Three Different Delivery Modes for Fresh-Caught Pacific Whiting, *Merluccius productus*

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Introduction

The objective of this paper is to aid American fishermen in making decisions on whether to enter into the Pacific whiting, *Merluccius productus*, fishery and to illustrate three possible modes of delivery. It is not the intention of this report to promote a particular approach but to create an unbiased view to put forth as many feasible options as possible to the potential Pacific whiting fisherman.

Costs and fishing periods mentioned in this paper are conservative. However, it must be remembered that the catch rates illustrated were recently achieved by a very modern and efficient trawler, designed for the purpose of catching a high volume species such as Pacific whiting, by a highly competent skipper and crew.

It should be stressed that this paper deals only with the nature of the Pacific whiting fishery at present and that persons concerned should realize that a continuing investigation of this fishery is needed as technology and effort increase. To avoid some of the problems that have characterized domestic fisheries in the past, management, business, and education should work together to guarantee that the Pacific whiting fishery sustain itself to as many people and for as long as possible.

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When the U.S. Congress provided the American fisherman with the 200-mile fishing zone, the United States became trustee of a valuable source of national income as well as a potential reserve of world protein. As a nation, we are responsible for its efficient utilization.

Pacific whiting is one of the most abundant species of fish in the northeast Pacific Ocean. During the months of April through November, long, narrow, dense schools of Pacific whiting migrate from waters off southern California to Oregon and as far north as Vancouver Island, Canada (Nelson and Larkins, 1970).

Pacific whiting are generally caught at depths that range from 20 to 200 fathoms. According to reports from a 1978 U.S. observer, large foreign trawlers set nets at depths usually between 100 and 150 fathoms while smaller American fishing boats concentrate their effort between 60 and 100 fathoms, using mid-water trawl gear. This species is harvested primarily during the day due to its rise and dispersion in the water column at night to feed (Nelson and Larkins, 1970).

In April 1966, the Soviets began an intensive trawl fishery for Pacific whiting off the coasts of Oregon and Washington, landing an estimated 141,000 tons. During the latter part of the 1960's and early 1970's, the Soviet fleet alternated fishing effort off the Oregon and Washington coasts. During April, May, August, and September, the Soviets fished primarily off the Oregon coasts while during June, July, October, and November, the Soviet fishing effort remained mostly off Washington (Hitz, 1970).

The general feeling from fishermen and government officials alike is that schools of Pacific whiting are now concentrated primarily off the coast of Oregon, between Coos Bay and Astoria. Part of this change of distribution pattern is due to the establishment of closed areas off the Washington coast and changes in the age composition of the stocks. According to Bill Neff of Pacific Hake Fisheries of Astoria, Oreg., most of the resource tends to congregate between Coos Bay and Newport, Oreg., from May to July. As August approaches the schools begin migrating northward, centering primarily off Astoria. A large percentage of the catch has occurred roughly 20-30 miles off Heceta Head, about a 6-hour run north of Coos Bay.

From an optimum yield for Pacific whiting of 130,000 metric tons (t), the domestic annual harvest (DAH) was established for 1978 at 41,000 t by the Preliminary Management Plan for the trawl fisheries of Washington, Oregon, and California.[1] The DAH for this species was established by surveying domestic processors concerning projections of their 1978 processing capabilities for Pacific whiting. Marine Resources Co.[2] projection of its processing intentions for Pacific whiting in 1978 was 34,000 t, or all but 7,000 t of the total DAH. Marine Resources Co. is a U.S. corporation which has succeeded in negotiating the lease of Russian processor vessels in order to process American-caught Pacific whiting off the coasts of Washington and Oregon.

In September of 1978, the trawler *Lady of Good Voyage* was one of two trawlers contracted by Marine Resources Co. to deliver Pacific whiting to the Russian BMRT trawler/processor,

[1]Stafne, S. E. 1978. White paper on the permit applications for the Sulak and Tikvin to process fish for Marine Resources Company, Inc., a U.S. company. Unpubl. manuscr., 104 p. Stafne and Hemphill, Seattle, Wash.

[2]Reference to trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

Table 1.—Delivery mode comparison and vessel characteristics.[1]

Item		Description		
(1)	Vessel, *Lady of Good Voyage*			
	(a) Two diesel engines: 365 hp each, 730 hp/1800 rpm			
	(b) Fishing gear: Polish rope wing trawl for midwater trawling			
	(c) Generating capacity: 150 kw			
	(d) Gearing: 5.1/7.1 reduction gear; kort nozzle; two propellers			
	(e) Hold capacity: 280,000 pounds iced; 5,300 cubic feet.			
	(f) Heading and gutting machine: Baader model 160, 35 to 45 fish per minute			
	(g) Chilled seawater system used for fishing mode delivering round Pacific whiting to shore-based processor			
(2)	Mode	A	B	C
		Round delivery to shore plant	Headed and gutted delivery to shore plant	Delivery to floating processor
(3)	Crew	6 (5 working)	7 (6 working)	5 (4 working)
(4)	Operating schedules[2]	20 days fishing/month 20 days down for adverse weather & processing complications 100 total annual fishing days	20.5 days fishing/month 20 days down for adverse weather and processing complications 103 total annual fishing days	24 days fishing/month 11 days down for adverse weather 133 total annual fishing days
(5)	Daily catch in weight delivered	42 tons/day	34.65 tons/day @ 60% yield = 20.79 tons/day	42 tons/day
(6)	Annual catch rate	4,200 tons/season	2,141.37 tons/season	5,628 tons/season
(7)	Ex-vessel price	0.06¢/pound ($132.00/ton)	0.15¢/pound ($300.00/ton)	0.06¢/pound ($132.00/ton)
(8)	Gross stock	$554,400.00	$642,411.00	$742,896.00
Operating Expenses; Expendables				
(9)	Fuel	$19,008.00	$18,981.00	$17,334.00
(10)	Provisions	$6,600.00	$7,931.00	$7,370.00
(11)	Ice	$23,650.00	$9,477.20	no ice needed
(12)	Lubrication etc.	$6,000.00	$6,000.00	$6,000.00
	Subtotal	$55,258.00	$42,389.20	$30,704.00
(13)	5% Contingency	$2,762.90	$2,119.46	$1,535.20
(14)	Oregon state landing tax	$21,000.00	$10,706.85	not applicable
Total operating expenses		$79,020.90	$55,215.51	$32,239.20
(15)	Gross profit for division	$475,379.10	$587,195.49	$710,656.80
(16)	Crew share (35%)	$166,382.68	$205,518.42	$248,729.88
	each crew share	$27,730.45 (5.8%)	$29,359.77 (5.0%)	$49,745.98 (7.0%)
(17)	Captain's share (15%)	$71,306.87	$88,079.32	$106,598.52
(18)	Gross vessel share (50%)	$237,689.55	$293,597.74	$355,328.40
Fixed annual costs				
(19)	Gear maintenance	$15,000.00	$15,000.00	$15,000.00
(20)	Hull insurance	$15,750.00	$15,750.00	$15,750.00
(21)	P & I	$12,500.00	$15,000.00	$10,000.00
(22)	Depreciation	$99,526.96	$99,526.96	$99,526.96
(23)	Business and indebtness	$75,000.00	$75,000.00	$75,000.00
	Total fixed costs	$217,776.96	$220,276.96	$215,276.96
	Profit before taxes	$19,912.59	$73,320.78	$140,051.44
(24)	Income tax	$3,989.52	$16,563.40	$33,913.37
Net profit		$15,930.07	$56,757.38	$106,138.07

[1]Table based on: Jaeger, S. 1977. Presentation to the North Pacific Fisheries Management Council on the subject of foreign joint ventures. Unpubl. manuscr., 28 p. North Pacific Fishing Vessel Owners Association, Seattle, Wash.
[2]Pacific whiting fishing season, 1 May through 31 October

the *18th Congress*. The catch was transfered to the Soviets by detaching the "cod-end" with the fish.

This historic event occured after an amendment to the Fisheries Conservation and Management Act of 1977, an act which initially provided U.S. fishermen with preemptive access to all waters within 200 miles of the U.S. coast. The amendment to this act, passed in August 1978, gave U.S. processors first option to process fish within this zone. Until domestic processors develop the capabilities needed to process this vast biomass, foreign processors are allowed to enter and offer their processing vessels as markets to U.S. fishermen. Whether it be a domestic or foreign processor, the U.S. fisherman is now guaranteed a market in which to sell his fish.

Vessel Characteristics (1)[3]

The *Lady of Good Voyage* is an 86-foot by 26-foot steel stern ramp trawler, designed to fish for high volume, low unit value species of fish, like Pacific whiting, that inhabit waters in close proximity to port. Other vessel characteristics are listed in Table 1. In this paper, this vessel is used as a hypothetical model to exhibit various processing capabilities, methods of icing fish, and fishing strategies, depending on the mode of fishing.

Delivery Modes (2)

Three different modes of fishing, A, B, and C, are discussed in this paper. Mode A entails delivering fresh-caught Pacific whiting in the round to a shore-based plant located within about 60 miles from the fishing grounds. The product would be quick chilled immediately after bringing it on board. Chilled seawater is the method used in this mode for chilling.

[3]Numbers in parentheses refer to item listing in Table 1.

Mode B entails delivering fresh-caught headed and gutted whiting to a shore-based plant located within 60 miles of the fishing grounds. Heading and gutting of the fish would be done on board the fishing vessel as soon after catching as possible. The product would be packed in ice provided by the shore-based plant.

In Mode C fresh-caught whiting would be delivered in the detachable "cod-end" portion of the net to an ocean-based processor variably located on the fishing grounds.

Due to the nature of this vessel and the scope of this paper, filleting Pacific whiting on board ship has not been mentioned. A filleting operation requires from 12 to 15 men and a vessel well over 100 feet in length.

Delivery Modes (2)

The three different fish delivery modes chosen assume that a school of whiting is located about 6 hours running time from the main port. The purpose of choosing these three modes of delivery revolve around the question concerning the time it takes Pacific whiting to spoil.

Pacific whiting migrating along the west coast of the United States contain a high incidence of microscopic myxosporidian parasites (*Kudoa* sp.) in their flesh. Pacific whiting containing these parasites in moderate amounts have a serious proteolysis of the tissue, reducing the edible portions of the product to a mushy unpalatable consistency shortly after it is hauled on board (Dassow et al., 1970).

The main variables which determine its deterioration are heat, the quality of shipboard handling, the amount of time before the fish is refrigerated or processed, and the degree of parasite incidence. According to Tom Dark of the National Marine Fisheries Service (pers. commun.), the amount of time it takes this fish to become unfit for human consumption without refrigeration is about 4 hours on deck. Personnel involved with handling whiting catch aboard the Soviet processing vessel state that the fish must be processed within 2 hours to make an acceptable food-grade quality product. Wally Welch (pers. commun.), a veteran Pacific whiting fisherman from Astoria, Oreg., insists that after 1 hour in the ocean, the catch is fit only for fish meal.

Logistically, a fisherman is left with three options. An alternative that has met with considerable success, mode C, is to simply tow the catch to a nearby processing vessel, "unzipper" the detachable cod-end portion of the net and transfer it by some means to the ramp of the processing vessel.

An early method of transfer involved having a Russian BMRT drop a line off the stern ramp with a buoy attached. The trawler, after bringing in the catch, would attach the cod-end to the line and the Russian vessel would haul the catch aboard for processing.

A much more efficient method now being used involves simply tieing a buoy to the cod-end after the trawler brings in the catch and radioing the factory ship to collect the tow. The efficiency of this delivery mode is furthered by allowing the fishing vessel a maximum amount of time to trawl and stay on the main school of fish.

A second delivery alternative for the Pacific whiting fisherman is to haul the catch aboard his own vessel and quick-chill the product in either chilled or refrigerated seawater. With adequate ice storage, a fisherman could readily adapt a chilled seawater system into the hull of his vessel.

There are limitations to this mode of delivery, however. It appears that with the present state of the art, Pacific whiting kept in chilled seawater remains at an acceptable marketable quality for up to 3 days (Dassow et al., 1970). Because the quality rapidly deteriorates after this time, a 2 day maximum would be the limit for mode A.

A third alternative for a fisherman is to upgrade the product before delivery, such as in mode B. By installing a heading and gutting machine on board the fishing vessel, a fisherman can haul his catch aboard, head and gut the product, and pack it in ice. This would increase the price of the raw material by roughly 250 percent. (The 1978 price paid for headed and gutted Pacific whiting from Pacific Hake Fisheries, Astoria, Oreg., was 15 cents/pound.) Headed and gutted Pacific whiting, if handled properly, will retain good quality up to 3 days.

Crew (3)

In each of these fishing modes, the work load expected of the crew is considerable; therefore, rotating the crew members would be a desirable means of increasing vessel production while allowing each of the crew a break in the action. Having an extra crew member assures the vessel an adequate crew in case of sickness or accident, increases the efficiency of a vessel, and allows enough rest for each crew member to secure a safe working environment on board.

The four working crew members on board fishing mode C, with the trawler delivering to a floating processor, are adequate to handle the fishing, gear handling, and product transfer. According to Barry Fisher, skipper of the *Lady of Good Voyage*, with increased fishing and technological efficiency in the future, three working crew members could very well be adequate for this fishing mode (pers. commun.).

Since fish hauled aboard the trawler using fishing mode B would have to be split and sorted on deck, this trawler would require four crew members handling the gear while two crew members operated the heading and gutting machine. Crew members would have to alternate between handling the gear and icing the finished product; therefore six crew members would be needed for fishing mode B.

Five crew members would be sufficient in mode A to handle the gear, ice the raw product in chilled seawater, and run it to a shore based facility.

Operating Schedules (4)

This paper uses a focal point 20 miles off Heceta Head as the location of the fishing grounds, and Coos Bay as the respective home port for shore-based facilities. This point was arrived at by investigating previous accounts of Russian trawler activity off the Coast of Oregon in 1966 and 1967 (Hitz, 1970), in addition to using the area where most activity took place during the 1978 Pacific whiting season. Within this

general area, a trawler has about 20-60 miles to cruise between port and the fishing grounds. An approximate maximum cruising time can be listed here as 6 hours, if average cruising speed is 10 knots.

A trawler with mode C's intentions is benefited with a more flexible operating schedule than a vessel delivering the product to shore. If the vessel encounters favorable fishing conditions, time at sea could be extended much more than if the vessel were limited with product delivery limitations encountered by modes A and B. The only necessary tasks that would be performed in port by mode C would be refueling, picking up groceries, and rotating the crew.

Fishing schedules vary tremendously within the inherent flexibility found in mode C. One Pacific whiting fisherman projects a rather demanding schedule of rotating an entire crew after 7 days of steady trawling. This projection recognizes no down time whatsoever. Another less strenuous schedule suggests fishing for 5 days interrupted by 2 days of down time.

Based on these projections, a practical fishing schedule for mode C can be listed at 8 days fishing followed by 2 days in port. This represents a maximum of 24 fishing days a month, or at best, 144 fishing days annually. Off the coast of Oregon, however, a fisherman can expect to confront weather complications that often force a vessel to stay in port a few days. Rough seas are compounded by the effect of shallow river bars, making passage unsafe. Barry Fisher, a veteran fisherman to the Oregon coast, expects a total of 11 days of adverse weather to prevent fishing and delivering to a floating processor. The majority of "down days" would occur in May (2 or 3 days), September (2 days), and October (3 days), while one day down would be all that one might expect in June, July, and August. Assuming the vessel is new and time out for breakdowns is minimal, this report discounts 144 total annual fishing days by 11 for adverse weather. This makes 133 days as the total number of annual fishing days when delivering to a floating processor.

For vessels delivering fish to a shore-based plant, the limiting factor is not the capacity of the vessel, but the limited amount of time the fisherman has before the product becomes unmarketable. The main limiting factor for the vessel heading and gutting Pacific whiting, with the present state of the art, is the amount of fish that can physically be headed and gutted in a day.

For mode A, the maximum safe amount of time Pacific whiting is able to keep in chilled seawater is 2 days. In addition, at this time, Pacific whiting cannot be fished at night with any success because they feed in a dispersed fashion near the surface. These limitations allow a maximum number of 2 days fishing for mode A, with a minimum of 1 day at port to unload, refuel, restock supplies, and rotate the crew. Extrapolated throughout a month, this represents a total of about 20 days fishing per month, or 120 days fishing per season, not including time out for weather and other complications.

Twenty days have been assigned modes A and B as the number of days held in port due to adverse weather. This represents more down time than mode C because of the greater susceptibility to extreme seas over river bars, and complications that might occur from bringing the product in when a shore plant is closed. This leaves mode A with a maximum of 100 fishing days a season.

When considering the fishing schedule for mode B, however, a slightly longer amount of fishing days are allotted due to the fact that Pacific whiting will keep longer in ice as a headed and gutted product than round product will in chilled seawater. With headed and gutted Pacific whiting upholding its quality for 3 days, a fishing vessel in mode B could optimistically fish for 3 days, run in, unload for a day, and return for another 3 days of fishing. This schedule is reduced to a less demanding, more practical framework by alternating 3 day fishing periods with 1, then 2 day increments of down time. Extrapolated consistently throughout the season, the mode B fishing schedule shows an average of 20.5 days of fishing per month, or a total of 123 fishing days a season. Subtracting 20 days calculated for presumed down time, mode B is left with 103 total fishing days per season.

It must be remembered, that with the present understanding of Pacific whiting product shelf life, there is a good possibility of delivering fish that is below food-quality standards. Modes A and B might expect 10-40 percent weigh-back (bad product rejection) due to a myriad of reasons. Mode C has less chance of delivering a substandard product because the close proximity of the trawler and processor implies less chance of fish spoilage.

Daily Catch Rate (5)

Schools of Pacific whiting arrive off the coast of Oregon in enough numbers that warrant fishing to begin off Coos Bay around the first of May. Catch rates increase throughout this month and remain at a high level from June through September as populations of Pacific whiting continue their feeding migrations northward into Washington. In October, catch rates taper off.

Even though this paper analyzes three separate methods of delivering freshly caught Pacific whiting, it can be assumed that a given vessel will be able to catch as much fish with a given amount of effort as a similar vessel with a different mode of delivering fish.

The *Lady of Good Voyage*, toward the end of the 1978 whiting season, was able to pull in tows of up to 17 t in 8 minutes. Barry Fisher expects to land from 1,000 to 1,200 t of whiting in the months of June through September. In May and October, the catches would be a little less at 700 and 800 t, respectively. Therefore, 42 t a day could be achieved as an average amount caught throughout the season.

This catch rate is representative when compared with an estimated catch rate worked up by Hillstrom Shipbuilding Co. of Seattle (Andrews[4]). Based

[4]Andrews, R. 1978. Economic appraisal of catcher/processor to produce Pacific whiting fillets. Unpubl. manuscr., 17 p. Hillstrom Shipbuilding Co., Bellevue, Wash.

on the 1976 vessel observer program, three Polish trawlers had a total catch of 11,400 t. There were 995 tows of approximately 2 hours each producing an average catch per tow of 11.45 t, thereby, a daily catch rate of 51.525 t with an average number of tows per day at 4.5. This large fish catch can be discounted when taking into consideration the Polish vessel size and the subsequent depth of tows.

Since Pacific whiting has such delicate flesh, the emphasis with this fishery is not to catch overwhelming amounts of fish per tow, but to catch a maximum amount in a tow and still maintain a quality product. Wally Welch, skipper of the *Willapa Bay*, has been fishing Pacific whiting for many years off Astoria, Oreg. Welch has said that 15,000 pounds in one tow is the maximum amount desirable to maintain quality standards set up by markets in the United States. Welch presently processes Pacific whiting into fillets on shipboard for delivery to shore facilities.

However, Walter Pereyra, Vice President of Marine Resources Inc., stated that to maintain standards of quality and to achieve a Soviet processing throughput of 60-70 tons a day, fishermen fishing for Marine Resources Co. would most likely be limited to 12 tons a tow. To help achieve this, new designs are being instituted for the 1979 season. ''Windows'' are being implemented into the upper level of the cod-end so that when a desirable amount of catch is achieved, the remaining portion will be able to spill out. Pereyra also indicated that since the product processed aboard Russian BMRT's belongs to Marine Resources Co. and competes with frozen whiting blocks on the world market, quality standards can be expected to be stringent enough so that if any portion of the delivered product is fit only for fish meal, the fishermen can expect a lower price to be paid as a result.

Forty-two tons a day is the amount of fish caught that was achieved by a very efficient trawler making in the range of 2-6 tows per day. Catch per unit effort in this fishery is likely to be sustained in the foreseeable future as foreign fishing effort is gradually replaced by domestic fishing effort.

Given the present state of the art, a vessel delivering headed and gutted fish will not be able to catch 42 tons a day because the majority of it would spoil due to the amount of fish the heading and gutting machine can process in a day.

The Baader 160 is a West German heading and gutting machine. The amount of fish headed and gutted depends on the operator's skill and ocean conditions. Experienced Soviet seamen are reported to head and gut 45 fish/minute in calm seas, but a workable figure can be pegged at 35 fish/minute, given crew's breaks, sea conditions, machine problems, and degrees in crew efficiency. Heading and gutting 35 fish/minute yields 2,100 fish/hour, and since the average whiting weights 2.2 pounds (Nelson and Larkins, 1970), the total weight of raw product processed per hour is estimated at 2.31 tons. Assuming a heading and gutting machine might begin operating at 8 a.m. and finish processing at 11 p.m., operating continuously by a rotated crew, the total number of hours operated per day will probably be around 15. Heading and gutting for 15 hours will allow a gross weight of 34.65 tons to be processed per day. Since the yield on a headed and gutted Pacific whiting is roughly 60 percent, 20.79 tons of headed and gutted Pacific whiting is the estimated weight delivered per day for mode B.

Annual Catch Rate (6)

The calculation of annual catch rate is derived by multiplying the daily catch by the number of days fished per season.

Ex-Vessel Price (7)

For round Pacific whiting, Marine Resources Co. offered $0.06 a pound when processed aboard Soviet BMRT's in September and October of 1978.

Gross Stock (8)

This calculation is derived from multiplying annual catch by the ex-vessel price.

Fuel (9)

As previously stated and for purposes of this paper, the Pacific whiting fishing grounds are said to be at the most, a 6-hour run from Coos Bay. Cruising at a speed of 10 knots, the vessel's two highly efficient turbocharged diesels yield the vessel a fuel consumption rating of 30 gallons/hour. In addition to running between the grounds and port, cruising is also performed while searching for fish which has been reported to take place in this fishery about 3 to 4 hours/day. Fuel consumption is said to be the same for cruising as it is for trawling with this vessel, which takes place anywhere from 2 to 7 hours/day. Barry Fisher reports that an overall daily average of 300 gallons/day was achieved by the *Lady of Good Voyage* over a 5.5 week period. This includes fuel used for the auxiliary engine.

Rates of fuel consumption were based on 30 gallons/hour as an overall rate of consumption for trawling and prospecting. Each mode was broken down into respective hours running and fishing in conjunction with associated fishing schedules, minus fuel saved during calculated down time.

Price for diesel fuel, when bought in quantities over 1,000 gallons at Ballard Oil of Seattle, was 41.6 cents/gallon. Due to price fluctuations along the coast of Oregon and the probability of fishing time over and above the scope of these figures, 45 cents/gallon was the price used in computing fuel consumption.

Mode C fishes a total of 192 hours/month and runs between port and the fishing grounds 36 hours/month. Consuming 30 gallons/hour, this vessel consumes 5,760 gallons of fuel while fishing per month. This implies the vessel will consume a total of 6,840 gallons/month, or 41,040 gallons/season. Allowing for a savings of 2,520 gallons during the presumed down time of 11 days, at 45 cents/gallon, the total seasonal fuel expenditure for mode C is $17,334.

Mode B fishes a total of 164 hours/month and runs between port and the fishing grounds 84 hours/month. Consuming the same 30 gallons/hour, this

vessel consumes 4,920 gallons of fuel fishing per month and 2,520 gallons running per month. The total fuel consumption of this vessel per month is 7,440 gallons, or 44,640 gallons/season. Allowing for a savings of 2,400 gallons during the presumed down time of 20 days, at 45 cents/gallon, the total seasonal fuel expenditure for mode B is $19,008.

Mode A runs between the fishing grounds and port a total of 126 hours/month and fishes 140 hours for a total of 266 operating hours per month. Consuming 30 gallons/hour, mode A's vessel consumes 42,180 gallons/season, excluding 5,700 gallons presumably saved during unscheduled down time. At 45 cents/gallon, this vessel's total fuel expenditure stands at $18,981/season.

Provisions (10)

A report to Members of the Nomenclature Committee on Pacific Whiting by New England Fish Company listed the cost of groceries per trawler crew member at $11.00 per day when computing an economic impact for the fisheries complete utilization. This price is representative of 1978 food prices and assumes that no food is eaten on board while the vessel is in port.

Ice (11)

The 1978 price for flake ice when bought from Pacific Hake Fisheries in Astoria, Oreg., was $20.00 a ton.

The amount of ice used per season varies tremendously between the three different modes. Obviously, no ice is used by mode C.

A chilled seawater system (CSW) is utilized by mode A. The method of chilling the product with CSW is much faster and less complicated to operate than a refrigerated seawater system.

Calculating the amount of ice needed by this mode involves adding the total amount of heat required to be removed from the product as well as the seawater medium in which it is held. Once this is determined, the amount of ice needed to meet this requirement is calculated as follows:

1) Assume:
   a) Fish holds are filled completely with fish, seawater, ice mixture;
   b) The amount of energy needed to lower 1 pound of fish 1°F = 0.85BTU (British Thermal Units);
   c) The amount of energy needed to lower 1 pound of water 1°F = 0.94BTU;
   d) 168,000 pounds of fish landed in 2 days plus 112,000 pounds of seawater used in hold equals
   e) 280,000 pounds of seawater and fish equal to the total weight capacity of the vessel;
   f) Fish cooled a total of 25°F, from 55°F to 30°F;
   g) Seawater cooled a total of 20°F, from 50°F to 30°F;
   h) Ice yields 144BTU per pound; and
   i) 20 percent heat lost through hold wall and by other miscellaneous losses.

2) Then, ice required to cool finished load of saltwater and fish mixture:
   a) Fish load = 168,000 lb × 0.85BTU/°F × 25°F = 3,570,000BTU;
   b) Water load = 112,000 lb × 0.94BTU/°F × 20°F = 2,105,600BTU;
   c) Total load = 5,675,600BTU;
   d) Plus 20 percent wall and miscellaneous losses: 1,135,120 BTU;
   e) Total amount of energy needed to freeze product: 6,810,720BTU;
   f) Pounds of ice needed to furnish energy per trip: 6,819,720BTU ÷ 144 lb/BTU = 47,296.66 pounds or 23.65 tons.

Mode A will perform an estimated 50 trips per season. At $20.00 a ton, this requires a seasonal ice cost of $23,650 for this mode.

Due to the difficulty in estimating heat loss on a vessel delivering headed and gutted product, the ice needed by this vessel is determined assuming ice will be loaded at 20 percent of the total estimated product weight. After 3 days of fishing, it is assumed that this vessel can head and gut 103.95 tons of whiting, yielding 62.37 tons of finished product at a 60 percent yield. The amount of ice needed to keep this product sufficiently cold is 12.47 tons. A trawler delivering headed and gutted whiting will perform an estimated 38 trips per season, requiring 473.86 tons of ice per season. At $20.00 a ton, $9,477.20 will be needed for ice by this fishing mode per season.

Lubrication, etc. (12)

Cost of lubricating a vessel can be considered the same for each mode because where one mode uses lubricants more in transportation, such as mode A, another mode makes up for the deficit in increased fishing time, such as mode C.

This figure also denotes items like hoses, spare tools and parts, sanitation chemicals, and other items needed to maintain a safe and efficient operating condition on board.

Contingency (13)

A 5 percent contingency figure is used here due to the unpredictability of circumstances, especially in the fisheries industry. The two contingency figures are incorporated in the operating expense section and in the section listing fixed costs.

Oregon State Landing Tax (14) (0.0025¢ per pound)

At this time, floating processors operating in Federal waters are not subject to State taxes. However, duties paid on finished products brought into the United States affect the processor in such a way as to probably lower the price for raw materials in the future. At this time, however, there is no way to represent this.

Gross Profit For Division (15, 16, 17)

This figure highlights and distinguishes the actual amount of profits per unit effort of the different fishing modes.

There are countless methods used to divide gross profit. The method used in this report is basic and does not go into

the details that make each fishing vessel different from the next.

The gross profit was divided in such a way as to have the crew receive 35 percent, the captain 15 percent, and the vessel 50 percent. To arrive at a crew share figure, the crew percentage was divided by the number of crewmen working for the vessel.

Gross Vessel Share (18)

The total sum left to the vessel for fixed annual costs.

Gear Maintenance (19)

The net presently used on the *Lady of Good Voyage* is a Polish rope wing trawl at an estimated cost of $15,000. This cost is used as a conservative estimate of annual gear maintenance.

Hull Insurance (20)

This figure represents 1.75 percent of vessel value. This is a rather low estimate due to the fact that this is a new vessel. The figure covers the vessel for 6 months of mid-water trawling for whiting and another 2 months of bottom fishing.

Protection and Indemnity (21)

The cost represents a figure of $2,500 per operating crewman, with a limit of $1 million.

Depreciation (22)

The method of depreciation used here is the declining balance method. The reason this method is used is to write off the vessel using a more expedient method in order to afford a more favorable tax posture. One should note here that depreciation values in the early years of ownership are considerably higher than other methods of depreciating equipment. Depreciation figures are not to be deducted from cash flow estimates.

The machinery and electronics are written off in 8 years and represent 40 percent of the vessel, while the hull and other structures are written off in 15 years and represent 60 percent of the vessel. Salvage value on the machinery and electronics is $36,040.65 and is $63,486.31 on the hull.

Business and Indebtedness (23)

This figure assumes a loan of $750,000 at 10 percent per annum.

Income Taxes (24)

Taxes used in this report are in line with the corporate income tax structure: 1) 20 percent on first $25,000 of taxable income. 2) 22 percent on taxable income in excess of $25,000. 3) A surcharge of 26 percent on taxable income in excess of $50,000.

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Literature Cited

Dassow, J. A., M. Patashnik, and B. J. Koury. 1970. Characteristics of Pacific hake, *Merluccius productus*, that affect its suitability for food. *In* Pacific hake, p. 127-136. U.S. Fish Wildl. Serv., Circ. 332.

Hitz, C. R. 1970. Operation of the Soviet trawl fleet off the Washington and Oregon coasts during 1966 and 1967. *In* Pacific hake, p. 53-75. U.S. Fish Wildl. Serv., Circ. 332.

Nelson, M. O., and H. A. Larkins. 1970. Distribution and biology of Pacific hake: A synopsis. *In* Pacific hake, p. 23-33. U.S. Fish Wildl. Serv., Circ. 332.

Reference

Nelson, M. O. 1970. Pacific hake fishery in Washington and Oregon coastal waters. *In* Pacific hake, p. 43-52. U.S. Fish Wildl. Serv., Circ. 332.