Southwest Fisheries Science Center
Administrative Report H-96-07

ECONOMIC DETERMINATION OF THE OPTIMAL NUMBER OF NORTHWESTERN HAWAIIAN ISLANDS BOTTOMFISH VESSELS

Samuel G. Pooley

Honolulu Laboratory
Southwest Fisheries Science Center
National Marine Fisheries Service, NOAA
2570 Dole Street, Honolulu, Hawaii 96822-2396

September 1996

NOT FOR PUBLICATION

SUMMARY

Overall economic conditions for the average Northwestern Hawaiian Islands (NWHI) bottomfish vessel are not good. On average, vessels continue to make marginal returns in this fishery. However, total bottomfish catch in the NWHI did not exceed the Maximum Sustainable Yield (MSY) level in 1994 nor was the MSY level of effort exceeded. The MSY level of catch was not being taken in the Ho'omalu (limited entry) zone, but it was exceeded in the Mau (open access) zone.

While the fishery appears able to sustain an increase in catch biologically (at least in the Ho'omalu zone), it does not appear economically justifiable to promote an increase in effort throughout the NWHI as a whole. Clearly, more effort is not justified in the Mau zone. Whether more vessels should operate in the Ho'omalu zone alone, or whether to combine the two zones, is open to interpretation.

The number of vessels economically appropriate for the NWHI as a combined limited entry zone depends on management objectives. Under current conditions it is roughly equivalent to the number currently (1994) operating in the two zones of the NWHI. However, potential changes in the per-vessel annual catch levels if operating in a combined NWHI zone and the degree of competition between boats previously restricted to the separate zones have to be considered.

Finally, the current regulatory regime, with nontransferable, use-it-or-lose-it permits in the Ho'omalu and open access in the Mau zone, appears to have a number of economic and operational shortcomings. Improvement in the existing system seems important: its basic framework should be pragmatic, determined by consultation of the relevant stakeholders, particularly the existing NWHI bottomfish fishing vessel owners and operators.

DATA

Data available for this analysis are based on 1994 fishery operations and catch levels. Information for 1995 was not available in time for this report.[Endnote: a]

ANALYSIS

Current conditions in the NWHI used as the vessel operations basis for this analysis are summarized in the following table.

NWHI bottomfish fishery, 1994[1]

	Vessels[2]	Fishing days	Bottomfish catch	Total revenue[3]
NWHI combined	16	893	438,000	1,330,000
Mau (open access)	12	448	158,200	460,000
Ho'omalu (limited entry)	5	445	279,800	875,000

PROCEDURE

The following procedure is used for this analysis:

(1) Estimate the annual bottomfish pounds taken per NWHI fishing vessel at various levels of economic operation based on cost-earnings simulators;

---

[1]Kobayashi, 1996.

[2]One vessel was active in both zones due to a change in permit.

[3]Revenue calculated from FMEP data sources.

(2) Determine the MSY level of bottomfish in the NWHI and its two regulatory zones based on Kobayashi's (1996) estimates.

(3) Divide the MSY by the annual bottomfish pounds per-vessel under various levels or scenarios of economic operations to:

Estimate the optimal number of vessels for the NWHI bottomfish fishery.

As an example of this procedure, if the MSY is estimated as 586,000 pounds, and the average annual bottomfish catch per vessel from the cost-earnings simulator for a particular level of economic operation is 32,200 pounds, then the optimal number of vessels is 18.

$$\frac{\text{MSY (pounds)} = 586{,}000}{\text{Annual catch per vessel} = 32{,}200} = 18 \text{ optimal vessels}$$

APPLICATION

Basic economic information on NWHI bottomfish fishing vessels was taken from Hamilton's cost-earnings report (H-94-01C) and applied to fleet-wide operating conditions, landings, and ex-vessel sales prices for the calendar year 1994. Tables 1-3 report the results in cost-earnings simulator format[*Endnote: b*] for the average NWHI bottomfish fishing vessel[4] as well as for the average Mau and Ho'omalu zone vessel. Table 4 indicates the parameter dependencies in the cost-earnings simulators. The bottom lines for all three vessel averages differ from those reported in Hamilton who used 1993 information. We updated her work using 1994 catch rates, vessel operating patterns, and input[5] and ex-vessel fish prices. These revised income

---

[4]The average vessel is an unweighted average of vessels surveyed by Hamilton (1994) from the two regulatory zones.

[5]Input costs were adjusted for inflation from Hamilton's report using the Honolulu consumer price index.

statements appear to be realistic portrayals of economic conditions in the NWHI bottomfish fishery in 1994.

People frequently ask why fishing vessels continue to operate when average net revenue is negative. There are at least four potential answers to this question. First, these are averages. Some vessels are making money and continuing to fish. Others are losing money and may be leaving the fishery or may be absorbing their losses through other business ventures or their corporate tax situation. Second, economic analysis based on either survey research or on self-reporting by participants tends to exaggerate costs of operations, particularly in terms of fixed costs. Tax accounting can have significant effects on fixed cost estimates. The importance of these factors depends on the sensitivity of the bottom line to these factors.[6] Third, although these vessels are not covering all their costs, they are covering all their operating costs and some of their fixed costs. This may be the best return on their investment in the short run. And owners may have mixed motivations for operating their vessels (particularly in the Mau zone) or may have alternative sources of income for covering these bottomfish fishing losses. Fourth, in the long run, full-time commercial fishing owners cannot sustain such losses. Evidence shows that participation in the fishery declined from the mid-1980s through 1993, increasing slightly in 1994.[7]

Tables 1-3 make clear that NWHI bottomfish vessel operations remain dramatically different between the Mau (open access zone) and Ho'omalu (limited entry zone) vessels. The Mau zone vessels land only 18,000 pounds of bottomfish a year (on average), while the Ho'omalu zone vessels land 64,000 pounds. The Mau zone boats include both part-time and full-time operations, with an average of only 93 NWHI sea days per year. The Ho'omalu zone boats tend to be more full-time NWHI bottomfish operators, with 204 NWHI sea days per year. These differences and their reasons need to be

---

[6]A 25% decrease in the fixed and operating costs improves the bottom line of a typical NWHI bottomfish fishing vessel by over 60% (from a net loss of $19,600 to a net loss of $6,000). Total labor (crew and captain) income improves by 11%.

[7]Kawamoto, 1995.

taken into account for policy decisions concerning changes in the regulatory structure.

Bottomfish MSY was estimated by Kobayashi (1996) for the NWHI as a whole at 586,000 pounds. This is the most bottomfish that could be harvested annually on an ongoing basis by average NWHI bottomfish fishing vessels. Kobayashi estimates that this catch would be taken by 1,112 fishing days. This translates into a catch rate (measured in bottomfish pounds per day fished) of 527 pounds.[Endnote: c]

Total NWHI bottomfish landings in 1994 were only 440,000 pounds with 900 days fished, both substantially less than MSY, while the catch rate was 490 pounds per fishing day, less than that predicted at MSY (Kobayashi, 1996). The implication is that the NWHI bottomfish fishery could biologically sustain a higher level of fishing effort and catch. Obviously, this conclusion may be tempered by SPR considerations for individual species.

However, the economic results suggest that the average NWHI bottomfish fishing vessel does not cover total costs although operating costs are covered. This is true for both the Mau zone and Ho'omalu zone components of the fishery. Even when pushed by economic analysis to FTE (full-time equivalent or maximum operating capacity) levels of activity (at MSY catch rates), the average NWHI bottomfish fishing vessel is covering only half its fixed costs. It appears that with bottomfish prices and the costs of operating in the NWHI as they are, only some of the fleet are likely to find the NWHI fishery to be an adequate source of investment income.[8]

Annual vessel catch and operating parameters under four levels or scenarios of economic operations for bottomfish fishing vessels in the Mau and Ho'omalu zones of the NWHI separately and the NWHI as a combined fishery are summarized in Table 5. The annual catch levels per vessel are determined by adjusting the

---

[8]As captain and crew income, the Ho'omalu zone vessels appear to provide adequate, if not lucrative, returns to labor on a per trip basis. Crew and captain shares in both zones are substantially higher than for several comparable Hawaii fisheries, but actual annual income per crew member is not.

catch rates or number of trips per year in the basic cost-earnings profile (as depicted in Tables 1-3).

SCENARIOS (LEVELS) OF ECONOMIC OPERATIONS
(average annual catch & operating rates per vessel)

A. Actual 1994 catch & operating rates
... the total catch derived using 1994 operations and the 1994 average catch rate for the average NWHI bottomfish fishing vessel

B. MSY catch rate
... the total catch utilizing the MSY catch rate with 1994 vessel operating rates

C. Full-time equivalent (FTE) economic operations @ MSY catch rate
... the total catch found by projecting the maximum number of days at sea a vessel can take during the year and using the MSY catch rate[Endnote:d]

D. Breakeven catch rate @ FTE economic operations
... the total catch found by increasing catch rates (if necessary) to break even economic conditions under FTE economic operating conditions
... this is essentially the procedure called for evaluating entry into the Ho'omalu zone under the Bottomfish Fishery Management Plan (FMP)

This generates 12 average annual bottomfish catch totals (bottomfish pounds per vessel) for the three categories of NWHI bottomfish fishing boats: NWHI combined, Mau zone, and Ho'omalu zone. These can then be utilized to calculate how many boats would be optimal in each zone or in the NWHI as a combined zone. The average annual catch per vessel for each scenario is included in the following table.

Bottomfish annual catch per vessel (optimal scenarios)

Scenario	NWHI Combined	Mau zone	Ho'omalu zone
1994 CPUE	32,248	18,233	64,158
MSY CPUE	34,683	17,717	64,668
MSY CPUE @ FTE	67,384	43,218	85,172
Break even CPUE @ FTE	59,457	49,896	88,397

Basic vessel operating rates appear in Table 6.

It is clear that there is not likely to be any one economically optimal fleet size in the NWHI bottomfish fishery under current operating conditions, cost structures, and ex-vessel bottomfish prices. MSY optimizes total yield (catch) from the fishery from a biological or production basis, but it is not an economic optimum (which must balance maximum catch with the cost required to harvest that yield).

The following table indicates the number of NWHI bottomfish vessels which would be required to harvest the entire MSY for the NWHI as a combined zone or as two separate zones under the four economic operating conditions.

Optimal number of NWHI bottomfish vessels by zone and operating condition

	NWHI combined	Mau zone	Ho'omalu zone
% of NWHI MSY catch level[9]	100%	22.4%	77.6%
MSY Pounds	586,000	131,000	455,000
1994 active vessels[10]	16	12	5
Economic operating condition	Estimated optimal number of vessels to harvest MSY by zone & economic operating condition		
Scenario A 1994 Average catch rate	18	7	5
Scenario B MSY catch rate	17	7	7
Scenario C Full-time equivalent operations (FTE) @ MSY catch rate	9	3	5
Scenario D Economic breakeven catch rate @ FTE	10	3	5

NOTE: The numbers of participating vessels are not additive horizontally (i.e., the number of bottomfish vessels for the NWHI as a whole is greater than the sum of the Mau and Ho'omalu zone

[9]As explained in previous text.

[10]One vessel switched its permit between zones during 1994.

vessels) because of changes in fleet composition from the current limited entry scenario with two separate zones (which precludes fishing in both zones with a Federal permit) to an alternative scenario in which a vessel might fish in either or both zones, or where the zones are combined.

CONCLUSIONS

The previous table shows that at the MSY catch rate, there are substantially more vessels fishing in the Mau zone than can be sustained on a full-time operating basis (or maximum operating capacity) while only one or two additional vessels can operate (at potentially a substantial economic cost to all involved) in the Ho'omalu zone.

For the NWHI as a combined bottomfish limited entry zone, there can be no more vessels operating on a full-time (FTE) optimal basis. In any of these scenarios, vessels will be presumed to fish harder (i.e., more trips per year) given the higher level of competition but economic losses nonetheless will continue (since catch rates would be lower on average through that competition). None of the options completely eliminates economic losses. Creating a limited entry zone for the Mau zone may be an improvement in economic operating conditions in terms of restricting new entry, but if the same number of vessels operated under the new regime, economic conditions will still be marginal.

While combining both zones into one NWHI bottomfish limited entry zone has its appeal, it is likely that the composition of the fleet will change. Determining the optimal number of vessels under such a change will be difficult. For example, using the combined NWHI bottomfish fishing vessel profile, a combined NWHI bottomfish fishery may sustain 17-18 average vessels. But using the current Ho'omalu zone type of fishing operations and MSY catch rates under full-time (FTE) operations, a combined NWHI bottomfish fishery may sustain only 9 FTE vessels (Table 5).

It is clear from anecdotal evidence and from economic theory that the current regulatory regime, with nontransferable, use-it-or-lose-it permits in the Ho'omalu and open access in the Mau zone has several of economic shortcomings. Some improvement in the existing system seems important, its basic framework will be pragmatic, determined by consultation of the relevant stakeholders, particularly the existing NWHI bottomfish fishing vessel owners and operators.

The costs and benefits of various limited entry options cannot be assessed by a budget model like this alone; additional information on the performance of NWHI bottomfish boats and the motivations for their owners and operators will be required. Thus, one problem for the economic analysis of limited entry options is determining what represents a true FTE level of operations. Hamilton (1994) suggests that for the average NWHI vessel, 20 trips per year will be a maximum annual operating level, with some of these trips allocated to non-bottomfishing activities. This is fairly consistent with the FTE calculations performed in this paper. However, the range of opportunities available for NWHI bottomfish fishing vessel owners and operators is changing regularly, increasing the analytical problem.

The central issue for policy makers under the current regulatory regime is determining what level of fishing vessel operations and economic returns is considered appropriate for choosing the optimal number of vessels in any limited entry zone. Does the Council want 17 potentially part-time participants in the fishery with marginal economic returns (on average) through their competition for a common use resource, or does the Council want to emphasize economic efficiency in the NWHI bottomfish fishery (with only 9 permitted vessels). The two zones were one method for mediating that choice (and also allowing an area of open access), but there remain significant regulatory and operational costs of that choice. It may be that alternative management options, including fractional licenses, individual transferable quotas (ITQs), or cooperative management institutions will be a preferable approach to what is basically an allocation problem.

REFERENCES

Hamilton, Marcia
1994. NWHI bottomfish fishery 1993 vessel activities, costs & economic returns. Joint Institute for Marine and Atmospheric Research, University of Hawaii. Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Southwest Fish. Sci. Cent. Admin. Rep. H-94-01C, 36 p.

Kawamoto, Kurt E.
1995. Bottomfish fishery in the Northwestern Hawaiian Islands, 1994. Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Southwest Fish. Sci. Cent. Admin. Rep. H-95-07, 26 p.

Kobayashi, Donald R.
1996. An update of maximum sustainable yield for the bottomfish fishery in the Northwestern Hawaiian Islands. (draft manuscript: 3/5/96)

1995. An update of the NWHI dynamic production model for bottomfish. NMFS Honolulu Laboratory (9/15/95).

ENDNOTES

Endnote a. Cost-earnings information

Some cost-earnings information for 1994 was not updated since the earlier version of this report and should be reconsidered at the next economic review of the NWHI bottomfish fishery. In subsequent years, the basic fishing vessel cost information should also be reviewed.

Endnote b. Cost-earnings simulators

The cost-earnings simulators are spreadsheets which read the cost-earnings results of the Hamilton (1994) survey of NWHI bottomfish boats into a hidden part of the spreadsheet and translate the annual costs and earnings into per trip, per day at sea, per fishing day, and other rates (also hidden).

Current year or hypothetical operating characteristics are then entered into the cost-earnings simulator (information at the bottom of the first page of each spreadsheet table). These include the number of trips, number of days at sea and days fishing, catch rates, and price per pound. (The cost-earnings simulators use catch rates and prices for all species, not just bottomfish species, taken during bottomfish trips. The amount of bottomfish within the overall catch rate and catch levels is calculated based on Hamilton's ratios.) A factor is also used for updating the survey year's (1993) imputed prices of production inputs (e.g., the price of fuel) to current year prices. We have applied the Honolulu Consumer Price (HCPI) index difference between 1994 and 1993 to all input prices.

The current or hypothetical operating conditions then adjust the cost and earnings portion of the simulators (information on the top half of each spreadsheet table) and the total catch figures (included within the operating conditions portion of each spreadsheet table), based on the rates which are in the hidden portion of the spreadsheet.

The primary independent parameters in the cost-earnings simulators are catch rate, price of fish, and trips. Other independent parameters are number of days at sea per trip, days fishing per trip, and the input price adjustment factor (HCPI).

The other variables vary according to changes in these independent parameters. The table referenced in the text indicates these relationships.

Endnote c. Maximum sustainable yield (MSY)

Maximum sustainable yield (MSY) can be derived statistically in a number of ways. Kobayashi used annual catch (bottomfish pounds landed) and effort (fishing days) statistics for the NWHI bottomfish fishery as a whole. Using a dynamic production model, a hypothetical trade-off between levels of fishing effort and resultant catch rates (catch per day fishing) at various paired levels of catch and effort can be determined. Catch and catch rates are intuitively linked to the underlying structure of the bottomfish population.

While total bottomfish catch increases as fleet-wide effort rises from zero (no fishing) to the MSY level of effort, the average catch rate (per fishing day) falls, as the population's overall size is reduced by fishing mortality. At fishing levels beyond the MSY level of population, total catch declines as the incremental catch rate becomes negative; i.e., every additional unit of fishing effort reduces everyone's catch rate. (The average catch rate remains positive, but it is obviously declining.)

The following is an example of the effort --> catch --> catch rate relationships implied by Kobayashi's model:

Effort ===> (fishing days)	Catch ===> (pounds of bottomfish)	Catch rate (fishing day basis)
500	325,000	650
750	450,000	600
1,500	675,000	450
2,336	837,000	358
3,000	**700,000**	**233**
3,500	**600,000**	**172**
4,000	**350,000**	**88**

The figures in the table are derived from material provided last fall by Kobayashi (as a result they do not represent the latest MSY estimates). The numbers bolded in the last three rows of the table are beyond the range of Kobayashi's displayed yield curve and are estimated by symmetry.

Endnote d. Full-time Equivalent (FTE)

The procedure is to allow 30 days for shipyard and 5 days between trips. All other days of the year are allocated to trip days. While this probably seems extreme, the number of trips for Ho'omalu zone boats is consistent with self-reporting maximums cited in Hamilton (1994). However, maximum days at sea and days fishing exceed the actual average reported by Hamilton. The point is not to suggest that all vessels can or will operate at this level of capacity but to indicate for analytical purposes what fishing power might be in the extreme. Increasing the number of days between trips from 5 to 10 reduces the Ho'omalu zone Full-time Equivalent (FTE) number of days at sea from 269 to 224 days annually and annual catch from 85,000 pounds to 71,000 pounds at MSY catch rates.

Table 1.--NWHI Bottomfish Vessel (All Areas): cost-earnings simulator.

nwhb94al \econ\data 3/28/96		1994 NWHI Bottomfish Vessel All areas: economic analysis 1994 Average: updated 3/27/96	
	Income Statement		
Revenue			$116,577
Fixed Costs			$ 43,800
	Capital	$ 12,396	
	Annual repair	$ 12,499	
	Vessel insurance	$ 13,532	
	Administrative	$ 4,855	
	Other	$ 517	
Operating Costs			$ 92,423
	Fuel and oil	$ 9,194	
	Ice	$ 2,376	
	Bait	$ 4,029	
	Handling	$ 11,700	
	Provisions	$ 4,855	
	Gear and supplies	$ 6,198	
	Other (trip basis)	$ 5,372	
	Crew's income	$ 25,900	
	Captain's income	$ 22,800	
Total Cost			$136,223
Net Revenue			$-19,600

	Operating Characteristics		
	Investment	$165,500	
	Trips	8.75	
	Trip days: Total and trip	124	14.19
	Fishing days: Total and trip	66	7.52
	Catch per day (lbs): Total	595	
	Bottomfish: Other	490	105
	Total catch (whole lbs)	39,158	
	Bottomfish: Other	32,248	6,910
	Price per pound	$ 2.98	
	Bottomfish: Other	$ 3.12	$ 2.31
	Unallocated trip days	167	

Table 1.--Continued.

Shared Operating Costs	$ 43,723
Crew and Captain shares	66.9%
Crew's share	35.5%
Captain's share	31.3%
Crew size (exc. Captain)	1.64
Total labor income	$ 48,700
Total income	$ 29,100
Return on investment	- 11.84%
Handling rate	10.00%
HCPI	1.03
Capital factor	7.50%
Depreciation factor	3.33%
Opportunity cost of capita	$ 12,413
Actual capita cost	$ 12,396
Physical depreciation	$ 5,517
Annual repair	$ 12,499

Marcia Hamilton, NWHI bottomfish fishery--1993 vessel activities, cost and economic returns. Joint Institute for Marine and Atmospheric Research, University of Hawaii. Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Southwest Fish. Sci. Cent. Admin. Rep. H-94-01C, 36 p.

Table 7, page 11.

1994 data compiled from Kawamoto, 1995.
(see Bttm95c.cal)

Prices taken from Honolulu market report (3/12/96): NBprice94.

Bttm catch per day values taken from Kobayashi, 1996.
Updated: 2/17/96

Table 2.--NWHI Bottomfish Vessel (Mau zone): cost-earnings simulator.

nwhb94ml \econ\data 3/28/96		1994 NWHI Bottomfish Vessel Mau zone: economic analysis 1994 Average: updated 3/27/96
Income Statement		
Revenue		$ 77,752
Fixed Costs		$ 34,939
Capital	$ 10,751	
Annual repair	$ 12,715	
Vessel insurance	$ 7,443	
Administrative	$ 4,031	
Other	$ 0	
Operating Costs		$ 65,018
Fuel and oil	$ 6,822	
Ice	$ 1,861	
Bait	$ 2,688	
Handling	$ 7,800	
Provisions	$ 2,998	
Gear and supplies	$ 4,031	
Other (trip basis)	$ 3,618	
Crew's income	$ 14,400	
Captain's income	$ 20,800	
Total Cost		$ 99,957
Net Revenue		$-22,200

Operating Characteristics		
Investment	$140,000	
Trips	8.61	
Trip days: total and trip	93	10.79
Fishing days: Total and trip	52	6.00
Catch per day (lbs): Total	542	
Bottomfish: Other	353	189
Total catch (whole lbs)	27,995	
Bottomfish: Other	18,233	9,762
Price per pound	$ 2.78	
Bottomfish: Other	$ 2.99	$ 2.38
Unallocated trip days	199	

Table 3.--NWHI Bottomfish Vessel (Ho'omalu zone): cost-earnings simulator.

nwhb94h1
\econ\data
3/27/96

1994 NWHI Bottomfish Vessel
Ho'omalu zone: economic analysis
1994 Average: updated 3/27/96

Income Statement

Revenue		$207,713
Fixed Costs		$ 65,500
Capital	$ 16,500	
Annual repair	$ 11,600	
Vessel insurance	$ 28,800	
Administrative	$ 6,800	
Other	$ 1,800	
Operating Costs		$161,100
Fuel and oil	$ 13,900	
Ice	$ 3,400	
Bait	$ 7,800	
Handling	$ 20,800	
Provisions	$ 10,600	
Gear and supplies	$ 12,600	
Other (trip basis)	$ 14,200	
Crew's income	$ 48,600	
Captain's income	$ 29,200	
Total Cost		$226,600
Net Revenue		$-18,900

Operating Characteristics

Investment	$233,300	
Trips	9.11	
Trip days: Total and trip	204	22.39
Fishing days: Total and trip	102	11.20
Catch per day (lbs): Total	652	
Bottomfish: Other	629	23
Total Catch (Whole lbs)	66,504	
Bottomfish: Other	64,158	2,346
Price per pound	$ 3.12	
Bottomfish: Other	$ 3.16	$ 2.12
Unallocated trip days	85	

Table 4.--Cost-earnings simulator--parameter dependencies.

Independent parameter	**Secondary parameters which change**
Trips (per year)	Total Trip Days
	Total Fishing Days
Catch rate (pounds per fishing day)	Total Catch & Total Bottomfish Catch
Price per pound	Revenue
Secondary parameters	**Tertiary variables which change**
Input price adjustment factor (HCPI)	All Fixed and Operating costs (except Handling, Crew's Income, and Captain's Income)
Trips (per year)	Other (trip basis) costs
Trip Days per Trip	Total Trip Days
Fishing Days per Trip	Total Fishing Days
Total Trip Days	Fuel & Oil costs
	Provision costs
Total Fishing Days	Catch
	Ice costs
	Bait costs
	Gear & supplies costs
Total Catch & Total Bottomfish Catch	Revenue
Revenue	Handling costs
	Crew's income
	Captain's income

Table 5.--Combined NWHI Limited Entry Zone. NWHI Bottomfish catch per vessel, alternative economic operating scenarios.

Scenario	Average NWHI vessels	Ho'omalu-type vessels
1994 CPUE	18	9
MSY CPUE	17	9
MSY CPUE @ FTE	9	7
Breakeven CPUE @ FTE	10	7

Table 6.--NWHI Bottomfish fishing vessels, basic operating rates.

nwhmsy94 NWHI Bottomfish MSY Economic Analysis
\econ\data 1994 Operating Basis
3/28/96 (updated: 3/28/96)

MSY, Breakeven and FTE Values taken from
Vessel Spreadsheets (nwhb94*.cal)

Basic vessel operating rates

Trips per year	NWHI combined	Mau	Ho'omalu
1994 CPUE optimal	8.8	8.6	9.1
MSY CPUE optimal	8.8	8.6	9.1
MSY CPUE @ FTE optimal	17.0	21.0	12.0
Breakeven CPUE @ FTE optima	17.0	21.0	12.0
Fishing days per year			
1994 CPUE optimal	66	52	102
MSY CPUE optimal	66	52	102
MSY CPUE @ FTE optimal	128	126	134
Breakeven CPUE @ FTE optima	128	126	134
Days-at-sea per year			
1994 CPUE optimal	124	93	204
MSY CPUE optimal	124	93	204
MSY CPUE @ FTE optimal	241	227	269
Breakeven CPUE @ FTE optima	241	227	269
Net revenue (annual)			
1994 CPUE optimal	$ -19,600	$ -22,200	$-18,900
MSY CPUE optimal	$ -17,300	$ -22,500	$-18,400
MSY CPUE @ FTE optimal	$ 7,600	$ 4,800	$- 3,400
Breakeven CPUE @ FTE optima	$ 100	$ 0	$ 0
Total revenue (annual) (all species)			
1994 CPUE optimal	$ 116,577	$ 77,752	$207,713
MSY CPUE optimal	$ 124,174	$ 76,207	$209,324
MSY CPUE @ FTE optimal	$ 241,253	$ 185,899	$275,696
Breakeven CPUE @ FTE optima	$ 216,519	$ 205,866	$285,884