MEMORANDUM

TO: Council, SSC and AP Members

FROM: Clarence G. Pautzke
Executive Director

DATE: June 15, 1989

SUBJECT: Open Access Management of the Fisheries

ACTION REQUIRED

Review reports on future problems under open access and identify measures that could be used to address them.

BACKGROUND

The Council began a comprehensive examination of limited access in January and recognized that for any analysis to be really meaningful, it must include a comparison of the alternatives with future conditions under continued open access, not today's "status quo". Regardless of the Council's final decision on limited access, projecting how the future might play out under open access is a useful exercise solely from the standpoint that the Council may be better prepared to anticipate and head off problems before they become "crises".

Ideally it would be nice to be able to project the future of fisheries over the next five or ten years. Unfortunately, it is not an easy task and may well be impossible. The technical workgroup that met on April 24-25 concluded that it was best not to try to anticipate fleet sizes and who would be catching what in which area. Instead they concentrated on laying out the general problems that might develop in the fisheries and identifying management measures that could be used to address them. Their discussions are summarized in item C-6(b)(1).

The workgroup recommended that resource conservation take priority over all other considerations and that the Council establish a stable regulatory environment within which industry can rationally plan their participation. The workgroup went on to identify various aspects of management that the Council should consider in establishing a basic management philosophy for the long term, issues such as whether the Council wants to be involved in micromanagement of the fisheries, whether seasons should be short or long, and the role the Council should play in shaping the industry. A major point made by the workgroup was that Council decisions would shape the industry regardless of their intent. The workgroup's discussion culminated in a list of problems anticipated for each fishery and suitable management measures that could be used to address them (Tables 1 and 2 of their report).

The Fishery Planning Committee reviewed the technical report and had several views of the sablefish fishery in the near future under open access. With the expected decline in sablefish TAC, CPUE will decline and seasons will shorten, especially in the West Yakutat and Southeast Outside areas. Short serial openings might be used to manage these fisheries and the Council may also resort to trip limits. Total longline effort will increase although the Committee anticipates that some vessels in the Central and Western Gulf may leave the fisheries. Ice boats will take longer trips (if allowed) resulting in increased rockfish discard (which cannot be iced beyond three days). At-sea processing will increase significantly though some factory longliners will move to the Bering Sea due to gear crowding in the Gulf. Crew safety will decrease as the number of injuries increases. In discussing halibut management, the Committee thought that seasons will remain short and that short, serial openings might be used to spread out the effort.

The staff and teams will be using the Committee's report and the technical report as supporting documentation for the analysis of limited entry alternatives against the future "status quo". Any discussion or recommendations the Council desires to add to these two documents would be appreciated.

OPEN ACCESS TECHNICAL WORKGROUP
April 24-25, 1989 Meeting Summary

The open access technical workgroup met in Seattle on April 24-25. Members present were Steve Davis and Dick Tremaine (NPFMC), Jay Ginter and Joe Terry (NOAA Fisheries), Bob Trumble (IPHC) and Sam Wright (WDF). The purpose of the meeting and this report is to identify and project some of the problems and solutions facing the Council's fisheries under open access during the next five years. The group considered only open access management regulations and how it might solve the Council's six identified problems (Table 1). This paper summarizes the discussions which occurred during the meeting and should not be misconstrued as a technical work focusing on open access.

There seem to be five types of regulations which can be used to solve fisheries problems. These regulations address the matters of who can fish, what can be caught, when fishing can occur, where fishing can occur and how to fish. The issue of who will be allowed to fish is not considered under an open access framework. Most if not all regulations which the Council will use can be categorized within the remaining four approaches.

Recommendations

(1) **Biological conservation of the resource must take priority over all other considerations.** The industry can only survive in the long term if the resource remains renewable and abundant. The use of open access management does not mean that the resource will be overharvested but it does mean that pressures will be placed on managers to increase harvests and that the costs of ensuring healthy stocks will increase.

(2) **The Council should set a course of action for the development of open access that will allow industry members to rationally plan their participation.** While it is not possible for the Council to anticipate all of the impacts of its actions it should be aware of the possible affects and plan accordingly by considering together the entire group of management measures it will use. A stable regulatory environment will be a great boon for industry investments, especially when profit margins decrease. This means moving away from micro-management (as is beginning to occur now) and more toward general management and periodic review on a long-term amendment cycle.

Items for Council Consideration

As with any search for solutions, it is extremely helpful to first identify the goals to be reached and specific problems to be solved. In this case, the specific problems will require further discussion and identification by the Council, plan teams, and industry. This discussion is a normal part of the Council process. What the Council does not normally consider is the long-term effects of its management decisions in the whole. Put another way, *the Council has, in the past, set domestic regulations to solve specific problems with little if any direct thought given to the cumulative set of regulations or their cumulative effects.* The Council has been forthright about not wishing to dictate the structure of the fishing industry but, by making management decisions, it <u>does</u> structure the industry.

There are several long term goals that the Council may wish to consider when setting future management plans. Four of these issues are posed below. There are other issues of equal importance and all are interrelated.

Where does the Council want to place itself between the extremes of being required to make micro-management decisions on a meeting by meeting basis verses a general set of regulations which require mainly periodic review and changes? Open access management could range from open seasons, 100% observer coverage and rigidly enforced species quotas to the other extreme of specific regulations concerning the quantity of fish, type of gear, area to be fished and days to fish on a trip by trip basis.

How quickly does the Council want the fishery seasons to end? The management measures available can be tailored to allow the fishery to last from as long as all year to as short as the unconstrained fleet can harvest and process. While this may not be a problem in most fisheries at this time, it is apparent from sablefish and halibut that once a course of action is chosen it is difficult to change and the consequences can be great.

What level and types of employment does the Council want in the industry? Full time equivalent employment can be equal but be part time employment (100 people working 4 months each) or full time employment (25 people working all year). This determination is integral to the length of season or at least to the sequence of seasons. The types of measures chosen (reducing by what, when or where or restricting by how fish are harvested) will directly shape employment in both the harvesting and processing sectors. The levels and duration of harvests will determine such things as the financial impact on coastal communities and residence of people participating in the fisheries.

What form and structure should the industry take? What should the fleet makeup be (trawlers, longliners, catcher/processors and processors); what processing capacity should exist onshore; what will the profits from the fishery be; will bycatch be utilized or not? As was stated before, the Council will shape the structure of the industry regardless of whether it intends to or not. The only unknown is whether the shaping will occur in a planned fashion or piecemeal.

Biological Conservation, Adequate Data and Sufficient Levels of Enforcement are All Necessary for the Continued Viability of the Fisheries

There are several items that the workgroup believes need to be acted upon regardless of the management approach taken by the Council.

Factors leading to resource damage include increased pressure on the managers to harvest more of the resource and declining or inadequate data on which to base such decisions. *There are no documented cases of permanent damage to resource conservation objectives simply because of excess harvesting capacity. This permanent damage will occur only if the managers do not have the will power, expertise and regulatory flexibility needed to properly respond to changes in fishing power.* However, worldwide, with rare exception, managers have not had the necessary willpower, resources, and ability to prevent such damage. Typically, there is a time lag between the point that increased restrictions are actually needed and their effective implementation. The transition during this lag period need only be short-lived with brief conservation impacts and an eventual return to stabilized stocks. Whether or not overly conservative management is necessary when faced with excess harvesting capacity is debatable. It is certainly one of the insurance measures available to managers.

Decreased profitability, increased industry pressure, and inadequate data can be directly linked to managers' decisions to overharvest many fisheries worldwide, including groundfish off New England. Segments of the industry, especially those experiencing financial instability, will bring pressure to bear on managers to increase harvests or at least maintain current levels in the face of declining stocks. As exploitation levels approach the biologically recognized maximums, greater effort must be exerted to properly estimate stock sizes and to fully account for non-landed mortality. This increase in data gathering, if conducted, requires increased costs on the part of the managing agencies.

The necessity for adequate data gathering is not isolated to an open access system with excess harvesting capacity. Any time managers wish to harvest as much of the resource as possible the chance of over harvest increases regardless of the management system being used.

Just as biological conservation and data gathering are required, so is adequate enforcement. *The effectiveness of regulations will be compromised without the use of adequate levels of enforcement. It is an axiom of such enforcement that the larger the number of participants and the greater the number of regulations the more difficult and expensive the enforcement job becomes.* Therefore, it is apparent that excess harvesting capacity and greater numbers of regulations will lead to significantly increased enforcement costs.

Anticipated Problems in the Fisheries

The Council's list of six general problems facing the fisheries was modified in an attempt to better state the problems. This resulted in 10 problems as presented in Table 1. It should be noted that open access, by design, allows new entrants into the fisheries given the existing set of regulations (a portion of problem 6(a)). The Council's list of possible management measures was modified and expanded to 28 different measures, also in Table 1. Finally, nine fisheries which are expected to suffer from these problems in the next five years were identified. These fisheries and the individual management measures noted for each of the problems are contained in Table 2.

There are two basic means of restricting effort, reducing the time or areas of fishing or amounts that can be harvested; and reducing the rate of harvesting or processing. The impacts of these two types of restrictions on the industry are different. The first set will tend to result in shorter seasons but not directly increase operating costs. However, short seasons will lead to increased operating costs and require even more harvesting and processing capacity. With shorter seasons it is possible that the vessels, gear and crew can participate in other fisheries or occupations. Restrictions which reduce the rate of harvesting or processing will directly increase the operating costs and slow the shortening of seasons but participation in other activities may be less likely. Most if not all other fisheries in the Council's jurisdiction and, in fact, in the entire U.S., currently suffer from overcapacity or will so in the near future. Therefore, *any shifting of effort from one U.S. fishery to another would compound existing problems.* If excess and idle capacity is shifted to fisheries off other countries or to other industries then the level of problems may possibly be lessened.

The workgroup identified nine fisheries and species groups which would experience problems throughout their range during the next five years. These are: halibut, sablefish, rockfish, turbot, Pacific cod, pollock, pollock roe, other roe fisheries, and crab. In addition, other fisheries are expected to experience specific or isolated problems but probably not throughout their range. Bycatch of crabs, halibut, sablefish, and others are not categorized with

TABLE 1. PROBLEMS FACING THE FISHERIES AND MANAGEMENT MEASURES WHICH WILL BE USED TO SOLVE THEM

PROBLEMS FACING THE FISHERIES

1. Allocation conflicts

   (a) Management or preseason allocations (examples include sablefish gear in the Gulf; shorebased versus at-sea processing).
   (b) Gear conflict, both intra- and inter-gear (examples include excessive amounts of longlines on the grounds causing tangles, grounds conflicts between trawlers and longliners during halibut season).

2. Control non-landed fishing mortality.

   (a) Deadloss -- ghost fishing and lost gear.
   (b) Bycatch loss -- species not landed for regulatory reasons.
   (c) Discard mortality -- species not landed for economic reasons.

3. Excess harvest capacity -- economic inefficiency at a fleet level.

4. Product quality.

5. Safety.

6. Opportunity for new entrants into the industry and increased economic development.

   (a) Ease of entry to the fishing industry and coastal community development.
   (b) New or less expensive fishery products and markets.

MANAGEMENT MEASURES WHICH WILL PROBABLY BE USED IN THE NEXT FIVE YEARS

1. Allocation of a species as bycatch or target.
2. Area closures and/or allocations.
3. Authorized retention of a percentage of PSC.
4. Biodegradable gear and other gear modifications.
5. Exclusive and/or super-exclusive registration areas.
6. Gear allocations.
7. Gear check-in/check-out reports.
8. Gear registration.
9. Limits on discarded fish parts.
10. Mandatory catch reporting.
11. Mandatory logbooks.
12. Mandatory observer coverage.
13. Mandatory price grading system at processor level.
14. Onshore/offshore processing allocations.
15. Pooning the fleet.
16. Positive incentives to catch less bycatch and PSC.
17. Prescribed fishery management practices to minimize gear conflicts in time and/or space.
18. Processor and other industry education programs.
19. PSC limits.
20. Quota by area, gear, and species.
21. Quota reductions.
22. Safety standards.
23. Seasonal closures and flexibility.
24. Technological innovation, perhaps with incentives.
25. Catch limits.
26. Trip duration limits.
27. Limits on the number of trips.
28. Vessel and/or gear restrictions.

TABLE 2. MANAGEMENT MEASURES FROM TABLE 1 WHICH COULD BE USED TO SOLVE IDENTIFIED PROBLEMS, BY FISHERY.

	Allocation Conflicts		Non-Landed Fishing Mortality						Increased Development		
	Management and Preseason	Gear Conflicts	Deadloss	Bycatch Loss	Discard Mortality/ Highgrading	Excess Harvesting Capacity	Quality	Safety	Communities	Product	Management Measures Occurring 50% or More
Halibut	1, 5, 6, 15, 20, 23, 25, 26, 27	2, 5, 15, 17, 18, 24, 25, 28	4, 5, 7, 8, 12, 17, 24, 25, 28	1, 2, 3, 4, 10, 11, 12, 16, 19, 21, 23, 24, 28		1, 2, 5, 15, 17, 23, 25, 26, 27, 28	13, 15, 18, 23, 24, 25, 26, 28	22, 23, 25, 26, 28	5, 7, 20, 23, 25, 26, 28		5, 15, 23, 24, 25, 26, 28
Sablefish	1, 5, 6, 15, 20, 23, 25, 26, 27	2, 5, 15, 17, 18, 24, 25, 28	4, 5, 7, 8, 12, 15, 17, 24, 25, 28	1, 2, 4, 6, 10, 11, 12, 16, 19, 20, 21, 23, 24, 28	4, 9, 10, 11, 12, 24, 28	2, 5, 15, 17, 23, 25, 26, 27, 28	13, 15, 18, 23, 24, 25, 26, 28	22, 23, 25, 26, 28			5, 15, 23, 24, 25, 26, 28
Rockfish	1, 2, 3, 21, 25		7, 8, 12, 15, 17, 24, 25, 28	2, 4, 10, 11, 12, 16, 19, 21, 24, 28							2, 21, 24, 25, 28
Turbot	1, 6		4, 7, 8, 12, 17, 24, 28			2, 23, 25, 28					28
Pacific cod	1, 2, 14, 20	2, 17, 18, 24, 28	4, 7, 8, 12, 24, 28		4, 9, 10, 11, 12, 16, 24, 28	2, 17, 23, 25, 26, 27, 28			5, 7, 20, 23, 25, 26, 28	18, 24	24, 28
Pollock roe	2, 9, 14, 23				9, 10, 11, 12, 24	2, 5, 9, 26, 27					2, 9
Pollock	1, 2, 5, 9, 14, 23, 25			1, 3, 5, 9, 10, 11, 12, 14, 16, 21, 24	4, 9, 10, 11, 12, 16, 24, 28	2, 5, 23, 25, 26, 27, 28				18, 24	5, 9, 24
Other roe	2, 9, 14, 23				9, 10, 11, 12, 24	2, 5, 9, 26, 27				18, 24	2, 9
Crabs		2, 15, 18, 24, 25, 28	4, 7, 8, 12, 24, 28	2, 3, 4, 10, 11, 12, 16, 19, 21, 23, 24, 28	4, 10, 11, 12, 16, 28	2, 5, 15, 23, 25, 26, 27, 28	13, 15, 18, 23, 24, 25, 26, 28	22, 23, 25, 26, 28			23, 24, 25, 28
Yellowfin sole/ Other flatfish*	2, 5, 6, 14, 20, 23		8, 12, 24, 28	2, 3, 10, 11, 12, 14, 16, 19, 20, 21, 23, 24, 28	9, 10, 11, 12, 16, 24, 28	2, 5, 17, 23, 28			5, 7, 20, 23, 25, 26, 28		2, 5, 12, 20, 23, 24, 28
Other species**	1, 2, 5, 6, 14, 20, 23, 25	2, 15, 17, 18, 24, 25, 28	4, 7, 8, 12, 24, 25, 28	1, 2, 3, 4, 10, 11, 12, 14, 16, 19, 20, 21, 23, 24, 28	4, 9, 10, 11, 12, 16, 24, 28	2, 5, 17, 23, 25, 26, 27, 28	13, 15, 18, 23, 24, 25, 26, 28	22, 23, 25, 26, 28	5, 7, 20, 23, 25, 26, 28	9, 18, 24	

Notes: * Added by the Fishery Planning Committee, May 18, 1989.
** Some of the identified species may be included in the other species category.

the target fishery catching them but, instead, with the rest of the crabs, halibut, etc. *All fisheries are expected to have excess harvesting capacity and therefore all will require some type of regulation beyond that currently in place.*

Specific management measures suitable for solving species specific problems were one part of the workgroup discussion. The longline fisheries in general and halibut and sablefish in particular suffer from the most problems including bycatch in trawl fisheries. The roe fisheries and pollock in the Gulf of Alaska are the most problematic trawl fisheries followed by trawling for mixed species in all areas. The crab fisheries suffer from problems in the directed pot fisheries and as bycatch in trawl fisheries. The groundfish pot fisheries are expected to have the least amount of problems. *No fishery or species group will be exempt from over capacity and other problems identified by the Council.*

An examination of Table 2 reveals that *there are often a number of different management measures which may be suitable for solving a given problem.* These solutions vary depending on which gear groups and species are involved. For instance, while measure 5, registration areas, is a possible solution for allocations of longline caught halibut and sablefish it is probably not as useful for rockfish which are often a bycatch in other longline fisheries. The listings presented in the table are not comprehensive and are based subjectively on what might be the most effective choices for each species specific problem.

A cursory examination of the possible management measures for each species shows that *some of the management measures are capable of solving more than one problem.* For instance, in the halibut row, it is apparent that vessel and gear restrictions, number 28, are suitable for solving all problems except management and preseason allocations. However, the specific restrictions may vary depending on which problem is being solved. The point here is that depending on how a management measure is structured, several problems could be addressed simultaneously.

There are several ways that the relative effectiveness of management measures can be measured a priori. Those measures occurring as solutions in 50% or more of a species' identified problems are shown in the far right column of Table 2. While this method shows the relative occurrence of the management solutions it does not address the relative severity of each problem. By addressing the severity and interrelated nature of the problems a different set of solutions could be identified. The set of common solutions for the group of other species (bottom row) was not determined because the nature and extent of the problems is too unspecific. Likewise, a list of the management measures occurring most often throughout the table is not useful.

General Comments

There are several projections which the workgroup made concerning open access management. These are that the tools available can solve most of the Council's identified problems, a unique relationship will develop between the exvessel value of the resource and the capitalized value of the fleet, and that the structure of the fishing industry will be shaped by each management measure implemented. There are certainly more topics which could be discussed in relation to open access but it was these three that the group discussed the most.

The management tools available under open access are capable of solving all of the Council's identified problems with the exception of excess harvesting capacity/economic inefficiency. Excess harvesting capacity and its counterpart, economic inefficiency on a fleetwide basis, are endemic problems with open access management. In this context, economic efficiency is defined as maximizing fleetwide production while minimizing the entire

fleet's costs. Over capacity can be defined as the presence of enough vessels, gear, labor, and other investments to harvest the available resource in less time than is available or "optimal".

The capacity and capitalization of an open access fleet grows until there are no excess profits to be made. This happens in open access fisheries worldwide and the group is unaware of any such fisheries in which it has not occurred or is not expected to occur in the foreseeable future. This does not mean that some fishermen are not successful but, rather, on a fleetwide basis these successful fishermen are balanced by others who have less than a normal rate of return or a negative cash flow. In this sense, excess profits are those beyond a "normal" rate of return on capital investment.

Implementation of open access management measures will result in some combination of shorter seasons and regulations which lower the catch per unit of effort. Certainly there will be more regulations than now exist and they will also be more complex. The end result is an increase in the cost per pound landed (economic inefficiency) and a decrease in overall profits. Any innovations which increase harvesting effectiveness, all else equal, will result in shorter seasons. However, on an individual vessel level, the only reasonable response to either of these management approaches is to purchase more equipment and increase harvesting effectiveness. The fleet will be forced into a cycle of increased expenditures with overall decreased revenues per vessel. *Management will consist of a cycle of progressively shorter seasons and/or further regulatory reductions in harvesting effectiveness.*

Over the long term, a unique ratio is arrived at between the value of the resource and the capitalized value of the fleet. This ratio is specific to the particular fisheries and fleet structure involved and to the external circumstances such as market demand, costs of fuel, and so forth. By the time this ratio is reached, all profits and crew wages are squeezed to a very low level due to each vessel's need to service debt loads and buy new equipment to stay competitive on an individual basis.

The fisheries under the Council's jurisdiction are expected to increase in value, at least for the foreseeable future, although this increase will be much less than that realized in recent years. The result will be an increase in the capital value of the fleet (more vessels, gear, labor, electronics, and so forth). At some point in the relatively near future this (unknown but unique) critical ratio of resource value to capitalized value will be reached. If all outside factors stay constant then, after a sufficient period of time, the fleet would stabilize at this point with no excess profits available. Certainly there will be short term fluctuations about this point resulting in financial troubles for some fishermen and profits for others. *The fleet will remain close to this critical balance point providing no changes occur in stock abundance, world fish markets, exchange rates, fuel prices, labor rates, or any number of other factors.* Any relatively minor change in these factors will, after time for adjustment, result in a proportionate change in the capitalized value of the fleet. Likewise, any major change in any of these external factors would cause a major change in the value of the fleet.

If (or when) external factors force the value of the resource down significantly, the fleet value would have to adjust. This adjustment would probably occur by the bankruptcy of fishing vessels. Unless the fish stocks decreased significantly, these vessels could reenter the fishery at a lower capitalized value. Should this happen, the value of the fleet would decrease but the overall fishing effort probably would not. This process of readjustment through bankruptcy will have significant ripple effects. Floating processors could enter salmon and herring processing (some have already stated they would do this), financial institutions would become more conservative on loans, and profit margins in all sectors of the industry would decline.

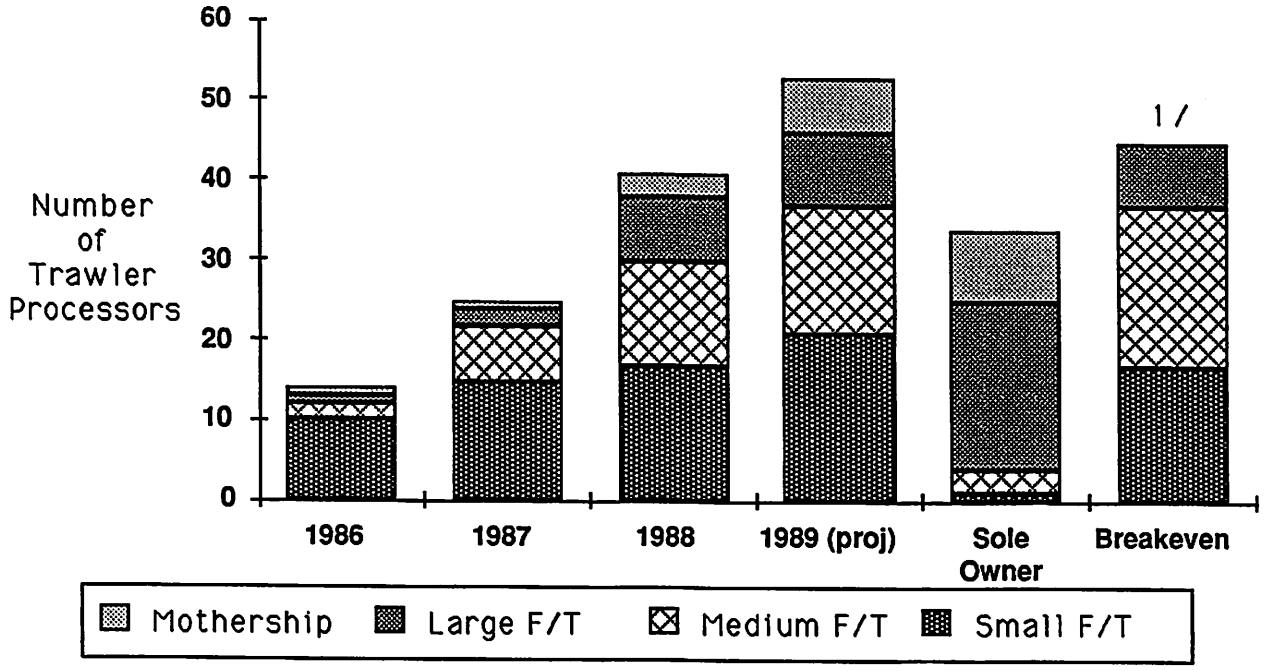
The suite of management measures used to solve the various problems will shape all sectors of the industry. As management measures impose restrictions on fishermen the fishermen will respond by employing more effort of a different form. This may be an interactive process since the new shape of the industry might, to some extent, shape the type of management measures to be used in the future. A clear example of this process is the salmon fisheries in Washington. Due to increases in the number and harvesting capacity of vessels, the fishing seasons were shortened. Vessels with low operating costs that had been very successful fishing during long seasons found they could not remain profitable. However, a new type of vessel appeared, one which was small, fast, and trailerable. While these new vessels were not competitive against the traditional salmon vessels during long seasons they were ideal for short, sequential seasons spread over several fishing areas. The structure of the fleet subsequently changed from larger vessels capable of inexpensively harvesting salmon to small vessels with much higher operating costs but capable of moving from area to area.

The example given above concerning Washington salmon is not an isolated instance. *All management measures impose burdens on the industry which the industry responds to by changes in operation or structure.* If a certain type of gear or vessel is not cost effective to operate under a given management system, the fishery is effectively closed to that particular unit. *More often than not the types of changes caused by management measures have not been anticipated by management agencies.*

Similar types of changes as a result of management measures, although indirect, will be experienced by other industry sectors including processing, transportation and storage. A case in point is surimi production in the Gulf of Alaska. The pollock resources in the Gulf of Alaska declined over the past few years. However, sufficient harvest limits remain for viable surimi operations in Kodiak. In 1989, the allowable pollock harvest was taken in such a short time that there was none left for surimi production later in the year and some of the fish harvested were not fully processed but taken out to sea and dumped. The result is that investments in surimi plants and equipment in Kodiak may remain idle for the remainder of 1989. This will result in decreased long term employment and a fixed cost burden to the processors. If the management policy of short seasons continues, surimi investments may be lost to Kodiak and such processing will be forced to move to the Bering Sea region or to at-sea processors. Conversely, if the management policy is to have an extended season with restricted landings, it is unlikely that floating processors could produce surimi in the area. Under either scenario, the choice of management measure would dictate at least several aspects of the industry development, employment, investment and overall profitability.

The workgroup did not feel that they had the time or resources to make educated projections concerning factors external to the fisheries. Some of these external events and factors include world fishery supplies, currency exchange rates, world fishery demand, number of new vessels entering the fleet, and future technical innovations. *All of these as well as other factors were recognized as being crucially important to the continued viability of the fisheries and its competitive position in the world market.*

A Comparison of Factory Trawler and Trawler Mothership Fleets from 1986 through 1989, a Sole Owner Optimum Fleet and a Breakeven Fleet.



Vessel size classes:	Small F/T	Medium F/T	Large F/T
1986 - 1989	< 200'	200' - 250'	> 250'
Breakeven	< 200'	200' - 250'	> 250'
Sole owner	162'	200'	300'

Notes: 1/ This model did not includes an estimate of the number of motherships, instead it assumed 120 trawlers delivering to shore and motherships.

None of the statistics above include longline, pot or crab vessels.
The sole owner fleet assumes 44 to 49 catcher vessels delivering to motherships.
The 1988 and 1989 fleets have over 100 catcher vessels each (including JV catchers).

Sources: 1986 - 1989 fleet size - NOAA Fisheries, AKR, Juneau, AK.
Sole owner fleet - Huppert, D.D. 1988. Managing Alaska Groundfish: Current problems and management alternatives. U of WA, FRI. FMF-FRI-001. 86p.
Breakeven fleet size - Wiese, C. 1988. The intelligent investor's guide to Alaska's groundfish fishery. Pacific Fishing, Sept. 1988. pp. 46-57.