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ECONOMIC FEASIBILITY OF LOBSTER FISHING IN THE NORTHWESTERN HAWAIIAN ISLANDS

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Easy Rider Too is a proposed fishing vessel which may be used to trap lobster, deep-sea handline, deep-sea longline, tender albacore trolling vessels, and conduct scientific charters. The vessel is scheduled to begin operations in the Northwestern Hawaiian Islands during 1980 and will be equipped to process and package frozen fish products at sea.

This report evaluates the economic efficiency of the vessel's lobster harvesting operations given the projections of investment cost, operating cost, and revenues as reported by the firm's investors. The economic feasibility of the investment is based on a discounted cash flow analysis for different combinations of discount rate, sustainable catch rate, average lobster weight, and ex-vessel price. The analysis abstracts from the other possible uses of the vessel which may, of course, affect the feasibility of the lobster operations.

Federal regulations under the Fishery Conservation and Management Act of 1976 may include minimum legal carapace lengths, among other regulations, which will influence legal catch rates, average sizes and thus, ex-vessel prices. The results of this report indicate that for a wide range of average lobster sizes and a wide range of discount rates, the minimum efficient catch rate is between 1 and 2.5 lobster per trap-day. The feasibility of the operation may be sensitive to a number of possible marketing constraints as discussed in the concluding remarks.

Recent developments in the Hawaii lobster fishery reflect the fact that increased utilization of the lobster resources requires fishermen to sell the product in markets other than Hawaii's traditional fresh fish market. Given the current levels of production, operating costs, and level of demand, it is not feasible to expand production of the live spiny lobster product in Hawaii. To increase utilization of the lobster resources, new vessels are processing and freezing lobster tails for the large restaurant markets in Hawaii and California which import similar products from Australia, New Zealand, and South America. The proposed vessel, Easy Rider Too, will represent the largest new addition to Hawaii's lobster fleet.

Discounted cash flow. Estimating the feasibility of lobster fishing begins with total revenue during the i^{th} period, R_i, which will vary for changes in the catch rate, γ_i (number of lobster per trap-day) and the average lobster size, σ_i (pounds per lobster tail). Total production of the firm is relatively small, such that it does not influence the market price. However, the price per pound may vary by the size of the fish. The size-price relationship may be due to the different processing efficiency of various fish sizes as in raw tuna for canning; or to different consumer preferences for various fish sizes as in the lobster market. Price, $P_i(\sigma_i)$ (dollars per pound for lobster tail), is given for each average lobster size. Associating a unique price to a catch with a particular average lobster size assumes a catch with that average lobster size has a unique size distribution. Fishing effort, E_i (number of trap-days), which may vary each period is constant in the analysis. Total revenue is written as

$$R_i = E_i \gamma_i \sigma_i P_i (\sigma_i) \tag{1}$$

Subtracting total operating costs, C_i, and depreciation, D_i, from total revenue yields taxable income. The combined state and federal income tax rate is t_i. The discount rate is δ_i. For i = 1, 2, ..., n, the discounted cash flow from period 1 to n-1 is

$$DCF_{1,\ n-1} = \sum_{i=1}^{n-1} \left[\frac{\left((R_i - C_i - D_i)\ (1 - t_i)\right) + D_i}{(1+\delta_i)^i} \right] \tag{2}$$

Upon termination of the investment, the cash flow at the end of the n^{th} period is increased by the operating capital and the scrap value of the capital equipment. Represented as fractions of depreciable capital, I, are operating capital, f, and scrap value, s. The discounted cash flow from all n periods may then be written as

$$DCF = DCF_{1,\ n-1} + \frac{\left((R_n - C_n - D_n)\ (1 - t_n) + D_n\right) + I(f+s)}{(1 + \delta_n)^n} \tag{3}$$

Using the notation for depreciable capital and scrap value, the straight-line method of depreciation is

$$D_i = \left(I(1 - s)\right) / n \tag{4}$$

<u>Net present value and the discount rate</u>. The total capital investment minus the discounted cash flow equals the net present value, NPV:

$$NPV = I(1+f) - DCF \qquad (5)$$

This assumes that all investment occurs at the beginning of the first period. For an appropriately chosen discount rate, if NPV $\geq$ 0 then the investment is considered feasible. The discount rate an investor chooses reflects the returns of the best alternative investment and the risk of the investment. For example, if the best alternative investment yields 7% return and the proposed investment is considerably more risky, then the appropriate discount rate may be 12%. If NPV = 0 for a proposed investment using this discounted rate, then the investor is indifferent between the proposed investment and the best alternative investment. If NPV > 0 then the investor will prefer the proposed investment. Using the net-present-value criteria, then, the feasibility of an investment is relative to alternative investments with consideration for differences in risk between investments.[1]

Minimum feasible catch rates. To evaluate the impact of regulatory policies on the feasibility of an investment such as Easy Rider Too requires, in part, an estimate of the minimum feasible catch rate. Given the specific operating conditions of the investment, a schedule of minimum feasible catch rates is estimated for a range of discount rates using the net-present-value criteria. Estimates of

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[1]For a comprehensive survey and analysis of alternative investment criteria see Edward J. Mishan, Cost-Benefit Analysis, New and Expanded Edition, Praeger Publishers, New York, 1976, pp. 165-272.

depreciable capital, operating costs and effort were obtained from the investors and are presented in the confidential appendix. Effort is assumed to be constant. The variables n, t_i, f, and s are equal to 20 years, 0.50, 0.05, and 0.10, respectively. Again, it is assumed that changes in the total catch for Easy Rider Too do not influence the prices or catch rate. Under the net-present-value criteria, $NPV \geq 0$, an average lobster size, and thus an ex-vessel price, will imply a minimum feasible catch rate for each discount rate. Four average lobster sizes (σ_i), 0.375, 0.500, 0.625, and 0.750, are evaluated with four associated ex-vessel prices $\left(P_i(\sigma_i)\right)$, 6.38, 6.00, 5.24, and 5.15, respectively. The prices are taken from Fishery Market News Report, National Marine Fisheries Service.

Figure 1 illustrates a schedule of minimum feasible catch rates for each average lobster size over a range of discount rates. The discount rate and minimum catch rate are positively related for each average lobster size. That is, the larger the discount rate used to evaluate the economic feasibility of the investment, the larger the required minimum feasible catch rate. On the other hand the average lobster size is inversely related to the minimum catch rate holding the discount rate constant. That is, a higher catch rate is required for the investment to be feasible if the average lobster size is smaller. Although price per pound is greater for the smaller size lobster, the increased revenue per pound is not enough to offset the decreased total weight due to the smaller average size. However, without the price differentials by lobster sizes, the four curves in Figure 1 would be

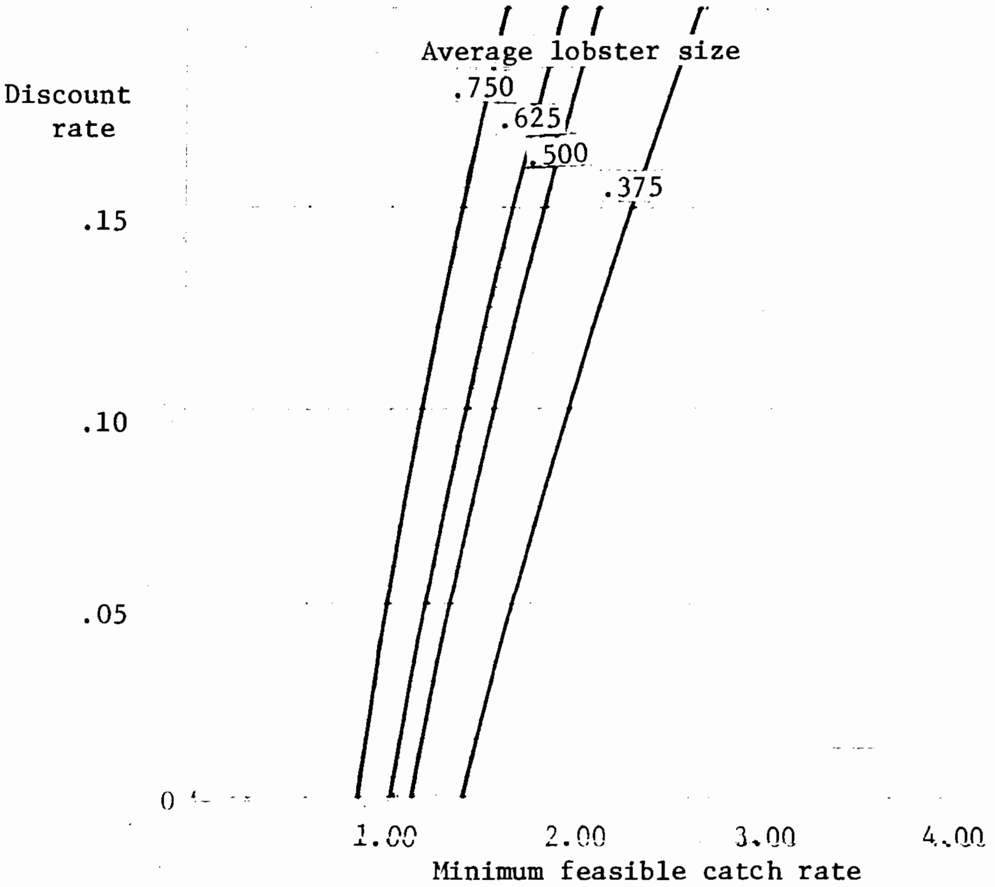

Figure--1. Minimum feasible catch rate by discount rate and average lobster size.

spread further apart. For a likely range of discount rates, say from 0.05 to 0.15, the minimum feasible catch rate is between 1.00 and 2.50 for all the average lobster sizes considered.

Unique marketing circumstances may cause shifts or discontinuities in the curves in Figure 1. For example, shippers or wholesalers may require a minimum total weight from a firm if all lobster tails are above some minimum size. Another peculiarity which may shift the curves is informal tying sales. Some major suppliers of lobster require the buyer to purchase larger size lobster tails in order to receive the smaller size tails. The investors express the concern that a minor supplier in the world market with a catch of only larger size lobsters may find it necessary to sell the larger tails below the existing market prices. For _Easy Rider Too_ this may mean the shifting of the curves in Figure 1 to the right--increasing the minimum feasible catch rates. Currently the industry is uncertain about marketing conditions. Figure 1 must be revised as the fishery develops to account for the specific marketing peculiarities. Furthermore, the biology of the lobster stocks in the Northwestern Hawaiian Islands may be such that some parts of the schedules in Figure 1 are irrelevant. Nevertheless, the feasibility of the operation may be estimated for alternative regulatory policies which result in different legal catch rates and different average lobster sizes. The accuracy of such estimates will be greatly improved with more information on the long-term impacts on the stocks and therefore on the catch rates and average lobster sizes over time. Variations in these variables over time will give rise to unequal cash flows between periods, when effort is constant, possibly improving the estimates of feasibility in this report.

Confidential Appendix

The following data was obtained from the investors. Depreciable capital, I, is $1,800,000, assumed to be purchased at the beginning of the first year. Effort, E, is 200,000 trap-days per year--5 trips per year for 40 fishing days each, fishing 1,000 traps per day. Operating cost, C, is $605,000 per year itemized in Appendix Table 1.

Appendix Table 1.--Estimated total annual operating costs.

Wages	$264,100
Fuel	49,700
Bait	90,000
Insurance	36,000
Food	25,200
Equipment replacement	5,000
Maintenance	75,000
Miscellaneous	60,000
Total	$605,000