VPI-T-85-001 C2

A Decision Model to Aid in Evaluation of the Cost-effectiveness of Alternative Virginia Oyster Grounds Management Strategies

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Introduction

The decline in Virginia's oyster industry has been the subject of public concern for the past several years. This concern has prompted a great deal of investigation into the causes for the decline and ways in which the decline may be counteracted. The Joint Legislative Audit and Review (JLARC) studies of 1977 and 1982 are examples of these investigative efforts. Although the JLARC studies did not focus exclusively on the oyster fishery they did highlight several problems in the State's oyster fishery management strategies and recommended ways of ameliorating these problems. One such recommendation which is of particular relevance here was to increase the use of mathematical modeling as a fisheries management tool. In response to this recommendation a mathematical programming model of the harvest of market oysters on public and private grounds has been formulated by researchers at Virginia Tech with funds provided by the Office of Sea Grant through the Virginia Sea Grant Consortium.

The central focus of the model is the State's repletion program. The purpose of this discussion is to explain the repletion program's role in the model and how the model can be used to evaluate the impacts of alternative policy changes on the cost of producing market oysters in the state of Virginia.

The Basic Model

The objective of the model is to minimize the present value of the private plus public sector costs of producing a sustained prespecified level of market oyster harvest. Private costs include the oyster production and harvest costs to private leaseholders and the harvest costs of watermen working the public rocks. The public costs consist of the State's expenditures on Baylor grounds repletion activities.

There are three basic repletion activities used by VMRC in its repletion program. These activities are: shelling seed beds to collect spat, shelling growing areas to catch a set and allow grow-out to a harvestable size, and transplanting seed from seed beds to growing areas for subsequent harvest. Although it would be possible to attempt any one of these repletion techniques in any given river system, each river system has its own environmental characteristics which favors one technique over another or has some environmental advantage making it a superior producer of seed (the James, for example) or market oysters if the appropriate repletion strategies are employed. The assistance of VMRC repletion officers was sought in determining what repletion techniques would be productive of seed or market oysters for each river system. The model, therefore, includes only those repletion activities which were identified as being feasible by repletion officers in each river system.

In achieving the objective of minimizing the cost of producing any target level of market oysters, the model will seek the least-cost combination of repletion activities and policies that will meet the prespecified market oyster harvest goal. Just what these activities are depends on what activities the model is permitted to choose amongst.

The model recognizes several important factors affecting oysters grounds productivity. The Baylor grounds are divided into two bottom types, firm and soft. Bottoms are differentiated by firmness because softer bottoms generally require greater quantities of shelling. The repletion cost, therefore, will be greater for soft bottoms than it will be for firm bottoms. Therefore, the model includes a restriction on the amount of soft and firm Baylor bottoms available in each river system. Second, the model recognizes the amount of repletion effort expended cannot exceed budgetary allocations. Third, the model can require that a minimum amount of repletion effort be made in each of several river systems which have historically received shell or seed. The minimum level of repletion effort may be varied in any way desired.

The Model as a Management Tool

Once a target harvest level has been identified the model seeks to minimize the cost of producing and harvesting the required quantity of market oysters. With respect to the repletion program, all possible combinations of feasible repletion activities are searched in developing the most cost-effective overall public grounds repletion strategy. Several alternative harvest levels may be evaluated and the resulting implications for repletion strategies may be assessed.

As a starting point for using the model the current program will be evaluated. Once this has been accomplished it will be possible to compare alternative repletion strategies with the current situation.

Current Situation

Initially the model has been used to reflect current repletion, production and harvest practices and policies that govern the production of oysters in Virginia. The 1983 repletion program was chosen as a representative repletion plan and it was then assumed that this plan would be replicated for the duration of the model's time horizon. It was further assumed that no changes will take place in State repletion strategies, private grounds production practices, and harvest technologies and regulations.

A harvest level was then chosen which represents average production levels from 1976 to 1981. Given this target harvest level and current production technologies and regulations the present value of the cost of producing and harvesting the prespecified level of market oyster harvest is computed.

There are many scenarios that can be formulated which represent changes from the current condition. One such scenario would be, for example, varying the target harvest goal to determine the level of repletion funding necessary to acheive an increased level of market oyster harvest. The scenarios which have been evaluated to date are presented below.

Scenario One: Increasing the Repletion Budget

Scenario one retains all aspects of the current situation except that the funding level for VMRC's repletion activities is doubled over 1983 funding levels. The model then evaluates how VMRC should allocate additional funding it receives so that 1) historical levels of repletion effort are maintained in each river system and 2) the greatest production results for each repletion dollar spent. An additional restriction, however, has been added in this scenario. An increased budget represents an increased public investment in the oyster fishery. It is clear that both private planters and harvestors working the public rocks will benefit from this investment. The added restriction in this case is that private planters are not permitted to benefit disproportionately to harvestors on Baylor grounds. This is accomplished by limiting repletion expenditures for production of seed which would go to private planters. This scenario may be expanded by changing the amount of additional funding received by VMRC or by varying the allowable percentage of repletion effort that benefits private planters in the form of increased seed production.

Scenario Two: Dredging Reef Shell in Virginia

Scenario two incorporates all elements of the current situation but it includes one change. This policy change permits the dredging of reef shell in Virginia waters. In the 1983 repletion program large quantities of reef shell were purchased from a Maryland firm. As might be expected, the cost of transporting shell from Maryland to the various river systems in Virginia is higher than it might be if the shell had been mined in Virginia. This scenario makes possible an evaluation of the cost savings to VMRC of having the option of using reef shell mined in Virginia in its repletion program.

Scenario Three: Decreasing Seed Harvest Costs by Dredging

Like the second scenario, Scenario three considers one change from the current situation. Seed harvesting costs make the cost of transplanting seed prohibitively high. Additionally, high seed prices, (which are linked to high harvesting costs) have been identified as a contributor in the decline of oyster production on leased bottoms. Scenario Three examines a policy change which would allow dredging for seed. The implications of this change for Baylor bottoms' repletion strategies and the cost savings to both private planters and VMRC can be determined under this scenario.

Scenario Four: Combining Scenarios

Scenario four simply combines the budget increase in scenario one and the policy changes from scenarios two and three with the current situation to create an entirely new scenario. This new scenario is an analysis of the effect of implementing all the changes suggested in scenarios one, two and three on private production costs, repletion costs and the implications of these alternatives to current repletion program management.

Conclusion

The scenarios described above are by no means exhaustive of the different analyses that can be conducted with the model. For example, additional scenarios may be created simply by combining the first three scenarios in different ways two at a time. Other entirely different scenarios can also be conceived. Two examples of this are i) evaluating the impacts of leasing market oyster dredging rights on public grounds, and ii) leasing nonproductive Baylor grounds to private individuals.

As the above discussion indicates, the model is designed to evaluate the public and private cost consequences of alternative policy or repletion program changes. As such, the model is a tool to supplement, but not substitute for, the experience and sound judgement of repletion program managers.

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