found in the TSLIB manual, starting at page **VII.11**. Format instructions for the three principal input files we will be using can be found at pages **VII.10**, **A.11**, and **A.14**.

1. ASSEMBLE THE HYDROLOGIC DATA INPUT FILE FOR HABNET.

For the existing hydrologic condition, we have constructed three USGS formatted flow files, entitled **MILE0.US**, **MILE5.US**, and **MILE10.US**, as well as three flow files for the NEBF alternative. Copy **MILE0.US** to what will become your "master" hydrologic input file for HABNET:

copy MILE0.US NETQPRE.US

Edit the new file, **NETQPRE.US**, and add one line directly below the first two title lines. This line should say: KENNEBEC RIVER, SEGMENT 1. Now, skip to the bottom of the file and type the line: KENNEBEC RIVER, SEGMENT 2. Just below this line, APPEND the file **MILE5.US**. Delete the two title lines that will appear between KENNEBEC RIVER, SEGMENT 2 and the rest of the streamflow data. Skip to the bottom of the segment 2 hydrologic data, and add the line: KENNEBEC RIVER, SEGMENT 3. Append the file **MILE10.US** below this line, and delete its two title lines. Review the completed master file, making sure that the station ID number for segment 1 is **SEG 1**, the station ID for segment 2 is **SEG 2**, and the station ID for segment 3 is **SEG 3**. When you are finished with this file, it should look like the example on the next page.

KENNEBEC RIVER, MAINE
SAMPLE DATA SET FOR ENTRY TO HABNET
KENNEBEC RIVER

Q	SEG 1	1985	1	490	490	490	1500	6330	6000
Q	SEG 1	1985	2	5040	2100	3120	6360	5140	2610
Q	SEG 1	1986	1	490	490	490	1660	6180	6720
Q	SEG 1	1986	2	6220	2010	3170	6270	5480	2410
Q	SEG 1	1987	1	490	490	490	1740	6260	6180
Q	SEG 1	1987	2	6270	4300	390	6090	6090	3010
Q	SEG 1	1988	1	490	490	490	3490	6240	6550
Q	SEG 1	1988	2	6270	2060	2000	7020	6150	2960
Q	SEG 1	1989	1	740	490	490	1650	5700	6440
Q	SEG 1	1989	2	6550	2470	1650	6330	6240	2740
Q	SEG 1	1990	1	1550	490	490	490	4600	6030
Q	SEG 1	1990	2	6670	2630	4170	5580	6550	4500
Q	SEG 1	1991	1	1800	250	490	490	2420	6150
Q	SEG 1	1991	2	5380	4570	4360	5520	6980	4910

KENNEBEC RIVER, SEGMENT 2

Q	SEG 2	1985	1	1425	490	490	995	5055	6045
Q	SEG 2	1985	2	5565	2805	2610	6360	5750	3705
Q	SEG 2	1986	1	1355	490	490	1075	4980	6915
Q	SEG 2	1986	2	6155	3315	2130	5920	5740	3400
Q	SEG 2	1987	1	1205	490	490	1115	4970	6210
Q	SEG 2	1987	2	6315	5285	390	5270	6090	3770
Q	SEG 2	1988	1	615	490	745	1990	6020	6305
Q	SEG 2	1988	2	6410	3175	2040	6335	6565	2610
Q	SEG 2	1989	1	1465	490	490	1070	5875	6295
Q	SEG 2	1989	2	6440	4295	1110	5195	6510	3575
Q	SEG 2	1990	1	1675	490	490	490	3335	6030
Q	SEG 2	1990	2	6500	4435	3120	5090	6395	5580
Q	SEG 2	1991	1	2185	565	980	490	1455	4285
Q	SEG 2	1991	2	5910	5270	4335	4890	6040	5945

KENNEBEC RIVER, SEGMENT 3

Q	SEG 3	1985	1	2587	490	490	827	3870	6140
Q	SEG 3	1985	2	5710	3550	2440	5280	5953	4183
Q	SEG 3	1986	1	1773	490	490	880	3873	6670
Q	SEG 3	1986	2	6343	4283	2090	5003	5917	4093
Q	SEG 3	1987	1	1607	490	490	907	3893	6227
Q	SEG 3	1987	2	6270	5613	1693	3643	6090	4543
Q	SEG 3	1988	1	1413	490	660	1490	5177	6283
Q	SEG 3	1988	2	6457	4207	2047	4890	6717	3790
Q	SEG 3	1989	1	1963	573	490	877	4467	6097
Q	SEG 3	1989	2	6440	5047	1563	4013	6450	4463
Q	SEG 3	1990	1	2030	843	490	490	2387	5553
Q	SEG 3	1990	2	6343	5180	2957	4783	6123	5903
Q	SEG 3	1991	1	2957	977	737	490	1133	3663
Q	SEG 3	1991	2	5990	5307	4413	4713	5867	6290

3. PREPARE THE HABNET JOB CONTROL FILE (JCF).

The job control file for HABNET is built using the program **HABINN**, the instructions for which begin on page **VII.7** in the TSLIB manual. When you run HABINN, name your JCF file **LAB4JCF**. Specify NO TEMPERATURE SUITABILITY INDEX FILE (**first option enter 0**), **English Units**, Water Year (enter **WY**). Your first year of processing will begin at 1985 and the last year will be 1991. For this lab, include all time periods for processing (when prompted, enter **111111111111**). When prompted for the first segment ID, enter **SEG 1** and give it a reach length of **3.3**. Continue with **SEG 2** and **SEG3**, giving each of them a reach length of **3.3**. Enter Quit. When prompted for species and life stage, enter **RAINBOW** <CR> **ADULT** <CR>, and **BROOK** <CR> **ADULT** <CR>. Enter **1** when prompted about whether or not to include the life stage for processing. When you have finished, your JCF should look like this:

```
KENNEBEC RIVER, MAINE.
TEMP FORMAT 0
ENGLISH UNITS
WY:KSQFT
FIRST YEAR OF DATA   1985
LAST YEAR OF DATA    1991
MONTHS              111111111111
1 SEG 1                   3.30
1 SEG 2                   3.30
1 SEG 3                   3.30
***************
1 RAINBOW   ADULT
1 BROOK     ADULT
***************
```

3. PREPARE ZHAQF FILE FOR INPUT TO HABNET.

The program used to prepare the flow versus weighted usable area file is called **HQFMON**, and is documented at page **VII.39** of the draft TSLIB manual. You should look this over carefully, but we have prepared a canned version of this file for you, with the file name **LAB4HQF**. When entering habitat values into **HQFMON** from an existing ZHAQF file, it is important to enter the actual WUA values (sometimes it is convenient to enter these values in thousands of square feet (KSQFT)), because HABNET will make the conversion and produce habitat in KSQFT. If you enter values as KSQFT, what you would get from HABNET is MSQFT, but the units specified by the program will print as KSQFT. This program can be confusing, and is prone to cause problems if it is not exactly right for the application at hand. If you finish this lab early, you might try building a file using HQFMON and see if you can produce a file that looks like LAB4HQF.

4. RUN THE HABNET PROGRAM.

The command string to run HABNET is listed on page **VII.5** of the TSLIB manual. This thing is quite a mouthful, so to help you out, type:

RHABNET LAB4JCF LAB4HTSN.EX NETQ LAB4HQF DUM1 DUM2 LAB4OUT

The two input files named DUM1 and DUM2 would have been temperature input files if we had used them. If HABNET has run successfully, you should have a message written to the screen, telling you that there were 0 fatal errors and 1 warning. The warning is to let you know that the two temperature files were empty...No big deal unless you really wanted to use temperature data. Check out the file LAB4OUT just to see what it looks like. If you ever make a run that results in fatal errors or warnings you didn't expect, this is the place to look to find out what the problem was. Your habitat time series for the network under the existing flow release pattern is contained in the file named **LAB4HTSN.EX**.

5. **RUN THE NEW ENGLAND BASE FLOW ALTERNATIVE THROUGH HABNET.** This sounds harder than it really is (presuming, of course that you got through the last step all right). Just pick up the three USGS formatted files you created in step A.3 above, edit them into a new NETQ file (step B.1) and run HABNET again. Use the same command string as above, **except change the name of your output file to LAB4HTSN.NE.**

6. **GENERATE DURATION STATISTICS USING LPTDUR.**

The output from LPTDUR should be similar to the duration statistics you obtained from the HABTS2.WK1 spreadsheet. The network habitat time series file for the existing release schedule is called **LAB4HTSN.EX**. The comparable network habitat time series file for the New England Base Flow Alternative will be **LAB4HTSN.NE** from step 5. To run the bi-hourly habitat duration analysis, use **LPTDUR** as follows:

RLPTDUR LAB4NE.DUR LAB4HTSN.EX LAB4HTSN.NE

In this command string, LAB4NE.DUR is the output file containing the duration statistics and graphics (if you want them). You should probably get the graphics just to see what they look like. Then you'll have a little better idea why we like to use Lotus to generate our duration curves. The two files LAB4HTSN.EX and LAB4HTSN.NE are the two bi-hourly network habitat time series files you just built in HABNET.

When you enter the command string for LPTDUR, you will be prompted for different kinds of information regarding the kind of output you wish to get out of the system. When prompted, select "groups of months" and specify months 1-12 as the valid months. Entitle your first table "EXISTING" and the second table "NE BASE FLOW". The summary statistics tables will be on the output file, **LAB4NE.DUR**.

7. **CLEAN UP YOUR OUTPUT.**

The duration summary table you just produced (LAB4NE.DUR) reflects the fact that HABNET (as well all of our other time series programs in TSLIB) were not designed to handle hourly or bi-hourly time steps. You can see this in the title lines and headers at the top of each table where it says "SUMMARY DATA FOR JAN THRU DEC." When you ran LPTDUR and entered 1 as the start and 12 as the end of the grouped time period, the program interprets that as January and December, respectively. At this point you should edit the title and header lines to indicate exactly what this duration analysis represents. For example, substitute 0100 hours for JAN and 2300 hours for DEC to indicate that this is a round-the-clock analysis. You should also add lines to indicate the inclusive dates of the time series (02/17-23/74) and any other pertinent information. Finally, if the output does not specify the units (e.g., KSQFT/KFT) you should type them in somewhere in the title lines. If you are familiar with Word Perfect, you can import the ASCII output file from LPTDUR (using the Text In/Out function), make your changes, save the file as a Word Perfect text file (change the extension to .wp) and print it. [Note: you should already have a copy of this as a DOS file. Saving it as a Word Perfect file is redundant, which does not hurt anything if you have plenty of memory. It is very easy to import DOS files into Word Perfect, so you are not in danger of losing data if you choose not to save the .wp file.]

When you finish, you should have two summary tables that look something like those on the next two pages.

SUMMARY STATISTICS FOR 0100 hours THRU 2300 hours

	NORMAL WINTER CONDITIONS EXISTING	NEBF
AVERAGE =	4931.451	2910.845
MEDIAN =	4120.000	2880.500
INDEX-A =	2508.627	1622.220
INDEX-B =	4733.777	2891.055
INDEX-C =	2371.295	1538.093 ***
10 PERCENT =	9596.000	4761.000
20 PERCENT =	8602.300	4747.800
80 PERCENT =	2070.100	1297.000
90 PERCENT =	1890.200	1246.900

*** INDEX-C IS THE AVERAGE PERCENTAGE EXCEEDENCE
BETWEEN: 50.00 AND 100.00

SUMMARY STATISTICS FOR 0100 HOURS THRU 2300 HOURS

	NORMAL WINTER CONDITIONS EXISTING	NEBF
AVERAGE =	7401.212	5154.819
MEDIAN =	7850.000	5368.500
INDEX-A =	5449.151	3539.062
INDEX-B =	7386.769	5163.267
INDEX-C =	5183.505	3373.663 ***
10 PERCENT =	10486.000	7491.000
20 PERCENT =	9704.200	7479.000
80 PERCENT =	4677.200	2958.500
90 PERCENT =	4294.100	2827.700

*** INDEX-C IS THE AVERAGE PERCENTAGE EXCEEDENCE
BETWEEN: 50.00 AND 100.00

REVIEW QUESTIONS

1. Suppose you wanted to look at the habitat time series and duration statistics for SEG 3 all by itself, as well as for the whole segment. How could you get HABNET to produce this kind of output for you?

2. What kinds of alternatives might be feasible to increase the rate of pulse attenuation downstream from the dam?

3. Although the effects of hydropeaking are the most extreme nearest the dam, what are some potential benefits to evaluating mitigation alternatives in the network?

4. Suppose you were dealing with a parallel network containing another hydropeaking facility on a tributary to the Kennebec. Would you expect the effects of rapid flow fluctuations to be greater or smaller below the confluence of the two streams?

REVIEW QUESTIONS

1. Suppose you wanted to look at the habitat time series and duration statistics for SEG 3 all by itself, as well as for the whole segment. How could you get HABNET to produce this kind of output for you?

If you look at the LAB4JCF file, you will see SEG 1, SEG 2, and SEG 3, each of which is preceded by a 1. This is an "on" switch that tells HABNET to include that segment in the calculation of network habitat. To look only at segment 3, you would enter a 0 before SEG 1 and SEG 2.

2. What kinds of alternatives might be feasible to increase the rate of pulse attenuation downstream from the dam?

The obvious solution is to reduce the differential between the generation flow and the base flow. The rate of pulse attenuation is related to the magnitude of the pulse. It is also related to the rate at which the flow is changed from the base flow to the generation flow, so by smoothing the pulse at the source attenuation will occur sooner downstream. Channel characteristics also play a major role in pulse attenuation; the rougher and more structurally complex the channel, the faster the pulse will attenuate. Adding boulders to the channel will tend to slow the advance of the generation peak, but may not have much effect on the return rate to base flow. Adding permeable berms in the channel will tend to retard the peaks and store some water for the return to base flow. Be cautious about suggesting structural modifications, however. You may inadvertently create a flooding hazard for residents along the river and bank erosion may increase due to adding materials to the channel.

3. Although the effects of hydropeaking are the most extreme nearest the dam, what are some potential benefits to evaluating mitigation alternatives in the network?

Chances are that if you fix the problem at the dam, you will also fix the problem downstream. If the problem cannot be corrected at the dam, it may still be possible to achieve gains in habitat downstream by instituting measures to reduce the magnitude of the pulse cycle. The greatest advantage to analyzing networks is that it opens up a much broader menu of potentially feasible alternatives.

4. Suppose you were dealing with a parallel network containing another hydropeaking facility on a tributary to the Kennebec. Would you expect the effects of rapid flow fluctuations to be greater or smaller below the confluence of the two streams?

That depends on whether the pulses from the two projects are in phase or out of phase when they reach the confluence (notice that this does not necessarily mean that the two projects are in or out of phase at the release point). In phase, the fluctuations will be greater. Out of phase, they will cancel each other.