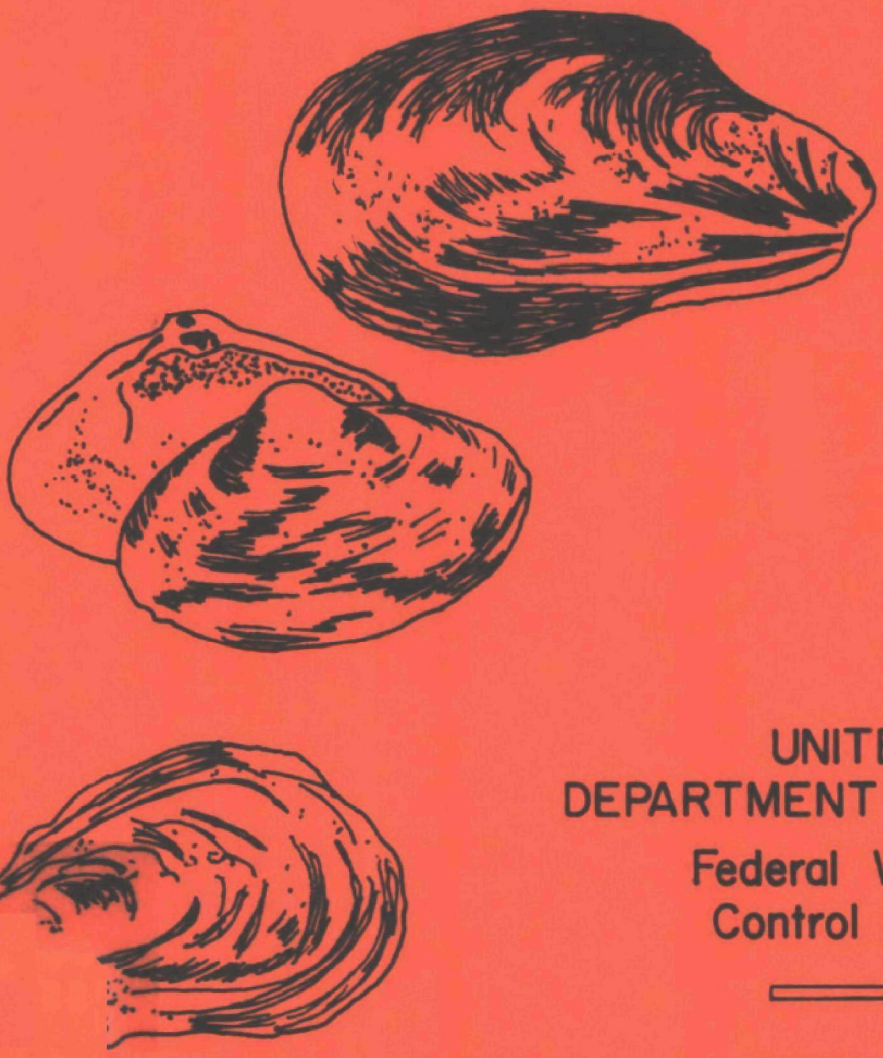
# A MULTIPLIER FOR COMPUTING THE VALUE OF SHELLFISH




UNITED STATES
DEPARTMENT OF THE INTERIOR
Federal Water Pollution
Control Administration

NORTHEAST REGION
NEW ENGLAND BASINS OFFICE
NEEDHAM, MASSACHUSETTS



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# A MULTIPLIER FOR COMPUTING THE VALUE OF SHELLFISH

by

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## OBJECTIVE AND ACKNOWLEDGEMENT

The objective of this study is to find a simple method for determining the economic value of a community's commercial shellfish production or of its potential resource--its supply of available shellfish in the natural environment.

Grateful acknowledgement is extended to Messrs. A. Russell Ceurvels, Director of the Newburyport Shellfish Treatment Plant, Massachusetts Department of Natural Resources; Dana Wallace, Resource Scientist, Maine Department of Sea and Shore Fisheries; Robert Campbell, Marine Biologist, Northeast Marine Health Sciences Laboratory, U.S. Public Health Service; and Frederick Siino, Chief Sanitarian, Rhode Island Department of Public Health, for their assistance, interest, and encouragement in the development of a Shellfish Multiplier.

DISCUSSION

If the value of the shellfish areas and the economic benefits resulting from the production of the shellfish passing through the commercial process were known, the protection of the local shellfish resources and an assessment of the losses to the community that is unable to utilize this resource can be determined.

When seeking the economic benefits, it is necessary to have a series of values denoting the worth of the shellfish during the commercial process through which they are utilized. Initially, all harvested shellfish landed in a local community carry a *Landed Value* (LV), a price that is paid directly to the fisherman.* It is understood that this is only a portion of the income attributed to the community; other accrued values of the shellfish are also a significant part of the economic contribution made by the resource. A further attempt, therefore, is made to show the amount of money generated in and outside of the community from the shellfish. In general, any gains credited to the value of the shellfish beyond the Landed Value between the wholesaler and consumer retailer, regardless of location, may be considered here as the *Value Added* (VA). The Value Added to the shellfish must be defined more closely since the shellfish may or may not be consumed in the same community from which they were harvested.

Further definition of the Value Added would lead to a division into smaller component parts. The Value Added is composed of certain values which may accrue to the shellfish when sold to retail consumers outside of the community, consumers within the community, or in a combination of both.

*A fisherman in some states may act as a shipper.

Retail sales outside of the shellfish producing community can be regarded as *Non-Community Value Added* (NCVA), whereas, the prices of the shellfish within the harvesting community, exclusive of the landed amount, comprise the *Community Value Added* (CVA). In assessing the generated value of the shellfish when sold through wholesale and retail outlets in the same community where the shellfish were harvested, two conditions should be considered: 1) the income resulting directly from the harvesting, and 2) the retail sale of the shellfish for different uses in the community. This value is then known as the *Community Value* (CV), a summation made up by adding the Landed Value (LV) to one or more of the Community Values Added (CVA).

In the final analysis, to evaluate the economic importance of the shellfish production or resource of the community, involving both shellfish sold locally and outside of the community, add the Community Value (CV) and one or more Non-Community Values Added (NCVA) to obtain a representation called *Total Value* (TV).

TABLES

The *Shellfish Multiplier* (SM) is an empirical value to assist in measuring the values of a commercial shellfish production of a community, or the value added to the shellfish accrued within or outside of the community. It must be noted that each calculated multiplier would vary with time, place and changing prices, and that any community analysis must be made within this framework; in other words, the multiplier is going to be different in every situation. The shellfish multiplier is obtained from the following relationship:

$$\text{SHELLFISH MULTIPLIER} = \frac{\text{retail value (price) per unit}}{\text{wholesale value (price)}}$$

$$\text{SHELLFISH MULTIPLIER} = \frac{\dfrac{\text{no. shellfish in wholesale}}{\text{no. shellfish in retail unit}} \times \text{price of retail unit}}{\text{price of wholesale}}$$

In arriving at the shellfish multiplier formula, it is necessary to establish four basic sets of criteria showing how the shellfish are sold, distributed, treated, moved or used by the shipper and the final consumers. (Appendix C). These four groups are:

Median Number of Shellfish per Wholesale . . = Value $N_w$ (Table 1, Column F)

Wholesale Price per Wholesale . . . . . = Value $P_w$ (Table 1, Column G)

Median Number of Shellfish per Consumer Unit = Value $N_r$ (Table 2, Column F)

Consumer Price per Consumer Unit . . . . . = Value $P_r$ (Table 2, Column G)

The values in columns 1-F (factor $N_w$) and 2-F (factor $N_r$) generally remain the same, while the values in column 1-G (factor $P_w$) and 2-G (factor $P_r$) would show the prices reflected in the market. Recent market prices, however, may be substituted in factors $P_w$ and $P_r$, together with appropriate explanations.

To allow for value substitution from the tables, the shellfish multiplier can now be expressed as follows:

$$\text{SHELLFISH MULTIPLIER} = \frac{\frac{N_w}{N_r} \times P_r}{P_w} = \frac{N_w}{N_r} \times \frac{P_r}{P_w}$$

Table 1. This table shows how the shellfish, as packed by weight or volume, are distributed in bulk form at the wholesale market level, and the cost of the shellfish at that location and level. This cost reflects the prices of the individual shippers or that of the diggers.

Table 2. This table shows the distribution and final cost of the shellfish in consumer units from the original bulk packing. The manner of distribution is expressed by the way it was sold, served, processed or used at the retail level. The costs of the items in Table 2 must relate directly to the same shellfish under Table 1.

The tables show the prevailing market prices of fresh or frozen shellfish commonly sold in the New England markets, unless otherwise indicated. They include all edible species of oysters, clams or mussels, either shucked or in the shell:

Identity of shellfish under discussion

| | |
|---|---|
| Soft-shell clam | Mya arenaria |
| Northern quahog | Mercenaria mercenaria |
| Eastern oyster | Crassostrea virginica |
| Blue mussels | Mytilus edulis |
| Surf clam | Spisula solidissima |

The bushel measurement used in the tables is based on the U.S. Standard bushel, which has a capacity of 2,150 cubic inches, or 32 dry measure quarts. Average weights shown in the tables for certain shellfish are market shipping weights used in the New England States. They were obtained by actual counts on lots representative of market samples at the shippers, and from tables contained in the Fishery Statistics of the U.S. 1964 Statistical Digest No. 58, Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries. Since it was impossible to obtain all of the shellfish per bushel figures by actual counts under field conditions, it was necessary, in some cases, to estimate their numbers by referring to the shellfish tables in the Marine Fisheries Series, 1 and 2 - The Soft-Shelled Clam Fishery of Massachusetts and The Quahaug Fishery of Massachusetts by David L. Belding, M.D.

It was generally found that the loss of shellfish due to breakage was about five percent for soft-shelled clams and three percent for oysters and hard-shelled clams. The loss due to spoilage of shucked shellfish was difficult to determine. However, industry members indicated that spoilage may amount to about five percent, or one pound per every twenty pounds of meats. These loses can be deducted in the final calculations from each component value; ie, LV, VA, CVA, NCVA, CV and TV.

Summary of Shellfish Multiplier - The shellfish multiplier is designed to assist those interested in arriving at a method for estimating and predicting the community value of the shellfish production or its resource. Also, the multiplier can be used to estimate local and non-local values added that were accrued to the shellfish after retail sale. The summation of all the values added (TV) would give a potentially generated economic value of the shellfish production.

Appendix A - Mathematical Derivations of Equations

Shellfish Multiplier - The shellfish multiplier (SM) is the ratio of the final consumer retail value to the initial market wholesale value of the shellfish with respect to the manner in which the shellfish were sold and used.

$$SM = \frac{\text{retail value (price) per unit}}{\text{wholesale value (price)}}$$

$$SM = \frac{\dfrac{\text{no. shellfish in wholesale}}{\text{no. shellfish in retail unit}} \times \text{price of retail unit}}{\text{price of wholesale}} \qquad \text{EQUATION 1}$$

Landed Value - The landed value (LV) is the price the shipper or dealer pays to the fisherman. It may be considered the initial wholesale value.

$$LV = \left(\begin{matrix}\text{number of}\\ \text{wholesale units}\end{matrix}\right)\left(\begin{matrix}\text{wholesale price}\\ \text{per unit}\end{matrix}\right) = \text{Wholesale value} \qquad \text{EQUATION 2}$$

Combining the shellfish multiplier (Equation 1) and the landed value relationships (Equations 1 and 2) gives:

$$\text{Retail value} = (LV)\ (SM) \qquad \text{EQUATION 3}$$

Retail Value Added - The retail value added (VA) is the difference between the retail value (Equation 3) and the wholesale value (Equation 2). Value added can be either local or non-local.

$$VA = \text{Retail value} - \text{Wholesale value}$$

$$VA = LV\ (SM) - LV$$

$$VA = LV\ (SM-1) \qquad \text{EQUATION 4}$$

The shellfish may be sold in any number of ways—fried, steamed, strips, in the shell and so on. Each means of its final retail use and value is associated with an amount, in percent (m), of the initial harvest or production. The retail value added (VA) associated with the amount of each means of retail use may be expressed as:

$$VA = (LV)(m)(SM_m - 1) \qquad \text{EQUATION 5}$$

Summation ($\Sigma$) of the various retail use of the shellfish gives the following relationship:

$$\Sigma VA = VA = LV\left[\Sigma (m)(SM_m - 1)\right] \qquad \text{EQUATION 6}$$

(VA) henceforth, may be expressed as (CVA) for values added within the community and (NCVA) for value added outside of the community.

Community Value - The community value (CV) is the income to the local community resulting directly from the sale of the shellfish under different uses. It is composed of the landed value (LV) (Equation 2) and one or more community retail values added (CVA) (Equation 6 where m=c community sales).

$$CV = LV + CVA_1 + CVA_2 + CVA_3 \ldots\ldots CVA_x$$

$$CV = LV + LV\left[\Sigma (c)(SM_c - 1)\right]_1 + LV\left[\Sigma (c)(SM_c - 1)\right]_2 \ldots\ldots \qquad \text{EQUATION 7}$$

Total Value - The total vaule (TV) is the final value of the commercial production of the shellfish industry. It is composed of one community value (CV) (Equation 7) plus one or more of the non-community retail values added (NCVA) (Equation 6 where m=n for non-community sales).

$$TV = CV + NCVA_1 + NCVA_2 + NCVA_3 \ldots\ldots NCVA_x$$

$$TV = CV + LV\left[\Sigma (n)(SM_n - 1)\right]_1 + LV\left[\Sigma (n)(SM_n - 1)\right]_2 \ldots\ldots \qquad \text{EQUATION 8}$$

APPENDIX

Appendix B - Example of Shellfish Production in a Community

What is the commercial value of the shellfish production and its generated values for the following community?

A Maine community has ten commercially licensed fishermen who rely on shellfish harvesting for a living; local sports harvesting is not included. These harvesters are not involved as shippers. The estuary adjacent to this community is known to support the growth of soft-shelled clams, but is not suitable for other shellfish. Each of the ten diggers is harvesting 1½-to-2½ inch clams at the rate of four bushels per day for a six-day working week. The shellfish are sold locally to intra and interstate shellfish shippers. The diggers charge $7.77 per bushel when delivered to the shipper. The average weight of each bushel is sixty-five pounds. The production rate of shellfish from the community for that period in a single day is 40 bushels, or 240 bushels for a six-day week. Records show that twenty-five percent of the clams are sold locally as fried clams and that another quarter is also sold locally as steamers. The remaining fifty percent is shipped to another state and sold as shellstock in the retail markets.

WANTED - Shellfish Multiplier(SM)for fried clams

" " " " steamers

" " " " shellstock

Landed Value(LV)

Community Value Added(CVA)

Non-community Value Added(NCVA)

Community Value(CV)

Total Value (TV)

HAVE - Soft-shelled clam beds in estuary, no sports fishing

10 harvesters at 4 bushels per day

240 bushels per week for six-day work week

25 percent of shellfish sold locally as fried clams

25 percent of shellfish sold locally as steamers

50 percent of shellfish sold non-locally as shellstock

From tables

| | | | |
|---|---|---|---|
| Values | $P_w$ | soft-shelled clams (Maine Resource) | 1 bu = \$7.77 |
| " | $P_r$ | fried clams, per unit | 1 pt = \$1.25 |
| " | $P_r$ | steamer clams, per unit | 1 serving = \$1.20 |
| " | $P_r$ | shellstock, per unit | 1 pt = \$0.38 |
| " | $N_w$ | soft-shelled clams (Maine Resource) | 1 bu = 1850 |
| " | $N_r$ | fried clams | 1 pt = 26 |
| " | $N_r$ | steamer clams, per unit | 1 serving = 13 |
| " | $N_r$ | shellstock, per unit | 1 pt = 27 |

$$\text{SM (Shellfish Multiplier)} = \frac{\frac{\text{no. in wholesale}}{\text{no. in retail unit}} \times \text{price of retail unit}}{\text{price of wholesale}}$$

SOLUTION:

A. Computing SM for fried clams, steamers and shellstock

$$SM = \frac{\frac{N_w}{N_r} \times P_r}{P_w}$$

$$SM = \frac{\frac{1850}{26} \times 1.25}{7.77} = 9.1 \text{ fried clams}$$

$$SM = \frac{\frac{1850}{13} \times 1.20}{7.77} = 21.0 \text{ steamers}$$

$$SM = \frac{\frac{1850}{27} \times .38}{7.77} = 3.2 \text{ shellstock}$$

B. Computing values for LV, CVA, NCVA, CV, AND TV*

a. Landed Value $LV = \left(\begin{matrix}\text{number of}\\ \text{shellfish units}\end{matrix}\right)\left(\begin{matrix}\text{wholesale}\\ \text{price per unit}\end{matrix}\right)$ EQUATION 1

$LV = (240)(\$7.77)$

$LV = \$1864$

b. Community Value Added CVA

$CVA_f = LV\left[\Sigma(m)(SM_m - 1)\right]$ EQUATION 6

$CVA_f = 1864\left[.25(9.1-1)\right]$

$CVA_f = 1864\left[.25(8.1)\right]$

$CVA_f = 1864\left[2.01\right]$

$CVA_f = \$3728$ fried clams (f)

$CVA_s = 1864\left[.25(21-1)\right]$

$CVA_s = 1864\left[.25(20)\right]$

$CVA_s = 1864\left[5\right]$

$CVA_s = \$9320$ steamers (s)

$NCVA_{st} = 1864\left[.50(3.2-1)\right]$

$NCVA_{st} = 1864\left[.50(2.2)\right]$

$NCVA_{st} = 1864\left[1.10\right]$

$NCVA_{st} = \$2050$ shellstock (st)

*Appendix A for equation derivations

c. Community Value CV

CV = Landed Value LV + Community Values Added CVA

$CV = LV + CVA_f + CVA_s$ EQUATION 7

CV = 1864 + 3728 + 9320

CV = $14,910 generated local community value for fried clams and steamers

d. Total Value TV

TV = Community Value CV + Non-community Values Added NCVA

$TV = CV + NCVA_{st}$ EQUATION 8

TV = 14,910 + 2050

TV = $16,960 Total value. . . . .of shellfish production (one week) including generated values within and outside the community.

Summary listing of SM, LV, CVA, NCVA, CV and TV

1. The SM shellfish sold in community as fried clams . . . . . 9.1
2. The SM shellfish sold in community as steamers . . . . . .21.0
3. The SM shellfish sold outside of community as shellstock . . . . . 3.2
4. The LV shellfish production to local shippers/week (100%) . . . . . $1864
5. The $CVA_f$ shellfish sold locally as fried clams/week (25%) . . . . . $3728
6. The $CVA_s$ shellfish sold locally as steamers/week (25%) . . . . . $9320
7. The $NCVA_{st}$ shellfish sold outside of community/week (50%) . . . . . $2050
8. The CV of the shellfish sold locally/week (50%). . . . . $14,910
9. The TV of the shellfish production and its generated values/week (100%) . . . . . $16,960

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AVAILABLE

DIGITALLY