

6.0 BIOLOGICAL AND PHYSICAL IMPACTS

Regardless of the alternative implemented, the management process and level of allowable catches for the fishery are likely to remain unchanged. Each year, the Council determines the status of stocks, calculates ABCs and sets guidelines or quotas for total allowable catch as appropriate. Annual catch levels should be essentially equivalent for the different alternatives, although differences could arise due to errors in management. For example, undocumented discarding could cause the effect of fishing to be underestimated, and the likelihood of significant discarding varies among the alternatives.

Except due to errors in the stock assessments, none of the alternatives would have an obvious specific impact on average spawning success, population structure and stability, species diversity or distribution of the resource. Specific biological impacts of the alternatives are discussed in the following sections. Impacts associated with measured discards are economic in nature as the impacts are on utilization and net economic benefits rather than on the amounts of mortality.

6.1 Status Quo

Under status quo, the number of participating vessels might vary around current levels or increase. Chapters 3 and 5 contain information to help the reviewer evaluate the probability of alternative future trends in numbers of vessels. It is also assumed the landing quotas used to regulate fishing mortality would be maintained for the species currently managed in that manner. The primary negative biological impact of status quo management, as compared to effective license limitation or ITQs, may be the higher unmeasured discarding that might occur due to more restrictive trip limits and closures.

Trip limits have been used to slow landings of certain stocks caught in multispecies fisheries (e.g., trawl sablefish, Vancouver and Columbia area yellowtail rockfish). The rationale is that trip limits encourage shifts in fishing strategy so that catches of unregulated species might be maintained or increased while the catch of regulated species would be reduced. In practice, substantial discarding occurs when catches of regulated species exceed trip limits (Pikitch *et al.* 1988). These losses can occur whether fishing effort is directed toward that species (targeting) or toward other co-occurring species (bycatch).

The rate of discard typically varies inversely with the magnitude of the trip limits (Pikitch *et al.* 1988). Trip limits are made more restrictive as the landed catch of the regulated species approaches the total allowable catch for the year. The rate at which the catch quota is approached would depend on the size of the quota, fishing power of the vessels and number of participating vessels. Thus, an increase in the number of vessels would be expected to increase discarding above current levels. Particularly when trip limits are low, some discarding is also due to highgrading (discarding the least valuable sizes of fish so a greater fraction of the trip limit will be comprised of more valuable size fish) (Pikitch *et al.* 1988).

Closures have been applied primarily to single-species fisheries in which most of the catch results from directed fishing. In those cases (e.g., widow rockfish, fixed gear sablefish), the directed fishery closes when the landed catch equals the quota less anticipated bycatch in other fisheries. In recent years, rather than closing the fishery, the Council has gone to a low trip limit which allows vessels landing small amounts of fish to continue fishing. Factors that reduce season length (e.g., a decrease in stock size, or an increase in vessel fishing power or the number of participating vessels) would

increase discarding for those species if sufficient allowances are not made for bycatch. For example, significant discarding of widow rockfish in the bottom rockfish fishery was observed following a closure in November 1987 (Pikitch *et al.* 1988).

Discarding results in direct losses in long-term production of stocks, as some yield available to fishermen would be lost as discard. Indirect losses also are likely, due to errors in the assessments, because the landed catch would be an underestimate of total mortality due to fishing. Except for short-term studies of segments of the fishery, there is no onboard observer program that could provide estimates of amounts discarded. For that reason, stock assessments incorporate assumptions about the level of discard, based on the perceived levels of fishing effort and regulations in effect. The long-term productivity of these stocks will be maintained only if the assumptions about discarding are reasonably accurate.^{1/} The impact of discarding would, in general, apply coastwide except when regulations pertain to only one area (e.g., Vancouver and Columbia area yellowtail rockfish trip limits).

One possible result of status quo management could be an increase in the number of participating vessels. An expected impact of an increase in participants would be earlier and stricter trip limits. For example, in 1987, a 30,000 pound trip limit for widow rockfish was in effect from January 1 through October 14, and a 5,000 pound trip limit was in effect from October 14 through November 25 when the fishery closed. Assuming a 10 percent increase in vessels (and, hence, fleet harvest rates), the cumulative total landings would be about one month ahead of 1987 (Table 6-1); thus, restrictive trip limits might begin a month or more earlier.

Table 6-1. Monthly Washington, Oregon and California widow rockfish landings (L) for 1987 and projected landings (1.1L) assuming a 10 percent increase in the number of participating vessels.

Month	Actual 1987 Landings (L)	Actual 1987 Cumulative Total	Projected Landings with 10 Percent Increase in Fleet Size (1.1L)	Cumulative Total Projected Landings
January	1,773	1,773	1,950	1,950
February	2,065	3,838	2,272	4,222
March	1,670	5,508	1,837	6,059
April	1,005	6,513	1,106	7,165
May	603	7,116	663	7,828
June	732	7,848	805	8,633
July	922	8,770	1,014	9,647
August	1,142	9,912	1,256	10,903
September	1,725	11,637	1,898	12,801
October	942	12,579	1,037	13,838
November	60	12,639	66	13,904
December	2	12,641	2	13,906

1/ The assumed discard mortality due to regulations for yellowtail and widow rockfishes is 16 percent. For trawl caught sablefish, the assumed discard mortality is 25 percent of the landed trawl catch.

6.2 Effective License Limitation

Under this scenario, it is assumed the number of active participants would be below status quo levels.^{2/} At the outset, the present system of total allowable catch limits, trip limits and closures would most likely be used, with discarding similar in magnitude to that described for status quo management. Eventually, regulations would be less restrictive, as compared to the situation which would have occurred under status quo, and most likely discarding would be lower.

Under the effective license limitation scenarios, it is assumed that at some time in the future there are fewer vessels present than would be present under status quo. How will this affect the resource? Reasons for a decrease in discards would be less restrictive trip limits and fewer number of trips for the fleet as a whole, hence, fewer opportunities to go over the trip limits. However, the effect of increases in vessel fishing power on discards must be considered. There will be impetus for increases in vessel power beyond what would have occurred under status quo from two main sources.

1. Independent of any increase in trip limits, vessel owners may see their profits as more secure (less threatened by increases in vessel numbers) once license limitation is in place and may increase investments in ways which will increase vessel power. However, until trip limits become much less restrictive, there would be little incentive to increase a vessel's fishing power.
2. With an increase in trip limits, vessel owners may increase the power of their vessel to take advantage of new opportunities.

Increases in vessel power would result in larger catches per trip, which would reduce the gains in discard reduction made from higher trip limits and fewer trips. To decide whether discards might increase under license limitation, the question which would have to be answered is "Will increases in vessel power cause vessels to go over the limits a greater portion of the time than they currently do, or by a greater amount each time they go over the limit, and if so, will these increases be sufficiently high to completely offset the effects of fewer trips being taken under higher landing limits?" While there is no particular reason to anticipate an increase in the number of trips exceeding trip limits or the amount by which individual trips exceed limits, sufficient information to answer this question is not available. Given that it will take a significant reduction in trip limits to provide incentive for increasing fishing power, it seems likely that a decrease in discards may result.

There may be some incentives for increased effort created by consideration of limited entry and the limited entry program itself. Gains from an effective license limitation program may be reduced if fishermen believe that an ITQ system will follow and they try to increase their landings to establish claim to a larger initial allocation of ITQs. There may also be a belief that at some time in the future the Council might decide that licenses will be revoked if they have not been used over a period of time. Over time, these kinds of behavioral responses are likely to diminish or increase to the degree that Council discussions allay or reinforce beliefs about the probability for future actions of this nature.

^{2/} When the program begins, there may be more permits issued than there are vessels currently active; however, many of these will be limited duration endorsements and will expire in 1997. At that time, the "effective license limitation" scenario might apply if a restrictive MLR has been adopted, a buy-back program has been implemented or if vessel numbers would have increased more under status quo management.

Very early in the program there may be a temporary offset of gains from reduced effort due to fishing requirements placed on vessels receiving provisional "A" endorsements. These endorsements require vessel owners to make a certain amount of landings in each of their first three years of activity in order to prove their intent to participate in the groundfish fishery. For many vessels, this period of activity will have passed prior to the decision to implement a license limitation program. The earliest date at which license limitation might be effective in reducing capacity (as compared to status quo) is January 1, 1997 (the date when "B" endorsements expire). By that time, most provisional "A" endorsements will have either expired or been upgraded. The upgraded versions of these endorsements do not require continued fishing to maintain their validity.

It should be re-emphasized, at this point, that references to less restrictive trip limits are references relative to a future status quo management situation. For example, current trip limits might remain unchanged; however, relative to some future year in which the trip limits might be more restrictive under status quo, the trip limits, which are currently in place, may be higher and therefore less restrictive as compared to what would have otherwise occurred.

Currently, fishing capacity is substantially greater than needed to take the allowable catches. Consequently, a considerable decrease in the number of participants relative to status quo and limits on fishing power would be needed in order to eliminate regulations resulting in discarding (Huppert 1986). While under the scenario of an effective license limitation program, a license limitation system may reduce the need for limits on total allowable catch, trip size and trip frequency, it is unlikely to completely eliminate the need for such limits for the foreseeable future.

The final form of the limited entry program adopted by the Council included open access fishing opportunities for all gears except trawl. The open access opportunity for longline and fishpot gears would be restricted to small producers through the use of restrictive trip limits. These trip limits and trip limits for exempted gears could result in increased discards. Vessels which previously had not been impacted by trip limits may now find themselves forced to discard when they have a particularly large catch. Tables in Chapter 4 show that trip limits which reduce the catch of a few vessels making large catches with exempted gear may result in enough of a reduction in catch to meet the needs of many small vessels. Additionally, the discard mortality rate for exempted gear is often much less than for trawl gear,^{3/} thus, the wastage from discarding may be lower than for other gears. If discards by open access gears become a problem, then a FMP amendment may become necessary to modify the limited access/open access allocation or change the nature of the open access fishery.

6.3 Ineffective License Limitation

Under ineffective license limitation, no decrease in discarding is expected. At the same time, there may be the same behavioral responses in anticipation of future Council action to further limit entry or more certainty about future income (the assurance that vessels will not continue to enter the fishery and dissipate profits). These expectations and responses are discussed in the above section. The responses may increase fleet harvest rates under ineffective license limitation, and hence increase the restrictiveness of regulations and discards.

3/ The mortality rate for trawl gear discards is assumed to be 100 percent.

6.4 ITQs

Under this alternative, it would be anticipated that the current system of trip limits and closures would not be required since each individual would control the rate at which his or her quota is harvested. Nevertheless, substantial discarding could occur due to highgrading, underreporting and discarding of any catch for which ITQs are not held. Highgrading might occur as fishermen try to maximize revenue received per unit of ITQ. There would be considerable incentive to underreport landings, so the unreported catches would not be deducted from a fisherman's quota. Unreported catches occurring in the absence of an observer program would result in the same type of errors in the stock assessments and in setting the quotas as would unmeasured discarding. However, results under a properly designed and implemented ITQ system may not be all that different from the problems which occur under status quo management with trip limits.

The individual quotas would need to take into account the multispecies nature of the groundfish fishery. Otherwise, fishermen would catch and discard species for which quotas had been reached, in order to land species with remaining quotas. It may be possible to design a carry-over or quota trading system so that species for which an individual's quotas had been reached could still be landed.

ITQs may have a positive effect on stocks if within-year rates of harvest decreased substantially, relative to current levels. Fish harvested later in the year could have a few months of additional growth; consequently, the total allowable catch might be made up of fewer individuals.

6.5 Conclusion

The primary biological impact of the above alternatives is the potential loss in production due to discarding. Under status quo management, discarding would be caused by the trip limits and closures used to limit total annual landings. Increases in discarding over current levels would be expected if the number of participating vessels increases. Under license limitation, discarding would be due to the same system of trip limits and closures and would occur at similar levels, unless the number of active vessels is sufficiently lower than would have been present under status quo (regardless of whether status quo entails an increasing, stable, or decreasing numbers of vessels). Under an individual quota system, discarding could be caused by highgrading or exceeding the quotas held by an individual. Management errors also could arise due to unreported landings and discard mortalities.

The lowest rates of discarding would occur for a license limitation or individual quota system that reduces fishing capacity substantially below future status quo levels, though discard problems may occur in the open access fishery if effort increases above window period levels. If open access fishery discard mortality does become a problem, a FMP amendment may be necessary to alter the open access allocation or the nature of the open access fishery. The rate of discarding could be documented and incorporated into stock assessments if an observer program were to be implemented. The cost of an observer program would probably be similar for the alternatives presented in this document. The least costly observer program would be for a license limitation or ITQ system that results in a substantial reduction in the number of participating vessels.