AquaPlan

Business Planning Software For Coastal Aquaculture

by

Patricia F. Lacey
Virginia Tech Seafood Agricultural Experiment Station
Virginia Cooperative Extension Service
P.O. Box 369
Hampton, Virginia 23669

and

Sayra G. Thacker
Virginia Institute of Marine Science
College of William and Mary
P.O. Box 1346
Gloucester Point, Virginia 23062

Computers and Business Management in Coastal Aquaculture

A final contract report prepared for the National Marine Fisheries Service under Grant Number NA26FK0399

FINAL REPORT

May 31, 1995

Virginia Sea Grant College Program
VSG-95-13
VIMS Marine Resource Advisory 62

This work is a result of research sponsored by NOAA Office of Sea Grant, U.S. Department of Commerce, under federal Grant No. NA 90AA-D-SG045 to the Virginia Graduate Marine Science Consortium and the Virginia Sea Grant College Program. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear hereon.

To obtain a copy of *Aquaplan*, write to:
Marine Advisory Services
Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

The cost of the publication is $5.00.

ACKNOWLEDGEMENTS

Thanks to the participants of the 1993 Bivalve Culture Workshop in Ocean City, Maryland for sharing their opinions and to those who help test the software. We are grateful for your assistance and the improvements you inspired. Also, thanks to Geoff Knobl for his contributions to AquaPlan software.

MISSION STATEMENT

Aquaculture presents exciting challenges to a business owner, creating a business that relies on growing living organisms is not easy. Knowledge and skills required include: biology, construction, and business management. This software is intended to assist growers in understanding the financial elements of managing their business. AquaPlan was designed as a stand-alone piece of software (doesn't require any other application software) so that it would work for a grower regardless of what spreadsheet software a grower has, if any.

TABLE OF CONTENTS

COMPUTERS AND BUSINESS MANAGEMENT

IN COASTAL AQUACULTURE

I. Introduction

The Value of Planning

When was the last time you went on a trip or vacation without making any plans? Unless your life is a credit card commercial, probably never. At the minimum there is packing, making travel arrangements (buying a ticket, gassing up the car) and checking your finances (stopping by the cash machine). Knowing where you are going, how long you can stay and what you want to do when you get there is generally helpful but not mandatory when going on vacation. Although this example may seem extreme, the point is that we usually have a plan. The level and structure of the plan vary depending upon conditions, goals and personality of the planner. Some people may keep a detailed calendar and list of things "To Do," these are their road maps. Others have an internal plan, or map, that guides their decisions and actions. Some just seem to be lost.

There are many things to consider when starting and operating an aquaculture business, evaluating the market, deciding what to grow, determining where to grow, getting the appropriate permits, etc. All of these

factors are important and many are interrelated. The result is that the amount of research and synthesis of information needed can be overwhelming. Getting lost is to be expected. However, if one must be lost it is preferable to do so in a safe environment. That is why you need a plan. It may seem a little premature to start planning without understanding all this information. It isn't. The first part of the plan is establishing where you want to go or your goals. This provides the proper perspective for evaluating the information collected. The primary goal maybe selling enough oysters to provide a certain level of personal income. This goal is stated in broad terms that are measurable and easily understood. Even those that have never heard of aquaculture such as investors, bankers, and lawyers, will comprehend what you are trying to achieve. Constraints must also be considered. Constraints may be biological, legal (regulatory), or financial. The amount of money available for investment, will in part determine the size of operations and the business' ability to generate revenue and returns.

Usually through the course of research some basic strategies begin to form. Commit these thoughts to paper. Like all good reporting the questions of what, when, how and why need to be answered. Having these strategies in writing makes the research effort more tangible. It also facilitates finding gaps in information or potential problems. Develop a consistent format for writing the strategies. Each strategy can then be evaluated systematically based on its

potential for achieving the goal. Strategy analysis at this point can be as simple as a list of pros and cons. Remember that plans can change and your commitment at this point is to the primary goal not a particular strategy. It may be possible to incorporate some of the elements of various strategies, to combine strengths and minimize weaknesses.

After finding the best alternative, then it is important to commit to that strategy and proceed with the writing of the business plan. This is simply an expansion of the written strategy. A business plan is important for many reasons. Having something in writing increases the sense of commitment and reduces the potential for miscommunication. The more people needed to achieve the business' goals the greater the need for a written plan that addresses goals, constraints, and expectations. A business plan is also a valuable yardstick for measuring the business' progress.

There are two acceptable results from any planning exercise: proceeding with the execution of the plan or deciding not to do it. Through the course of planning and systematically evaluating various alternatives, it may become evident that accomplishing the goal is not feasible, given the constraints. Learning that aquaculture is not a viable business opportunity for you can be quite valuable. The planning process might identify what is the limiting constraint, allowing entrepreneurs to focus attention on research, technology,

market trends, or regulations that are likely to affect that factor.

Any business environment is dynamic and changing. Uncertainty generally increases whenever living organisms (including employees) are included in the equation. This means that plans need to be somewhat flexible. The best way to make a plan flexible is to build in contingency plans.

Although we anticipate revenues by 1995,
we have obtained a line of credit that along with cash reserves
is more than projected expenses through 1996.
or
Although freezing is not expected at the production site
we can quickly move or submerge any gear
likely to be damaged by ice or severe winter weather.

Plans, plans, contingency plans....alot of time can be spent generating plans and evaluating alternatives. There are two things that can make planning more efficient. The first is having good information, so the focus remains on what is probable rather than what is possible. The second is a computer.

The Value of Computers

Computers are power tools and like a drill or a saw, they allow the skilled user to do things more quickly, precisely, and consistently. In this analogy, software can be equated with attachments. There are three basic software applications that are capable of serving most business needs: word processors, spreadsheets, and databases. Frequently new computers have these applications pre-installed. The pre-installed software may be a single integrated program that contains all of these applications or each application may be installed separately. Benefits of the integrated package are the ease of sharing information between the applications and many commands are the same. A possible disadvantage of an integrated package is that it will not have as many specialized functions as a collection of individual software packages.

Uses for a computer include:

1. Storing, organizing and retrieving information such as customer names, addresses and phone numbers.
2. Performing complex mathematical computations quickly and accurately, such as a loan amortization schedule or cash flow projections.
3. Preparing the same activity frequently and accurately;
4. Printing information quickly and accurately.

How Planning and Computers Facilitate Business Operations

What if the basic strategies developed in the planning stages were committed to disk rather than paper? Using a computer and word processing software, once the first strategy is written, then subsequent strategies can be created by editing the original document. The result is that all potential strategies are in a consistent format. As more information is obtained to "fill in the gaps" then it can be added to the written strategies.

Besides "writing-up" the strategy it is important to "crunch the numbers." In terms of business planning a spreadsheet program is the most versatile tool for small business owners. Spreadsheets organize data and you can include formulas in a spreadsheet to make calculations with the data. By using formulas in the spreadsheet, routine calculations can be made with increased speed and consistency. Accuracy, however, depends on the formula. An error in the formula will result in a systematic error in the results. One of the most valuable uses of computer in business planning is the ability to examine "what-if" scenarios.

To be competitive athletes must practice and train. Computer simulations or models are a way of "training" for business. It allows the manager to evaluate the likely consequences of events and formulate an effective response. The value of this training is that you can look at the available options over a longer

period, ponder them and think them through completely. Frequently when a crisis arises the immediate problem must be solved. The time or the level headedness to consider the consequences of a solution are not available.

For example, the primary water supply for a research facility growing tilapia connected with the fire hydrant system. The system used surface water and for reasons of safety the lines were periodically chlorinated, not particularly healthy for the fish. Occasionally the safety staff forgot to notify the researchers, and one day a worker smelled chlorine in the green houses. This sparked a mad dash to change all the systems over to the well, saving many fish and valuable research. Crisis averted normal activities resumed and everyone forgot that the water going into the tanks was a chilly 55°F rather than the customary 82°F. Fortunately the afternoon feeding came before temperature shock, and none of the fish died. Although contingency planning had included an additional water source, lack of training was nearly very costly.

It is not unreasonable to assume at some point someone will forget protocol or a natural disaster will strike. While these are beyond your control, your response isn't. Over a 10 year planning horizon many things are likely to change that you have no control over: interest rates, fuel prices, etc. Some of these may be predictable others not. By using computer simulations and models however there is at least some inkling of the magnitude of these events. This

game of "what-if" can prepare the business owner, so that during a crisis precious time is not spent figuring out what to do, but doing what needs to be done.

Sometimes opportunities are also time critical. Suppose that halfway through the first production season, the opportunity to buy equipment at a discount presents itself. However, no oysters have been sold and the revenue for buying the equipment is not available. By having a business plan, financial statements and a spreadsheet to analyze the alternatives, it is possible to explain and document the benefits of buying the equipment immediately, rather than waiting six months. This information could then be used to obtain a loan. Although there are no guarantees, a business plan and financial analyses generally increase the probability of loan approval.

Spreadsheets are versatile tool for small business owners but, they are ambiguous. An empty spreadsheet is like a blank sheet of paper and a calculator. The format and formulas are set by the user. Although it is wonderful to know that you can do anything, for the novice the nagging question "what do I do" keeps ringing in the ears. That is why we created the AquaPlan software. AquaPlan consists of pre-programmed and pre-formatted financial statements and ratios for shellfish aquaculture. It is possible to examine the financial consequences of variables such as survival, equipment costs, etc., by

simply changing their value. Besides providing quick useful information to the business owner it provides an introduction to spreadsheets in a structured environment.

Despite a very defined target audience for this software, each aquaculture operation is unique. Once the understanding of spreadsheets is developed, it is likely that each business owner and or manager will think of ways that the software could be improved or tailored to their operations. We hope that with this software, an owner or manager will develop sufficient understanding and confidence in the use of computers for financial planning that they will invest time in writing spreadsheet routines that are more tailored to their operations. With this in mind, the next section addresses the basics of business planning and spreadsheets. Additionally a Lotus (version 2) compatible copy of the sample spreadsheet is included on the diskette. This file can be read by most DOS and Windows compatible spreadsheet programs. This should save some time in custom programming a spreadsheet to meet specific business needs. However, some time will be needed to unprotect cells and trace items through the spreadsheets.

II. BUSINESS PLANNING WITH SPREADSHEETS

Financial planning is crucial to business success. Before the arrival of personal computers and spreadsheet applications, the ability to "test" different contingency scenarios' impact on financial performance was a tedious paper, pen and calculator debacle. Every time a change was made to a number (such as the sales price of your product), numbers would have to be changed throughout most of the financial statements. Spreadsheets automate this function, and make it easier not to make errors of omission, which are common when trying to manually "hunt" all the other areas in the statements that needed change.

Another advantage this "automated" sensitivity analysis provides is to allow those who are interested in particular changes a quick way to visualize the bottom line when their idea for a change is implemented. For instance, if you and a partner disagreed on a particular item to be purchased because of price and performance, you could quickly put both purchase prices into the electronic spreadsheet and see what the financial impact would be. This kind of analysis can be extremely helpful in the decision making process. This ability to do analysis, as well as provide outside persons with a vested interest (such as a financial institution) with projections and performance data quickly and in an understandable format is invaluable.

Production Schedule / Statement

A production schedule or statement as it is sometimes called, is simply a basis for the production you plan to accomplish. It is a basic listing statement of how many of what you plan to produce in its simplest form. It takes your basic production assumptions (such as grow out time) and puts them into spreadsheet format that can be used to formulate other numbers in financial statements.

The statement used in AquaPlan places assumptions about biological conditions (such as animals stocked, survival, density, etc.), equipment, expenses and revenue in spreadsheet (tabular) form. These numbers then form the basis for the rest of the financial statements.

Initial Investment Schedule

The initial investment schedule gives a listing of where money will be spent. All initial purchases to start-up the business are found here; quantities are based on the production schedule. (If you are growing oysters, the number of oysters and the grow-out system would determine how much would show up here for trays or bags for growing purposes.) Other capital items require that the owner have an accurate estimate of what is needed and what it is likely to cost. Once reliable estimates are obtained, the investment schedule provides a rough draft of capital needed for initial and reinvestment.

The capital cost and investment schedule in AquaPlan requires you to input quantity, price, salvage value, and maintenance numbers in for all initial purchases relative to the business, as well as start-up costs. Information is also required about taxes, financing, and cash availability.

Depreciation

A depreciation schedule shows how assets "lose" value over time. Many people argue that their assets don't really lose value. However, if just for tax purposes, depreciation is very important. For instance, if you were spending $100 on a piece of equipment with a legally defined depreciable life of 10 years, you could have a $10 tax deduction for 10 years. It also helps to see how much money over time should be considered for replacement reinvestment so that cash crunches can be minimized when items eventually do need replacement. Depreciation is also used to estimate the future "market value" of assets. These "market values" are needed to evaluate the net worth of the business. These values also provide an estimate of capital that could be generated if the company sold these assets.

Loans / Financing

This spreadsheet explains where credit is being used, and what for such as land, machinery, operating funds, etc. This statement is valuable to outsiders

(such as financial institutions) so that you can demonstrate a real plan for using your acquired funds. It is very valuable to you because you can follow the cost of debt (interest) and easily program in a change in interest rates to determine if a financing is worth the effort. Closing fees are important and usually negotiable, so don't forget to consider these.

AquaPlan has a statement called "Loan Amortization" that calculates payments, balances, interest, etc., for all categories of credit (Land and Construction; machinery; non-machinery; and operating loans.)

Cash Flow Statement

The cash flow statement is the day-to-day bottom line instrument for the operator of a business. The statement does not give an idea of profitability like the income statement, but it does give a very direct picture of a most important business concept: money in must exceed money out. That is really what a cash flow statement is. It takes all cash items in, subtracts all cash paid out, and shows what is left. Financial institutions are very interested in this statement, as well as other creditors. It shows whether on a projected basis, the business can meet its financial obligations.

The AquaPlan cash flow statement is very simple. First, there is a listing of all "positive" (cash in) items, such as beginning cash, revenues, interest, loans, etc. This is followed by a listing of all "negative" (cash out) items such as capital investments and expenses. Subtracting negative items from positive items yields a subtotal, which is net cash before an owners draw. An owner's draw is what the proprietor takes out of the business for his own personal compensation, which is separate from an owner's salary, if there is one. This leaves an ending cash balance for the operational period (one year). An internal rate of return (IRR) and net present value (NPV) of the operation are calculated for you by AquaPlan. An IRR is the discount rate that equates the net present value of cash flows to zero. The NPV is the present value of all cash inflows and outflows of a business at a discount rate. An owner's discount rate is the expected rate of return for an alternative investment of equal risk. The discount is generally greater than 15%.

Balance Sheet

The balance sheet is the most misunderstood of the financial statements by those who are not familiar with them. Very simply put, a balance sheet says this; the net worth of a business equals the sum of the assets minus the sum of the liabilities. This statement is used by financial institutions to calculate various ratios that help give them and idea not only of the performance of your

business, but an "equalized" way to compare it to other similar businesses. (Doing this internally can also give the operator of the business a way to gauge performance and look for ways to improve.)

AquaPlan provides an annual proforma balance sheet, dividing assets into current and fixed categories. It then performs for you eight calculations that are used by managers and creditors to evaluate the company's performance. These ratios are:

Current Ratio. This measures liquidity. It is calculated by dividing current assets by current liabilities.

Working Capital. Working capital is the excess of current assets over current liabilities. This is conceptually the funds available for everyday operations. It is important to note that these funds are often not directly available, and is only an approximation of what can be raised to fund the business on short notice. For example, accounts receivable are generally considered current assets However, there are no guarantees that you will get paid in a timely fashion.

Debt to Asset Ratio. This is a measure of indebtedness to "asset value" of the business. It is calculated by dividing total debt by total assets. In simple terms, this is a measure of what you owe relative to what you own.

Leverage Ratio. This is used to measure the level of profitability. It is calculated by dividing total average assets for the period by shareholder's equity. In the case of a single proprietor, the net worth line from the balance sheet is often substituted for an equity number.

Return on Assets. (ROA) This is used to determine profitability, based on the level of assets owned by the business. It is calculated by dividing net income (with the addition of interest expense) by average total assets for the period.

Return on Equity. (ROE) This is used to calculate a measure of profitability based on equity or net worth. It is calculated by dividing net income by average shareholder's equity for the period. (Again, for a proprietor, net worth is often substituted here.)

Asset Turnover Ratio. (ATR) This is also used as a profitability measure. It is calculated by dividing revenues by average assets for the period

measured.

Income Statement

The income statement, at first glance, looks a lot like a cash flow statement. The difference is that several non-cash items show-up on the income statement. Things like depreciation (which will eventually have to be reinvested, so it is "spent") and adjustments to inventory are deducted from or added to income here. Basically, income less expenses (cash and non-cash) equals net income. Financial institutions use this statement to help determine the profitability of a business. You could be paying all your bills, according to the cash flow statement, but you haven't allowed money to replace items as they wear out, which will effect future profitability. That is why noncash items, such as depreciation, are placed in the income statement.

The income statement generated by AquaPlan is very simple. It categories are cash income, cash expenses and non-cash adjustments to income. Subtracting cash and non-cash items from income yields net income.

Enterprise Budget

An enterprise budget is simply a budget for your operation. It uses revenues matched with expenses, to calculate "standard" business numbers used

to evaluate performance. It is useful in that it separates fixed from variable costs.

The AquaPlan enterprise budget separates items into these three categories and calculates for you useful information such as break-even costs and quantity (how much has to be sold to cover fixed costs), margin per unit of sale (oyster, clam, etc.), survival rates necessary for break-even, average variable cost and average fixed cost per unit of sale.

III. SPREADSHEET BASICS

An electronic spreadsheet is a representation via computer of the same concept most people use when organizing numbers on paper. Normally, numbers are organized by columns and rows, to facilitate mathematics. An electronic spreadsheet is just the same, except, where we might manually write in the answer for adding (or performing any other mathematical calculation) on paper, we enter a formula telling the electronic spreadsheet to do the math for us.

"Math Example"	"Spreadsheet Equivalent"
4	A
+ 2	1: 4
6	2: 2
	3:(A1+B1)

Note that only on your command line will cell address "A3" display (A1+A2). In the space allotted to that cell, the number "6" will show as the result of the calculation.

Menus

Menus appear at the top of the spreadsheet. The user activates the menus when certain commands are needed. While the menus are on the screen, you

cannot move about the spreadsheet. The menus tell the spreadsheet application what instructions to carry out. There are two ways to access menu items. The first is to use the arrow keys to highlight the item and follow this with the "enter" key. This activates the highlighted command. A second way to access menu items is to press the first letter of the menu command you want.

In AquaPlan, if you perform a function and temporarily "lose" the menus from the top of the keyboard, simultaneously press the "Alt" and "M" keys to access the AquaPlan menus. This will bring the menus back into view. In other applications the "/" or "Alt" keys bring up the menus.

Cells

A cell is a location where data or formulas can be stored in a spreadsheet. Across the top of the spreadsheet window, there are alphabetical letters, vertically, down the left side are numbers. Think of a crossword puzzle. Cell "A2" is the space in where column A meets row 2. "A2" is known in spreadsheet terminology as a cell address.

Cell Pointer

The cell pointer shows where you are in the spreadsheet. This area is usually highlighted with shading or a different color. You can move from cell to cell

by using the arrow keys on the keyboard or by using a mouse. Another way to move around is to use the page up and page down keys. These will move you further than arrow keys. If you get lost "paging around" a spreadsheet, use the home key. It will return you to the upper left hand cell ("A1").

Saving a File

While open, spreadsheets keep their data in temporary memory (that disappears when you shut the computer off or exit the application). Therefore, to make a permanent copy of your work, you must save the spreadsheet. Select the "Save" item from the spreadsheet and give the file a name. The name can only be 7 characters long. Do not assign a "suffix" as the spreadsheet application will assign one for you. (A suffix is a "." followed by three letters identifying the type of spreadsheet you have.)

Errors

If when working with a spreadsheet, your computer beeps and you see an error message in the upper right hand corner, you have done something the electronic spreadsheet doesn't understand. Try pressing the "Esc" key and try the operation again. If a more detailed error message appears, follow the instructions given. You may have given an out of range number or a number in the wrong format.

IV. USING AQUAPLAN SOFTWARE

Getting Started

One of the goals established in this project was to minimize the equipment and software needed for using the software. The AquaPlan software is stand-alone, requiring only the basic disk operating system (DOS) and a 3.5" high density diskette drive. The software is limited to one diskette so it can be operated from the floppy disk drive or installed on the computer's hard drive, if available. Like most things computers and diskettes can break. Usually the worst part is the frustration from losing the information that you have worked hard to create, and the time that it will take to recreate it. Therefore, it is important to save your work and back-up frequently.

Creating a Back-up Diskette.

1) You will need a blank high density diskette
2) Start the computer
3) Insert the diskette in the appropriate sized diskette drive (A: or B:).
4) Change drives, type "A:" or "B:"
5) Press "enter"
6) Type "diskcopy"
7) Press "enter"

On older computers it may be necessary to provide source and destination drives to do this:

type "diskcopy A: A:" or "diskcopy B: B:"

The computer will display the following message "insert the source diskette into the drive and press enter. Follow the remaining directions on the screen exchanging the diskettes as prompted. When copying is completed, the computer will prompt "Do you want to copy another diskette, Y/N ?" Type "N" (upper or lower case) to return to the system prompt. Label and store the back-up diskette in a safe place.

Installing AquaPlan

1) Turn on your computer
2) Insert the diskette into the appropriate sized disk drive; usually A: or B:
3) Change drives to where the diskette is located "A:" or "B:"
4) Type "install"
5) Press "enter"

You will be asked, "Do you want to proceed with installation?" If you want to install, press Y (upper or lower case), any other key aborts the installation. The next message that appears is: "Installation can be stopped at any time by pressing "ctrl" and "c" key simultaneously, ctrl-c. The installation software creates the

subdirectory C:\coastal on the computers hard drive (C:), then copies the files from the diskette to the new subdirectory. After installation is complete, you will be asked "Do you want to start the software now? Y/N" Pressing the Y key (either case) starts the software. Pressing any other key results in the following the message: "To start the software go to subdirectory C:\coastal and type start", then returns to the system prompt (A: or B:).

Starting AquaPlan

Installed on the Hard Drive

1) Turn on the computer
2) At the system prompt "C:" Change to the coastal subdirectory "cd\coastal"
3) Type "start"or "AquaPlan"
4) Press "enter"

From the Floppy Disk Drive

1) Turn on the computer
2) Insert the diskette
3) Change to the appropriate disk drive ("A:" or "B:")
4) Type "start" or "AquaPlan"
5) Press "enter"

It will take a few seconds for the software to start-up, so be patient. You will next be asked to select a file to run. Using the down arrow highlight the file you want to run, then press "enter." When you first start the only choice available to you should be "sample.jwk". As you modify the spreadsheets, examining various possibilities, use the "Save" and "Different-Name" menu commands within AquaPlan to create a new spreadsheet. The .jwk file extension identifies files that AquaPlan can execute or run. In the future, when starting AquaPlan your new files will be available for selection.

Working with AquaPlan Spreadsheet Menus

A custom menu is available when AquaPlan is started. To activate this menu from within the spreadsheet press the "alt" and "m" keys simultaneously, alt-m. The menu presents several options. Using the left/right arrow keys or the first letter to highlight the menu items, press "enter" to select the highlighted item.

VIEW -

It lets you select which spreadsheet to view. Spreadsheet choices are:

- Amortization--loan schedule;
- Assumptions--production schedule, variables and assumptions;
- Balance--balance sheet or net worth statement;
- Enterprise--enterprise budget;
- Capital--capital investment worksheet;

- More--additional choices
- Depreciation--depreciation schedule
- Income--income statement
- Investment--capital investment schedule for 10 yrs.
- Quit--exits the menu system

SAVE -

It lets you save your changes.

- Same-Name updates the original spreadsheet with the new information;
- Different-Name creates a new spreadsheet.

This option can be used to create a series of spreadsheets that examine the effects of different variables. Done systematically this can be a sensitivity analysis, or an examination of best-case and worst-case scenarios. Coding filenames can sometimes be a little difficult since they are limited to eight characters. The .jwk file extension which identifies the executable files is automatically added.

PRINT -

Sends the selected spreadsheet to the printer.

GRAPH -

Displays or prints one of the graphical analyses.

CHECK -

Marks out of range entries in the assumptions worksheet.

EXIT -

Exits the software.

QUIT -

Turns off the AquaPlan menu panel.

V. BUSINESS PLANNING AQUAPLAN SPREADSHEETS

Many functions in the AquaPlan spreadsheets are already programmed. The cells containing these formulas are protected. Other cells require that the user input accurate data, these cells are unprotected. If your computer has a color monitor, then the data in unprotected cells (those you can change) will be green in color.

Assumptions

Production is an integral part of any manufacturing process and the aquaculturist is essentially a manufacturer, that uses biological processes. The purpose of the spreadsheet entitled, Important Assumptions and Expectation, "ASSUMPTIONS" is to provide an organized table that details assumptions related to the biological and financial management of the firm. The first part of the program is simply record keeping and labeling. Cells A1-A4 contain the title of the simulation. In this case the following descriptive title was selected:

Oyster Aquaculture

Floating tray (wood) Grow-out System

1 man operation w/expansion

Proforma

An alternative might be to use the company name, strategy, and site. The word "proforma" needs to appear on all statements other than actual farm records. This identifies these statements as projections rather than documentation of historical performance.

General Assumptions

The first set of assumptions are general and are set for the entire planning horizon. These items that are not likely to change from year to year. Included in this list are tray size, the number of trays that will fit on a tether, and the first year of operations. Most of these titles can be changed to reflect production practices. For instance, a bay scallop grower using racks and bags would change oysters to scallops, trays to bags, and units to racks.

Tray size (B9) is the size of the container in square feet. Trays/unit (B10) is how many trays a unit holds. In the oyster example, trays are considered to be independent (not connected to a tether or rack). Whatever container is used for growing the shellfish it is reasonable to expect that a surplus (D9) will be needed to facilitate cleaning (removing fouling) of the container. Some growers transfer oysters to a clean bag then use air drying to remove fouling. This practice can result in about 30% more bags needed. The percentage should be based on operational plan, including expected fouling. It is also likely that some extra trays/bags will be needed to replace those that show signs of wear early, "Tray

wear" (D10). As with surplus, the percentage input should be based on operational factors (exposure to sun, wave action, and durability of materials).

Some oyster and bay scallop growers pack their shellfish in boxes for shipping to their markets and others use mesh bags (like clams) for their product. Naturally the label (A10) and number per container (B10) should reflect the marketing plan, product size and size of container.

First operating year (H9) is the year of first stocking. Input the appropriate year here such as 1995 and the year headings will be adjusted accordingly.

"Mesh sizes" (H10) are the number of different size mesh that trays will be needed for growing the bivalves. Some growers start with a smaller animals that require small mesh netting to remain in the containers. As the animals grow they can then be transferred to containers with larger mesh openings, improving water flow through the containers. If larger animals are stocked and only one mesh size is needed then input the number 1. This number should never be zero, or the effect is that you have no mesh sizes and no trays.

Biological Assumptions

Animals Stocked	B-K13	User input. The total number of seed animals stocked each year.
Density (#/ft2)	B-K14	Calculated by dividing number per tray (B-K15) by tray size (B9).
Animals/tray	B-K15	User input. How many animals stocked in each tray?
Split (Y/N)	B-K16	User Input. Do you want to split the original stocking level between two trays later?
Survival (Yr. 1)	B-K17	User Input. Projected survival from time of stocking until December 31 of that year.
Survival (Yr. 2)	B-K18	Survival from December 31, until time of harvest. It is assumed that any trays in use as of 1 January will not be available for restocking in the spring.
Available	B-K19	Calculated. This is the number of animals stocked in the current year multiplied by the Yr. 1 survival, plus the number of animals carried-over from the previous year multiplied by Yr. 2 survival.
Harvested (%, year crop)	B-K20	User Input. This number is used to estimate growth. It is the percentage of the current year's crop that will reach market before Dec. 31.
Harvested (#)	B-K21	Calculated. This is the number of animals harvested in the current year. The number is calculated by multiplying current year stocking levels by survival Yr. 1, then multiplying by harvested (% year crop) to get harvest from that year's crop. Then the number of oysters carried

		over from the previous year multiplied by survival for Yr. 2.
Carry-over (#)	B-K22	Calculated. This is the number of oysters that survive the first year but are too small to market, the inventory is carried over into the next year. The number is calculated by subtracting Harvested (#) from Available (#).
Marketed (%)	B-K23	User input. What percentage of oysters harvested will be marketed? Reasons for less than 100% include quality control, promotions, and personal consumption.
Marketed (#)	B-K24	Calculated. The number of animals harvested multiplied by the percent marketed.

Equipment

The total number of animals stocked, number per container, etc. will affect expected equipment needs. Note labels can be changed to reflect production practices. Care should be taken however to assure that the new title fits the calculations.

Trays stocked	B-K26	Calculated. The number of animals stocked divided by the number per tray.
Trays stocked (larger mesh)	B-K27	Calculated. Some growers transfer the animals to larger mesh containers as they grow. The larger mesh increases water-flow and food availability. This calculated on a 1:1 ratio with stocked. Growers may split their animals into containers of larger mesh. The extra larger mesh trays needed in this scenario would still be calculated in the Trays (splitting, carry-over etc.) B-K28.
Trays (splitting, carry...)	B-K28	Calculated. Generating this number requires use of if/then formulas.

Total trays (incl. surpl...)	B-K29	Calculated. Sum of all container categories multiplied by 1 plus surplus and wear factors (%).
New trays needed	B-K30	Calculated. Total trays for current year less those available from the year before plus replacement trays for those over three years old.
Units	B-K31	Calculated. If/then formulas are used to generate this number. If trays/unit>0, then round to the nearest digit (trays stocked/trays per unit) then add 1, else 0.
New units	B-K32	Calculated. Units for the current year less the units available from the year before plus replacements for those over five years old.
Expenses		
Management Salary ($/yr.)	B-K34	User Input. Salary for a manager.
Labor 1 rate ($/hr.)	B-K35	User Input. Hourly wage for skilled labor.
Labor 2 rate ($/hr.)	B-K36	User Input. Hourly wage for unskilled labor.
Labor 1 hrs.	B-K37	User Input. Total hours of skilled labor needed to stock, maintain and harvest each year.
Labor 2 hrs.	B-K38	User Input. Total hours of unskilled labor needed to stock, maintain and harvest each year.
Fuel price ($/gal.)	B-K39	User Input. Yr. 1 only. Fuel prices for subsequent year are dependent upon inflation factors.
Fuel use (gals.)	B-K40	User Input. Expected fuel use in gallons for each year.

Phone ($/yr.)	B-K41	User Input. Expected phone expenses for each year of operations.
Utilities ($/kwh)	B-K42	User Input. Yr. 1 only. Utility rates for subsequent years are calculated based on inflation factors.
Utilities (kwh)	B-K43	User Input. Estimated annual utility usage in kwh.
Seed price ($/animal)	B-K44	User Input. Estimated seed prices (paid) for each year.
Oyster boxes ($/box)	B-K45	User Input. Price in dollars for each container. Label can be changed to reflect marketing practices (bags, bushel etc.).
Tags ($/tag)	B-K46	User Input. Price in dollars for each tag. Tags are the waterproof interstate shellfish shippers tags.
Marketing ($/yr.)	B-K47	User Input. Marketing budget per year in excess of phone calls and basic packaging. This might include travel and advertising to promote the product.
Legal fees ($/yr.)	B-K48	User Input. Cost of retaining legal counsel for each year.
Accounting fees ($/yr.)	B-K49	User Input. Cost of general accounting services such as tax preparation and advice.
Insurance ($/yr.)	B-K50	User Input. Cost of insurance for vehicles, production equipment, product liability, workmen's comp, etc. Cost will be based on levels and types of insurance purchases.
Land/Building...($/yr.)	B-K51	User Input. You may have the option of leasing capital assets rather than purchasing them. This expense line allows for such options.

Miscellaneous ($/yr.)	B-K52	User. Input. Allows for the incorporation of annual expenses not itemized above.

Investment

In order to have equipment and other resources required for growing bivalves the business needs capital investment. The worksheet entitled "ASSUMPTIONS" is to provide a organized table that details needed resources and their cost. Cost can be viewed in two ways, one is the price of an item that needs to be purchased. the second is the value of an item an owner is assigning to the business venture. An example of this might be property, although the land doesn't "cost" you anything in the sense that you don't have to buy it. Using it for the business does have a cost, because it limits the ability to use that property for other things, including selling it. The first part of this spreadsheet (A62-A65) copies the original title (A1-A4). The title of this spreadsheet is contained in cell A5 "Initial Investment & Financial Assumptions."

% Owner Financing Original	B67	User input. This is the percentage of capital for initial investment that the owner(s)will supply. If the plan is to finance 60% of the investment then 40% is entered here.
% Owner Financing Replace	F67	User input. This is the percentage of capital investment for replacing equipment that the owner(s) will supply.

Rows 69 through 105 establish the laundry/shopping list for the aquaculture business. The categories/items and their useful lives are set. The useful life (life, column B) is the number of years an item is expected to be in operation or the number of years that it is legally allowed to lose value for tax purposes. The salvage value of an item is its value at the end of its usable life. Frequently this value is zero, since the items are worn-out. The user supplies the quantity (Column C), unit costs (Column E), and salvage value (Column G) for each item needed. The exceptions to this are the quantity requirements for trays and units, these values are calculated based on production information. This list is not expected to be comprehensive. Some of the items that are listed will not be needed, in this instance the user sets the quantity to zero. It is also likely that some items were omitted. To account for this are "other" items for each cost category. The total of this capital investment is calculated in cell F105 "subtotal." The user also supplies a maintenance factor (Column H). This percentage is multiplied by total cost (Column F) to calculate annual maintenance expenses.

Start-up Costs

Rows 107 through 117 lists some of the one-time costs associated with establishing an aquaculture business. In this section the user inputs the quantity, units and unit cost of each item. Cell C117 calculates the subtotal of these start-up items. Capital investment and start-up costs are combined in cell

F119.

Financial Assumptions

The last section of this spread sheet contains the remaining financial assumptions.

Owner Financing	B121	User Input. This is the percentage of operating capital that the owner(s) will supply.
Cash Reserves	B122	User Input. Anticipated capital needed for initial cash reserves. This value is a percentage of the total calculated in cell F119.
Minimum Cash Available	B123	User input. This sets the minimum cash (can be in checking or savings accounts) that the business will always have available. If ending cash drops below this level then additional investment occurs to bring it up to this minimum.
Opportunity Cost	B124	User Input. The rate (%) that money invested in a "secure" alternative could generate. This rate is generally approximated by the average rate paid on AAA rated bonds.
Interest land and Construction	B125	User Input. Interest rate on long-term loans for large capital items such as land and construction.
Interests original equipment (3 Yr.)	B126	User Input. Interest rate on original equipment loans although technically a short-term (<5 yr.) loan. These loans are identified as "intermediate" on other statements. This differentiates them from

		the short-term (<1 yr.) operating loans.
Interest replace equipment (3 Yr.)	B127	User Input. Interest rate on replacement equipment loans. Since these loans originate four years after the original it is logical that interest rates may be different.
Interest, operations	B128	User Input. Interest rate on operating loans (<1yr.).
Tax rate	B129	User Input. Tax rate for land and property.
Discount Rate	B130	User Input. This is the expected rate of return for an alternate investment of equal risk.

Capital Investment and Asset Addition (Capital-10 yr.)

The usable life of an item is used not only for tax purposes but for estimating when capital items will need to be replaced. All the items in the Capital Investment & Asset Addition (Capital -10 yr.) are calculated. The categories and usable life in columns A&B are taken from the Initial Investment Worksheet. The first year costs also mirrors the worksheet estimates. Tray and unit costs are calculated based on annual needs (ASSUMPTIONS) and original price (INVESTMENT). Other items are replaced at the end of their usable life. Items' usable lives and replacement schedules do not change, they are fixed. Investment is totaled by year and by item. It is interesting to evaluate costs associated with each item over the planning horizon. Note that in this example tray cost accounts for nearly

half of capital investment over the long-term. Information from this spreadsheet is used to create a pie graph illustrating the distribution of capital expenditures. This is substantial and suggests that if tray costs are reduced then production costs should also be reduced. Frequently, however, there is a trade-off between initial capital cost and expenses for operating and maintenance (especially labor).

Depreciation

Investment, usable life, and salvage value for items in this spreadsheet are from the initial investment worksheet. Annual depreciation is calculated using the straight-line method, (initial - salvage)/usable life. Annual depreciation for trays and units is slightly more difficult to calculate, because the inventory of these items fluctuates each year. Calculating these values requires tracking tray purchases by year. The tables below the depreciation schedule are where these calculations are made. The other value examined in this schedule is current market value (book value). The values of these assets are estimated using the straight line depreciation formula.

Amortization

Starting an aquaculture business generally requires substantial capital investment. Often this exceeds the resources of a single owner,

requiring that either loans or additional investors to obtain the capital. Another reason for borrowing is to increase business efficiency. If the company can generate returns that exceed the interest costs, then it makes sense to make money using the bank's resources. The first part of this spreadsheet (A530-A533) copies the original title (A1-A4). Keeping the original title with each spreadsheet makes it easier to compare analyses. The title of this spreadsheet is contained in cell A535 "Loan Amortization". The loan amortization also restates financing assumptions entered in the Investment & Financial Assumptions Worksheet.

Land and Construction

The first loan examined is the long-term note for land and construction. Beginning balance for time period zero is where the original amount of the loan is calculated. The amount of the loan is determined by the cost of land and construction and the percentage of owner financing original. Both of these numbers are from the Investment & Financial Assumptions Worksheet. This number becomes the beginning balance for the first year of the loan. This long- term loan starts one year before stocking. Since stocking usually occurs in the spring there are only a few months to complete large projects. It is more likely that land acquisition and construction will start in year before first stocking. The sum of beginning balance (principle) and interest charges for the year equal the prepayment

balance. Payments are calculated so that the series of equal annual payments result in the loan being paid-off on schedule. Subtracting payment from prepayment balance gives the remaining balance due on the loan. Subtracting remaining balance from the beginning balance results in the amount of the payment that reduced principle. The result of an equal total payment is that most of the early payments service the interest charges rather than reducing debt. The benefit is that these payments are less than would be required for a loan payment schedule based on equal principle payments. This is especially important in the early years of operation when cash-flow is more likely to be restricted.

Machinery and Nonmachinery

Original loans for machinery and nonmachinery (equipment) occur during the first year of production. These are four-year loans for items that generally have a usable life of five years. Calculations of initial loan value are based on cost estimations and "% owner financing original" in the Investment & Financial Assumptions Worksheet. Tray costs are not included in this figure. Beginning balance, interest, prepayment balance, payment, and principle paid are calculated in the same manner as they were for the land and construction loan.

Loans for replacement equipment are identical to the original equipment loan except that the occur five years later and use "% owner financing replace" to determine what percentage of the investment will be financed.

Operating Loans

Operating loans are based on expected expenses (labor, seed, utilities, fuel...), tray purchases, and "% owner financing operations". These loans last for one year. Payments occur in November and December, when revenue should be available from the sale of animals). Interest charges are compounded monthly.

Cash Flow

As the name implies, the cash flow statement is a projection of all the cash transactions relating to the business that occur during the accounting period. Noncash items are not included. Most of the items within this spreadsheet are derived from estimates and assumptions in other spreadsheets. The exception is cash inflows from contract services. An aquaculturist might use their skills and assets to create other sources of income (fishing guide, contractor, etc.). The spreadsheet begins with start-up and positive cash flows. Included within positive cash flows are beginning cash, revenues, interest (from cash reserves), new loans, contract services,

and investment (by the owners). Negative cash flows include purchase of capital items and expenses (management salary, labor, fuel, phone, stocking, etc.). If the business is profitable, the owner(s) will want to start receiving returns from their investment, rather than having the business accumulate cash. The category "Draw" is included as a reminder of this option.

Preparing the cash flow budget is a simple concept. It consists of identifying the timing and magnitude of expected cash flows. As such it is tied very closely with the production schedule and assumptions.

Balance Sheet

The balance sheet or net worth statement is a systematic listing of what the business owns (assets) and what is owed (liabilities) at a specific point in time. A business' net worth (owner's equity) is equal to total assets less total liabilities. Ratios based on this fundamental equation are used to evaluate the businesses financial position. All items within this spreadsheet are taken directly or are derived from estimates and assumptions in other spreadsheets. For analytical purposes, assets and liabilities are classified according to their liquidity. Liquidity refers to the business' ability to generate cash quickly and efficiently to meet its financial obligations as they fall due. Those assets that can be quickly converted to cash with little or no delay and little or no loss in the net value of the firm are considered highly liquid. The first items within the

balance sheet are the title for analyses and the spreadsheet title. AquaPlan creates a balance sheet for each year of operations. There are some categories that AquaPlan is not designed to handle, such as accounts payable/receivable and payroll taxes. However these items are important when operating a business and should not be overlooked, so they are included as a reminder.

The current ratio

Computation:	Total current assets minus total current liabilities
Interpretation:	This ratio (expressed as xx:1) indicates the extent to which assets if liquidated would cover liabilities. If the ratio is greater than 1.0:1, the business is considered liquid; the higher the ratio the greater the liquidity.

Working capital

Computation:	Total current assets minus Total current liabilities
Interpretation:	Working capital is a theoretical measure of the amount of funds available to purchase inputs and inventory items after the sale of current assets and payment of all current liability. The amount of working capital considered adequate should be related to the size of the business and operations.

Debt/asset ratio

Computation:	Total liabilities minus Total assets
Interpretation:	This ratio measures financial position. It expresses what proportion of total assets is owed to creditors. This is one way to express the risk exposure of the business; the higher the ratio the more risk exposure of the business. NOTE: The ratio is greatly influenced by the value

placed on assets. The standards for this value vary by enterprise/industry and are generally given as a range.

Equity/asset ratio

Computation: Total equity minus total assets.

Interpretation: This ratio measures financial position. Specifically it measures the proportion of total assets financed by the owner's equity capital. In other words, against the assets of the business, this is the owners claim. The higher the ratio the more total capital supplied by the owner(s) and less by the creditors.

Leverage ratio

Computation: Total liabilities minus total equity.

Intrepretation: This ratio measures financial position. It reflects the extent to which debt capital is being combined with equity capital. The higher the value of the ratio, the more capital supplied by creditors and less by the owner(s).

Rate of Return on Assets (ROA)

Computation: (Net income from operations plus interest expense) minus average total assets.

Interpretation: This ratio measures rate of return on assets and is often used as an overall index of profitability; the higher the value the more profitable the operation. NOTE: Some operations do not include a salary for owner labor and management. A charge for any unpaid labor/management should be subtracted to accurately calculate return on assets. The only way to avoid this pitfall in AquaPlan is to include owner's time in estimating costs.

Return on Equity (ROE)

Computation:	Net income minus average total equity
Interpretation:	This ratio measures the rate of return on equity capital employed in the business; the higher the ratio value the more profitable the operation. NOTE: As with ROA, the value of any unpaid owner labor and management should be subtracted from income to prevent overestimating rate of return.

Asset Turnover Ratio (ATR)

Computation:	Gross revenues minus average total assets.
Interpretation:	The asset turnover ratio is a measure of how efficiently assets are being used to generate revenue. A business has two ways to increase profits--either by increasing the profit per unit produced or by increasing the volume of production (provided the business is profitable). The higher the ratio, the more efficiently assets are being used to generate revenue.

Income Statement

The income statement is the summary of the revenue and expenditures of the business over a specified period of time to determine its profit position. Within AquaPlan, the accounting period is one year. The income statement within AquaPlan is actually a series of income statements, one for each year of operation. The business can generate revenue in several ways, such as cash receipts from the sell of products or increasing the value of items that were produced and not sold (inventory or works in progress). AquaPlan examines the cash and noncash contributions to income and expenses. This is an accrual

accounting system. Although this system provides a more accurate assessment of profitability, it is likely to be more advantageous to use a cash-based statement for tax purposes. The cash system would allow for the costs to be charged as they were incurred throughout the first year of production, but the business would not be taxed on the increased value of the animals carried over (inventory) until they were sold. This is especially important if the animals can lose value due to mortality in the second year of production. Since aquaculture is generally considered to be agriculture, the business should have the option using a cash-based income statement. However, tax rules change so it is best to discuss this with an accountant. In addition to calculating net income for each year of operation, AquaPlan also examines net income across the planning horizon with cumulative net income.

Enterprise Budget

The enterprise budget is very similar to the income statement, except that it focuses entirely on the aquaculture portion of the business. It does not include any sources of off-farm income (contract services). Revenue comes solely from the sale of animals. Costs are classified as variable or fixed. Variable costs increase with increases in production. Unlike fixed cost that remain constant over a range of production volume. The ratio analyses within the enterprise budget are important for evaluating the business' performance.

Cost per animal/break-even price

Computation:	Total cost divided by # marketed
Interpretation:	The price that is required for the revenue generated from the predicted number of animals marketed to equal total costs.

Margin/animal

Computations:	Predicted market price minus break-even price
Interpretations:	Portion of predicted selling price that goes to paying return oninvestment and profit.

Break-even animals

Computation:	(Total cost divided by market price)
Interpretation:	The number of animals that would have to be sold in that year at the predicted market price in order for revenue to equal total cost. NOTE: The calculations determine what is required, not what is possible. If projected costs are high or price low, then the number of animals needed for sale can exceed the number stocked. When this happens projected break-even survival will exceed 100%. Though in reality, this is not possible.

Break-even survival

Computation:	[(Break-even animals minus (number of animals stocked times % harvested yr. 1)} minus % marketed.
Interpretation:	The percentage of animals stocked that would have to survive in order to have sufficient quantity marketed at the predicted prices to equal total cost. NOTE: The enterprise budget also examines cost based on their fixed and variable components.

Average variable cost

Computation:	Total variable costs minus animals marketed
Interpretation:	This is the amount of cost per animal marketed that comes from variable costs, those that increase with production volume.

Average fixed cost

Computation:	Total fixed costs minus animals marketed
Interpretation:	This is the amount of costs per animal marketed that comes from fixed costs, those that remain the same regardless of production volume.

The enterprise budget within AquaPlan look not only at each year, but operations to date, through the cumulative analyses. If production requires more than one year, using the cumulative analyses allows costs and revenues to be examined across more than one year as well. However, this function still has the lag in revenues that is inherent in operations.

VI. PRINTING WITH AQUAPLAN

Once you have created your spreadsheet financial statements, you may have need for a "hard" or paper copy of your work. That will require that you use AquaPlan's print command from the menu. Before you use the command, however, there are two things you must do.

Choosing a Printer for AquaPlan

The first step is choosing a printer. This is actually easier to do before you begin the program. You do this in DOS (C:> system prompt on the screen) to the coastal sub-directory, where you have installed the program. Do this by typing :

cd\"coastal"

Press "enter"

where *"coastal"* is what you called the subdirectory your application is in. The computer will respond by changing the screen prompt so that it reads:

c:\coastal>

If you are running AquaPlan from diskette, change to the appropriate drive.

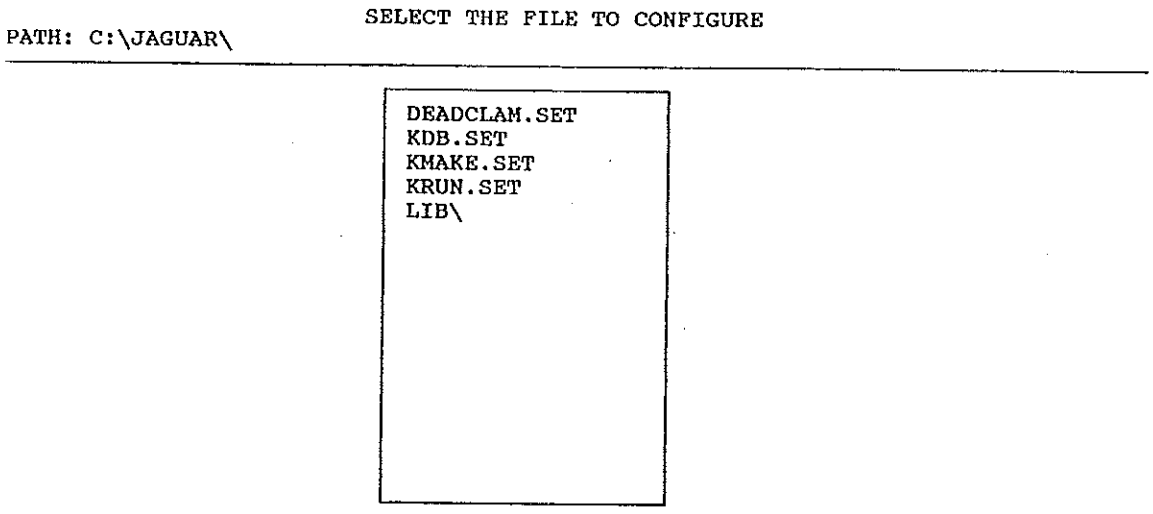
Now you will type in:

"kconfig"

Press "enter"

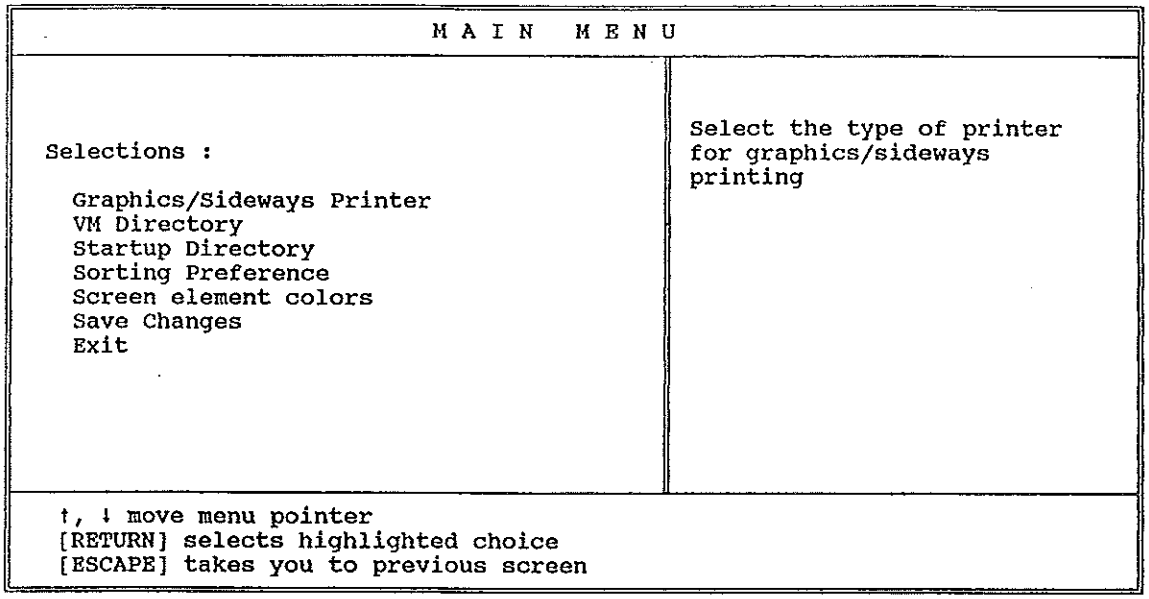
which will bring up the screen that allows you to choose your printer. The screen will look like this (Figure 1):

Figure 1.



At this point, "AquaPlan.set" will be highlighted. Press the "enter" key to proceed with set-up. A second screen will be on your screen. It will look like this (Figure 2):

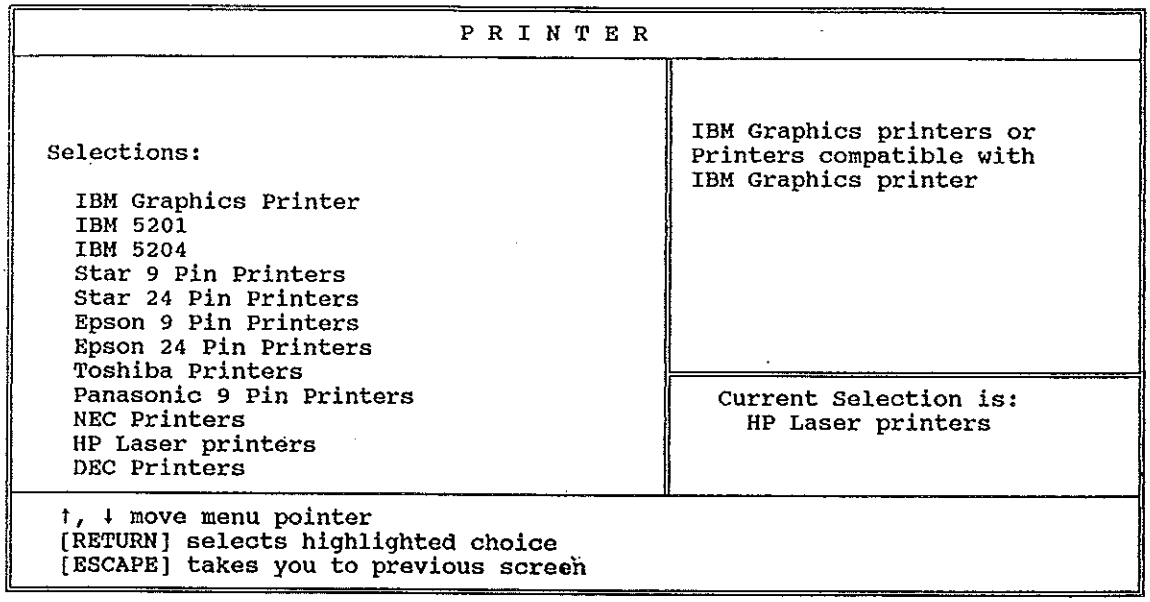
Figure 2.



You should already have highlighted the first choice "Graphics/Sideways Menu" which is the correct entry. If you have moved from that choice, use the up and down arrow keys to highlight it and press "enter".

A third screen titled "Printer" will now be visible. It looks like this (Figure 3):

Figure 3.

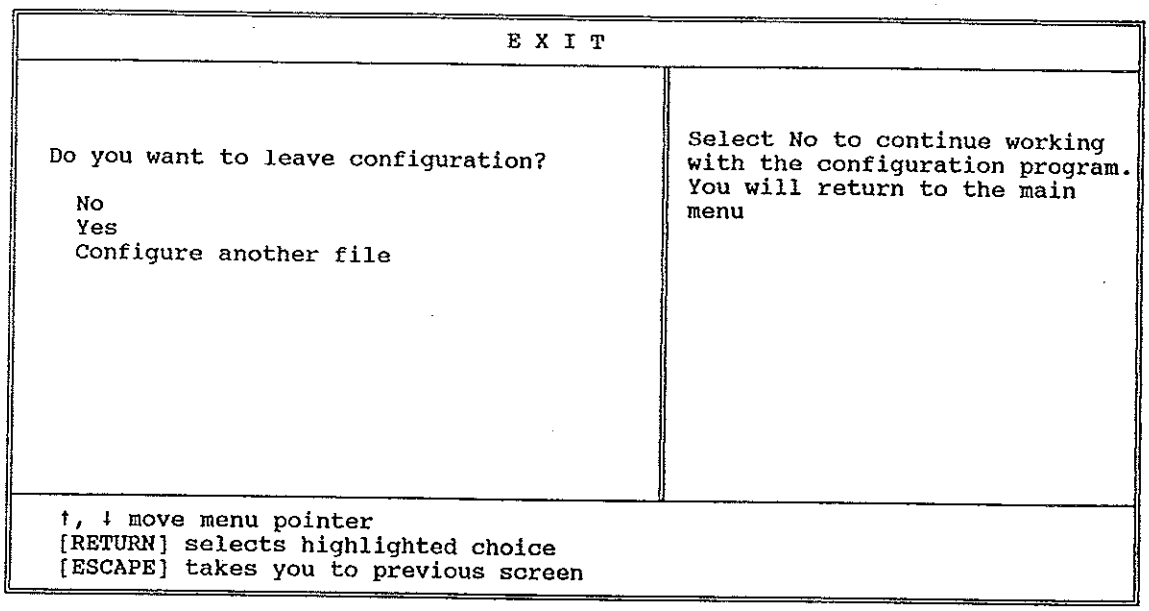


As you can see from this screen, there are seven brand names of printers to choose from. Use the up and down arrow keys to scroll through the list to see if your printer is listed in the upper right hand box of the screen. (This box changes each time you change selections in the left list.) If your printer is not listed under one of the selections for your "brand name," choose that brand name anyway. Often, printers are re-released with new "model" numbers, but use the same printer driver. (A driver is software instructions that allow your printer to understand what your computer is telling you to print.) As with the other screens, when your selection is highlighted, press "enter".

This will bring back the second screen viewed earlier, where you chose "Graphics/Sideways Printer." This time, however, you will use the up and down arrow keys to choose "Save Changes." When this is highlighted, press "enter". The same screen will be visible. Now you must choose "Exit" with the up and down arrow keys and press "enter" again.

A last screen will appear, which looks like this (Figure 4):

Figure 4.


E X I T
Do you want to leave configuration?
No
Yes
Configure another file
Select No to continue working with the configuration program. You will return to the main menu
↑, ↓ move menu pointer
[RETURN] selects highlighted choice
[ESCAPE] takes you to previous screen

This asks if you want to leave the configuration program. Use the up and down arrow keys to highlight "Yes" and press "enter." This should return you to the DOS "C:\>" screen. At this point you have let the program know which printer to use when printing your spreadsheets.

Compressing Print

Finding the Compressed Print Code.

Some of the financial spreadsheets are quite large in AquaPlan, and therefore, using the default size print for your printer will not result in putting all or even most of each sheet on one page of paper. To "shrink" the size of the print, you must look up a "printer code" for your printer. This will be found in your printer's manual. There are three ways to look in the manual for the code that you need. First, if there is a section about using your printer with "Lotus 1-2-3" brand software, it is possible the code for compressed print will be found in that section. If there isn't a section for that software, there will likely be a heading in the index for "compressed print." If so, look in that section for instructions. The third place to look is usually an appendix to your manual called either "Escape Sequences," "Control Codes" or "ASCII Escape Codes." What we are looking for is the "code" to enter into the program. The particular one we are looking for is either "compressed print" or "print pitch." There should usually be a listing after this of three formats you can use: 1) Escape Sequence; 2) Decimal Equivalent; and 3) Hex. Equivalent. The one that works with this

program is "Decimal Equivalent." Copy this set of numbers down before you proceed into the program to print.

Entering the Compressed Print Code in AquaPlan

Once you have located the compressed or print pitch code, you must enter it into the AquaPlan program. Start the program and bring your spreadsheets onto the screen. To enter the code, we must get rid of the specialized menus you have been using, temporarily. To do this, press the "Esc" key once. If the menus do not disappear, press the "escape" key a second time. The area where the menus were should be blank now.

Now you are going to activate the spreadsheet's default menus. (This should be the only time you have to do this.) Press the slash key(" / ") . A new set of menus should appear. You choose the items the same way you do with the other menus. The choices to make are first "Print." After choosing this, you have a choice of "Printer" or "File." Choose "Printer." Now you will have a list of choices, including "Options" which you will now choose. Your next (and thankfully, last) choice to make is "Setup String." When you have made this choice, the program will tell you to enter the setup string.

Now you will type in the code we looked up earlier, that you should have written down. It should be a string of three numbers followed by more sets of

three numbers. Enter the numbers by typing them, including the spaces as they appeared in your manual. When you are done, press "enter". You may now press "Esc" until these menus disappear from the top of the screen.

Once the top of the screen is devoid of menus, press the "Alt" and "M" keys simultaneously, to bring back the program's specialized menus. Now, printing should be simple. Choose the "Print" command. This will give you a choice of which statement you would like to print. Choose the one you want and press "enter". (Make sure your printer is on, on-line, and has paper before you do this or you will get an error.) You should now be printing the spreadsheet.

What If This Isn't Working?

There are two things that could be wrong here. One, an incompatible printer driver is chosen. (This is what we did earlier in the section titled "Choosing a Printer in AquaPlan." Second, the escape code could be incorrect for your printer.)

What If My Print Looks Like Gibberish?

If you have chosen an incompatible printer driver, it is likely if you are printing anything at all, it is gibberish. If this is the case, you will need to exit the program and go back to the instructions for "Choosing a Printer in

AquaPlan." When you get to the screen that lists the printer choices (Figure 3) again, follow the same instructions as earlier go to the choice you made earlier, and determine if in the upper right hand box the model number of your printer is present. If it is not, you may have to try a couple of other choices.

Unfortunately, it requires you to go back to your printer manual to decide which other choice to make. Printer companies realize that all software may not come with the exact printer driver that your printer requires, so they program the printer to be able to "emulate" or pretend to be another type of printer. You need to look through your manual to find out what printers can be emulated. Usually, this information can be found one of two places. First, look in the index under "Emulation" or "Printer Emulation" and look up the information for that section. If you can't find it there, in the section with instructions for initially setting up your printer, there may be instructions on emulation. Once you find the emulation possibilities, you need to see if what are called "DIP" switches need to be reset on your printer. If they do, set them according to the manual for the printer it can emulate.

Many printers come with the capability to emulate "IBM Graphics Printers" and "Epsom 9 or 24 Pin Printers" which are choices available with the AquaPlan program. If one of these, or any of the listings from the choose "Printer" screen from KCONFIG can be emulated, follow the printer manual's

instructions to cause it to do so. Now, you must follow the instructions under "Choosing a Printer in AquaPlan" again to select the driver of the printer you are now emulating. You should then try to print again.

What If the Print is Legible But Not Compressed?

This is a more difficult problem to solve. First check the escape code in the manual and compare it with what you typed in. Use the instructions given in the section "Entering the Compressed Print Code in AquaPlan." If you seem to have entered the correct code, you most likely will have to call the technical support center number for your printer company. You will likely need to know the brand, model number and registration number (if there is one) for your printer before you call. What you are asking for is a "decimal equivalent" of an "escape code" to print compressed size print. If further information is needed, the program AquaPlan uses codes compatible with Lotus 1-2-3 (brand) spreadsheets, Version 2. They should be able to give you a correct code from there. Take that code and use the instructions under "Entering the Compressed Print Code in AquaPlan" to enter your new code.

CASE STUDY APPENDIX

CASE STUDY

Economic Analysis of Small Scale Off-Bottom Oyster Culture: growing market size oysters in floating trays

Introduction

Fishing for oysters, *Crassostrea virginica,* has long been a part of the history and heritage of Chesapeake Bay. However, in recent times oyster harvests have declined disastrously. Harvests in 1992 were a 60 year low. The 105,000 bushels harvested in 1992 are less than 3% of 1959 harvest, approximately four million bushels (Figure 1). Between 1880 and 1904 bay oyster harvest estimates were seven million bushels (Hargis and Haven 1988). The main reasons sited for the decline are overharvesting, pollution and disease. While scientists, politicians, fishermen, and fisheries managers formulate and debate various strategies for maintaining and restoring the traditional fishery thus preserving the jobs and heritage of the working watermen, others are looking at new ways of harvesting oysters from the Bay. Off-bottom oyster aquaculture is a potential method of continuing the oyster harvest.

Marine aquaculture, the controlled production of marine or estuarine organisms, has been part of the oyster industry on Chesapeake Bay for about a century. In fact, most market size oysters harvested in Virginia are from oyster

planters and their private leases. Oyster planting generally includes moving naturally produced seed oysters (small young oysters) from areas where they are present in abundance to privately leased areas of the Bay where they are planted at lower densities, promoting growth. According to Mann et al. (1991), the life cycle and growth of the native oyster are such that colonization of a presently denuded (clean) high salinity oyster bed would require a minimum of three years--without serious loss--before a crop could be harvested.

Two diseases Dermo, *Perkinsus marinus*, and MSX, *Haplosporidium nelsoni*, present serious threats to the oyster fishery and any attempts at oyster culture. Distribution and abundance of these diseases are limited by salinity and temperature. High salinity and temperature are favorable to both Dermo and MSX. As a result, most oyster mortality occurs during the summer. During the drought years of the late 1980s salinities within the Bay rose allowing Dermo to migrate into areas where it had not existed previously. Dermo has spread to all public oyster beds in Virginia, and accounts for 70% to 90% of oyster mortality (Burreson and Andrews 1988). Mortality from Dermo is more closely related to previous exposure than current infection intensity (Paynter and Burreson 1991). Given these conditions, an oyster that requires three years to reach market size is likely to have two Dermo exposures and die before harvest. In recent years, Dermo has presented the larger disease threat. However, MSX is still a serious production hazard.

Unlike Dermo which has persisted in areas even after salinities decrease, the presence of MSX is controlled by salinity. When salinities are below 15 ppt, MSX is generally not observed. This makes disease exposure less likely than Dermo. However, MSX is still a serious threat to production. Infection is more difficult to predict and mortality from MSX generally occurs within one season of exposure. Mortality can be as high as 80%, though it is usually 30% to 50% of the crop (Burreson 1994).

Strategies for growing oysters in the presence of these obstacles fit two general categories "Fight or Flight." The fight alternative involves developing or using oysters that are disease resistant or at least less susceptible to diseases. Unfortunately, oysters that are resistant to one disease are generally more susceptible to the other. Off-bottom aquaculture exploits the flight strategy, growing oysters to market size before mortality is expected. Research by Paynter and DiMichele (1990) showed that oysters maintained off-bottom grew faster than those on bottom. Off-bottom culture methods have produced market size oysters within 17 to 23 months of hatchery spawning (Luckenbach 1993). Off-bottom culture does not provide oysters with increased disease resistance so careful management and timing are required for a grower to avoid two Dermo exposures and related mortality. The oyster aquaculture program at the Virginia Institute of Marine Science (VIMS) works in cooperation with private growers to improve production technology and management.

A fledgling oyster aquaculture industry has started in Maryland and Virginia based on off-bottom culture. A benefit of off-bottom culture is that it tends to produce oysters that are relatively free from fouling and are uniform in size. These attributes are desired by the valuable half-shell market. A review of historic ex-vessel prices by region shows that the smaller producing states of the Northeast have higher ex-vessel prices than other areas on the East Coast of the U.S. (Lipton and Kirkley 1993). The explanation for the price difference is, most of the oysters harvested from these areas are destined for the high-value half-shell trade. Of the 190 companies contacted, 95% sold half-shell oysters, 61% stated that half-shell oysters accounted for most of their business, and 43% indicated a preference for Eastern oysters for the half-shell trade (Lipton and Kirkley 1993).

Scientists have demonstrated that oysters can be grown to market size using off-bottom culture methods, and economists have shown that high quality half-shell oysters command the highest prices. What businessmen need to know, however is can oysters be grown profitably. This analysis describes one off-bottom culture method used for the production of market oysters, and the financial consequences of changes in various aspects of production and financing. Evaluating the effects of changes in production and financial assumptions helps oyster growers and scientists target research and development efforts towards areas where they are likely to have the greatest benefit.

Methods and Data

Literature review and personal interviews of producers, suppliers, and researchers provide the basis for farm design and management strategies. Although the uncertainty associated with oyster culture (disease threat, availability of seed, and market variability) has not prevented people from investing in off-bottom culture, it has tempered expectations and short-term goals. Most of the growers/businesses are small, marketing less than 50,000 animals per year. Many individuals have maintained sources of "off-farm" income and designed production methods around existing assets (waterfront property, boats, truck, and oyster leases) and skills (carpentry, welding, engineering, etc.).

Description of the "Farm" Model

This analysis uses Quattro Pro spreadsheet software and examines only the grow-out component of off-bottom culture (production of market-ready animals). The floating wood tray grow-out system is used in this analysis because it is one of the oldest off-bottom culture methods used in the Bay and there is relatively good information about the cost and usable life of these floating trays in production systems. The strategy is to stock large oyster seed (0.75 inch to 1.00 inch) during the spring (March/early April) in a sheltered estuary. Maintenance is required through the spring and summer to remove fouling organisms and predators. Through the fall and early winter oysters are culled; those attaining 3" are harvested and marketed. Remaining oysters are overwintered and harvested from

February until May. The intent is to avoid disease while maximizing margins by marketing during periods of peak demand. November, December, and January are the major sales months for oysters on the East Coast (Lipton and Kirkley 1993). Although production levels are currently low and many growers wish to remain relatively small businesses; most growers want to expand operations beyond current production levels. The stocking levels assumed for each year of production follow this expansion philosophy (Figure 2).

Individual floating trays are constructed of wood and 0.25 inch plastic mesh with the dimensions 2' x 3' x 4" similar to those described by Paynter et al. (1992). Including factors for tray wear and spare trays to facilitate cleaning and maintenance activities, a 15% surplus of trays was incorporated into the analysis (Table 1). The production cycle does not follow the calendar year and extends beyond 12 months. This requires that inventory (works in progress) be carried over from one calendar year to the next. This inventory is not market-ready and is valued at 75% of expected market prices.

Oysters are stocked at their final grow-out density of 50/ft^2, 300 per tray, in the spring of the year listed. Survival yr. 1 is the survival from time of stocking through 31 December and is estimated at 70%. Oysters that are not harvested in the year they are planted as "carry-over" to the next year. Survival yr. 2 is the survival of these remaining animals from 1 January to market size, and is

estimated at 50%. This two-stage survival results in an overall survival of 45%, including animals harvested in the first year. This represents a midpoint survival estimate. Depending upon location, survival of oysters cultured off-bottom has ranged from 0% to 90% (VIMS oyster aquaculture program, unpublished data). The number of oysters available for harvest in a given year is calculated using the following formula:

$$Available_i = (Stock_i * S_1) + (Carry_i * S_2)$$

WHERE:

$Available_i$	=	oysters available in yr. 1;
$Stock_i$	=	number of oysters stocked in yr. 1;
$Carry_i$	=	number of oysters carried over from previous years stock;
S_1	=	survival yr. 1
S_2	=	survival yr. 2

Oyster growth is estimated by what percentage of oysters that reach market size in the first year, "Harvested (%, year crop)." The baseline assumption is 30% of the oysters planted in the spring will reach market size before 31 December. The projected number of oysters harvested, "Harvested", is calculated using the following formula:

$$Harvested_i = (Stock_i * S_1) * Harvest_1)) + (Carry_i * S_2).$$

WHERE:

$Harvested_i$	=	oysters harvested in yr. 1;
$Stock_i$	=	number of oysters stocked in yr. 1;
$Harvest_1$	=	the percentage of crop ready for harvest in yr. 1;
$Carry_i$	=	number of oysters carried over from previous years stock;
S_1	=	survival yr. 1;
S_2	=	survival yr. 2.

Not all animals that attain market size will be marketed, some will be misshapen, clumped together, heavily fouled or needed for quality assurance checks, and promotional efforts. It is assumed that about 95% of harvested oysters will be shipped to markets. Marketed number is the total number of oysters expected to be sold in each year listed.

Biological and production assumptions translate directly into equipment (tray) needs. Trays stocked is calculated based on the number of animals stocked and their initial density (number per tray). Trays required for carry-over and rounding are also calculated. Trays needed for these purposes are totaled. Then trays needed for wear and surplus are added to estimate total tray requirements. New tray needs are calculated by subtracting the number of trays available (required) from the year before from those needed for the present year. Trays are assumed to have a useful life of three years; trays purchased in 1994 are replaced in 1997.

Expenses

Other expenses that are considered in the analysis include: management salary, labor, fuel, phone, utilities, seed oysters, packaging, and labeling. General overhead items include marketing, legal fees, accounting fees, insurance, leases, and miscellaneous charges. A management salary is not charged against the business since almost none of the businesses have a full-time manager dedicated to

oyster culture. A labor rate of $10/hr. is used to account for the investment of time a grower would need to dedicate to the business or pay skilled labor to maintain the production system. The lower $6/hr. figure is for unskilled labor. Labor estimates are based on discussions with growers, VIMS oyster aquaculture field staff, and the work reported by Paynter et al. (1992). Fuel price is estimated at $1.05/gal. Fuel use increases with stocking levels. Telephone expenses are based on $30/month for local service with long distance charges increasing with production to account for increased marketing efforts. Utility rates are $0.14/kwh and usage increases with production. Fuel, telephone, and utility expense estimates are primarily educated guesses, since many growers do not track their expenses by enterprise. Seed costs are estimated at $0.05 each. This is based on private hatchery prices for large seed. Waxed boxes used for shipping and storing half-shell oysters cost about $1 each for the 100 ct. size. Producer labels and tags documenting harvest site and other certifications needed for interstate shipping are $0.15 per box. A budget for marketing expenses beyond packaging, and long distance communications was not included in this analysis. Legal and accounting fees were based on the costs of chartering a company, retaining legal counsel, and hiring a certified public accountant to generate and maintain annual financial records, and prepare tax documents.

Revenue

Oyster prices are estimated at $0.28 each; shipped FOB to their destination. This price is the average half-shell price for cultured oysters for the period December 1992 through June 1993 (Figure 3). Prices are published by Virginia Department of Agriculture and Consumer Services (VDA&CS). Interest on cash reserves was assumed to be 3.5% annual percentage rate (APR). The analysis assumes 1993 real dollars and does not include inflation.

Securing bank loans for aquaculture is difficult; even in the more established clam industry bank financing is rare. Owner financing for original and replacement equipment plus operations is 100%. Table 2 provides a schedule of capital costs, start-up costs, and financial assumptions. Land requirements and costs are based county requirements of one to five acres for development of waterfront property and prices quotes obtained from various real estate agencies. Cost of a small building for packing oysters and office space represents the only building costs included in this analysis. Depending upon site selection, production goals, and desires of management, other building options might include a pier and storage buildings. Estimated costs of buildings and land are about $46,500. Field equipment includes: boat, motor, trailer, a half-ton truck, trays, hand tools, and miscellaneous field equipment totaling $16,588. Office equipment includes: a computer, printer, telephone, furniture, and miscellaneous office equipment totaling $2,860. Start up costs included are: site selection, permitting, insurance,

legal fees, accounting fees, salary, telephone, travel, office expenses, and miscellaneous expenses. Including cash reserves at 25% of total capital investment and start-up costs, the total estimated initial investment is $88,000.

The net present value (NPV) of an investment is the sum of the present values for each year's net cash flow (to the investor) including ending equity less the cost of investment. An investor's discount rate is the basis for present value calculations. The discount rate represents the opportunity costs of capital; it is the rate of return the equity capital generates in its best alternate use of equal risk. This discount rate has two components: a risk free rate representing the time value of money and a risk premium reflecting the uncertainty of future cash flows. In this research the discount rate is 15%. The risk premium necessary to make oyster farming financially attractive justifies this rate. Opportunity costs is 9%, this represents a capital rent charge.

Statements generated include: capital investment and asset addition, cash flow, income, and enterprise budget. Other analyses include: cumulative capital investment by major categories and break-even analyses.

Sensitivity Analysis

The baseline assumptions represent expectations for an average site in an average year and as such do not change. In reality however, conditions affecting production, expenses, revenues, and financing do change. Allowing these parameters to vary around the assumed levels will provide some insight into how sensitive the profitability of oyster culture is to each of these parameters. Eight variables are manipulated independently to evaluate each variables' effects on the financial performance of the business. The variables analyzed are: survival yr. 1, survival yr. 2, growth (% of animals expected to reach market in yr. 1), seed prices, labor amounts (hrs.), tray price, market oyster prices, and equity (Table 3). The effects of changes in these variables will be compared on the following criteria: 1999 proforma revenues, operating expenses, interest (expense), depreciation, net income, break-even price, break-even survival, and net worth. Over the 10 year planning horizon, the cumulative break-even price and survival, and NPV of the investment are compared.

Results

Baseline case

Initial capital investment represents what is required to start the business. Many of these items have to be replaced and/or supplemented during the 10 year planning horizon (Table 4). Tray cost represents the single largest cost category, nearly double land cost. Evaluating total investment for the planning period by

category, shows that the next highest level of investment is field equipment, followed by construction, office equipment, and start-up expenses (Figure 4).

Start-up expenses mark the beginning of the cash flow statement (Table 5). It is assumed that the expenses charged during start-up occurred in 1994. Also, shown during this period is the initial investment amount of $88,000. Because production does not begin until spring it is assumed that many purchases can be made in early 1994 including trays and field equipment. Cash outflow for these items is shown in the categories "replace machine" and "replace non-machine" and total $65,873. Projected revenues for 1994 consist of $2,234 from the sale of oysters. Variable operating expenses include the following: labor, fuel, telephone, utilities, seed, packing, shipping, maintenance of equipment. These items total $8,450. Fixed overhead expenses include: insurance, legal and accounting fees, and property taxes. These items total $856. Variable expenses increase with production levels. Figure 5 illustrates how production, revenue, and expenses are expected to change over time with farm expansion. Since this operation is assumed to be 100% owner (equity) financed no loans occur, hence no loan values. If ending cash balance becomes negative, an investment equal to the amount required to obtain a positive cash balance of $5,000 occurs in the following year. Based on projected cash flows the NPV of the investment is ($112,529).

The proforma income statement shows cash exchanges (income and expenses) as well as noncash changes such as inventory value and depreciation for the planning period (Table 6). During 1999, sales generate about $9,682 in income that is offset by $14,207 in operating expenses and $7,718 in depreciation charges resulting in a net income of ($12,243). Net income is always negative. Only in 2001 do changes in inventory exceed depreciation. Cumulative net income for the entire planning period is ($130,763).

In the enterprise budget total revenues from the crop and total cost (total variable costs plus total fixed costs) associated with producing the crop are calculated (Table 7). "Net before tax returns to capital and risk" is the result of total revenues less total cost. For 1999 this dollar amount is ($7,898) and represents the amount of money that is available for, in this case owed before paying corporate income taxes and providing returns to the owner's equity (investment) and risk. Net before tax return to capital and risk is negative throughout the planning horizon. If the 9% risk capital rent charge is applied to initial investment the "net before tax returns to risk" is ($15,818) for 1999.

Break-even analysis reveals that $0.51 is required for revenue to equal production cost for 1999. This represents a margin of ($0.23). As production increases, annual and cumulative break-even price requirements are reduced as shown in Figure 6. With a selling price of $0.47 per oyster, the business would

generate enough income to equal production costs (not including opportunity costs) for the entire planning period. Break-even oysters is the number of oysters marketed at the expected market price needed to meet production costs. Break-even survival is the percentage of the oysters planted that would need to be harvested in order provide the required number of market oysters. Eighty-three percent of the oysters intended for harvest in 1999 would need to survive in order for the farm to break-even. The cumulative break-even estimate is 80%. Break-even survival estimates are corrected for growth (30% marketed in year 1) and marketability factors (95%). In the early years, it is impossible for business to break-even, given length of production season, market prices, and expenses. The number of oysters harvested would have to exceed the number planted.

Sensitivity Analysis

Production values

Survival yr. 1 is the percentage of oysters stocked that are harvested before or survive until 31 December of the year they are planted. Table 8 shows the effects of adjusting survival yr. 1 by increments of 5 percentage points, 7.1% of baseline assumptions. Increasing survival yr. 1from 70% to 75%, increases the number of oysters marketed in 1999 by 2,698 and results in a 7.1% increase in revenue. There is a slight increase in operating expenses and depreciation costs due to the additional number of trays needed. Year 5 (1999) net income increases 4.5%. Break-even price decreases 5.6%. Cumulative break-even price decreases 6.4%.

Net worth increases by 1.9% and NPV increases $3,844 (3.45%).

Increasing yr. 2 survival by 20% (10 percentage points) increases revenues by 10.8% and net income by 8.2% (Table 9). Break-even price for 1999 decreases by 9.8%, and 1999 net worth increases by 1.9%. Cumulative break-even price decreases 8.5% and NPV increases by 5.4% .

If the percentage of oysters that reach market in the first year increases by 33%, revenue improves 7.7%, net income increases 7.6%, 1999 break-even price decreases 7.8%, break-even survival decreases 1.2%, cumulative break-even price decreases 10.6%, and cumulative break-even survival decreases 2.5% (Table 10). Net worth (1999) increases 0.7% and NPV increases 6.0%.

Input expenses

Increasing seed costs by 40% ($0.02) has no effect on revenue, but it does increase operating expenses by 11.3% and net income by 11% (Table 11). Break-even selling price for 1999 increases $0.04 (7.8%) and 1999 break-even survival increases 8.4%. Net worth decreases 3%. Cumulative break-even price and survival increase 12.8% and 11.2% respectively. Net present value decreases 10.1%.

Increasing labor hours by 50% also has no effect on revenues. It does, however, increase annual operating expenses for 1999 by 16.7% and decreases net income by 19.4% (Table 12). Break-even prices increase 13.7% and break-even survival increases 13.3%. Net worth decreases 4.4%. Cumulative break-even price and survival increase by 12.8 and 13.8% respectively. NPV decreases 12.7%.

Increasing tray price by 25% ($5) increases depreciation charges by 13.5%; decreases net income by 8.6%, and increases break-even price by $0.03 per oyster (Table 13). Break-even survival also increases nearly 6%. Increasing price of trays has no effect on net-worth. Cumulative break-even price increases by 6.4% or $0.03 and cumulative break-even survival increases by 6.2%. Changes in NPV are about 5.7%.

Revenues

Increasing the price received for market oysters by $0.07 or 25% increases revenues by 25% and does not affect expenses or depreciation or any break-even price (Table 14). It increases net income by 19.8 %, decreases break-even survival from 83% to 66% (20.5% decrease), and reduces cumulative break-even survival by 20.%. The NPV of the investment increases from ($112,529) to ($96,756) or 14%.

Financing

Decreasing owner equity by 25% or utilizing debt capital for 25% of capital investment has no effect on revenues, operating expenses, or depreciation (Table 15). It does, however, increase interest expenses by 953.34. Net income decreases from (12242.61) to (13195.95), 7.8%. Break-even prices increase 5.9% or $0.03 and break-even survival increases 4.8% or 4 percentage points, cumulative break-even price and survival increase by $0.02 and 3 percentage points respectively. Net worth (1999) decreases to $44,068.14, 17.8%, and NPV increases to ($85,266).

Discussion

Size related trends in growth and mortality for other oyster species, *C. gigas* and *Ostrea edulis,* generally supports the strategy of off-bottom culture to out-run disease (Askew 1978). However technical feasibility does not mean financial viability. Ridler and Roderick (1991) compared the financial feasibility of growing *O. edulis* in Nova Scotia using suspension culture and bottom culture methods. Bottom culture resulted in a lower survival and less attractive product but lower costs yielded a NPV (17.6% discount rate) nearly doubled suspension culture for the cottage farmer (Ridler and Roderick 1991). Ridler and Roderick (1991) also made a distinction between a commercial enterprise and a cottage farmer. An assumption applied to the cottage farmer/fisherman is: no opportunity cost for the use of land, trucks, or boats. The commercial enterprise in contrast purchased all of these items. The cottage farmer/fisherman was also assumed to have an off-farm income

from the fishing industry. Not surprisingly the cottage farms were found to be more profitable. The research by Paynter et al. (1992) which also treated oyster culture as a cottage industry excluding charges for land, facilities, marketing, and distribution. The estimated costs were $0.13-$0.19/oyster for 150,000 oysters. This amount is substantially less than the $0.38 projected for 171,000 oysters marketed in 2004 under baseline assumptions in this analysis.

Farm size and expansion plan was selected to match the production goals of a plurality of oyster growers on the Chesapeake Bay and the mid-Atlantic region. The expansion plan increases production throughout the planning horizon. During growth phases, companies traditionally incur debt at a rapid rate. Due to the lack of debt financing in aquaculture, expansion is financed by additional equity capital. Although an appropriate expansion plan given the variability inherent in culturing marine organisms and learning curves, this plan does not represent the most profitable alternative under certainty. Efficient utilization of fixed resources (land, buildings, and vessels) does not occur until higher production levels are achieved. Scale economies are important in aquaculture. Research by Keenum and Waldrup (1988) shows the advantages associated with size of catfish farms. Similarly scale economies were documented in shrimp culture by Lambregts et al (1993). Coffen and Charles (1991) found increasing returns to scale in Canadian oyster culture, which included on-bottom methods. Returns to scale, however were constant for mussel culture. Mussels are produced principally through suspension (off-bottom)

culture that is conceptually very similar to off-bottom oyster culture. The modular design inherent in both systems favors constant returns to scale.

The most obvious and erroneous conclusion that could be drawn from this study is that off-bottom oyster culture in Virginia cannot be made to be profitable. The error in that conclusion is that this analysis uses aggregate information from a number of research and grow-out sites. Included in this pool of information are sites that are part of a long-term study to determine the physical characteristics of growing sites propitious for off-bottom culture. The goal is that in the future growers will be able to select "better than average" sites or at least avoid sites where the probability of success is below average. Production systems (including sites) need to be better than the Bay average in many categories (survival, growth, capital costs, labor, financing, etc.). The following sections discuss factors affecting the variables examined in this study and current research that may provide improved management strategies for the future.

Production values

Of the three biological factors evaluated survival yr. 1 has the greatest financial effect. Low survival during the first year can be caused by many factors: availability of high quality disease-free seed, inaccurate counts, animals escaping through the mesh, red tides (dinoflagellates), flat worms, and MSX. Salinity and temperature limit the distribution of MSX and Dermo. High salinity and

temperature favorable to both (Ford 1985). Low temperature was considered to be the controlling factor in the failure of Dermo to persist in Delaware Bay or become epizootic north of Chesapeake Bay (Christensen 1956; Ford 1992; Andrews and Hewatt 1957). Other research also suggests that the concentration and or virulence of infective Dermo life stages is higher at higher salinities (Chu and Greene 1989; Chu and LaPeyre 1991) or physical characteristics with respect to disease tolerance are more robust at lower salinities (Fisher and Newell 1986).

Wetter climate regimes should reduce disease pressure. To base business decisions on long-term (multi year) global or regional weather projections increases uncertainty levels substantially. It may be more prudent to manage around the weather and locate nursery enterprises in lower salinity areas, or to permit multiple sites and have multiple or "portable" nursery systems. Juvenile oysters (spat) can become infected with either pathogen, but because they are in contact with a much smaller volume of water than adult oysters, the probability of encountering disease is lower. When this attribute is combined with the lower volume and weight for a given number of oysters, a portable nursery system would seem more feasible than grow-out. As these production options are studied, careful monitoring of the costs and expected returns associated with these endeavors should also be included in the analyses.

Yr. 2 survival is most likely to be affected by slow growth (failure to reach market size before a second exposure to Dermo) MSX, red tides, natural and manmade disasters. Advancements in the production of disease resistant oysters should improve yr. 2 and overall survival. Potential sources of disease resistance in oysters include: the Pacific oyster, *C gigas*; triploid oysters; and oysters selectively bred for disease resistance.

By reducing disease susceptibility growth may also be improved. Oysters which are infected with Dermo grow slower (Menzel and Hopkins 1955; Ray et al. 1953; Andrews 1961; Paynter and Burreson 1991). Reduction in growth rate after Dermo infection is essentially immediate within a tray at a given site and once infection occurred the entire population within the tray appeared to be infected (Paynter and Burreson 1991). The impact of infection on growth is positively correlated with salinity as is oyster growth. However, once infected absolute growth values are not different between salinities, approximately 3mm/month (Paynter and Burreson 1991). Large oysters tend to acquire Dermo earlier and more intensely. Mortality of larger oysters is one factor that may explain the reduced growth associated with disease.

Input costs and expenses

Seed oysters are a major component (20%-25%) of annual expenditures and reducing seed price has a substantial impact on profitability. A 1% change in seed

price changes net income by 0.33%. Price estimates are from supplier price lists. Depending upon resources available a grower will need to determine if it is more economical to integrate production and include nursery facilities or continue to buy nursery services in the form of large seed. This is still a very young industry in the mid-Atlantic region. It is believed that as grow-out industry expands, hatcheries and nurseries will increase their output; thus reducing per unit cost and gaining experience that will lead to improved production methodologies.

Purchase of trays accounts for nearly 47% of capital outlays for the planning horizon. Cost reductions in this area will improve profitability of the farm. A 1% change in tray price results in a 0.34% change in net income. Increasing the size and capacity of the tray may improve profitability in much the same way that increasing pond size increases profitability of shrimp farming (Griffin et al. 1993). Increasing tray size might also decrease the amount of labor required for maintenance on a per oyster basis. This benefit would need to be judged against the need for more equipment as tray size would quickly surpass what could be handled safely from a small boat. Changing labor hours has a slightly greater effect than tray price a 1% change in labor changes net income by 0.39%. The input cost and expense categories all have roughly equivalent effects on the financial performance of the farm though labor hours have a slightly greater effect than seed price and tray cost.

Revenue

Market oyster price has the greatest effect on revenues and no effect on operating expenses, depreciation, or break-even price. Of all the variables considered market price has the greatest financial effect. A 1% change in market price produces a 0.79% change in net income and a 0.56% change in NPV. The importance of market price and survival in the financial feasibility of oyster culture was also noted in the research examining tray culture on the Texas Gulf Coast (Martinez et al. 1992). However, increasing oyster prices is much easier in a simulation analysis than in real life. In fact, considerable marketing efforts will likely be required just to maintain current prices as production increases. Review of landings statistics (VMRC) show prices of oysters from the Virginia fishery declining in recent years despite decreases in supply; indicating possible reduction in demand (Figure 1). There is also evidence that negative media publicity, such as what happened in the late 1980s, significantly reduced the demand for oysters (Lin et al. 1991). Lipton and Kirkley (1993) concluded that the demand for oysters has declined in the past 10 years.

Financial

Changing the ratio of equity to debt capital used to finance farm operations naturally has the greatest effects on net worth and NPV. Using NPV to compare investments that are of substantially different magnitudes however, is not appropriate. Debt capital will reduce the magnitude of NPV by reducing

investment. Appropriate use of debt and equity capital is important for the success of aquaculture enterprises. The availability of debt capital will be important for the development of aquaculture in general. To gain access to these funds however, Chesapeake Bay oyster growers will need to document that their production system (including site) will be a substantial improvement over those presented here. This documentation should include a thorough business plan.

Although they are businessmen, many of the individuals growing oysters off-bottom are motivated by reasons other than profit. They want to be part of an industry that helps the Bay. They enjoy working on the water and producing high quality food for people to enjoy. It is difficult to place a value on these personal benefits along with the potential ecological benefits of oysters culture. According to a study by Jonas and Tuttle (1990), oyster culture may improve water quality in the Bay. Despite the difficulty in quantifying these non-economic elements of growing oysters, they are important considerations in evaluating the overall value of oyster culture in Virginia.

References

Andrews, J.D. 1961. Measurement of shell growth in oysters by weighing in water. *Proc. Natl. Shellf. Assoc.* 52:1-11.

Andrews, J. D. and W.G. Hewatt. 1957. Oyster mortality studies in Virginia II: The fungus disease caused by *Dermocystidium marinum* in oysters of Chesapeake Bay. *Ecolog Monogr.* 27:1-26.

Askew, C.G.. 1978. A generalized growth and mortality model for assessing the economics of bivalve culture. *Aquaculture* (14):91-104.

Burreson, E.M. 1994. Personal communication.

Burreson, E. M. 1991. Effects of *Perkinsus marinus* infection in the eastern oyster, *Crassostrea virginica*: I. Susceptibility of native and MSX resistant stocks. *Journal of Shellfish Research 10(2):417-423.*

Burreson, E. M. and J. D. Andrews. 1988. Unusual intensification of Chesapeake Bay oyster disease during recent drought conditions. Oceans 88 Proc. Vol,. 3:799-802. IEEE Cat. No. 88-CH2585-8.

Christensen, G. 1956. The occurrence of *Dermocystidium marinum* (Mackin, Owen, and Collier) in Delaware Bay. Unpublished manuscript. Haskin Shellfish Research Laboratory, Rutgers University, Port Norris, NJ, USA. 30p.

Chu, F.E. and K.H. Greene. 1989. Effect of temperature and salinity on in vitro culture of the oyster pathogen, *Perkinsus marinus* (Apicomplexa: Perkinsea). *J. Inv. Path.* 53:260-268.

Chu, F.E. and J.F. LaPeyre. 1991. Effect of salinity in *Perkinsus marinus* susceptibility and defense-related activities in eastern oysters, *Crassostrea virginica. Journal of Shellfish Research* 10:294.

Coffen, S.S. and A.T. Charles. 1991. Production economics of shellfish aquaculture in Atlantic Canada: a preliminary analysis. *Aqua. and Fish. Mgmt.* 22:193-202.

Crosby, M.P. and C.F. Roberts. 1990. Seasonal infection intensity cycle of the parasite *Perkinsus marinus* (and an absence of *Haplosporidium spp.*) in oysters from a South Carolina salt marsh. *Diseases of Aquatic Organisms* 9:149-155.

Fisher, W.S. and R.I.E. Newell. 1986. Salinity effects on the activity of granular hemocytes of American oysters, *Crassostrea virginica. Biol. Bull.* 170:122-134.

Ford, S.E. 1992. Evidence surrounding the spread of disease by introduction and transfer of mollusks, with special reference to *Perkinsus marinus* (Dermo) *and Haplosporidium nelsoni* (MSX). *Journal of Shellfish Research* 11(2):539-546.

Griffin, Wade L., Johannes A.D. Lambregts, M.W. Yates, and A. Garcia. 1993. The impact of aquaculture pond design on returns to shrimp farms. *J. World Aquac. Soc.* 24:23-30.

Hargis, W.J., Jr. and D.S. Haven. 1988. Rehabilitation of the troubled oyster industry of the lower Chesapeake Bay. *Journal of Shellfish Research* 7:271-279.

Jonas, Robert B. and Jon H. Tuttle. 1990. Improving Chesapeake Bay Water Quality: Influence of rafted oyster aquaculture on microbial processes and organic carbon. *Chesapeake Research Consortium.* Publication No. 137.

Keenum, M. E. and J. E. Waldrup. 1988. Economic analysis of farm-raised catfish production in Mississippi. Technical Bulletin 155, Mississippi Agriculture and Forestry Experiment Station, Mississippi State University.

Lambregts, Johannes A.D., Sayra G. Thacker, and Wade L. Griffin. 1993. Economic evaluation of different stocking densities for various sized shrimp farms in Texas. *J.World Aqua. Soc.* 24:12-22.

Lipton, Douglas and James Kirkley. 1993. A Profile of the oyster industry of the Northeastern United States. Final Contract Report to the National Marine FIsheries Service, Northeast Region, under Grant Number NA90AA-D-FM740 and NA90AA-D-FM743.

Luckenbach, Mark. 1993. Personal communication.

Lin, C., T. Jordan, W. Milon, and E. Babb. 1991. Determinants of Subjective Food Safety Perceptions: A case study of oysters in the Southeast. *J. Agribus.* 9(1):71-84.

Mann, Roger, Eugene M. Burreson and Patrick K. Baker. 1991. The decline of the Virginia oyster fishery in Chesapeake Bay: considerations for introduction of a non-endemic species, *Crassostrea gigas* (Thunberg, 1793). *Journal of Shellfish Research* 10(2):379-388.

Martinez, Mirella, Leonard DiMichele, and Sammy M. Ray. 1992. Cultchless eastern oyster *Crassostrea virginica* (Gmelin 1791) culture on the Texas Gulf Coast: a feasibility analysis and comparison to traditional oyster fishing. *Journal of Shellfish Research* 11(1):149-156.

Menzel, R.W. and S. H. Hopkins 1955. The growth of oysters parasitized by the fungus Dermocystidium marinum and by the trematode *Bucephalus cuculus.* *J. Parasitol.* 41:333-342.

Paynter, Kennedy T. and Leonard DiMichele. 1990. Growth of tray cultured oysters (*Crassostrea virginica* Gmelin) in the Chesapeake Bay. *Aquaculture.* 87: 289-297.

Paynter, Kennedy T., Jr. and Eugene M. Burreson. 1991. Effects of *Perkinsus marinus* infection in the eastern oyster, *Crassostrea virginica*: II. Disease development and impact on growth rate at different salinities. *Journal of Shellfish Research* 10(2):425:431.

Paynter, Kennedy T., Michael E. Mallonee, and Samuel H. Shriver. 1992. Cost analysis of floating raft oyster production in Chesapeake Bay. *Journal of Shellfish Research* 11(1): 163-167.

Ray, S. M., J.G. Mackin, and J.L. Boswell. 1953. Quantitative measurement of the effect on oysters of disease caused by *Dermocystidium marinum. Bull. Mar. Sci. Gulf and Carib.* 3:6-33.

Ridler, N.B. and W. Roderick. 1991. Financial feasibility and farm systems in cultivating *Ostrea edulis* Linnaeus, 1750. *Journal of Shellfish Research* 10(2):395-398.

Virginia Department of Agriculture and Consumer Services. 1993. Aquaculture Market News; various issues.

Virginia Marine Resources Commission. 1985-1993. *Commercial fisheries statistics -- Virginia landings.*

Figure 1. Virginia Oyster Fishery Landings 1931-1992.

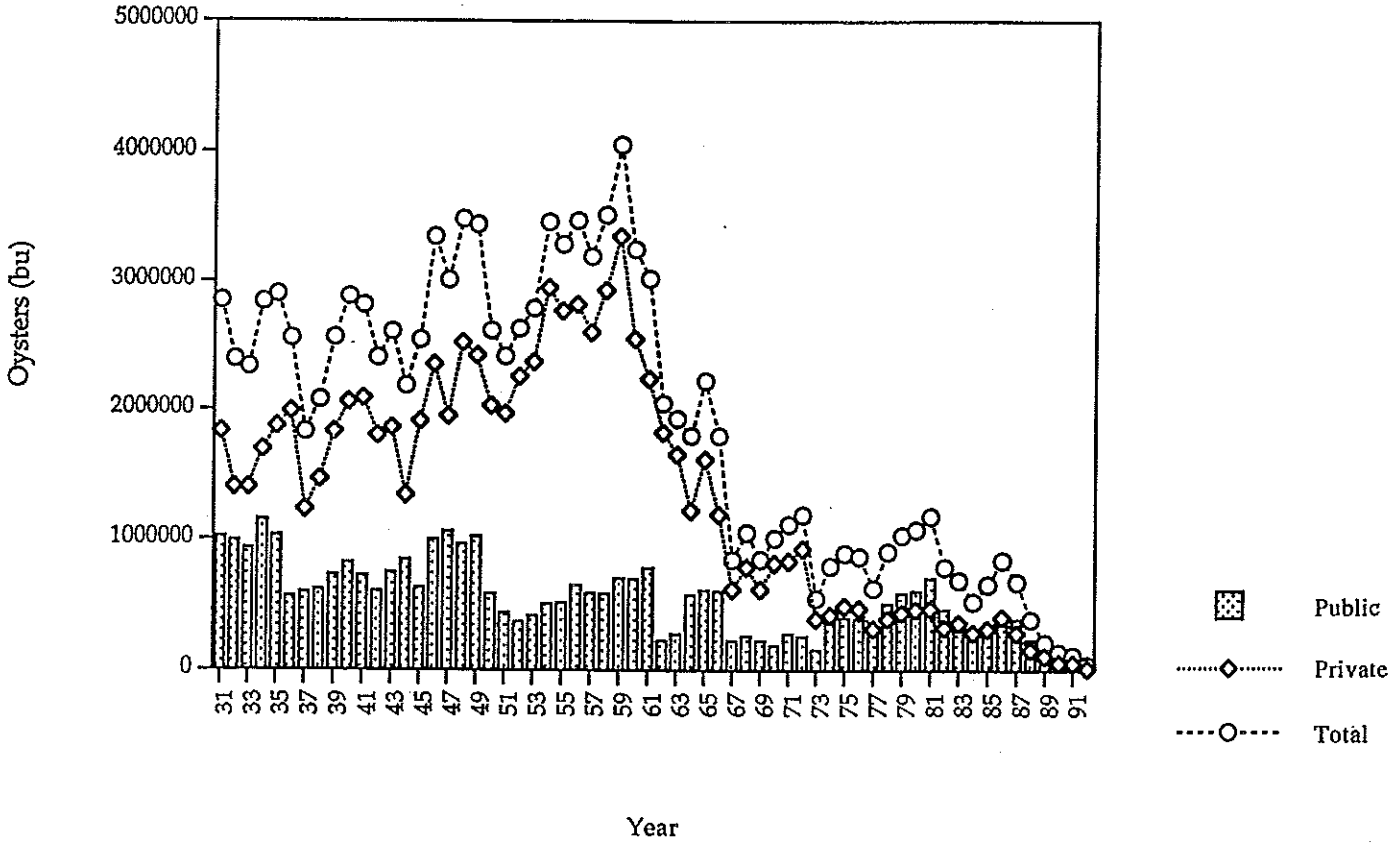


Figure 2.

production data

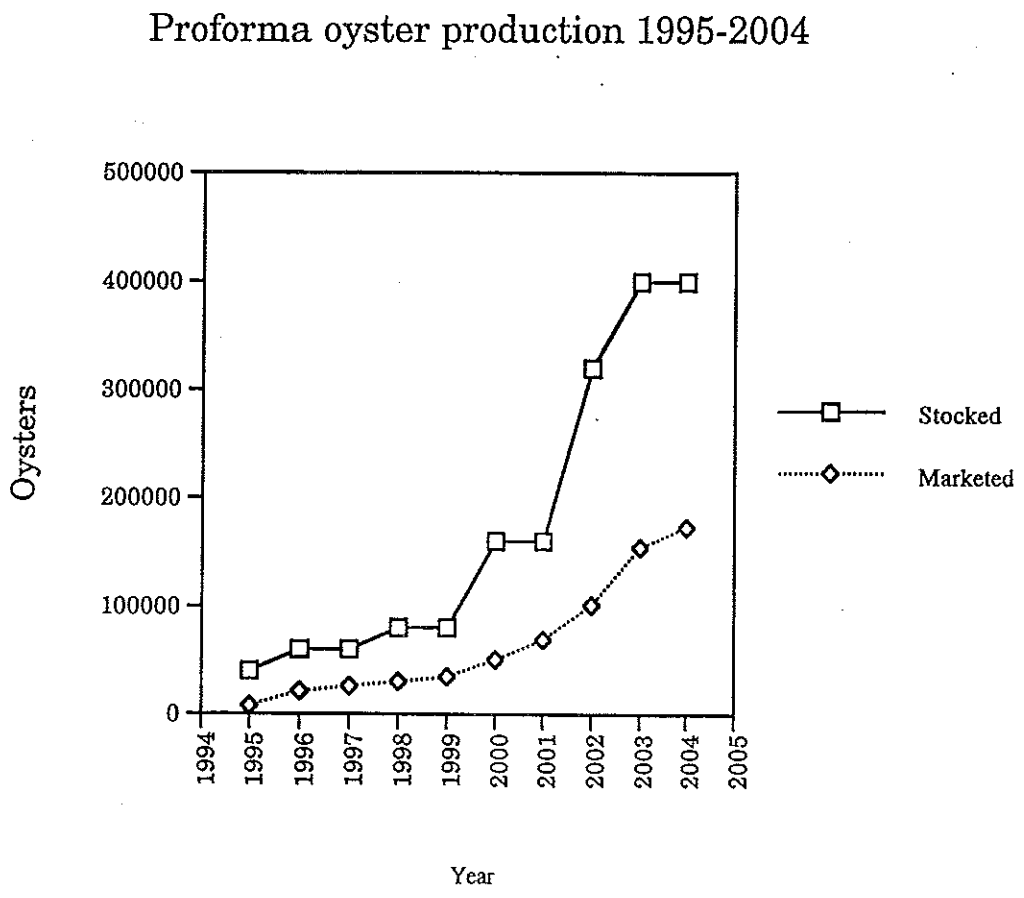


Figure 3.

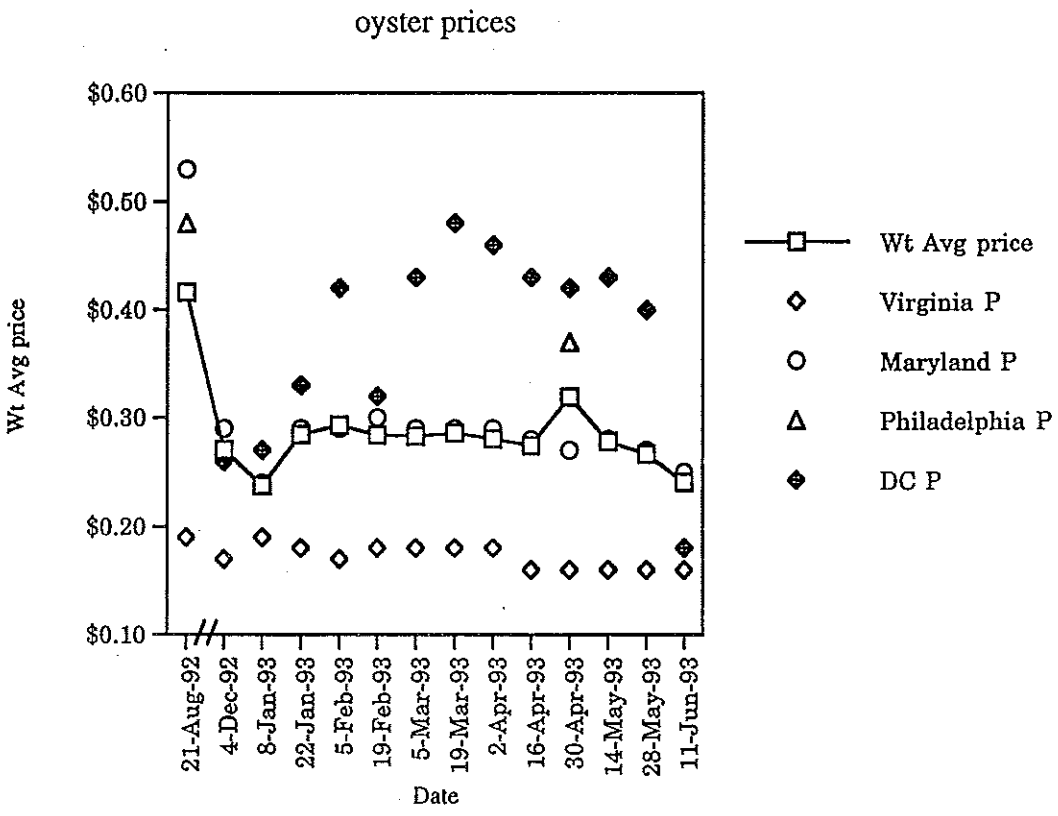

oyster prices
$0.60
$0.50
$0.40
$0.30
$0.20
$0.10
Wt Avg price
21-Aug-92
4-Dec-92
8-Jan-93
22-Jan-93
5-Feb-93
19-Feb-93
5-Mar-93
19-Mar-93
2-Apr-93
16-Apr-93
30-Apr-93
14-May-93
28-May-93
11-Jun-93
Date
Wt Avg price
Virginia P
Maryland P
Philadelphia P
DC P

Figure 4.

Asset addition for the 10 year planning horizon

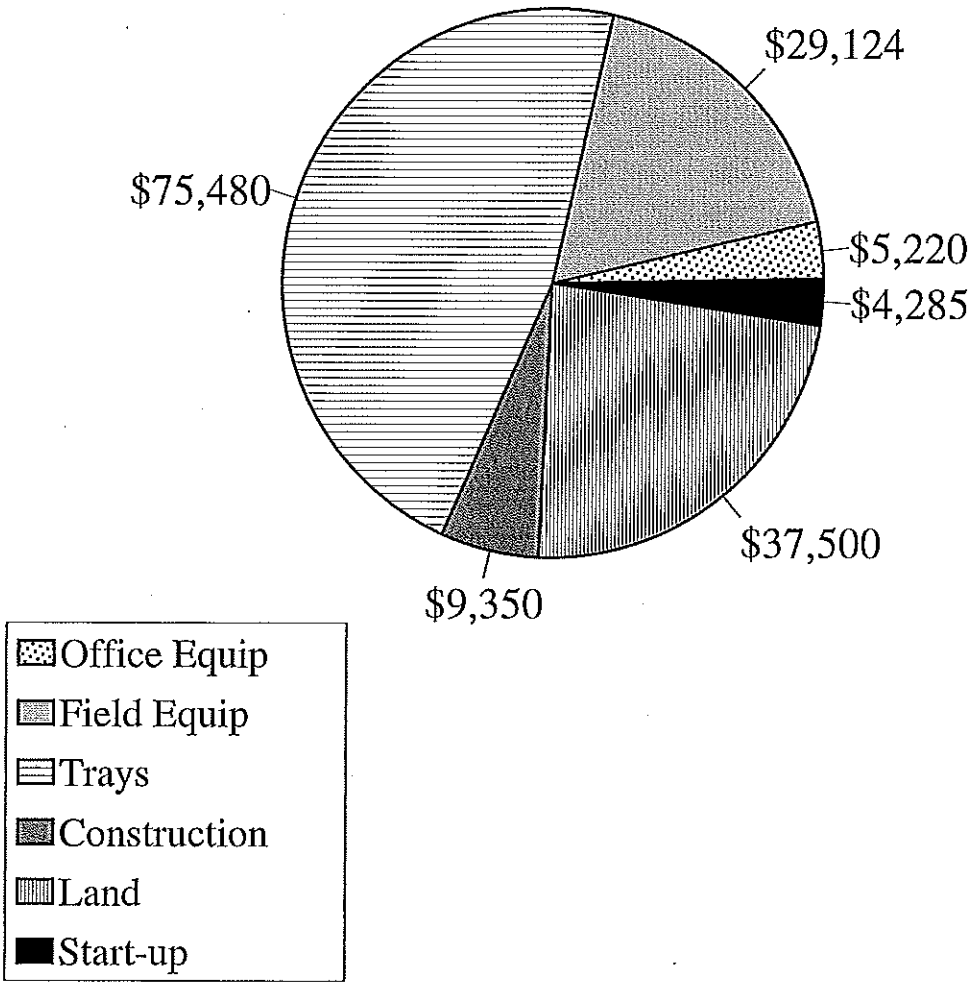


Figure 5.

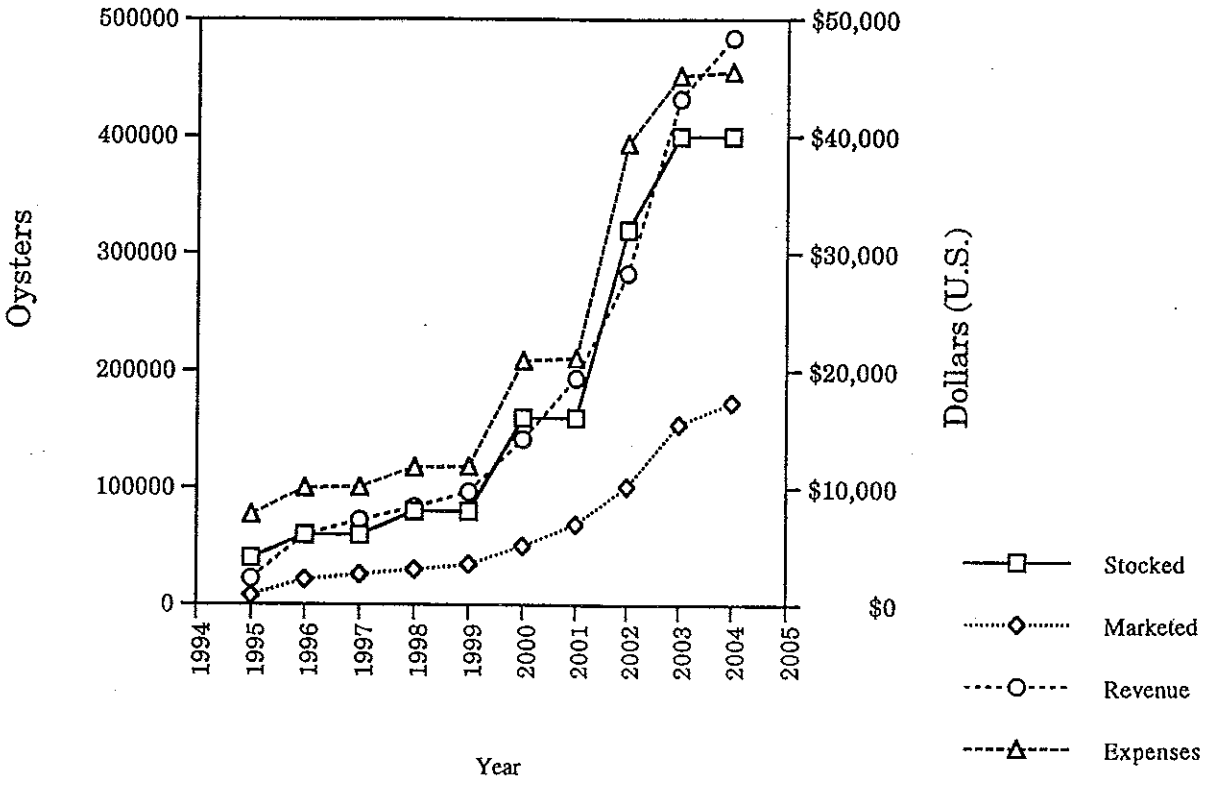

500000
400000
300000
200000
100000
0
Oysters
$50,000
$40,000
$30,000
$20,000
$10,000
$0
Dollars (U.S.)
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year
Stocked
Marketed
Revenue
Expenses

Table 1.

Important Assumptions

Oyster Mariculture
Floating Tray (wood) Grow-out System
1 man operation w/expansion
Baseline PROFORMA
IMPORTANT ASSUMPTIONS & EXPECTATIONS

ASSUMPTIONS

Tray size (ft2)	6	Tray surplus	0.05	oyster/box	100	Tray wear	0.1			
Trays/Unit	0.00			Inv value	75%	Mesh sizes	1.00			

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
BIOLOGICAL										
Animals Stocked	40000	60000	60000	80000	80000	160000	160000	320000	400000	400000
Density (#/ft2)	50	50	50	50	50	50	50	50	50	50
Animals/tray	300	300	300	300	300	300	300	300	300	300
Split	N	N	N	N	N	N	N	N	N	N
Survival yr1	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Survival yr2	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Available	28000	51800	56700	70700	75600	131600	151200	263200	358400	378000
Harvested (%, year crop)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Harvested (#)	8400	22400	27300	31500	36400	53200	72800	106400	162400	182000
Carry-over(#)	19600	29400	29400	39200	39200	78400	78400	156800	196000	196000
Marketed (%)	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Marketed (#)	7980	21280	25935	29925	34580	50540	69160	101080	154280	172900
EQUIPMENT										
Trays stocked	133	200	200	267	267	533	533	1067	1333	1333
Trays larger mesh	0	0	0	0	0	0	0	0	0	0
Trays (splitting,carryover, rounding)	1	66	99	99	132	132	262	262	524	654
Total Trays (inc surplus & wear)	154	306	344	421	459	765	914	1528	2136	2285
New Trays needed	154	152	38	231	190	344	380	804	952	529
Units	0	0	0	0	0	0	0	0	0	0
New Units	0	0	0	0	0	0	0	0	0	0
EXPENSES										
Management Salary	0	0	0	0	0	0	0	0	0	0
Labor1 rate	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Labor2 rate	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Labor1 hrs	305.00	415.00	415.00	475.00	475.00	950.00	950.00	1800.00	1800.00	1800.00
Labor2 hrs	0.00	0.00	0.00	0.00	0.00	0.00		200.00	400.00	400.00
Fuel price	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Fuel use	200	200	225	250	275	400	400	600	600	700
Phone	540	540	540	600	600	700	700	750	750	800
Utilities ($/Kwh)	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Utilities (Kwh)	1200	1800	1800	2000	2000	3500	3500	6000	7000	7000
Seed price	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Oyster boxes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Tags	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Marketing	0	0	0	0	0	0	0	0	0	0
Legal fees	300	300	300	300	300	300	300	300	300	300
Accounting fees	250	250	250	250	250	250	250	250	250	250
Insurance	700	700	700	700	700	700	700	700	700	700
Land/Building/Dock lease	0	0	0	0	0	0	0	0	0	0
Miscellaneous	0	0	0	0	0	0	0	0	0	0
REVENUE										
Oyster price	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Interest	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%
Inflation (% annual)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 2.

ASSET ADDITION

Oyster Mariculture
Floating Tray (wood) Grow-out System
1 man operation w/expansion
Baseline PROFORMA

Capital Investment & Asset Addition

CATEGORY/ITEM	life	Investment 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total	
Land		37500										37500	23.30%
Packing area/Office	20	8500										8500	5.28%
Storage	20	0										0	0.00%
Dock	20	0										0	0.00%
Miscellaneous	5	425					425					850	0.53%
Boat	8	2000								2000		4000	2.49%
Motor	5	1000					1000					2000	1.24%
Trailer	8	700								700		1400	0.87%
Truck-1/2 ton	5	8000					8000					16000	9.94%
Trays	3	3080	3040	760	4620	3800	6880	7600	16080	19040	10580	75480	46.89%
Units	5	0	0	0	0	0	0	0	0	0	0	0	0.00%
Snorkling-SCUBA	3	0			0			0			0	0	0.00%
Tools	3	300			300			300			300	1200	0.75%
Other Machines	3	0				0					0	0	0.00%
Other Non-Machines	3	0				0					0	0	0.00%
Miscellaneous	3	1508				1508					1508	4524	2.81%
Computer	5	1500					1500					3000	1.86%
Printer	5	500					500					1000	0.62%
Fax machine	5	0					0					0	0.00%
Phone/Answer	5	100					100					200	0.12%
Furniture	10	500										500	0.31%
Other	5	0					0					0	0.00%
Miscellaneous	5	260					260					520	0.32%
Start-up costs	0	4285										4285	2.66%
Total		70158	3040	760	4920	5308	18665	7900	16080	21740	12388	160959	100%

Table 3.

INVESTMENT

Oyster Mariculture
Floating Tray (wood) Grow-out System
1 man operation w/expansion
Baseline PROFORMA

Capital Cost & Initial Investment Schedule — 100% Owner Financing Original; 100% Owner Financing Replace

CATEGORY/ITEM	life	quantity	units	unit cost	total cost	salvage value	Maintain Factor	Annual Maintenanc
REAL ESTATE								
Land		2.50	acres	15000	37500	37500	3.00%	1125
Subtotal(U-life/group)	50				37500	37500		
CONSTRUCTION/BUILDINGS								
Packing area/Office	20	500	sq ft	17	8500	2550	5.00%	425
Storage	20	0	sq ft	10	0	0	5.00%	0
Dock	20	0	sq ft	9	0	0	5.00%	0
Miscellaneous	5	1		425	425	0	5.00%	21
Subtotal(U-life/group)	20				8925	2550		
FIELD EQUIPMENT								
Boat	8	1		2000	2000	0	5.00%	100
Motor	5	1		1000	1000	0	5.00%	50
Trailer	8	1		700	700	0	5.00%	35
Truck-1/2 ton	5	1		8000	8000	0	5.00%	400
Trays	3	154		20	3080	0	0.00%	0
Units	5	0		0	0	0	5.00%	0
Wet suits	3	0		200	0	0	5.00%	0
Snorkling-SCUBA	3	0		75	0	0	5.00%	0
Tools	3	1		300	300	0	5.00%	15
Other Machines	3	0		0	0	0	5.00%	0
Other Non-Machines	3	0		0	0	0	5.00%	0
Miscellaneous	3	1		1508	1508	0	5.00%	75
Subtotal(U-life/group)	4				16588	0		
OFFICE EQUIPMENT								
Computer	5	1		1500	1500	0	5.00%	75
Printer	5	1		500	500	0	5.00%	25
Fax machine	5	0		300	0	0	5.00%	0
Phone/Answer	5	1		100	100	0	5.00%	5
Furniture	10	1		500	500	0	5.00%	25
Other	5	0		0	0	0	5.00%	0
Miscellaneous	5	1		260	260	0	5.00%	13
Subtotal(U-life/group)	5				2860	0		
SUBTOTAL					65873			
START-UP COSTS								
Site selection		1		200	200			
Permitting		1		125	125			
Insurance		6	months	50	300			
Legal fees		5	hrs	120	600			
Accounting fees		2	hrs	80	160			
Salary		200	hrs	10	2000			
Phone bill		6	months	30	180			
Travel		1	ct	500	500			
Office expenses		1	ct	150	150			
Miscellaneous		1	ct	70	70			
Subtotal					4285			
TOTAL					70158			

Owner Financing Ops	100%		
Cash Reserve	25%	Initial Investment	88000
Minimum Cash Avail	5000		
Oportunity Costs	9.00%		
Interest land&constr(15 yr.	7.50%		
Interest original equip (3 yr.	8.00%		
Interest replace equip (3 yr.	8.00%		
Interest ops	8.00%		
Tax rate land & equip	0.50%		
Discount rate	15.00%		

Table 4.

MK-VALUE

Oyster Mariculture
Floating Tray (wood) Grow-out System
1 man operation w/expansion
Baseline PROFORMA

Asset Values & Depreciation

CATEGORY/ITEM	life	Investment 1995	Salvage Value	Annual Depreciation	Value 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Book Value 2005
Land		37500	37500		37500	37500	37500	37500	37500	37500	37500	37500	37500	37500	37500
Packing area/Office	20	8500	2550	298	8203	7905	7608	7310	7013	6715	6418	6120	5823	5525	5228
Storage	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dock	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous	5	425	0	85	340	255	170	85	0	340	255	170	85	0	0
Boat	8	2000	0	250	1750	1500	1250	1000	750	500	250	0	1750	1500	1250
Motor	5	1000	0	200	800	600	400	200	0	800	600	400	200	0	0
Trailer	8	700	0	88	613								700		0
Truck-1/2 ton	5	8000	0	1600	6400	4800	3200	1600	0	6400	4800	3200	1600	0	0
Trays	3	3080	0		2053	3053	1520	3333	4073	5853	7360	13253	18053	13400	3527
Units	5	0	0		0	0	0	0	0	0	0	0	0	0	0
Snorkling-SCUBA	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tools	3	300	0	100	200	100	0	200	100	0	200	100	0	200	100
Other Machines	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Non-Machines	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous	3	1508	0	503	1005	503	0	1005	503	0	1005	503	0	1005	503
Computer	5	1500	0	300	1200	900	600	300	0	1200	900	600	300	0	0
Printer	5	500	0	100	400	300	200	100	0	400	300	200	100	0	0
Fax machine	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phone/Answer	5	100	0	20	80	60	40	20	0	80	60	40	20	0	0
Furniture	10	500	0	50	450	400	350	300	250	200	150	100	50	0	0
Other	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous	5	260	0	52	208	156	104	52	0	208	156	104	52	0	0
Start-up costs	0	4285													
Total		70158	40050	3645	61202	58032	52942	53006	50189	60196	59954	62290	66233	59130	48107

Table 5.

Cash FLOW

Oyster Mariculture
Floating Tray (wood) Grow-out System
1 man operation w/expansion
Baseline PROFORMA

Cash Flow Statement (Annual)

CATEGORY	Start-up	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
POSITIVE											
Beginning Cash		70090	-3527	-4387	-864	-5666	-4817	-23130	-7364	-25295	-22031
Reciepts											
revenues		2234	5958	7262	8379	9682	14151	19365	28302	43198	48412
interest			0	0	0	0	0	0	0	0	0
new loans											
long	0										
intermediate		0					0				
operating		0	0	0	0	0	0	0	0	0	0
Contract Services											
Investment	83000	0	8527	9387	5864	10666	9817	28130	12364	30295	27031
Total	83000	72324	10958	12262	13379	14682	19151	24365	33302	48198	53412
NEGATIVE											
Capital Investment											
Land	37500										
Construction	8925										
Operating expenses											
Managemtent Salary		0	0	0	0	0	0	0	0	0	0
Labor	2000	3050	4150	4150	4750	4750	9500	9500	19200	20400	20400
Fuel		210	210	236	263	289	420	420	630	630	735
Phone	180	540	540	540	600	600	700	700	750	750	800
Utilities		168	252	252	280	280	490	490	840	980	980
Stocking		2000	3000	3000	4000	4000	8000	8000	16000	20000	20000
Packing & Shipping		92	245	298	344	398	581	795	1162	1774	1988
Marketing		0	0	0	0	0	0	0	0	0	0
Insurance		700	700	700	700	700	700	700	700	700	700
Fees and Taxes											
legal fees	600	300	300	300	300	300	300	300	300	300	300
accountant fees	160	250	250	250	250	250	250	250	250	250	250
property taxes		295	285	265	264	250	301	299	311	331	295
Repair and replace											
repair-nonmach		1819	1819	1819	1819	1819	1819	1819	1819	1819	1819
repair-mach		555	555	555	555	555	555	555	555	555	555
replace-nonmach		54773	3040	760	4920	5308	7565	7900	16080	21740	12388
replace-mach		11100	0	0	0	0	11100	0	0	0	0
Miscellaneous	1045	0	0	0	0	0	0	0	0	0	0
Loans											
interest-long		0	0	0	0	0	0	0	0	0	0
interest-interm		0	0	0	0	0	0	0	0	0	0
interest-operating		0	0	0	0	0	0	0	0	0	0
principal-long		0	0	0	0	0	0	0	0	0	0
principal-interm		0	0	0	0	0	0	0	0	0	0
principal-operating		0	0	0	0	0	0	0	0	0	0
Subtotal	12910	75852	15345	13125	19045	19499	42281	31728	58598	70230	61210
Draw		0	0	0	0	0	0	0	0	0	0
Total	12910	75852	15345	13125	19045	19499	42281	31728	58598	70230	61210
ENDING CASH	70090	-3527	-4387	-864	-5666	-4817	-23130	-7364	-25295	-22031	-7798
IRR	#NUM!										
NPV	-112053										

Table 6.

INCOME STATEMENT

Oyster Mariculture
Floating Tray (wood) Grow-out System
1 man operation w/expansion
Baseline PROFORMA

Income Statement

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CASH INCOME										
Sales	2234.40	5958.40	7261.80	8379.00	9682.40	14151.20	19364.80	28302.40	43198.40	48412.00
Interest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Contract Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Cash Income	2234.40	5958.40	7261.80	8379.00	9682.40	14151.20	19364.80	28302.40	43198.40	48412.00
CASH EXPENSES										
Operating	10005.43	12326.53	12380.86	14141.32	14207.01	23631.84	23844.76	42533.52	48505.03	48838.65
Financial (interest)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Cash Expenses	10005.43	12326.53	12380.86	14141.32	14207.01	23631.84	23844.76	42533.52	48505.03	48838.65
NONCASH ADJUSTMENTS TO INCOME										
Depreciation	4671.33	5684.67	5938.00	7478.00	7718.00	8998.00	11278.00	15098.00	20178.00	21411.33
Changes in inventory	4116.00	2058.00	0.00	2058.00	0.00	8232.00	0.00	16464.00	8232.00	0.00
Net Noncash Adjustments	-555.33	-3626.67	-5938.00	-5420.00	-7718.00	-766.00	-11278.00	1366.00	-11946.00	-21411.33
Net Income	-8326.36	-9994.80	-11057.06	-11182.32	-12242.61	-10246.64	-15757.96	-12865.12	-17252.63	-21837.99
Cumulative Net Income	-8326.36	-18321.16	-29378.22	-40560.53	-52803.15	-63049.79	-78807.75	-91672.87	-108925.50	-130763.49

Table 7.

ENTERPRISE BUDGET

Oyster Mariculture
Floating Tray (wood) Grow-out System
1 man operation w/expansion
Baseline PROFORMA

Enterprise Budget	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
REVENUES										
Oyster sales	2234.40	5958.40	7261.80	8379.00	9682.40	14151.20	19364.80	28302.40	43198.40	48412.00
OPERATING EXPENSES										
Variable costs										
Seed	2000.00	3000.00	3000.00	4000.00	4000.00	8000.00	8000.00	16000.00	20000.00	20000.00
Fuel	210.00	210.00	236.25	262.50	288.75	420.00	420.00	630.00	630.00	735.00
Maintenance	2389.65	2389.65	2389.65	2389.65	2389.65	2389.65	2389.65	2389.65	2389.65	2389.65
Boxes&Tags	91.77	244.72	298.25	344.14	397.67	581.21	795.34	1162.42	1774.22	1988.35
Labor	3050.00	4150.00	4150.00	4750.00	4750.00	9500.00	9500.00	19200.00	20400.00	20400.00
Marketing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneous	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Variable Costs	7741.42	9994.37	10074.15	11746.29	11826.07	20890.86	21104.99	39382.07	45193.87	45513.00
Fixed costs										
Overhead										
Insurance	700.00	700.00	700.00	700.00	700.00	700.00	700.00			
Miscellaneous	1564.01	1632.16	1606.71	1695.03	1680.94	2040.98	2039.77	2451.45	2611.16	2625.65
Management Salary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	1026.67	2040.00	2293.33	3833.33	4073.33	5353.33	7633.33	11453.33	16533.33	17766.67
Total Fixed Costs	2590.68	3672.16	3900.04	5528.36	5754.28	7394.32	9673.10	13904.78	19144.50	20392.32
Total Costs	10332.10	13666.53	13974.19	17274.65	17580.35	28285.18	30778.09	53286.85	64338.37	65905.32
Net returns before tax to capital and risk	-8097.70	-7708.13	-6712.39	-8895.65	-7897.95	-14133.98	-11413.29	-24984.45	-21139.97	-17493.32
Oportunity cost of initial owner equity	7920.00	7920.00	7920.00	7920.00	7920.00	7920.00	7920.00	7920.00	7920.00	7920.00
Net Return before tax risk	-16017.70	-15628.13	-14632.39	-16815.65	-15817.95	-22053.98	-19333.29	-32904.45	-29059.97	-25413.32
Yearly analyses										
Cost per Oyster/Breakeven Price	1.29	0.64	0.54	0.58	0.51	0.56	0.45	0.53	0.42	0.38
Margin/oyster	-1.01	-0.36	-0.26	-0.30	-0.23	-0.28	-0.17	-0.25	-0.14	-0.10
Break-even oysters	36900.34	48809.04	49907.83	61695.18	62786.95	101018.48	109921.76	190310.19	229779.88	235376.14
Break-even Survival	3.24	1.12	0.88	0.98	0.83	1.02	0.72	0.96	0.70	0.62
AVC	0.97	0.47	0.39	0.39	0.34	0.41	0.31	0.39	0.29	0.26
AFC	0.32	0.17	0.15	0.18	0.17	0.15	0.14	0.14	0.12	0.12
Cumulative analyses										
Cost per Oyster/Breakeven Price	1.29	0.82	0.69	0.65	0.61	0.59	0.55	0.54	0.50	0.47
Margin/oyster	-1.01	-0.54	-0.41	-0.37	-0.33	-0.31	-0.27	-0.26	-0.22	-0.19
Break-even oysters	36900.34	85709.38	135617.21	197312.38	260099.33	361117.82	471039.57	661349.76	891129.65	1126505.79
Break-even Survival	3.24	1.56	1.21	1.13	1.04	1.03	0.94	0.95	0.87	0.80
AVC	0.97	0.61	0.50	0.46	0.43	0.42	0.39	0.39	0.36	0.33
AFC	0.32	0.21	0.18	0.18	0.18	0.17	0.16	0.15	0.14	0.14

Sensitivity

Table 8

Survival yr 1	0.60	0.65	Baseline 0.70	0.75	0.80
1999 Information					
Revenues	8299.20	8990.80	9682.40	10374.00	11065.60
Operrating expenses	14149.14	14178.01	14207.01	14235.95	14264.89
Interest	0.00	0	0.00	0.00	0.00
Depreciation	7504.67	7604.67	7718.00	7824.67	7931.33
Net income	-13354.61	-12791.88	-12242.61	-11686.62	-11130.62
Break-even price	0.58	0.54	0.51	0.48	0.45
Break-even survival	0.81	0.82	0.83	0.83	0.84
Net worth	51193.23	52397.29	53587.89	54785.22	55982.54
10 year horizon					
Cum. break-even price	0.54	0.51	0.47	0.44	0.42
Cum break-even survival	0.79	0.80	0.80	0.81	0.81
NPV	-120220.00	-116374.00	-112529.00	-108685.00	104841.00

Sensitivity

Table 9

Survival yr 2	0.30	0.40	Baseline 0.50	0.60	0.70
1999 Information					
Revenues	7596.96	8639.68	9682.40	10725.12	11767.84
Operrating expenses	14121.36	14164.19	14207.01	14249.84	14292.66
Interest	0.00	0.00	0.00	0.00	0.00
Depreciation	7718.00	7718.00	7718.00	7718.00	7718.00
Net income	-14242.40	-13242.51	-12242.61	-11242.72	-10242.82
Break-even price	0.64	0.57	0.51	0.46	0.42
Break-even survival	0.82	0.82	0.83	0.83	0.83
Net worth	51588.10	52587.99	53587.89	54587.78	55587.68
10 year horizon					
Cum. break-even price	0.58	0.52	0.47	0.43	0.40
Cum break-even survival	0.80	0.80	0.80	0.80	0.80
NPV	-124658.00	-118593.00	-112529.00	-106464.00	-100400.00

Sensitivity

Table 10

Growth	0.10	0.20	Baseline 0.30	0.40	0.50
1999 Information					
Revenues	8192.80	8937.60	9682.40	10427.20	11172.00
Operrating expenses	14147.97	14177.49	14207.01	14236.54	14265.99
Interest	0.00	0.00	0.00	0.00	0.00
Depreciation	8144.67	7931.33	7718.00	7504.67	7284.67
Net income	-14099.84	-13171.22	-12242.61	-11314.01	-10378.66
Break-even price	0.61	0.56	0.51	0.47	0.43
Break-even survival	0.84	0.83	0.83	0.82	0.81
Net worth	54296.00	53941.94	53587.89	53233.83	52886.51
10 year horizon					
Cum. break-even price	0.61	0.53	0.47	0.42	0.38
Cum break-even survival	0.86	0.83	0.80	0.78	0.75
NPV	-126061.00	-119294.00	-112529.00	-105767.00	-98101.00

Sensitivity

Table 11

Seed prices	0.01	0.03	Baseline 0.05	0.07	0.09
1999 Information					
Revenues	9682.40	9682.40	9682.40	9682.40	9682.40
Operrating expenses	11007.01	12607.01	14207.01	15807.01	17407.01
Interest	0.00	0.00	0.00	0.00	0.00
Depreciation	7718.00	7718.00	7718.00	7718.00	7718.00
Net income	-9042.61	-10642.61	-12242.61	-13842.61	-15442.61
Break-even price	0.42	0.46	0.51	0.55	0.60
Break-even survival	0.68	0.75	0.83	0.90	0.98
Net worth	56787.89	55187.89	53587.89	51987.89	50387.89
10 year horizon					
Cum. break-even price	0.37	0.42	0.47	0.53	0.58
Cum break-even survival	0.62	0.71	0.80	0.89	0.98
NPV	-88965.00	-101196.00	-112529.00	-123862.00	-135194.00

Sensitivity

Table 12

Labor hrs	0.50	0.75	Baseline 1.00	1.50	2.00
1999 Information					
Revenues	9682.40	9682.40	9682.40	9682.40	9682.40
Operrating expenses	11832.01	13019.51	14207.01	16582.01	18957.01
Interest	0.00	0.00	0.00	0.00	0.00
Depreciation	7718.00	7718.00	7718.00	7718.00	7718.00
Net income	-9867.61	-11055.11	-12242.61	-14617.61	-16992.61
Break-even price	0.44	0.47	0.51	0.58	0.65
Break-even survival	0.71	0.77	0.83	0.94	1.05
Net worth	55962.89	54775.39	53587.89	51212.89	48837.89
10 year horizon					
Cum. break-even price	0.40	0.44	0.47	0.53	0.59
Cum break-even survival	0.68	0.74	0.80	0.91	1.00
NPV	-95321.00	-104758.00	-112529.00	-126831.00	-140737.00

Sensitivity

Table 13

Tray price	10.00	15.00	Baseline 20.00	25.00	30.00
1999 Information					
Revenues	9682.40	9682.40	9682.40	9682.40	9682.40
Operrating expenses	14183.81	14197.94	14207.01	14216.08	14225.15
Interest	0.00	0.00	0.00	0.00	0.00
Depreciation	4616.67	6674.00	7718.00	8762.00	9806.00
Net income	-9118.08	-11189.54	-12242.61	-13295.68	-14348.75
Break-even price	0.42	0.48	0.51	0.54	0.57
Break-even survival	0.68	0.78	0.83	0.87	0.92
Net worth	54083.76	53579.96	53587.89	53595.82	53603.75
10 year horizon					
Cum. break-even price	0.41	0.45	0.47	0.50	0.53
Cum break-even survival	0.69	0.76	0.80	0.85	0.89
NPV	-97621.00	-106124.00	-112529.00	-118933.00	-125338.00

Sensitivity

Table 14

Market oyter prices	0.14	0.21	Baseline 0.28	0.35	0.42
1999 Information					
Revenues	4841.20	7261.80	9682.40	12103.00	14523.60
Operrating expenses	14207.01	14207.01	14207.01	14207.01	14207.01
Interest	0.00	0.00	0.00	0.00	0.00
Depreciation	7718.00	7718.00	7718.00	7718.00	7718.00
Net income	-17083.81	-14663.21	-12242.61	-9822.01	-7401.41
Break-even price	0.51	0.51	0.51	0.51	0.51
Break-even survival	1.65	1.10	0.83	0.66	0.55
Net worth	44630.69	49109.29	53587.89	58066.49	6254.09
10 year horizon					
Cum. break-even price	0.47	0.47	0.47	0.47	0.47
Cum break-even survival	1.60	1.07	0.80	0.64	0.53
NPV	-144075.00	-128302.00	-112529.00	-96756.00	-80087.00

Sensitivity

Table 15

Equity	0.50	0.75	Baseline 1.00
1999 Information			
Revenues	9682.40	9682.40	9682.40
Operrating expenses	14207.01	14207.01	14207.01
Interest	1906.69	953.34	0.00
Depreciation	7718.00	7718.00	7718.00
Net income	-14149.30	-13195.95	-12242.61
Break-even price	0.56	0.54	0.51
Break-even survival	0.92	0.87	0.83
Net worth	35628.39	44068.14	53587.89
10 year horizon			
Cum. break-even price	0.51	0.49	0.47
Cum break-even survival	0.87	0.83	0.80
NPV	-58117.00	-85266.00	-112529.00