



2000 Scallop Fishery Management Plan SAFE Report
(Stock Assessment and Fishery Evaluation)

Scallop Plan Development Team

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1.0 EXECUTIVE SUMMARY

1.1 *Background*

At its June 14-15, 2000 meeting, the Council re-examined and expanded the scope of the upcoming annual framework adjustment for fishing year 2001. The original plan was to have a narrow focus for Framework Adjustment 14 and adjust the annual day-at-sea allocation, if Amendment 10 could be implemented later during the 2001 fishing year. After working on Amendment 10 from February to June, the Council found that the issues were very complex and technical. More time would therefore be needed to develop and analyze the impacts of the management options.

The need for Amendment 10 to implement an area rotation system has arisen from the results in the Georges Bank and Mid-Atlantic closed areas, where biomass has grown dramatically and the access programs have been successful. Also, good recruitment in 1998 and 1999 present an opportunity to implement an area rotation system with minimal negative impacts (the first step being closing areas with small scallops). These conditions, plus the policy and analytical efforts to develop Amendment 10 have created some confusion about the objectives of Framework Adjustment 14 and this SAFE report.

Since it appeared that a draft amendment was several months in the offing, the Council expanded the scope of Framework Adjustment 14 to include an access program for the Hudson Canyon and VA/NC Areas and a potential loophole caused by shell-stocking. In addition, the Council directed the Scallop Oversight Committee to evaluate area closures that might be implemented by Interim Action during the 2000 fishing year, possibly relieving the need for a Supplemental Environmental Impact Statement (SEIS) for the framework adjustment.

There is considerable debate among the PDT about the objectives for management measures in Framework 14, the annual adjustment for 2001. The objectives for Framework 14 are furthermore clouded by the unclear Council policy concerning the relationship between this year's annual adjustment and Amendment 10, an issue that has seesawed back and forth during the past year and whose distinction is blurred by the possible requirement to prepare an SEIS for Framework Adjustment 14. For this reason, the SAFE report contains general recommendations for the annual adjustment, also giving estimates and discussion of some potential management options.

There are two ways of thinking about the annual framework adjustment: a strict interpretation that addresses fishing mortality and the progress toward rebuilding and a liberal interpretation that looks at the adjustment as an interim step toward area rotation. Choice of this may dictate whether the Council needs to prepare an SEIS for Framework 14 or not and how many of the management options are included.

1.2 *Document summary*

This SAFE report is the product of three months of hard work by the PDT, addressing the expanded scope of issues that the Council has identified. The document was prepared to meet the annual monitoring requirements set forth under the FMP by Amendment 7. A broad range of issues, including the ability to increase the annual day-at-sea allocations without jeopardizing the Amendment 7 objectives, potential access options for opening the Hudson Canyon and VA/NC Areas on or after March 1, 2000, new area closures to conserve small scallops and promote fishing on large ones, and shell-stocking are addressed. Detailed summaries of landings, surveys, day-at-sea use, economic factors, and social factors

are presented. Some other issues, like changes in bycatch and impacts on habitat, could not be addressed either for a lack of data, time, or both.

One important facet that was not analyzed due to limits on resources and time was the effect of recent management changes on habitat and bycatch. As a result of the management changes in Framework 12 and Framework 13, the distribution and amount of fishing effort was affected. Significant amounts of fishing effort shifted from other areas into Closed Area II during 1999. A similar phenomenon is expected in 2000 because of Framework 13. For the first time, a rigorous examination of the VMS data allows a quantification of the effects, but more work is needed to firmly evaluate the implications for bycatch and habitat. In 1999, effort increased on Georges Bank (mostly in Closed Area II) and declined along the northern part of the NY Bight region. Fishing effort in the spring of 2000 was high along the western edge of the Hudson Canyon Area and in the South Channel, where vessels encountered high catch rates. Potential reasons for this improvement are due in part to good recruitment and in part to the shift in fishing effort to Georges Bank during 1999.

Two important and significant improvements have been added to this report to address National Standard 8 and 10. Section 3.4.4 gives a detailed description of economic and social factors in the major scallop ports, from Maine to Virginia. These data will be critical to understanding the potential distributional impacts of future management options, including closure and access to fishing grounds. This community-level data will also be used by inclusion or reference in the next SEIS for the FMP. A second source of important data is at-sea casualties aboard scallop vessels. Focusing on the offshore scallop fishery (excluding the inshore fishery, primarily operating in Maine), show some interesting trends. Either from improved safety practices required by the Fishery Vessel Safety Act or from simply having fewer days fishing and less crew, casualties have declined markedly since the early 1990s. Close examination of the data in Section 7.0 reveals no obvious threats to the safety of vessels and crew due to regulations implemented by the Council since 1994.

1.3 Resource condition

The past several years have seen a considerable improvement in the status of the sea scallop stock (Table 1). In 1999 and 2000, the increased biomass is partially due to the closures implemented in the Mid-Atlantic in 1998. In the Hudson Canyon closure area, the standing stock biomass, as indicated by the annual survey dredge index, is now over an order of magnitude higher than just three years ago. However, the open areas of the Mid-Atlantic and Georges Bank have also seen great improvement.

Preliminary analysis of the 2000 survey indicate that both these indices now stand at record highs. The increases in biomass seen in the open areas is due to good recruitment and to effort reduction measures. The gradual reduction in days-at-sea (DAS) for full-time vessels from 204 in 1994 to 120 in 1999, as well as ring size and crew limitations, has given time for many small scallops to grow to a larger size before being caught, thereby increasing yields and standing stock biomass. Restricted access to closed areas, together with DAS tradeoffs in exchange for this access, have also reduced effort in the open areas, thus further alleviating overfishing in the open areas. These measures and good recruitment have turned the sea scallop fishery into a highly profitable and successful fishery, unlike the conditions during the mid-1990s.

Table 1. Observed and projected Albatross survey biomass per tow (kg)

	Observed				Projected at 120 DAS ¹			
	1997	1998	1999	2000 ²	2001	2002	2003	2004
GB Closed Areas	2.5	7.1	6.33	13.2	6.6	8.1	9.5	10.9
GB Open Areas	0.6	0.8	1.1	3.0	2.1	2.5	2.8	2.9
MA Closed Areas	0.8	2.9	6.3	9.2	15.5	16.1	15.4	14.2
MA Open Areas	0.5	0.7	1.5	2.3	2.1	2.3	2.4	2.4

Table 2. Observed and predicted Albatross survey average exploitable meat count.

	Observed				Projected at 120 DAS ⁴			
	1997	1998	1999	2000 ⁵	2001	2002	2003	2004
GB Closed Areas	25.0	34.8	34.9	35.4	16.7	14.9	13.6	12.7
GB Open Areas	32.5	43.9	43.0	33.6	23.0	20.7	19.3	18.5
MA Closed Areas	30.9	38.4	33.7	40.5	22.4	17.3	14.6	13.0
MA Open Areas	20.6	21.7	20.9	22.1	25.3	22.1	20.2	19.2

The analysis prepared for this document indicates that an allocation of 120 full-time days-at-sea will prevent fishing mortality from exceeding the Amendment 7 targets and will not jeopardize rebuilding of stock biomass by 2008. In fact, the projections are quite optimistic due to good recruitment in 1998 and 1999 as well as the role that closed areas have played in allowing biomass growth.

Due the lower day-at-sea allocations, crew limits, gear restrictions, and a complete closure of the groundfish closed areas next year, a continuation of the current DAS allocations will result in an overall effective fishing mortality below the Amendment 7 rebuilding target of $F = 0.28$. However, the SAW pointed out in the last assessment of the sea scallop fishery (SAW 29; NEFSC 1999) that whole-stock fishing mortality targets, as specified in Amendment 7, are inappropriate when there are large long-term closures:

The SARC discussed the appropriateness of basic YPR calculations and YPR-based reference points in the context of exploitation of a non-mobile stock that lies substantially within closed areas. Many difficulties arise, particularly if the closed areas last for several years. Current fishing mortality calculation for the stock as a whole will underestimate fishing mortality on scallops in the open areas, i.e. those scallops currently available to the fishery. Further, the basic YPR curve will misrepresent yields as a function of whole-stock F . Management that ignores these factors could lead to policy contradictions. As an example, in a transitional situation where biomass is increasing in the closed areas, whole-stock fishing mortality will no longer be proportional to fishing effort. It would be possible to increase effort so that whole-stock

¹ Projections from 1999 Albatross survey data. Assumes a 1,400 lbs./DAS tradeoff equivalency and a TAC to allow fishing mortality of 0.3 (High F) in the Hudson Canyon and VA/NC Areas.

² Preliminary.

³ 4.8 g/tow if using the 1998 Albatross survey in the Nantucket Lightship Area to project biomass in 1999, as was done in the projections for this document.

⁴ Projections from 1999 Albatross survey data. Assumes a 1,400 lbs./DAS tradeoff equivalency and a TAC to allow fishing mortality of 0.3 (High F) in the Hudson Canyon and VA/NC Areas.

⁵ Preliminary.

F declines to levels far below F_{max} , so that the fishery appears sustainable, while the open-area stock is fished so hard that total fishery yield collapses...For all these reasons, basic YPR calculations do not provide appropriate reference points for whole-stock fishing mortality. However, the reference points are still relevant for determining growth overfishing of the open-area component of the stock, assuming that existing closure regimes persist.. (pgs. 111-112)

The current situation is exactly that which was anticipated by SAW 29. The high level of biomass locked up in the Georges Bank closed areas means that it would require a unsustainably high level of effort elsewhere in order to achieve a whole-stock fishing mortality of $F = 0.28$ (or even $F_{max} = 0.24$). A high amount of fishing effort in the open areas would temporarily increase landings, but would remove most of the standing stock now present in the open areas, thereby reducing long term yields and yield-per-recruit. This effect was not anticipated during the design of Amendment 7 because the contribution of area closures was ignored, consistent with a management plan without a closed area policy.

Rebuilding can be also enhanced by a carefully-developed access program with a day-at-sea tradeoff that would allow management to achieve the biomass targets much more quickly than anticipated by Amendment 7. In fact, the projections indicate that the rebuilding target may be met in the Mid-Atlantic during the 2001 fishing year, mostly as a result of two successive years of exceptional recruitment in the Hudson Canyon Area. Georges Bank could take longer than the Mid-Atlantic but the most conservative scenario estimates achieving the biomass target by 2004 and other scenarios are not considerably worse.

1.4 Recommendations

Given these events and the projections through 2004 with the potential management options, it would be beneficial to adjust the day-at-sea allocations and the area access program for two years, rather than one. This strategy would reduce the burden and the pressure of preparing for the 2002 annual adjustment and allow the Council to devote more resources to developing Amendment 10. Last year, the effort to analyze and develop Framework Adjustments 12 and 13 took nine months (June 1999 to February 2000), not including the administrative resources needed for approval and implementation. Combining all the issues for Framework Adjustment 14, the workload could be of similar proportions, especially if an SEIS is required.

Unless the Council chooses options that are more liberal than those analyzed in the scenarios in this document, the analysis shows that continuation of these options for two year (and possibly three) will meet the Amendment 7 objectives, continue rebuilding, and provide for attractive landings and revenue. The PDT therefore recommends that the day-at-sea adjustment and area access program should be developed as a two-year adjustment, rather than a one-year adjustment that again requires substantial re-evaluation and adjustment next year.

There are several reasons that the PDT believes that increasing (or continuing, depending on your point of view) a 120 day-at-sea allocation⁶ is justified, but higher allocations are inadvisable. The biological and economic justification for this choice is:

⁶ If Framework Adjustment 14 increases the 2001 day-at-sea allocation to the 2000 level, full time limited access scallop vessels would receive 120 days-at-sea, part-time vessels would receive 48 days-at-sea, and occasional vessels would receive 10 days-at-sea.

1. **Uncertain stock status:** Although the updated projections indicate that rebuilding is proceeding ahead of schedule and that fishing mortality is lower than the Amendment 7 targets, the total biomass and fishing mortality estimates are susceptible to sampling variance and modeling errors. These include interannual changes in availability to the survey and assumptions about dredge efficiency. If the uncertainties tend to make the projections overestimate total biomass, the fishing mortality that would be achieved by future management policies could be higher than estimated, slowing the progress toward a rebuild stock. Nonetheless, the results are reasonably robust compared to survey biomass targets and the overall condition of the resource. Unlike several years ago, the scallop resource now exhibits characteristics that are consistent with lower fishing mortality: age structure has broadened, biomass has increased, and recruitment has improved.

Further, underwater video surveys conducted by CMAST in 1999 and 2000 will produce a series of maps of the sea floor in closed areas of Georges Banks containing high aggregations of sea scallops detailing the distribution of substrate, depth, live scallops, dead scallops, and macroinvertebrates (sponges, starfish, filamentous fauna). This or other new survey methods could provide a better estimate of scallop biomass that can be analyzed in tandem with the NMFS dredge surveys to address then some of the above uncertainties.

2. **Uncertainty in the fishing mortality reference points:** The F_{\max} reference point was estimated with flat-topped partial recruitment, with $P = 0.5$ on age 3 and $P = 1$ on older ages. As indicated above, it is difficult to estimate F_{\max} and furthermore a stock-wide F_{\max} is an inappropriate proxy for F_{MSY} if permanent area closures exist where scallops are abundant and especially large. Depending on conditions, closed areas can impose a dome-shaped partial recruitment by forcing the industry to fish hard on recruiting scallops within the open area. One implication is that a dome-shaped partial recruitment function (where large scallops are less vulnerable to fishing) is to raise F_{\max} , but this policy would reduce yield below long-term optimum results. Supplemental measures thought to increase the age of recruitment have also been implemented, but not analyzed. These measures include a larger ring size, elimination of chaffing gear and cookies, seven man crew limit, and 8-inch twine tops (10-inches in the Georges Bank closed areas). These measures also have implications for the amount of fishing mortality generated by a day-at-sea.
3. **Uncertainty in the biomass reference point:** The B_{\max} reference point was derived from product of the calculated biomass per recruit at F_{\max} and median recruitment. This has an implicit assumption that density dependent mechanisms affect stock productivity and that there is no relationship between stock size and recruitment. Whether due to temporary conditions or due to more spawning potential (particularly in closed areas), we are observing much higher recruitment than has occurred regularly in the past.
4. **Uncertainty in the DAS/F estimate:** The projections contained in this document were tuned such that the total day-at-sea use would be about 25,000. While the methods in this document differ from those in last year's SAFE report, there are certain other assumptions and ad hoc adjustments which introduce uncertainty into the results. One such adjustment reduced the estimated days-at-sea use in the Hudson Canyon and VA/NC Areas. This adjustment was applied because the projected biomass was higher than estimated by the VIMS experimental survey in the Hudson Canyon Area. If the VIMS survey is correct, then the day-at-sea tradeoff would be less than estimated, without this adjustment to make the two information sources agree. The projection also assumes that the eventual policy would create a tradeoff system that is equivalent to accumulating one day-at-sea for each 1,400 pounds of scallops caught in the closed areas. Changes in fishing behavior and misspecification could lead to inaccurate estimates of the amount of fishing mortality generated by a 120 day-at-sea allocation, projected to generate a total

of 25,000 days scallop fishing. It is also possible that limited access scallop vessels could increase the proportion of day-at-sea allocations that are actually fished or that fishermen re-activate Confirmation of Permit Histories.

5. **Stable management:** The combination of day-at-sea reductions, closed areas, and supplemental regulations have resulted in a rapid increase in biomass, expanded the age structure, and reduced fishing mortality. This has been achieved however by forcing vessels to grow overfish in the remaining open areas while conserving slow growing, older scallops in the closed areas (especially Georges Bank⁷). Yield is being foregone under this regime, partly mitigated by a controlled access program in areas where the scallops have grown to larger size. Postponing mortality at this time will provide additional time for rebuilding, particularly in areas that are now open, and better implementation of an area rotation system that does not significantly depress yield when new areas close to protect small scallops for future harvest.
6. **Consistency with secondary FMP objectives:** Amendment 7 listed three major reasons for delaying the reduction to 51 day-at-sea in 1999. These reasons include: 1) time to develop a buyback and “provide the opportunity to develop the most successful possible scallop management strategy”, 2) “to use the information collected from the experimental fishery in Closed Area II to further evaluate the DAS reduction schedule” and “allow the Council to develop a strategy that takes advantage of the rapid growth of scallops, such as rotational area management system...”. These three reasons for delaying the reduction to 49 DAS remain valid in 2000, especially given the improved resource conditions, but they may not warrant an increase of days-at-sea above the 1999 allocation.
7. **Benefits to the scallop fishery:** A more stable production over years would benefit sea scallop fishing firms, wholesalers and retailers to plan production and marketing activities in an more orderly fashion (versus a boom-bust cycle). Thus, the industry can increase efficiency by reducing production and marketing costs, improve competitiveness with imports, and increase economic returns (profits). The increase in profits can also be achieved by reducing the prices to the consumers if the whole increase in profits is shared with consumers through price reduction. A more stable production could also benefit related industries.
8. **Reduced community impacts:** A boom-bust cycle recreates an enormous fluctuation in economic activities for scallop-dependent communities. The economic fluctuation would create a hardship for community members through extremely high or low employment and income. Social problems (crime, suicides, ...) associated the extremely low employment and income from boom-bust cycles would be less frequent with a more stable resource and supply. Governments would derive similar benefits from a more stable and reliable tax base.

New closures, as recommended by the PDT for Interim Action, would also have beneficial results especially when tied to the access program for the Hudson Canyon and VA/NC Areas. Although the access program would cause a reduction in fishing effort elsewhere (especially when accompanied by a day-at-sea tradeoff), the area closure options would reduce fishing mortality to near zero in the areas that it was most beneficial. Catch in 2000 would be less than other options and biomass growth would improve (Table 3). Depending on the length of the closures, this could mean significant improvements in yield and ability to implement an area rotation strategy later. The Council should, however, re-evaluate

⁷ N.B. The closed areas on Georges Bank were established to reduce groundfish fishing effort and bycatch while those stocks rebuild. According to the Scallop FMP, however, the three Georges Bank closed areas would not be closed and effort would be less in areas with small scallops.

this management option annually to see if the boundaries should be altered in response to new recruitment.

Table 3. Summary of projections and economic analyses for various potential management scenarios in 2001 – 2003.

Scenario	2001 Catch (mt)	2002 Biomass (thousand mt)	2004 Biomass (thousand mt)	Economic Benefits (million \$) ⁸
Status quo (No Action)	12,850	185	242	592
Low F	20,312	174	194	801
High F	22,173	172	188	844
New Closures (Low F)	17,650	187	225	717

Shell-stocking has been observed to be more prevalent in the 2000 fishing year than it had been in the recent past. During the spring of 2000 when scallop catches were high, some vessels returned with some of their scallop catch in-shell and anchored inshore of the day-at-sea monitoring line to finish shucking their catch. Due to the potential for paralytic shellfish poisoning (PSP) of the viscera and disposal problems, landing shell stock is rare, especially in New England. The reasons that vessels practiced shell stocking are primarily to spend more time under favorable and safer conditions when it is necessary for the crew to keep up with the vessel's catch rate. Another primary reason is to do this work "off the clock", while the day-at-sea system classifies the vessel as being "at the dock".

While the current prevalence of shell stocking has created problems for other near-shore resources, the amount of shell stocking does not seem to be a problem for sea scallop management or significantly undermines the primary management measures (i.e. day-at-sea allocations and crew limits). It does however have some undesirable side-effects and could become a significant loophole in the regulations, especially since the daily catch (LPUE) is expected to rise. The PDT recommends adjusting the regulations to close the loophole to maintain the effectiveness of the day-at-sea and crew limit regulations, as long as the plan relies on these measures to achieve the desired fishing mortality rates.

In conclusion, it has been difficult if not impossible to incorporate the 2000 survey data into the SAFE report. The majority of field work is accomplished during the summer and early fall, much too late to be available for the SAFE document. With the current schedule, the PDT begins preparing the SAFE report and performing analyses even before the annual research survey begins. To make matters worse, the demands of the two activities on some PDT members occur simultaneously. As a result, many of the analyses contained in this document have to be redone, usually in a very short period in October. This is very wasteful. To relieve the burden and improve efficiency, the Council should alter the fishing year or the framework process.

⁸ Cumulative present value of consumer and producer surplus for 2001 to 2003, discounted by seven percent.

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